THE ENCYCLOPÆDIA BRITANNICA

THIRTEENTH EDITION

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THE
ENCYCLOPÆDIA BRITANNICA

A DICTIONARY OF ARTS, SCIENCES, LITERATURE & GENERAL INFORMATION

THIRTEENTH EDITION

Being Volumes One to Twenty-eight of the Latest Standard Edition with the Three New Volumes covering Recent Years and the Index Volume

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VOLUME 29

THE THREE NEW VOLUMES

I

AALAND ISLANDS *to* EYE

LONDON

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TO

THE TWO HEADS OF THE ENGLISH-SPEAKING PEOPLES

HIS MAJESTY GEORGE THE FIFTH

KING OF GREAT BRITAIN AND IRELAND

AND OF THE BRITISH DOMINIONS BEYOND THE SEAS

EMPEROR OF INDIA

AND

CALVIN COOLIDGE

PRESIDENT OF THE UNITED STATES OF AMERICA

24050

PREFATORY NOTE

THE present Supplementary Volumes of *The Encyclopædia Britannica* are an entirely new survey of the march of events, the progress of knowledge and the innumerable changes of the world's aspects, thoughts, activities, in the years from 1910 to 1926. There have been no more momentous and transforming years in the experience of mankind. Formerly that space of a decade and a half would have been called at best a period. We may justly term it an epoch. It crowds into itself more historic drama and social significance, more economic energy and moral ferment, more destructive force, yet more constructive effort and idealism in every sphere, than have been known in most centuries. In wide regions the former political structure and lines of the map have been altered in a manner that would have surpassed all powers of belief if prophesied beforehand. Old Empires and dynasties have vanished; new nations and systems have appeared. With this, science and invention have gone forward with accelerating speed to wonderful results. All industrial life is searched by questioning and full of new developments. In this short epoch the former fundamental conceptions of time, space, matter and energy have been dissolved or modified. Speculation on the possibilities of further scientific discovery and of its practical addition to human power never was more daring. Medicine and surgery have made at least an equal advance in their resources for the defence, repair and prolongation of human life. Civilised taste, fashion and habit present very visibly a thousand interesting contrasts with the former modes. The new generation differs quite radically in many ways from the pre-War notions of its elders. Philosophy, literature and art re-examine with more unsparing scrutiny the mysteries of human being and purpose and the problems of human relations. Wide and signal as have been the changes in the world's external circumstances, still more general and profound have been the changes in the world's thought and feeling. In 15 years, as a result partly of physical conflict unparalleled for scale, violence and intensity; partly of the subsequent mental reactions; partly of the full and manifold working of influences which had begun to appear before the War, there has occurred a universal revolution in human affairs and the human mind.

After the War, when the extent of this revolution began to be seen, *The Encyclopædia Britannica* made a first attempt to supply the new storehouse of needed information. In this enterprise it followed its own great precedent of over 100 years ago, when Archibald Constable began to issue immediately after the long Napoleonic Wars his splendid six volumes. In one way the supplementary three volumes issued after the World War will always keep irreplaceable value as an aid to the future historian and social investigator. They are exhaustive as a record in minute detail of the War itself and every subject connected with it. They reflect the overpowering extent to which people's minds were still possessed and absorbed by the recent convulsion and its more immediate consequences. We may say that, while the tempest was past, the ocean still heaved and surged on all sides and the air was still obscure. There was as yet no clearness, no repose. There was

no restoration of ordinary understanding between nations and classes, nor even of civilised community in the sphere of knowledge and scholarship. The international collaboration conspicuous in *The Encyclopædia Britannica* for generations before was not sufficiently available. And, above all, the proportion of matter occupied by the War and related references bulked so mightily as to allow no adequate space for very many other subjects essential to a general survey of recent information.

Every day during the last five years has emphasised the need for that more comprehensive undertaking. The present writer was invited to frame a plan, to devise the proportions of this more extended design, and to supervise the construction. These three latest volumes of *The Encyclopædia Britannica* are the result. While the verdict on the merits of the execution must belong to the reader, several things may be stated with confidence.

First, this Supplement, as was remarked at the beginning, is an entirely fresh survey of the requirements of common knowledge concerning all the important and interesting additions to human experience and thought equipment and ideas, knowledge and speculation, made during the short but tremendous epoch from 1910 to this present day. Second, no pains have been spared, no resource of inquiry has been neglected, in the endeavour to make the range of the subjects as inclusive and the authority of the contributors as conclusive as some 3,000 pages can permit or the efforts of an editor and his colleagues can secure. Third, the subjects of reference are in fact more numerous and offer a wider range of information than has hitherto been achieved in encyclopaedias proper as distinguished from works of a different kind where very many of the references are as brief as dictionary definitions and no more illuminating than the statement that "an archdeacon is one who performs archidiaconal functions." Fourth, the writers in these volumes do, in fact, represent a larger array of celebrated persons of many nations, and of established repute beyond their own nations, than have ever before been assembled as a band of contributors to any composite work of importance. Fifth, the record of information and ideas is more generally and fully brought up to the time of publication than in any other work existing in any language. This is not to say that achievement satisfies ideals; the Editorial Boards in London and New York are too conscious of the opposite. "The ample proposition that hope makes . . . fails in the promised largeness." A perfect encyclopaedia compiled with no regard to the brevity of human existence would extend to at least 100 volumes exclusively written by experts of genius. On the same principle, a Supplement would be better in 10 such volumes than in three. Happily these perfections are unattainable.

Some account of the spirit and method of the present New Volumes must be given. The Editor and his colleagues had to grapple at the outset with those problems of unity and multiplicity which have beset the architects and builders of encyclopaedias from of old. How to construct the "mighty maze" yet keep it to the plan? How to treat main subjects as a whole and yet facilitate reference by dealing with their subdivisions under separate headings? How to provide for an unprecedented diversity of information—life and thought becoming every day more complex—and for an equal diversity of contributors, yet impress some distinctive spirit on the work as a whole? In the first approach to the solution of these questions a series of circles was drawn. The first allocated the proportions of space to be occupied by the chief departments of knowledge as broadly distinguished.

It was agreed in the discussions of the Editorial Board that tradition must be modified in one respect. Tradition demanded excessive space for all those aspects of life and thought which lend themselves to literary description; whereas, every day, science, invention and economics are becoming relatively a larger part of living interests. It was accordingly decided to give a quarter of the 3,000 pages available in the three Supplementary Volumes to science, theoretical and technical, including medicine and surgery—a larger proportion than has hitherto been devoted to this side of knowledge. History and politics, formerly overflowing all reasonable margins and submerging the more modern developments of civilised life and its apparatus, were dyked back; but over half the whole space is still given to history and politics, with their inseparable adjuncts of biography and geography. Main sections of the great circle having been demarcated in this way, the arrangement of related subjects belonging to each main section, and then the necessary subdivision of each compartment—as literature, economics, agriculture and so forth—were similarly plotted out in a long series of subsidiary and more subsidiary circles, until the whole space of some 3,000 pages was allocated methodically on principles of proportion very carefully considered. On the relative claims of different subjects to space, the discussions of the Editorial Board were continually interesting; and as the points arising were well argued, the decisions were well weighed. Then came the far more difficult matter of breaking up each distinctive group of subjects into hundreds of separate encyclopaedic headings while steadily holding to the proportions of the original plan in the broad. Necessarily all the obvious appearances of such a plan disappear amidst the details of the execution. Proportioned design could only be discovered by a very curious and exceptional reader taking as much pains to trace it as the Editorial Board took to form it. None the less, the plan is there; and while all manner of miscellaneous subjects neighbour each other in alphabetical order, as between the large categories—like national histories and literatures; war; post-War controversies and settlements, political and financial; science and mechanism in all their aspects; economics proper and social movements of a more political kind—the distribution of space is controlled by a reasoned though invisible adjustment.

But however assiduously managed, these after all are only the orderly mechanics of encyclopaedic arrangement. To what spirit have they been subordinated? The whole endeavour has been guided by a few definite purposes. The first purpose has been to reveal what has really happened throughout the whole range of the outward life and the inward being of human kind since 1910, during that decade and a half whereafter nothing in the world can ever be the same again. The second purpose has been to escape from the passions and prejudices and shattering discords of the War period—to revive and enhance that intellectual co-operation between distinguished authorities of every nation, that civilised community in the sphere of intellect, which the War temporarily destroyed but which throughout the century before 1914 it was the increasing object of *The Encyclopædia Britannica* to nourish. Vitally the progress of knowledge and that of its application depend upon the free and ceaseless interchange of ideas between each people and every other. International collaboration—though in politics the views of equally sincere writers belonging to different countries exhibit wide disagreements—plays a more remarkable part, and if dispassionately received, a more enlightening part, in these Three Volumes than in any of their predecessors throughout the long history of *The Encyclopædia Britannica*. The

third purpose has been to interpret the life of the English-speaking communities to each other. In their common tongue this work is written, and that tongue has become more definitely than ever during the "short but tremendous" epoch with which this supplement is engaged the leading language of mankind. It is now familiarly spoken by at least 200,000,000 of people spread about the whole globe. No good thinker supposes that community of speech implies community of thought and feeling. That assumption is amongst the most superficial and dangerous of fallacies. For instance, the relations between Great Britain and America are of decisive significance for the general future of the world and are well capable of determining either way for all mankind the choice between peace and chaos. But for the sake of the best relations between America and Britain under present conditions, it must never be forgotten that though England is the mother country of the language and law of the United States, all Europe is the mother-region of the racial blood and feeling of the United States—now the strongest society relatively to others that has arisen since the Roman Empire. A good judgment in Anglo-American affairs will always remember this fact, and that Great Britain cannot promote English-speaking solidarity by identifying itself wholly with one or the other side in the controversies between the nations and groups of continental Europe. In that regard, from the standpoint of English-speaking community, the steady policy of Great Britain should be mediating, reconciling and full of understanding of opposite European views. By a settled temper in that sense the preparation of these volumes has been guided.

Sóme difficulties and the method of dealing with them must be explained. The treatment of the World War itself was one difficulty but perhaps the least. Its more compact handling in these New Volumes, by comparison with the first post-War supplement, excludes a mass of insignificant detail but throws into bolder relief all those essentials with which the good general reader of history is concerned. The Editorial Board believes that the information concerning the Treaty of Versailles and the connected treaties, the birth and working of the League of Nations, the movements of diplomacy before the War, during the War and after the War in all the international questions arising from the disputable principles and arrangements of the Peace, is given with a clearer method and in a more impartial temper than have been hitherto placed at the disposal of the general reader in any comprehensive work of this kind. It must be remembered that since 1921 when the previous Supplement was completed a flood of new light has been thrown upon the origins and conduct of the World War, upon the personal and circumstantial influences which determined the character of the Peace Treaties, and upon the subsequent international struggles and negotiations. From this fullness of new light the present volumes derive advantage.

How to deal rightly with the political history of nations was a knotted doubt. Here the traditions of *The Encyclopædia Britannica* were no guide, because the nature of the problem was without precedent. From the ruin of former Empires many new States have arisen. Each of them defends its antecedents and position. The peoples defeated in the World War repudiate the charge of exclusive guilt, and protest partly that the tragedy sprang from causes beyond the control of any belligerent, partly that the victors were in fact more culpable. This latter view is as egoistical and self-righteous—like too many claims for the Allies—as the former is impressive. Particularly the vanquished nations,

with Russia, with a wide extent of neutral judgment, and with a large degree of opinion amongst the victorious peoples themselves, deny the justice of the Peace Treaties and declare that these without revision will be fatal to the future. In this situation, to seek to enforce an editorial judgment on all contested issues would be premature and presumptuous. For instance, no finally impartial view of the Russian revolution can yet be formed when Russians themselves still differ violently or are silently perplexed, drifting with events, shunning convinced opinion. Upon the chaos in China, the narratives and views of two equally intelligent and honest Chinese, one let us say from Peking and the other from Canton, may be found irreconcilable. What thoughtful person can yet draw up the balance-sheet of Fascism in Italy or of Kemalism in Turkey? Who can predict the future of France or of Germany? In these circumstances, it seemed to the Editor almost unquestionably right to depart from the principle of Olympian judgment practised by *The Encyclopædia Britannica* at long leisure in more stable times. The Editorial Board determined instead to interpret all the variations of national opinions and to have each nation's account of its action and motives since 1910 stated, as a rule, by some leading spokesman of its own. When the narratives are compared the contradictions cancel out; and to an intelligent user of these volumes this method is far more illuminating than would have been any attempt by the Editor to "tune the pulpits" and make them sing one song. To know what are the differences of national views, whether justified or not, is a vital matter of political information.

This edition adds to the *The Encyclopædia Britannica* an entirely new feature—a chronology of the world showing the dates of important events of all kinds since 1910. The universal usefulness of this addition needs no emphasis.

The thanks of the Editor and his colleagues are due to friends and helpers so numerous on both sides of the Atlantic that it is impossible to mention them all. To a still larger extent than in connection with any former edition or supplement, nearly all existing Governments have aided in amassing material, and it must be put on record especially that various embassies and legations in London have taken infinite trouble to assist. Particular acknowledgment must be made in the first case to statesmen and other national leaders who have furnished authoritative contributions—to President Masaryk of Czechoslovakia; to Count Bethlen, Prime Minister of Hungary; to two other Prime Ministers, Sir James Craig of Northern Ireland and the Hon. J. G. Coates of New Zealand; to three Ministers for Foreign Affairs, Dr. Stresemann (Berlin), Dr. Benesh (Prague) and M. Emile Vandervelde, who was still in office when this preface was written; to Mr. Andrew W. Mellon, U.S. Secretary of the Treasury; to Mr. Dwight F. Davis, U.S. Secretary of War; to Mr. C. D. Wilbur, U.S. Secretary of the Navy; to Mr. William M. Jardine, U.S. Secretary of Agriculture; to Mr. James J. Davis, U.S. Secretary of Labor; to Viscount Cecil and the Duchess of Atholl, members of Mr. Baldwin's present administration in Great Britain; while Commissary Trotsky himself has been persuaded to write the biography of Lenin, whose career, whatever else may be thought, has been one of the astonishing features of modern history. We must add Sir Arthur Salter, Director of the Economic and Finance Section of the League of Nations, and Monsieur Albert Thomas, head of the International Labour Office.

Amongst contributors who have held high office or position are Dr. Gustav Ador,

ex-President of the Swiss Republic; three former Prime Ministers, of Britain, Canada and France respectively—Mr. Ramsay MacDonald, Sir Robert Borden and Monsieur Edouard Herriot; Mr. Elihu Root, Secretary of State in the administration of President Roosevelt; Mr. Bernard M. Baruch, who was Chairman of the U.S. War Industries Board; Monsieur Joseph Caillaux and Monsieur Louis Loucheur, French ex-Ministers of Finance. Colonel House must be included with these, for his semi-official position under President Wilson was not less powerful though less formal.

But amongst these, two must be singled out for repeated thanks. Lord Haldane and Sir Arthur Salter have been more than contributors. Above all others they have given in various ways generous and invaluable assistance.

Marshal Foch, Adml. von Scheer, Sir Frederick Maurice, Air-Vice-Marshal Sir Sefton Brancker, British Director of Civil Aviation, and Gen. Sir Ian Hamilton are amongst men who held command in the world-changing struggle which fills so many of the ensuing pages; and they write on various aspects of war and arms.

On technical subjects distinguished authorities have given assistance and advice here gladly recognised—in economics Sir Josiah Stamp, Sir William Beveridge of the London School of Economics, and his colleagues Dr. T. E. Gregory and Mr. C. M. Lloyd; in political history and matters entering into its making, Lord Meston, Sir George Aston, Sir William Goode, Mr. H. W. V. Temperley, M. Auguste Gauvain of the *Journal des Débats*, Dr. F. Silberstein of the *Allgemeine Zeitung*, Mr. H. B. Butler of the International Labour Office and Monsieur Henri Davray; in agriculture Sir A. D. Hall; in different sciences Sir J. J. Thomson, Sir W. Bragg, Professor J. T. Hewitt, Professor C. H. Lees, Professor E. N. da C. Andrade, Dr. Reginald Clay, Sir Charles Sherrington, Dr. Hartridge and Dr. C. S. Myers; in medicine and surgery Sir Humphrey Rolleston, Dr. W. Broughton-Alcock, Dr. W. S. Lazarus-Barlow and Colonel MacArthur; in engineering Sir Alexander Gibb and Sir Richard Glazebrook especially, and also Professor J. A. Fleming, Sir Charles Parsons and Sir John Denison-Pender; while in anthropology and archaeology this work owes much to the staff of the British Museum, Dr. H. R. Hall, Mr. T. A. Joyce, Mr. E. J. Forsdyke and Mr. R. K. Granville, and equally to Sir Flinders Petrie, Mr. Myles Burkitt, Dr. A. C. Haddon, Mr. A. J. B. Wace and Dr. R. M. Wenley.

In various other fields the following are amongst those who have read over articles and furnished suggestions: Sir Maurice Hankey, Mr. Lionel Curtis, Professor A. J. Toynbee, Colonel H. Carslake, Lord Morris and Sir Archibald Montgomery. In settling the spelling of place-names good assistance was received from Lord Edward Gleichen and Mr. J. H. Reynolds, respectively Chairman and Secretary of the Royal Geographical Society's Permanent Committee on this subject. We owe assistance likewise to the Royal Statistical Society and the British Institute of International Affairs. In some matters of biography and literature we have been aided also by Mrs. W. L. Courtney, Mr. G. H. Johnstone of *The Times* office in Paris, Baron George de Ottlik of *The Pester Lloyd* and Hussein Bey of Robert College, and by Madame Vengerova in Russian details.

As to the services of the Editor's principal colleagues, no tribute can be too high. No work known is more arduous and exacting than that of making an encyclopaedia—a task demanding constant resource in dealing with contributions and contributors, as well as minute supervision of innumerable details. Mr. A. W. Holland has been at the head of

the daily administration; Miss Margaret Bryant and Colonel T. C. Hodson, in charge of different groups of articles, have organised the larger part of the Three Volumes; Mrs. D. Harwood has been responsible for other groups, and Mr. J. R. Thompson for art; while Miss Hollowell, as secretary of the Editorial Board, has shown ceaseless efficiency in aiding every part of the work. Closely associated with the Board itself have been Capt. B. H. Liddell Hart on military questions, Capt. A. C. Dewar on naval; Mr. C. W. Guillebaud on economics; Mr. George Glasgow on foreign politics; while Capt. F. A. M. Webster has helped in arranging the extended treatment of sports and games.

But, above all, it must be recorded here that without the collaboration of Mr. Franklin H. Hooper, the American Editor, in an inseparable partnership with the Editor-in-Chief, the making of these volumes as they stand would have been impossible. Amongst those connected with *The Encyclopædia Britannica* Mr. Hooper is by far the most experienced. He has been its mainstay for many years. In the present undertaking, he has not only brought to the work an endless suggestive fertility and vigour of execution, but has been personally responsible for the array of American contributors. These include four of five living Americans who have received Nobel prizes; the Secretaries of the Treasury, War, the Navy, Agriculture and Labor in the Cabinet of President Coolidge; men of like authority through the whole range of the arts and the sciences; and men dominant in industry and business, as the heads of the Ford industries, the American Telephone and Telegraph Company, the Eastman Kodak Company, the General Electric Company, and the National City Bank of New York—a group of distinguished Americans such as hitherto no enterprise of peace has assembled. To all these Mr. Hooper expresses his thanks and in particular to his assistants in the New York office, Mr. John W. Taylor and Mr. C. F. Ansley.

To the Editor-in-Chief this particular example of co-operation and friendship between America and Britain has been by far the most attractive part of his task. A century and a half after the political severance of the two great English-speaking peoples, *The Encyclopædia Britannica* remains what it was then, and more than ever, a common institution. Once more, by express permission, its volumes are dedicated jointly to His Reigning Majesty King George and to the President of the United States, Mr. Calvin Coolidge. May the day never come when that symbol of kinship and friendship will disappear.

J. L. GARVIN.

London,
September 1, 1926.

ABBREVIATIONS USED IN THESE VOLUMES

A

A.A. = anti-aircraft; Army Act; Automobile Association.
A.A.G. = Assistant Adjutant-General.
A.B.C. = Argentina, Brazil, Chile.
ac. = acre; acres.
A.C.I. = Army Council Instruction.
A.C. of S. = Assistant Chief-of-Staff.
A.D. = *Anno Domini* = in the year of our Lord (Latin).
Adml. = Admiral.
A.E.F. = American Expeditionary Force.
A.F. = Air Force (British).
A.F.C. = Air Force Cross.
A.F.M. = Air Force Medal.
A.F. of L. = American Federation of Labor.
A.G. = Adjutant-General.
A.I.D. = Aircraft Inspection Department.
A.I.F. = Australian Imperial Force.
Ala. = Alabama.
Alta. = Alberta.
amp. = ampère; ampères.
A.M.S. = Army Medical Service.
ANZAC. = Australian and New Zealand Army Corps.
A.P. = armour piercing (shells).
A.P.D. = Army Pay Department.
A.P.M. = Assistant Provost Marshal.
Ariz. = Arizona.
Ark. = Arkansas.
A.S.E. = Amalgamated Society of Engineers.
A.V.S. = Army Veterinary Service.

B

b. = born.
bar. = barrel; barrels.
B.C. = before Christ; British Columbia.
Bde. = Brigade.
Bde-Maj. = Brigade-Major.
Beds. = Bedfordshire.
B.E.F. = British Expeditionary Force (in particular in France and Belgium).
Berks. = Berkshire.
B.E.S.A. = British Engineering Standards Association.
B.G.G.S. = Brigadier-General, General Staff.
b.h.p. = brake horse-power.
B.L. = breech-loading (artillery; as distinct from Q.F.).
B.M.A. = British Medical Association.
Bn. = Battalion.
b.p. = between perpendiculars.
Brig.-Gen. = Brigadier-General.
Bs. = Bolivianos.
B.T.U. = British thermal unit.
Bty. = Battery.
bu. = bushel; bushels.
Bucks. = Buckinghamshire.

C

c. = *circa* = round about (Latin).
Cal. = California.
Cambs. = Cambridgeshire.
Capt. = Captain.
Cav. = Cavalry.
C.B.E. = Commander of the Order of the British Empire.
c.c. = cubic centimetre.
C.F. = Chaplain to the Forces.
cf. = *confer* = compare (Latin).
C.G.E.A. = *Compagnie Générale d'Entreprises Aéronautiques* = General Company for Aeronautical Services.
C.G.S. = Chief of the General Staff.
C.H. = Companion of Honour.
C.I.D. = Criminal Investigation Department.
C.I.D.N.A. = *Compagnie Internationale de Navigation Aérienne* = International Aerial Navigation Co.
C.I.G.S. = Chief of the Imperial General Staff.
C.-in-C. = Commander-in-Chief.
cm. = centimetre; centimetres.
C.O. = Commanding Officer.
Co. = Company.
co. = county.
C. of S. = Chief of Staff.
Col. = Colonel.
Colo. = Colorado.
Comm. = Commander.
Conn. = Connecticut.
C.O.S. = Charity Organisation Society (British).
C.P. = common pointed (shell).
c.p. = candle power.
C.R.A. = *Commission Régulatrice Automobile* = Motor Regulation Staff (French).
cu. ft. = cubic feet.
C.W.S. = Co-operative Wholesale Society.
cwt. = hundredweight.
cyl. = cylinder.

D

D. = Director (*e.g.*, D.M.O. = Director of Military Operations); as prefix of office-abbreviations = Deputy (*e.g.*, D.D.M.I. = Deputy Director of Military Intelligence).
d. = died; penny; pence.
D.A. = direct action (fuse).
D.A.I. = direct action impact (fuse).
D.A.Q.M.G. = Deputy Assistant Quartermaster-General.
D.B.E. = Dame of the Order of the British Empire.
D.C. = District of Columbia.
D.C.M. = Distinguished Conduct Medal.
deg. = degrees.
Del. = Delaware.
dept. = department.
D.F. = direction finding.
D.F.C. = Distinguished Flying Cross.
D.F.M. = Distinguished Flying Medal.
D.G. = Director-General (*e.g.*, D.G. A.M.S. = Director-General Army Medical Service).
Div. = Division.
D.O.R.A. = Defence of the Realm Act.
D.Q.M.G. = Deputy Quartermaster-General.
D.R. = dead reckoning.
D.R.F. = depression range-finder.
D.S.C. = Distinguished Service Cross.
D.S.M. = Distinguished Service Medal.
D.S.O. = Distinguished Service Order.

E

E. = east.
ed. = editor; edition.
E.E.F. = Egyptian Expeditionary Force.
e.g. = *exempli gratia* = for example.
E.M.F. = electromotive force.
et seq. = *et sequentia* = and the following (Latin).

F

fig. = figure (illustration); figures.
Fla. = Florida.
F.M. = Field Marshal.
f.o.b. = free on board.
fr. = franc; francs.
F.R.S. = Fellow of the Royal Society.
fs. = foot seconds.
F.S.R. = Field Service Regulations (British).
ft. = foot; feet.
ft.² = square feet.
ft.³ = cubic feet.
fur. = furlong or furlongs.
F.W.D. = four-wheel drive.

G

Ga. = Georgia.
gal. = gallon; gallons.
G.A.R. = Grand Army of the Republic.
G.B.E. = Grand Cross of the Order of the British Empire.
Gen. = General.
G.H.Q. = General Headquarters.
Glos. = Gloucestershire.
G.M.T. = Greenwich mean time.
G.O.C. = General Officer Commanding.
Gov. = Governor.
gr. = gramme or grammes.
G.S. = General Staff; General Service (British).
G.S.G.S. = Geographical Section, General Staff.

H

H.A. = Heavy Artillery; less frequently, Horse Artillery; high-angle (gun).
Hants. = Hampshire.
H.E. = high explosive.

ABBREVIATIONS USED IN THESE VOLUMES

Herts. = Hertfordshire.
hhd. = hogshead; hogsheads.
H.M.S. = His Majesty's Ship.
H.P. = high pressure.
h.p. = horsepower.
H.Q. = Headquarters.
Hunts. = Huntingdonshire.
H.V. = high velocity (gun).

I

I. = Island.
I.A. = Indian Army.
Ia. = Iowa.
ib. *or* **ibid.** = *ibidem* = in the same place (Latin).
Ida. = Idaho.
i.e. = *id est* = that is (Latin).
i.h.p. = indicated horsepower.
Ill. = Illinois.
I.L.P. = Independent Labour party.
in. = inch; inches.
in.² = square inches.
in.³ = cubic inches.
Ind. = Indiana.
Inf. = Infantry.
I.O.C. = International Oxygen Company (Electrochemistry).
Is. = Islands.
I.W.W. = Industrial Workers of the World.

J

J.C.A. = Jewish Colonisation Association.
J.I.C. = Joint Industrial Council.
jun. = junior.

K

Kan. = Kansas.
K.B.E. = Knight Commander of the Order of the British Empire.
kc. = kilocycle; kilocycles.
kgm. = kilogramme; kilogrammes.
km. = kilometre; kilometres.
K.R. = King's Regulations.
kv. = kilovolts.
kva. = kilovolt ampères.
kw. = kilowatt; kilowatts.
Ky. = Kentucky.

L

La. = Louisiana.
Lancs. = Lancashire.
lb. = pound; pounds.
L.C.C. = London County Council.
Leics. = Leicestershire.
Lincs. = Lincolnshire.
L. of C. = Line of Communications.
L.P. = low pressure.
L.R.C. = Labour Representation Committee (British).
Lt. = Lieutenant.
Lt.-Comm. = Lieutenant-Commander.
Lt.-Gen. = Lieutenant-General.

M

m. = mile; miles.
Maj. = Major.
Maj.-Gen. = Major-General.
Man. = Manitoba.
Mass. = Massachusetts.
M.B.E. = Member of the Order of the British Empire.
M.C. = Military Cross.
Md. = Maryland.
Mdx. = Middlesex.
Me. = Maine.
M.E.F. = Mediterranean Expeditionary Force (British, 1915–7).
M.F.N. = most favoured nation.
M.G.C. = Machine-gun Corps.
M.G.G.S. = Major-General, General Staff of an Army.
M.G.O. = Master-General of the Ordnance.
M.I. = Mounted Infantry (British).
Mich. = Michigan.
min. = minute; minutes.
Minn. = Minnesota.
Miss. = Mississippi.
Mk. I, II, etc. = Mark (artillery, ammunition, etc.).
M.L. = muzzle-loading.
M.M. = Military Medal (British).
mm. = millimetre.
Mo. = Missouri.
Mon. = Monmouthshire.
Mon. = Montana.
m.p.h. = miles per hour.
M.S. = Military Secretary.
M.T. = Mechanical Transport.
Mt. = Mount.
M.V. = muzzle velocity.

N

N. = north.
N.A.C.B. = Navy and Army Canteen Board.
N.B. = New Brunswick.
N.C. = North Carolina; nitro-cellulose.
N.C.O. = Non-commissioned Officer.
N.C.T. = nitro-cellulose, tubular.
N.D. = North Dakota.
Neb. = Nebraska.
Nev. = Nevada.
N.H. = New Hampshire.
N.H.P. = nominal horsepower.
N.J. = New Jersey.
N.M. = New Mexico.
n.m. = nautical miles.
Northants. = Northamptonshire.
Northumb. = Northumberland.
N.O.T. = Netherlands Overseas Trust.
Notts. = Nottinghamshire.
N.S. = Gregorian, or new style, calendar (*see* 4.994); Nova Scotia.
N.U.R. = National Union of Railwaymen (British).
N.U.W.S.S. = National Union of Women's Suffrage Societies.
N.U.W.W. = National Union of Women Workers.
N.W.T. = North-West Territories.
N.Y. = New York.

O

O. = Ohio.
O.B.E. = Officer of the Order of the British Empire.
O.C. = Officer Commanding.
Okla. = Oklahoma.
Ont. = Ontario.
Ore. = Oregon.
O.S. = Ordnance Survey; Julian, or old style, calendar.
O.T.C. = Officers Training Corps.
Oxon. = Oxfordshire.
oz. = ounce; ounces.

P

P. = percussion (fuse).
Pa. = Pennsylvania.
p.a. = per annum.
pdr. = pounder (gun designation).
P.E.I. = Prince Edward Island.
P.O. = Post Office.
pop. = population.
Pres. = President.
Prof. = Professor.
pt. = pint; pints; part.

Q

Q.A.I.M.N.S. Queen Alexandra's Imperial Military Nursing Service.
Q.A.M.F.N.S. Queen Alexandra's Military Families Nursing Service.
Q.A.R.N.N.S. Queen Alexandra's Royal Naval Nursing Service.
Q.F. = quick firing (artillery).
Q.M.A.A.C. = Queen Mary's Army Auxiliary Corps (W.A.A.C.).
Q.M.G. = Quartermaster-General.
qr. = quarter; quarters.
qt. = quart; quarts.
Que. = Quebec.
q.v. = *quod vide* = which see (Latin), for reference.

R

R.A. = Royal Artillery.
R.A.C. = Royal Automobile Club.
R.A.E. = Royal Air Force Establishment.
R.A.F. = Royal Air Force.
R.A.M.C. = Royal Army Medical Corps.
R.A.O.C. = Royal Army Ordnance Corps.
R.A.P.C. = Royal Army Pay Corps.
R.A.S.C. = Royal Army Service Corps.
R.A.V.C. = Royal Army Veterinary Corps.
R.C.S. = Royal Corps of Signals (since 1919).
R.E. = Royal Engineers.
Regt. = Regiment.
Res. = Reserve.
rev. = revolution.
R.F.A. = Royal Field Artillery.
R.F.C. = Royal Flying Corps.
R.G.A. = Royal Garrison Artillery.
R.H.A. = Royal Horse Artillery.
R.I. = Rhode Island.
R.I.B.A. = Royal Institute of British Architects.
R.I.C. = Royal Irish Constabulary.
R.M. = Royal Marines.
R.M.A. = Royal Military Academy (Woolwich); Royal Marine Artillery.
R.M.C. = Royal Military College (Sandhurst).
R.M.L.I. = Royal Marine Light Infantry.
R.N. = Royal Navy.
R.N.A.F. = Royal Naval Air Force.
R.N.A.S. = Royal Naval Air Service.
R.N.R. = Royal Naval Reserve.
R.N.V.R. = Royal Naval Volunteer Reserve.
r.p.m. = revolutions per minute.
Rs. = rupees.
R.S.F.S.R. = Russian Soviet Federal Socialist Republic (Russian).
R.T.O. = Railway Transport Officer (British and U.S.A.).

S

S. = south.
s. = shilling; shillings.
S.A.E. = Society of Automobile Engineers.
Salop. = Shropshire.
Sask. = Saskatchewan.
S.B. = simultaneous broadcast (wireless).
S.C. = South Carolina.
S.D. = South Dakota.
sec. = seconds.
seq. = *sequens*, *sequentia* = the following (Latin).
sen. = senior.
s.h.p. = shaft horsepower.
S.M.O. = Senior Medical Officer of a formation or station.
S.M.T.O. = Senior Mechanical Transport Officer of a formation.
Som. = Somerset.
S.O.S. = wireless call for life-saving at sea.
S.P.R. = Society for Psychical Research.
S.P.V.D. = Society for the Prevention of Venereal Disease.
sq.ft. = square feet.
Sqn. = Squadron.
s.s. = steamship.
S.S.F.A. = Soldiers' and Sailors' Families Association.
Staffs. = Staffordshire.

T

T. = Territorial (British Army).
T. = time (fuse).
T.A. = Territorial Army.
T.B.D. = torpedo-boat destroyer.
T.D. = Territorial Officers' Decoration.
Tenn. = Tennessee.
Tex. = Texas.
T.F. = Territorial Force.
T.M. = trench mortar.
T.N.T = trinitrotoluene (high explosive).
T.T. = torpedo tubes.
T.U.C. = Trades Union Congress (British).

U

U.S. = United States.
U.S.A. = United States of America.
U.S.S. = United States Ship.
U.S.S.R. = Union of Soviet Socialist Republics (Russian).

V

Va. = Virginia.
V.A.D. = Voluntary Aid Detachment; nursing service, Territorial Force.
V.C. = Victoria Cross.
V.D. = Volunteer Officers' Decoration.
Visct. = Viscount.
viz. = videlicet = namely.
v/m. = volts per metre.
Vt. = Vermont.
V.T.C. = Volunteer Training Corps.

W

W. = west.
W.A.A.C. = Women's Army Auxiliary Corps (Q.M.A.A.C.).
W.A.F.F. = West Africa Frontier Force.
Wash. = Washington.
W.D. = War Department.
Wilts. = Wiltshire.
Wis. = Wisconsin.
W.O. = War Office.
Worcs. = Worcestershire.
W.R.A.F. = Women's Royal Air Force.
W.R.N.S. = Women's Royal Naval Service.
W.S.P.U. = Women's Social and Political Union.
W.T. = Wireless Telegraphy.
W.U.S.L. = Women's United Service League.
W.Va. = West Virginia.
Wyo. = Wyoming.

Y

yd. = yard; yards.
Y.M.C.A. = Young Men's Christian Association.
Yorks. = Yorkshire.
Y.W.C.A. = Young Women's Christian Association.

INITIALS USED IN THIS VOLUME TO IDENTIFY CONTRIBUTORS, WITH THE HEADINGS OF THE ARTICLES TO WHICH THESE INITIALS ARE SIGNED

A. Ab.	A. Abbott. Formerly Assistant Secretary, Department of Scientific and Industrial Research, South Kensington, London.	**Continuation Schools** (*in part*).
A. B. K.	Arthur Berriedale Keith, D.C.L., D.Litt. Regius Professor of Sanskrit and Comparative Philology, Edinburgh University. Secretary to the Crown Agents for the Colonies, 1903–5. Author of *The Belgian Congo and the Berlin Act*; *Dominion Home Rule in Practice*; *War Government of the British Dominions*; etc.	**Belgian Congo**; **British Empire**: *History.*
A. C.	Albert Calmès. Professor at the University of Luxembourg. Member of the League of Nations Commission of Inquiry into Albanian Affairs.	**Albania.**
A. C. B.	Lieutenant-Commander Archibald Colquhoun Bell, R.N. Naval Assistant to the Official Historian of Naval Operations during the World War. Formerly Editor of *The Journal of the Royal United Service Institution.*	**Blockade.**
A. C. D.	Alfred C. Dewar, R.N. (ret.), B. Litt. Gold Medallist, Royal United Service Institution. Late of the Historical Section, Naval Staff, Admiralty, London.	**Admiralty, Board of**; **Coronel, Battle of**; **Dogger Bank, Battle of the**
A. C. I.	Andrew Conway Ivy, Ph.D., M.D. Nathan Smith Davis Professor of Physiology and Head of the Division of Physiology and Pharmacology, Northwestern University Medical School, Illinois.	**Anaemia.**
A. C. T.	A. C. Thaysen, Ph.D. Member of the Staff of the Bacteriological Laboratory, Royal Naval Cordite Factory, Holton Heath, Wareham, Dorset.	**Bacteriology** (*in part*).
A. Cu.	General Sir Arthur William Currie, G.C.M.G., K.C.B., LL.D. Principal of McGill University, Montreal. Formerly General Officer commanding the Canadian Corps in France.	**Canada**: *Defence and Education.*
A. D. H.	Sir A. Daniel Hall, K.C.B., F.R.S. Chief Scientific Adviser and Director General of the Intelligence Department, Ministry of Agriculture and Fisheries, London. Author of *The Soil*; *Fertilisers and Manures*; *A Pilgrimage of British Farming*; *Agriculture after the War*; etc.	**Agriculture**: *General Survey.*
A. D. L.	Alexander Dunlop Lindsay. Master of Balliol College, Oxford. Professor of Moral Philosophy, Glasgow University, 1922–4. Author of *The Philosophy of Bergson*; etc.	**Adult Education**: *Great Britain.*
A. Du.	Albert Dubarry. Editor of *La Volonté* (Paris).	**Caillaux, Joseph.**
A. E. A.	Algernon Edward Aspinall, C.M.G., C.B.E. Secretary to the West India Committee and to the Imperial College of Tropical Agriculture. Author of *The British West Indies*; *The West Indies and Guiana*; etc.	**Bahamas.**
A. E. M. F.	Alfred Edye Manning Foster. Late Proprietor and Editor of *The Country Gentleman*, and *Land and Water Illustrated.* Author of *Auction Bridge Made Clear*; *Auction Bridge and Variations*; etc.	**Bridge, Auction** (*in part*).
A. E. Mo.	Arthur E. Morgan. President of Antioch College. Formerly Chief Engineer of the Miami Conservancy. Author of *Education—The Mastery of the Arts of Life*; *New Light on the Boyhood of Lincoln*; *The Human Goal of Education.*	**Antioch College.**

A. E. T.*	A. E. Twentyman. Formerly Librarian and Information Officer, Board of Education, London.	**Education:** *Literature.*
A. Fl.	Alexander Fleming, M.B., F.R.C.S. Director of the Department of Systematic Bacteriology, St. Mary's Hospital, London.	**Antiseptics.**
A. F. P.	Albert Frederick Pollard, M.A. Professor of English History and Chairman of the Institute of Historical Research, University of London. Fellow of All Souls College, Oxford. Assistant editor, *Dictionary of National Biography* 1893–1901. President of Historical Association 1912–5. Author of *The Reign of Henry VII. from Contemporary Sources*; *A Short History of the Great War*; *The Evolution of Parliament*; etc.	**English History.**
A. F. Pr.	Alfred Francis Pribram, Ph.D. Professor of Modern History in the University of Vienna.	**Europe** (*in part*); **etc.**
A. F. S.	Alexander Faulkner Shand. Author of *The Foundation of Character.*	**Character.**
A. F. W.	Arthur F. Woodward. Editor of *The Produce Markets Review* (London).	**Canning** (*in part*).
A. Fy.	Alexander Findlay, D.Sc., F.I.C. Professor of Chemistry, University of Aberdeen. Formerly Professor of Chemistry, University College of Wales, Aberystwyth. Author of *The Phase Rule and its Applications*; *Practical Physical Chemistry*; etc.	**Colloids.**
A. G. L.	Alfred Goodman Levy, M.D., M.R.C.P., M.R.C.S. Physician to the City of London Hospital for Diseases of the Chest. Late Anaesthetist, Guy's Hospital, London.	**Anaesthetics.**
A. G. P.	Arthur George Perkin, F.R.S., F.R.S. (Edin.), F.I.C. Professor of Colour Chemistry and Dyeing and Dean of the Faculty of Technology, University of Leeds. Davy Medallist of the Royal Society, London, 1925. Joint Author of *The Natural Organic Colouring Matters.*	**Dyeing** (*in part*).
A. Ha.	Arthur Harden, D.Sc., Ph.D., F.R.S. Professor of Bio-Chemistry and Head of the Bio-Chemical Department, Lister Institute, University of London. Author of *Alcoholic Fermentation*; *Inorganic Chemistry for Advanced Students*; etc.	**Bacteriology** (*in part*).
A. H. B.*	Alfred H. Brooks, B.S., D.S. Formerly Geologist with the U.S. Geological Survey, in Charge of Geologic and Topographic Surveys and Investigations of Mineral Resources in Alaska. Vice-Chairman of the First Alaska Railroad Commission.	**Alaska** (*in part*).
A. H. P.*	Arthur Joseph Hungerford Pollen. Director, Birmingham Small Arms Co. and other companies. Pioneer of naval fire control and writer on naval matters.	**Beatty, Earl.**
A. J. B. W.	Alan John Bayard Wace, M.A. Deputy Keeper Victoria and Albert Museum, London. Late Director, British School of Archaeology at Athens, and Norton Lecturer, American Archaeological Institute. Author of *A Catalogue of the Sparta Museum*; *Prehistoric Thessaly*; *The Nomads of the Balkans.*	**Archaeology:** *Greece and Eastern Mediterranean*; **Athens.**
A. J. Gl.	Arthur James Glazebrook. Lecturer on Finance, University of Toronto.	**Canada:** *Finance.*
A. J. T.	Arnold Joseph Toynbee. Professor of International History, University of London. Member of Middle Eastern Section, British Delegation to the Peace Conference at Paris. Koraes Professor of Byzantine and Modern Greek Language, Literature and History at the University of London, 1919–24. Author of *Nationality and the War*; *A Survey of International Affairs, 1920–24*; etc.	**Aaland Is.**; **Asia Minor**; **Dardanelles**; **etc.**
A. L. Bo.	Arthur Lyon Bowley, Sc.D., F.B.A. Professor of Statistics at the London School of Economics. Formerly Professor of Mathematics and Economics, University College, Reading. Author of *Elements of Statistics*; *An Elementary Manual of Statistics*; *Measurement of Social Phenomena*; etc.	**Cost of Living.**
A. L. D.	Arthur L. Dakyns, M.A. Barrister-at-law.	**Companies and Corporations**; **Co-Partnership.**
A. Le.	André Levinson. Lecturer on Art at the Louvre and the Sorbonne, Paris.	**Bakst, Léon.**
A. Lo.*	Adolf Lorenz. Professor of Orthopaedic Surgery, University of Vienna. Formerly Director of the Clinic for Orthopaedic Surgery, Vienna. Inventor of the German plaster bed. Author of *A New Method of Treatment of Irreducible Acquired or Congenital Hip Dislocations*; etc.	**Bloodless Surgery.**
A. Ly.	A. Loveday. Member of the Economic and Financial Section, League of Nations, Geneva.	**Balance of Payments.**

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A. P. W.	COLONEL ARCHIBALD PERCIVAL WAVELL, C.M.G., M.C. General Staff Officer, War Office, London. British Military Attaché on the Caucasus Front, Nov. 1916–June 1917. General Staff Officer with Egyptian Expeditionary Force, July 1917–March 1918. Brigadier General, General Staff, with Egyptian Expeditionary Force, April 1918–20.	Brest-Litovsk, Battles of; Carpathians, Battles of the; Caucasus, Campaign in the; Dunajec-San, Battle of the; Eastern Front Campaigns.
A. R.	ARTHUR RANSOME. Author and Journalist, Contributor to *The Manchester Guardian*; *The English Review*; *The Fortnightly Review*; etc. Author of *Six Weeks in Russia*; *The Crisis in Russia*; etc.	Brest-Litovsk, Treaty of.
A. Sa.	A. SAFRASTIAN. Formerly British Vice-Consul at Bitlis, Kurdistan.	Armenia.
A. S. D.	AUGUSTUS SEISS DOWNING, M.A., L.H.D., LL.D. Assistant Commissioner for Higher Education and Director of Professional Education, University of the State of New York, Albany.	Education: *United States* (*in part*).
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A. Sr.	SIR JAMES ARTHUR SALTER, K.C.B. Director of the Economic and Finance section of the League of Nations. General Secretary to the Reparation Commission, 1920–2. Secretary of the British Department of the Supreme Economic Council, 1919. Secretary of the Allied Maritime Transport Council and Chairman of the Allied Maritime Transport Executive, 1918. Author of *Allied Shipping Control; an Experiment in International Administration.*	Control, Inter-Allied.
A. Th.	ALBERT THIBAUDET. Professor of the History of French Literature in the University of Geneva. Literary Critic of *La nouvelle revue française*. Contributor to *The London Mercury*. Author of *La Poésie de Stéphane Mallarmé*, *Trente ans de vie française*; etc.	Barrès, Maurice; Bergson, H.
A. Th.*	ALBERT THOMAS. Director of the International Labour Office, Geneva. Minister of Munitions in the French Government, 1916. Assistant Editor of *L'Humanité*, 1904. Author of *Le Syndicalisme allemand*; *Histoire anecdotique du Travail.*	Co-operation.
A. V.	AUGUSTE VERMEYLEN. Professor of Modern Philology at the University of Ghent, Belgium. Member of the Belgian Senate.	Belgian Literature: *Flemish*; Belgium: *Flemish Movement.*
A. V. K.	A. V. KERRISON, R.A. Instructor in Gunnery and Mathematics, Artillery College, Woolwich, London.	Ballistics.
A. V. Le C.	ALBERT VON LE COQ. Director, Asiatic Section of the Ethnological Museum, Berlin.	Archaeology: *Central Asia and Eastern Asia.*
A. W. A.	LIEUT.-COL. ALFRED WILLIAM ALCOCK, C.I.E., M.B., LL.D., F.R.S. Indian Medical Service (Ret). Formerly Professor of Medical Zoology at the London School of Tropical Medicine. Author of *A Naturalist in Indian Seas*; *Entomology for Medical Officers*; etc.	Entomology, Medical.
A. W. H.*	ARTHUR WILLIAM HOLLAND Managing Editor (London office) of *The Encyclopædia Britannica*, 13th edition; member of the staff of the 11th edition, 1905–11.	Betting Tax.
A.W.H.E.W.	WING-COMMANDER A. W. H. E. WYNN, O.B.E. Member of the staff of the Intelligence Department of the British Air Ministry, 1916–22.	Air Forces: *Great Britain*; Air Ministry: *Great Britain.*
B. B.	BRUCE BAIRNSFATHER. Author and Journalist. Author of *Fragments from France*; *The Better 'Ole*; etc.	Cartoon.
B. B. L.	BENJAMIN BARR LINDSEY. Judge of the Juvenile Court of Denver, Colorado. Author of *Problems of the Children*; *The Doughboy's Religion*; etc.	Children's Courts (*in part*).
B. C. S.	BERNARD CHRISTIAN STEINER, M.A., PH.D., LITT.D. Librarian, Enoch Pratt Free Library, Baltimore; Dean and Professor of Law, Baltimore Law School, 1900–4. Author of *Education in Maryland*; *Institutions and Civil Government of Maryland*; etc.	Baltimore.

B. E. P.	BARTHELÉMY EDMOND PALAT. Formerly General of Brigade in the French Army. Commanded a Division, 1915–6. Author of *La Grande Guerre sur le Front Occidental*; *Les Batailles d'Arras et de Champagne*; and, under the pseudonym "Pierre Lebautcourt," of *La Défense Nationale, 1870–1.*	**Champagne, Battles in** (*in part*).
B. H. L. H.	CAPTAIN B. H. LIDDELL HART, F.R. Hist. S. Military Correspondent of *The Daily Telegraph* (London). Inventor of the Battle Drill and various tactical methods adopted by the British Army. Joint Author of the official manual *Infantry Training* and editor of *Small Arms Training*. Author of *The Somme Offensive*; *Science of Infantry Tactics* (transl. for Bulgarian Army, 1925); *Paris, or the Future of War*; etc.	**Allenby, Viscount; Cambrai, Battle of; etc.**
B. L.	JOHN GILBERT BOHUN LYNCH. Author and Caricaturist. Author of *Max Beerbohm in Perspective*; etc.	**Caricature**
B. Ma.	BRONISLAW MALINOWSKI, PH.D., D.SC. Reader in Social Anthropology, London School of Economics, University of London. Author of *The Problem of Meaning in Primitive Languages*; etc.	**Anthropology.**
B. M. J.	B. MELVILL JONES, A.F.C. Mond Professor of Aeronautical Engineering, Cambridge University. Fellow of Emmanuel College, Cambridge.	**Aerodynamics.**
B. R. C.	B. R. COAD. In charge of Delta Laboratory, Bureau of Entomology, United States Department of Entomology.	**Boll Weevil.**
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B. Wi.	ARTHUR FREDERIC BASIL WILLIAMS, O.B.E. Professor of History, Edinburgh University; formerly Professor of History, McGill University, Montreal. Author of Vol. IV. of *The Times History of the South African War*; *Cecil Rhodes*; etc.	**Botha, Louis.**
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C. Bre.	CLOUDESLEY BRERETON, M.A., L-ÈS.-L. Divisional Inspector (Modern Languages) to the London County Council. Corresponding Member of the National Educational Association (America). Author of *The Organisation of Modern Language Teaching*; *Studies in Foreign Education*; etc.	**Classical Education** (*in part*); **Commercial Education** (*in part*).
C. Ch.	CHARLES CHREE, SC.D., LL.D., F.R.S. Formerly Assistant Director of the Meteorological Office and Superintendent of the Observatory at Kew, London.	**Atmospheric Electricity.**
C. Ch.*	CECIL CHISHOLM. Chairman of Business Publications Ltd.; Editorial Director of *The Advertiser's Weekly*; Editor of *System.* Author of *Marketing and Merchandising.*	**Advertising** (*in part*).
C. D. C.	LIEUTENANT-COLONEL C. D. CROZIER, R.A. (RET.). Director of Inspection of High Explosives, Ministry of Munitions, 1915–9.	**Explosives, Military.**
C. De B.	CECIL DELISLE BURNS, M.A., LITT. D. Lecturer in Logic and Philosophy, Birkbeck College, University of London. Author of *Government and Industry*; *Industry and Civilisation*; etc.	**Civil Service.**
C. Du.	CHARLES ST. L. DUFF. Barrister-at-law. On the staff of the Foreign Office, London. Author of "The Panama-Costa Rica Boundary Dispute" in *The Fortnightly Review* (Oct. 1921); etc.	**Brazil** (*in part*); **Central American Union; Chile** (*in part*).
C. D. W.	WILLIAM CECIL DAMPIER WHETHAM, M.A., F.R.S. Chairman of the Home Office Committee on Factory Lighting. Fellow of Trinity College, Cambridge. Author of *The Theory of Experimental Electricity*; *Back to the Land, a Medley*; etc.	**Agriculture:** *Electric Power.*
C. E. C.	MAJOR-GENERAL SIR CHARLES EDWARD CALLWELL, K.C.B. Director of Military Operations at the War Office, London, 1914–6. Author of *Small Wars*; *The Dardanelles*; etc.	**Army:** *General*; **Balkan Wars; Dardanelles Campaign.**
C. E. Ch.	CHARLES EDWARD CHAPMAN, A.M., PH.D. Associate Professor of History, University of California. Author of *The Founding of Spanish California*; *A Californian in South America*; *A History of Spain*; *Catalogue of Materials in the Archivo General de Indias for the History of the Pacific Coast and the American Southwest*; *A History of California*; *History of the Cuban Republic.*	**Cuba.**

C. E. F.	CHARLES ERNEST FAYLE. Author of *Seaborne Trade*; *The New Patriotism*; *The Great Settlement*; etc.	Convoy.
C. E. I.	CHARLES EDWARD INGLIS, O.B.E., M.I.C.E. Professor of Mechanism and Applied Mechanics, University of Cambridge. Fellow of King's College, Cambridge.	Bridges.
C. F. C.	CHARLES FREDERICK CROSS, F.C.S. Analytical and Consulting Chemist. Member of the firm of Cross and Bevan. Joint-author (with E. J. Bevan) of *Researches on Cellulose*; *Text-book of Paper-making*.	Artificial Silk; Cellulose.
C. F. Re.	CHARLES FERNAND REY. Commander of the Star of Ethiopia. Formerly Assistant Secretary, Ministry of Labour, London. Author of *Unconquered Abyssinia as it is To-day*; etc.	Abyssinia.
C. G. B.*	BRIG.-GEN. HON. CHARLES GRANVILLE BRUCE, C.B., M.V.O. Leader of the Mount Everest Expedition. Author of *The Assault on Mount Everest*; etc.	Everest.
C. G. D.*	CLAUDE GORDON DOUGLAS, M.B., CH.B., C.M.G., F.R.S. Fellow and Tutor in Natural Science, St. John's College, Oxford. Temp. Lieut.-Col., R.A.M.C., 1918. Author of papers on respiration and kindred physiological subjects in scientific journals.	Chemical Warfare (*in part*).
C. G. S.	CHARLES GABRIEL SELIGMAN, M.D., F.R.C.P., F.R.S. Professor of Ethnology, London School of Economics, University of London. Formerly President of the Royal Anthropological Institute. Author of *The Melanesians of British New Guinea*; *The Veddas* (jointly with B. Z. Seligman).	Archaeology: *South and Central Africa*; Anthropology, Applied.
C. H. B.	C. H. BEST. Attached to National Medical Research Institute, London.	Diabetes.
C. H. J.	CHARLES HUBBARD JUDD, PH.D., LL.D. Director of the School of Education and Chairman of the Department of Psychology, University of Chicago. Author of *Psychology, General Introduction*; *Psychology of High School Subjects*; etc. Editor of *The Supplementary School Journal*; *The School Review*; etc.	Co-education; Commercial Education: *United States*; Elementary Education: *United States*.
C. H. K. E.	WING-COMMANDER CHARLES H. K. EDMONDS, O.B.E., D.S.O. Served through the European War. Cuxhaven Raid, Dec. 1914 (Despatches), Gallipoli 1915 (Despatches).	Air Warfare.
C. K. H.	CHARLES KENNETH HOBSON. Author of *The Export of Capital*, etc.	Capital, Export of.
C. K. O.	C. K. OGDEN, M.A. Editor of *The Cambridge Magazine*; *The International Library of Psychology*; *The History of Civilisation*. Author of *The Meaning of Meaning* (with I. A. Richards); *The Foundations of Aesthetics*; etc.	Aesthetics.
C. L. C.	CHARLES LYON CHANDLER. Curator of South American History and Literature in the Harvard College Library. Manager of the Foreign Commercial Department of the Corn Exchange National Bank of Philadelphia.	Buenos Aires.
C. Ll. M.	CONWY LLOYD MORGAN, D.SC., LL.D., F.R.S. Emeritus Professor of Zoology and Geology in the University of Bristol. Formerly Professor of Zoology and Geology in University College, Bristol. Principal of the College, 1887–1909. Author of *Introduction to Comparative Psychology*; *Habit and Instinct*; *Instinct and Experience*; *Emergent Evolution*.	Evolution (*in part*).
C. L. T. B.	C. L. T. BEECHING. Secretary, Institute of Certified Grocers, London.	Cocoa; Coffee.
C. M. E. M.	CHARLES MARIE EMMANUEL MANGIN, K.C.B. General Commanding the French V., VI. and X. Armies, 1916–8, and the French forces in the Rhineland, 1918–9. Formerly member of the Supreme War Council and Inspector-General of Colonial Forces.	Champagne, Battles in (*in part*).
C. P. S.	CLIFFORD P. SMITH. Member of the Committee on Publication of the First Church of Christ, Scientist, Boston.	Christian Science; Mrs. Eddy.
C. Ri.	C. RICHARDSON. Formerly Hunting and Turf editor of *Land and Water* and *The Field* (London). Part author of *Racing at Home and Abroad*.	Coaching.
C. Ro.	REV. CAMILLE ROY, D.PH., L-ÈS-L., F.R.S. (Can.). Professor of French Literature and Rector of Laval University, Canada. Author of *Essais sur la littèrature canadienne*, etc.	Canadian Literature, *French*.
C. Ro.*	CARL ROOS, PH.D. Chief Librarian of the Royal Library, Copenhagen.	Danish Literature.
C. R. W.	CLINTON ROGERS WOODRUFF, LL.B. Attorney-at-law. Hon. Secretary, National Municipal League. Vice-President, American Civic Association. President, Civil Service Commission of Philadelphia.	City Government (*in part*).

C. Sey.	CHARLES SEYMOUR, M.A., PH.D., LITT.D. Sterling Professor of History in Yale University. Technical Delegate at the Paris Peace Conference, 1919. Author of *The Diplomatic Background of the War*; *Woodrow Wilson and the World War*; etc.	**Coolidge, Calvin.**
C. T. B.	CHARLES THOMAS BRUES, B.S., M.S. Assistant Professor of Economic Entomology, Harvard University. Author of *Insects and Human Welfare*. Editor of *Psyche* (journal of entomology).	**Entomology, Economic.**
C. T. G.	CHARLES THEODORE GREVE, A.B., LL.B. Referee-in-bankruptcy, U.S. District Court, Southern District of Ohio. Secretary to the Trustees of the Sinking Fund of Cincinnati, Ohio. Author of *The Centennial History of Cincinnati*.	**Cincinnati.**
C. T. R.	CHARLES TATE REGAN, M.A., F.R.S. Keeper of Zoology, Natural History Museum, London. Member of Freshwater Fish Committee, 1917–20. Author of *British Freshwater Fishes*; *Animal Life and Human Progress*; etc.	**Colours of Animals; Distribution of Animals.**
C. V. D.	CARL VAN DOREN, PH.D. Literary Editor of *The Century Magazine*, New York. Associate Professor in English, Columbia University, New York. Formerly Literary Editor of *The Nation*, New York. Author of *The American Novel*; *The Roving Critic*; *Many Minds*; *Contemporary American Novelists*; etc.	**American Literature:** *Fiction.*
C. W. C. O.	SIR CHARLES WILLIAM CHADWICK OMAN, K.B.E., F.B.A., M.P. M.P. for Oxford University, Chichele Professor of Modern History, Oxford, and Fellow of New College. President, Royal Historical Society, London, 1917–21, and Royal Numismatic Society, London, 1919.	**Coinage.**
C. W. F.	MAJOR C. W. FORD, R.A. Senior Instructor in Ammunition, Artillery College, Woolwich.	**Ammunition.**
C. W. J. O.	CHARLES WILLIAM JAMES ORR, C.M.G. Colonial Secretary, Gibraltar. Formerly Chief Secretary and Acting High Commissioner, Cyprus. Author of *Cyprus under British Rule*.	**Cyprus.**
D.	THE RIGHT HON. LORD DESBOROUGH (WILLIAM HENRY GRENFELL), G.C.V.O. Chairman of the Thames Conservancy Board. Past President, Oxford University Boat Club. President of the British Imperial Council of Commerce. Late President, London Chamber of Commerce.	**Easter, Fixed.**
D. A. MacG.	D. A. MACGIBBON, PH.D. Professor of Political Economy at the University of Alberta, Canada. Author of *Railway Rates and the Canadian Railway Commission*.	**Alberta; British Columbia.**
D. D.	DWIGHT FILLEY DAVIS, LL.B. United States Secretary of War.	**Army:** *United States.*
D. D. S.	DOROTHY D. STEEL. Winner of the Open Championship and Ladies Championship at Croquet, 1925.	**Croquet.**
D. M. S. W.	DAVID MEREDITH SEARES WATSON, M.Sc., F.R.S. Jodrell Professor of Zoology and Comparative Anatomy, University College, University of London. Author of many papers on Vertebrate Palaeontology and connected subjects in *Proc. Zool. Soc.*; *Journal of Anatomy*; etc.	**Evolution** (*in part*).
D. R. P.	D. R. PYE, M.A. Lecturer in Mechancial Science and Fellow of Trinity College, Cambridge.	**Aero Engines.**
D. S. Mi.	PRINCE D. S. MIRSKY. Lecturer in Russian Literature, King's College, London University. Author of *Modern Russian Literature*; *Pushkin*; *Russian Literature, 1875–1925*.	**Chekhov, Anton P.**
D. Sn.	DAVID SNEDDEN. Professor of Education, Columbia University, New York. Author of *Vocational Education* (1920); etc.	**Continuation Schools** (*in part*).
D. St.	DANIEL STARCH, M.A., PH.D. Associate Professor of Business Psychology, Harvard University. Director of the Department of Research, American Association of Advertising Agencies. Author of *Advertising: Its Principles, Practice and Technique*.	**Advertising** (*in part*).
D. T.	DOROTHY TODD. Editor of *Vogue*, London.	**Costume.**
D. Y. T.	DAVID YANCEY THOMAS, M.A., PH.D. Professor of History and Political Science in the University of Arkansas. Author of *A History of Military Government in Newly Acquired Territory of the United States*; *One Hundred Years of the Monroe Doctrine*; *Arkansas in War and Reconstruction*. Associate editor of *The Southwestern Political Science Quarterly*.	**Arkansas.**
E. B. A.	MAJOR-GENERAL EDWARD BAILEY ASHMORE, C.B., C.M.G. General Officer Commanding Territorial Air Defence Brigades. Formerly G.O.C. Air Defences of London.	**Air Raids.**
E. B. O.	E. B. OSBORN. Literary Editor of *The Morning Post* (London). Author of *The New Elizabethans*; etc.	**Boxing.**

E. Ca.*	EMILE CAMMAERTS. Professor of French Literature at Queen's College, London. Author of *Belgian Poems*; *New Belgian Poems*; *The Treasure House of Belgium*; *Belgium* (The Story of the Nations); etc.	Belgian Literature: *French.*
E. C. K.	EDWARD CAMERON KIRK, D.D.S., Sc.D., LL.D. State Dean and Emeritus Professor of Dental Pathology and Therapeutics, Dental School, University of Pennsylvania. Editor of *The Dental Cosmos.*	Dentistry.
E. Co.	EINAR COHN. Department of Statistics, Copenhagen.	Denmark: *Financial and Economic History.*
E. E. A.*	EDWARD E. ALLEN. Director of Perkins School for the Blind, Watertown, Massachusetts. Lecturer on the Education of the Blind, Graduate School of Education, Harvard University.	Blind, Training of the (*in part*).
E. F. B. G.	ELLINOR F. B. GROGAN (Lady Grogan). Author of articles on Balkan subjects in *The Nineteenth Century*; *New Europe*; etc.	Bulgaria: *Political History.*
E. F. C.	EDGAR FREDERICK CARRITT, M.A. Fellow and Praelector in Philosophy, University College, Oxford. Author of *The Theory of Beauty.*	Ethics.
E. F. S.	LIEUT.-COL. EDWARD FAIRBROTHER STRANGE, C.B.E. Late Keeper of Woodwork, Victoria and Albert Museum, London. Author of *Alphabets, A Handbook of Lettering*; *Japanese Illustration*; *The Colour Prints of Japan*; *Flowers and Plants for Designers and Schools*; etc.	Decorative Art (*in part*).
E. He.*	ERNST HERTZFELD. Professor of Oriental Archaeology, University of Berlin. Author of *Erster vorläufiger Bericht über die Ausgrabungen von Samarra.*	Archaeology: *Persia.*
E. H. P.*	E. H. PLATT. Secretary of the Royal Toxophilite Society, England.	Archery.
E. J. Di.	EMILE JOSEPH DILLON. Foreign Correspondent of *The Daily Telegraph* (London). Author of *Russian Characteristics*; *Maxim Gorky*; *From the Triple to the Quadruple Alliance*; *The Eclipse of Russia*; etc.	Alfonso XIII., King of Spain, etc.
E. J. F.	EDGAR JOHN FORSDYKE, M.A., F.S.A. Assistant Keeper of Greek and Roman Antiquities in the British Museum. Editor of *The Journal of Hellenic Studies.*	Archaeology: *North Africa and Crete.*
E. J. G.	EDGAR JOHNSON GOODSPEED, PH.D. Professor of Biblical and Patristic Greek and Chairman of the New Testament Department, University of Chicago. Author of *The Story of the New Testament*; *Things Seen and Heard.*	Chicago, University of.
E. J. R.	SIR EDWARD JOHN RUSSELL, D.Sc., F.R.S. Director of the Rothamsted Experimental Station, Harpenden, Hertfordshire. Author of *The Fertility of the Soil*; *Soil Conditions and Plant Growth*; *Farm Soil and Its Improvements*; etc.	Agriculture: *Scientific Developments* (*in part*).
E. J. S.	EDWARD JAMES SALISBURY, D.Sc., F.L.S. Reader in Plant Ecology and Fellow of University College, University of London. Hon. Secretary, British Ecological Society. Author of *An Introduction to the Study of Plants*; etc.	Ecology.
E. K. R.	ERIC KEIGHTLEY RIDEAL, D.Sc., PH.D., F.I.C. Owen Jones Lecturer in Physical Chemistry and Fellow of Trinity Hall, Cambridge. Author of *Electrometallurgy*; *Catalysis in Theory and Practice* (in part); *Water Supplies*; etc.	Catalysts; Conduction, Electric (*in part*).
E. L.	EDWARD LAAMAN. Chief Editor of *Waba Maa* (Estonian newspaper). Director of the Press Bureau at the Estonian Ministry for Foreign Affairs, 1920–4. Secretary to the Estonian Peace Delegation in Paris and London, 1918–20.	Estonia: *Political History.*
E. Le.	EMIL LEDERER, PH.D. Professor in the Faculty of Philosophy, University of Heidelberg. Editor of *Archiv für Sozialwissenschaft und Sozialpolitik.*	Communism.
E. M. D.	SIR ERNEST MACLEOD DOWSON, K.B.E. Surveyor-General of Egypt, 1909–19. Under-Secretary of State for Finance, Egypt, 1919–21. Financial Adviser to the Egyptian Government, 1920–3	Egypt: *Financial and Economic.*
E. M. E.	EDWARD MEAD EARLE. Assistant Professor of History, Barnard College, Columbia University, New York. Author of *Turkey, The Great Powers, and the Baghdad Railway.*	Baghdad Railway.
E. Mo.	E. MORESCO. Professor of Colonial Politics at the School of Commerce, Rotterdam.	East Indies, Netherlands.
E. N. S.	COLONEL ERNEST NORMAN STOCKLEY, R.E., D.S.O. Chief Engineer of the Western Command, England. Chief Engineer, XIX. Corps, 1918, and VI. Corps, 1919.	Bridging, Military.
Er. A.	ERIK ARUP, PH.D. Professor of Danish History at the University of Copenhagen.	Denmark: *Political History* (*in part*).

E. R.-B.	Sir Evelyn J. Ruggles-Brise, K.C.B. Chairman, Prison Commission, England and Wales, 1895–1921. Late President, International Prison Commission. Author of *The English Prison System*; *Prison Reform at Home and Abroad.*	**Borstal System.**
E. Sc.	Ernest Scott. Professor of History in the University of Melbourne.	**Australian Literature.**
E. T. D'E.	Sir Eustace Henry William Tennyson-D'Eyncourt, K.C.B., F.R.S. Managing Director, Armstrong Whitworth and Co., Ltd. Director of Naval Construction at the Admiralty, 1912–24.	**Aircraft Carrier; Dreadnought.**
E. Va.	Emile Vandervelde. Minister for Foreign Affairs in the Belgian Government. Formerly Minister of Justice. Represented Belgium at the Paris Peace Conference, 1919. Chairman of the Socialist Group in the Belgian Parliament. Author of *Three Aspects of the Russian Revolution*; *Le parti ouvrier belge*; etc,	**Belgium:** *Economic History.*
E. V. P.	Ernest Vincent Pannell. Electrical Engineer. Technical adviser of the British Aluminium Company, New York. Author of *High Tension Line Practice.*	**Aluminium; Electricity, Transmission of.**
E. W. Be.	Edward Wentworth Beatty, K.C., LL.D. President of the Canadian Pacific Railway. Chancellor of McGill University, Montreal.	**Canada:** *Communications.*
E. Wi.	E. Wilson, M.A. Contributor of Acrostics and Crosswords to *The News of the World* (London).	**Acrostics; Crosswords.**
E. W. MacB.	Ernest William MacBride, M.A., D.Sc., LL.D., F.R.S. Professor of Zoology, Imperial College of Science, South Kensington, London. Formerly Strathcona Professor of Zoology at McGill University, Montreal. Author of *A Text Book of Zoology*; etc.	**Cytology; Embryology; Evolution** (*in part*).
E. W. P. N.	Major E. W. Polson Newman. Correspondent of *The Daily Mail* in Jerusalem. War Correspondent in Syria 1925–6.	**Damascus.**
F. A. Cl.	Frederick Albert Cleveland, Ph.B., Ph.D., LL.D. Formerly Professor of United States Citizenship, Maxwell Foundation, Boston University. Author of *Organized Democracy*; *First Lessons in Finance*; etc.	**Boston.**
F. A. L.	Frederick Alexander Lindemann, Ph.D., F.R.S. Professor of Experimental Philosophy, Oxford University.	**Einstein, Albert.**
F. A. M. W.	Captain F. A. M. Webster. Joint Editor of *The Blue Magazine*, London, and writer on Athletics.	**Athletics.**
F. Ba.	Fernand Baudhuin. Professor of Commerce in the University of Louvain.	**Belgium:** *Finance.*
F. C. B.*	F. C. Bartlett, M.A. University Reader in Experimental Psychology and Director of the Psychological Laboratory, Cambridge.	**Culture Contact, Psychology of.**
F. C. L.	F. C. Lane. Editor of *Baseball.*	**Baseball.**
F. D.	F. Debenham, O.B.E. Lecturer on Geography and Fellow of Gonville and Caius College, Cambridge.	**Antarctica.**
F. G. B.	Frank George Barnes. Superintendent, Homerton Residential School for the Deaf, London, N.E. Formerly Editor of *The Teacher of the Deaf.*	**Deaf and Dumb:** *Great Britain.*
F. H. B.*	Frank Herbert Brown, C.I.E. Member of the staff of *The Times* (London). London correspondent of *The Times of India.* Formerly Editor of *The Indian Daily Telegraph.*	**Das, C. R., etc.**
F. Ho.	Frederick Webb Hodge. Ethnologist with Museum of the American Indian, Heye Foundation, New York. Ethnologist-in-charge, Bureau of American Ethnology, Smithsonian Institution, 1910-8. Founder and ex-President of American Anthropological Association. Editor of *Handbook of American Indians North of Mexico*; and sometime Editor of *The American Anthropologist.*	**Archaeology:** *North America.*
F. H. S.	Major-General Sir Frederick Hugh Sykes, G.B.E., C.M.G. M.P. for the Hallam division of Sheffield. Brigadier-General, General Staff, Supreme War Council, Versailles, 1917-8. Deputy Director, War Office, London, 1917. Chief of the Air Staff, 1918-9. Chief of British Air Section of the Peace Conference, Paris. Controller-General of Civil Aviation, 1919-22. Author of *Aviation in Peace and War.*	**Air Power.**
F. I.	Florence Irwin. Author of *The Complete Auction Player*; *Master Auction*; etc.	**Bridge, Auction** (*in part*).
F. J. C. W.	Major F. J. C. Wyatt, O.B.E., M.C. Organizer and Controller of Camouflage, British Expeditionary Force, France, 1916-8.	**Camouflage** (*in part*).

F. L. En.	F. L. Engeldow. On the staff of the Plant Breeding Institute, Cambridge, England.	**Agriculture**: *Scientific Developments (in part).*
F. L. M.	Frank Lidgett McDougall, C.M.G. Australian Representative on the Imperial Economic Committee, London. Author of *Sheltered Markets*; etc.	**Australia**: *Production, Industry and Trade.* **British Empire**: *Trade and Commerce.*
F. L. N.	Sir Frederic Lewis Nathan, R.A., K.B.E. Director of Alcohol Section, Fuel Research Board, London. Works Manager of the Ardeer Works of Nobel's Explosives Co., 1909-14.	**Alcohol** (*in part*).
F. M. R.	Flight-Lieutenant Frederick Michael Rope, R.A.F. Member of Staff, Royal Airship Works, Cardington, Bedford, England.	**Airship** (*in part*).
F. O. B.	Frederick Orpen Bower, F.R.S. Emeritus Professor of Botany, University of Glasgow. Twice President of the Botanical section of the British Association and ex-President of the Royal Society of Edinburgh. Author of *The Origin of a Land Flora*; *Plant Life on Land*; *Plants and Man*; etc.	**Botany.**
F. Pe.*	Franklin G. R. S. Petersen. Member of the editorial staff of *The Times* (London).	**Australia**: *Political History*; etc.
F. R. C.	Frank Richardson Cana, F.R.G.S. Editorial staff of *The Times* (London). Author of *South Africa from the Great Trek to the Union*; etc. Member of the editorial staff of the *Encyclopædia Britannica* (11th edition).	**Africa** (*in part*); **Basutoland; Bechuanaland; Cameroons; Eritrea; etc.**
F. R. M. de P.	F. R. M. de Paula, O.B.E., F.C.A. Reader in Accounting and Business Organisation at the London School of Economics, University of London. Author of *The Principles of Auditing.*	**Bookkeeping.**
F. W. A.	Francis William Aston, Sc.D., F.R.S. Fellow of Trinity College, Cambridge; Nobel Prizeman for Chemistry. Author of *Isotopes.*	**Atomic Energy.**
F. W. E.-G.	Frederick William Edridge-Green, C.B.E., M.D., F.R.C.S. Special Examiner and Adviser to the Board of Trade, London, on Colour Vision and Eyesight. Author of *The Physiology of Vision.* Inventor of the Colour Perception Spectrometer and Colour Perception Lantern—used as the official test of the British Navy.	**Colour Vision and Colour Blindness.**
F. W. Ha.*	F. W. Hack. Of Neufeldt and Kuhnke.	**Diving.**
G. Ab.	Grace Abbott, M.A. Chief of the Children's Bureau, U.S. Department of Labor. Author of *The Immigrant and the Community.*	**Child Labour and Child Welfare** (*in part*).
G. A. O.	George Alexander Orrok. Consulting Engineer. Formerly on staff of the New York Edison Company. Author of *Power Engineering.*	**Boilers.**
G. A. Y.	Lieutenant-Colonel Gilbert A. Youngberg, D.S.O. Corps of Engineers, U.S. District Engineer, Jacksonville, Florida. Formerly Assistant to the Chief of Engineers, U.S. Army.	**Engineers, Military**: *United States.*
G. Bo.	George Boncescu. Rumanian correspondent of *The Times* (London).	**Bessarabia; Bratianu, Jon; Bukowina; Dobruja; etc.**
G. C.	Gustav Cassel. Professor of Economics at the University of Stockholm. Author of *The World's Monetary Problems*; *Money and Foreign Exchange after 1914*; *The Theory of Social Economy*; etc.	**Exchanges, Foreign.**
G. C. D.	G. C. Dixon. Literary Editor, *The Daily Mail* (London). Author of *From Melbourne to Moscow.*	**Bruce, Stanley M.; etc.**
G. E. B.	George Earle Buckle, M.A., LL.D. Editor of *The Times* (London), 1884–1912. Formerly Fellow of All Souls College, Oxford. Author of *Life of Disraeli* (vols. III., IV., V. and VI). Editor of *The Letters of Queen Victoria.*	**Balfour, Earl of; Bryce, Viscount; Carson, Lord; Curzon, Marquess; etc.**
G. F. N. C.	George Felix N. Clay, F.R.I.B.A. Author of *Modern School Buildings.*	**Education**: *Architecture.*
G. F. St.	George Frederic Still, M.A., M.D., F.R.C.P. Professor of Diseases of Children, King's College, University of London. Physician to the Hospital for Sick Children, Great Ormond Street, London. Physician for Diseases of Children, King's College Hospital. Author of *Text Book on Diseases of Children*; etc.	**Children, Diseases of.**
G. G. A.	Major-General Sir George Grey Aston, K.C.B. Lecturer on Military History, University College, University of London. Formerly Professor of Fortification at the Royal Naval College, Greenwich. Author of *Sea, Land and Air Strategy*; *Memories of a Marine*; etc.	**British Empire**: *Defence.*
G. Gl.	George Glasgow. Author and Publicist. Author of *The Minoans*; *Ronald Burrows: a Memoir*; etc.	**Beneš, E.; etc.**

G. H. R.	George H. Ryden, M.A. Associate Professor of History and Political Science, University of Delaware. Director of the American Red Cross in South Russia, 1919-20.	Delaware.
G. H. T.	George Herbert Thring. Solicitor. Secretary of the Incorporated Society of Authors, Playwrights and Composers, London.	Copyright.
G. K. A. B.	Very Reverend George Kennedy Allen Bell, D.D. Dean of Canterbury. Formerly resident chaplain to the Archbishop of Canterbury. Author of *The Meaning of the Creed*; etc.	Anglicanism; Davidson, Randall T.
G. L.*	Gonzalez Lodge. Professor of Latin and Greek at Teachers College, Columbia University, New York. Editor-in-chief of *The Classical Weekly*, 1907-13.	Classical Education: *United States.*
G. le G. N.	G. le G. Norgate, B.A. Contributor to *The Dictionary of National Biography.*	Chelmsford, Viscount; etc.
G. le Q. M.	Major G. le Q. Martel, D.S.O., M.C. Deputy Assistant Director of Fortification and Works, Ordnance Department, War Office, London. General Staff Officer, Tank Corps Headquarters, B.E.F., France, 1916-8. Inventor of the One-man Tank.	Armoured Car.
G. L. K.	Geoffrey Langdon Keynes, M.A., M.D., F.R.C.S. Hunterian Professor, Royal College of Surgeons, London. Author of *Blood Transfusion*; etc.	Blood Transfusion.
G. M. W.	George Mackinnon Wrong, M.A., LL.D., F.R.S.(Can.). Professor of History, University of Toronto. Author of *The Fall of Canada*; *The Conquest of New France*; etc.	Canada: *Political History.*
G. O. M.	George O. May. President of the American branch of the firm of Price, Waterhouse and Co., Accountants.	Cost Accounting.
G. S. Du.	Rev. George Simpson Duncan, M.A., B.D. Professor of Biblical Criticism in St. Mary's College, University of St. Andrews.	Biblical Criticism.
G. T.*	Major Edward Geoffrey Toye. Conductor for Sir Thomas Beecham's Opera Companies and other societies. Author of *Experance Morris Dance Book No. 2.*	Dancing.
G. T. B.	George Thomas Burrows. Editor of *The Live Stock Journal* and agricultural correspondent of *The Daily Telegraph* (London).	Bowls.
G. W. G.	G. W. Giles, F.R.H.S. Secretary, Allotments Organisation and Small Holders Society Ltd., London.	Allotments.
G. W. K.*	George Washington Kirchwey, LL.D. Head of the Department of Criminology, New York School of Social Work. Formerly Warden of Sing Sing Prison. Author of *Readings in the Law of Real Property*; etc.	Criminology.
H.*	Right Hon. Viscount Haldane (Richard Burdon Haldane), K.T., O.M., LL.D., F.R.S. Lord High Chancellor of England, 1912–5 and 1924. Secretary of State for War, 1905–12. Chancellor of the University of Bristol. Gray Scholar and Ferguson Scholar in Philosophy of the four Scottish universities, 1876. Author of *Education and Empire*; *The Philosophy of Humanism*; etc. Joint author of *Essays in Philosophical Criticism.*	Education: *General.*
H. A. B.	Brig.-Gen. Henry Arthur Bethell, C.M.G., R.A. Author of *Modern Guns and Gunnery*; *Modern Artillery in the Field.*	Artillery.
H. A. H.	Howard Archibald Hubbard, M.A. Professor of History and Head of the Department of History and Political Science in the University of Arizona.	Arizona.
H. A. T.	H. Avray Tipping, M.A., F.S.A.	Chequers.
H. B. H.	Brig.-Gen. Harold Brewer Hartley, M.C. Fellow and Tutor of Balliol College, Oxford. Controller of the Chemical Warfare Department, Ministry of Munitions, London, 1918–9. Formerly Assistant Director of Gas Services, G.H.Q., France.	Chemical Warfare (*in part*).
H. Bi.*	Henri Bidou. Member of the staff of *Le Journal des Débats* (Paris). Chevalier of the Legion of Honour.	Alsace-Lorraine.
H. Br.*	Henri Brenier. Director-General of the Chamber of Commerce, Marseilles. General Secretary to the National Colonial Exhibition at Marseilles, 1922, and to the Colonial Organisation Congress, 1922.	Algeria.
H. C. Ha.	Henry C. Harwood. Literary Critic, *The London Mercury*; *The Outlook* (London). Author of *Judgment Eve*; etc.	Bennett, Arnold; Ellis, H. Havelock.

H. Co.	HENRY COUSENS. Late member of the Archaeological Survey of India. Author of *Architectural Antiquities of Western Asia.*	**Archaeology:** *India.*
H. C. W.	HENRY C. WATTS, D.Sc., A.M. Inst.C.E. Fellow of the Royal Aeronautical Society, England.	**Airscrew.**
H. C. Wo.	HENRY CHARLES WOODS. Special correspondent of *The Times* (London) in the Balkans, 1911, and of *The Evening News* (London) during the Balkan Wars, 1912–3. Military and Diplomatic Correspondent for *The Evening News*, 1914–5. Author of *War and Diplomacy in the Balkans*; etc.	**Constantine, ex-King of the Hellenes.**
H. D.*	HAROLD DORE. Political correspondent of *The Manchester Guardian.*	**Daylight Saving.**
H. E. A.	HENRY EDWARD ARMSTRONG, PH.D., LL.D., D.Sc., F.R.S. Emeritus Professor of Chemistry at the City and Guilds College, South Kensington, London.	**Chemistry.**
H. E. B.	HENRY ELDRIDGE BOURNE, L.H.D. Professor of History in Western Reserve University, Cleveland, Ohio. Author of *The Revolutionary Period in Europe*; *History of the United States*; etc.	**Cleveland.**
H. E. Ba.	HARRY EVERETT BARNARD, PH.D. Director of the American Institute of Baking. Formerly Food and Drug Inspection Chemist, U.S. Department of Agriculture.	**Bread Making** (*in part*).
H. Fi.	HERMAN FINER, D.Sc. Lecturer in Public Administration, London School of Economics. Author of *Foreign Governments at Work*; *The Case Against Proportional Representation*; etc.	**Electoral Laws.**
H. F. O.	HENRY FAIRFIELD OSBORN, D.Sc., LL.D., PH.D. Honorary Curator of the Department of Vertebrate Palaeontology of the American Museum of Natural History. Senior Geologist, United States Geological Survey. Research Professor of Zoology, Columbia University, New York. Author of *Age of Mammals*; *Men of the Old Stone Age*; *Origin and Evolution of Life*; etc.	**Evolution** (*in part*).
H. G. C.	HAROLD G. COLMAN, D.Sc., PH.D., F.I.C. Analytical and Consulting Chemist.	**Coal Tar Products.**
H. G. J.	HERMAN GERLACH JAMES, M.A., PH.D. Dean of the College of Arts and Sciences and Professor of Political Science in the University of Nebraska. Author of *Principles of Prussian Administration*; *Applied City Government*; *A Handbook of Civic Improvements*; *Local Government in the United States*; *The Constitutional System of Brazil.*	**Chile** (*in part*).
H. G. T.	H. G. THORNTON. Head of the Bacteriology Department, Rothamsted Experimental Station, Harpenden, Hertfordshire.	**Bacteriology** (*in part*).
H. Gu.	HUGH GUNN, M.A. Director of Education and Member of the Legislative Council, Orange River Colony, 1902–10. Editor of *The British Empire.*	**Beyers, C. F.**
H. H. J.	SIR HARRY HAMILTON JOHNSTON, G.C.M.G., K.C.B., Sc.D., F.R.G.S. Commissioner and Consul-General in British Central Africa, 1891. Consul-General in the Regency of Tunis 1897–9. Special Commissioner, Commander-in-Chief and Consul-General for the Uganda Protectorate, 1899–1901. Author of *British Central Africa*; *The Uganda Protectorate*; *The Nile Quest*; *Liberia*; etc.	**Africa** (*in part*).
H. Ho.	HARRY HOUDINI. Professional Magician. Author of *Handcuff Secrets*; *The Unmasking of Robert Houdin*; *A Magician Among the Spirits*; etc.	**Conjuring.**
H. I. P.	HERBERT INGRAM PRIESTLEY, M.A., PH.D. Professor of Mexican History and Librarian of the Bancroft Library, University of California. Author of *The Mexican Nation*; etc.	**Costa Rica.**
H. J. Br.	H. J. BRAUNHOLTZ, M.A. Assistant Keeper of Ceramics and Ethnography, British Museum, London.	**Archaeology:** *Oceania and Easter Island.*
H. J. F.	HERBERT JOHN FLEURE, D.Sc. Professor of Geography and Anthropology, University College of Wales, Aberystwyth. Hon. Secretary, Geographical Association; and Hon. Editor of *The Geographical Teacher.* Author of *Human Geography in Western Europe*; etc.	**Exploration.**
H. J. T.	H. J. TEMPLE. Political Representative in England of the European Association of Ceylon.	**Ceylon.**
H. Le.*	HARPER LEECH, M.A. Financial writer with *The Chicago Tribune.* Formerly managing editor, Memphis *Press*, and editor, Denver *Express.*	**Chicago.**
H. L. M.	HENRY LOUIS MENCKEN. Editor of *The American Mercury.* Contributing editor of *The Nation* (New York). Formerly editor (with George Jean Nathan) of *The Smart Set.* Author of *In Defense of Women*; *The American Language*; *Prejudices*; etc.	**Americanism.**

H. L. T.	HENRY LETHEBY TIDY, M.A., M.D., F.R.C.P. Assistant Physician to St. Thomas's Hospital, and Physician to the Great Northern Hospital, London. Hon. Secretary, Royal Society of Medicine. Formerly Demonstrator of Clinical Pathology to the London Hospital. Author of *Synopsis of Medicine*; etc.	**Encephalitis Lethargica.**
H. Lu.	H. LUND.	**Denmark:** *Political History (in part).*
H. M. H.*	HENRY METCALF HOBART, B.S. Consulting Engineer of the General Electric Company, Schenectady, N.Y. Author of *Electric Motors*; *Continuous Current Dynamo Design*; *Design of Static Transformers*; etc.	**Dynamo-Electric Machines.**
H. Mi.	J. HAMISH MILES. Literary Critic of *The New Statesman* and *The Outlook* (London). Author (with R. Mortimer) of *The Oxford Circus.*	**Beerbohm, Max; Doughty, C. M.**
H. Ni.	HON. HAROLD NICOLSON, C.M.G. First Secretary, British Legation, Teheran. Served on British Delegation to the Peace Conference, 1919. Author of *Paul Verlaine*; etc.	**Diplomacy.**
H. P.	HENRI PIRENNE. Professor of Mediaeval History, University of Ghent. Member of the Royal Academy of Belgium and the Institute of France. Author of *Histoire de Belgique;* etc.	**Albert I., King of the Belgians; Belgium** (*in part*).
H. P. W.	HENRY PARKER WILLIS, PH.D. Professor of Banking in Columbia University, New York. Formerly Director of Research, Federal Reserve Board. Editor-in-chief, *The Journal of Commerce* (New York). Author of *American Banking*; *The Federal Reserve System*; *Federal Reserve Banking Practice*; etc.	**Banking,** *United States.*
H. R. H.	HARRY REGINALD HOLLAND HALL, F.B.A., Litt. D., F.S.A. Keeper of Egyptian and Assyrian Antiquities, British Museum, London. Author of *Egypt and Western Asia in the Light of Recent Discoveries*; *Aegean Archaeology*; etc.	**Archaeology:** *Western Asia and Mesopotamia.*
H. Ro.	SIR HUMPHRY DAVY ROLLESTON, BART., K.C.B., M.D., D.Sc., D.C.L. Regius Professor of Physic, Cambridge University. Physician in Ordinary to His Majesty King George V. President of the Royal College of Physicians of London. Author of *Diseases of the Liver*; etc.	**Diagnosis.**
H. Sc.	HAROLD LORAIN SCOTT. Associate Professor of History, Robert College, Constantinople.	**Constantinople.**
H. S. C.	HENRY SEIDEL CANBY, PH.D. Professor of English, Yale University. Editor of *The Saturday Review of Literature.* Author of *The Short Story*; *English Composition in Theory and Practice*; *Everyday Americans*; etc.	**American Literature** (*in part*).
H. Si.	HERBERT SIDEBOTHAM. Contributor to *The Daily Chronicle*; *The Daily Graphic*; *The Sunday Times* (London). For many years on the editorial staff of *The Manchester Guardian* and known as "Student of War" and "Student of Politics." Author of *Pillars of the State;* etc.	**Churchill, Winston L.**
H. Sp.*	HERBERT JOSEPH SPINDEN, A.M., PH.D. Curator of Mexican Archaeology and Ethnology, Peabody Museum, Harvard University. Author of *Ancient Civilizations of Mexico and Central America*; *Civilization and the Wet Tropics*; etc.	**Archaeology:** *Mexico and Central America.*
H. St. J. B. P.	HARRY ST. JOHN BRIDGER PHILBY, C.I.E. Chief British Representative in Transjordan, 1921–4. Formerly Adviser to the Ministry of the Interior, Mesopotamia. Commanded the British Political Mission to Central Arabia, 1917–8. Author of *The Heart of Arabia.*	**Arabia** (*in part*).
H. T.*	BRIGADIER-GENERAL HARRY TAYLOR, D.S.M. Chief of Engineers, United States War Department. Chief Engineer, American Expeditionary Force, in France 1917–8.	**Colorado River.**
H. Ti.*	HERBERT TILLEY, B.S., F.R.C.S. Surgeon, Ear, Nose and Throat Department, University College Hospital, London. Laryngologist to the Radium Institute. Ex-president of the Sections of Laryngology and Otology, Royal Society of Medicine. Author of *Diseases of the Nose and Throat*; etc.	**Ear, Nose and Throat, Diseases of.**
H. T. S.	HUGH TEMPEST SHERINGHAM. Angling Editor of *The Field* (London). Author of *An Angler's Hours*; *Elements of Angling*; *Trout Fishing: Memories and Morals*; etc.	**Angling.**
H. V. S. C.	LIEUTENANT-COLONEL HAROLD V.S. CHARRINGTON, M.C. General Staff Officer, 2nd Grade, at the Staff College, Camberley, England.	**Cavalry.**
H. Wa.	HERBERT WARD, M.A., C.B.E. Formerly Chief Inspector for the Training of Teachers, Board of Education, London.	**Education, Experiments in:** *Great Britain.*
H. W. Ba.	H. W. BARTLEET. Writer on Motoring and Cycling topics.	**Cycling.**

H. W. C.	HARVEY WILEY CORBETT, F.R.I.B.A. Lecturer in Architecture, Columbia University. Post-President, Architectural League of New York; member Fine Arts Commission, State of New York. Member of the firm of Helmle & Corbett, New York. Architect of Bush Terminal Office Building (New York); Bush House (London); Springfield Municipal Group (Mass.); George Washington Masonic National Memorial (Alexandria, Va.); etc.	Architecture.
H. W. M.	HENRY WILLIAM MARDON. Formerly Lecturer in Geography and Education in the Tewfikieh and Dar el Ulum colleges, Cairo. Author of *A Geography of Egypt and the Anglo-Egyptian Sudan*; etc.	Aden; Arabia (*in part*).
H. W. V. T.	HAROLD WILLIAM VAZEILLE TEMPERLEY, M.A., LITT.D., O.B.E. University Reader in Modern History and Fellow of Peterhouse, Cambridge. British Representative on the Albanian Frontiers Commission, 1921. Military Adviser at the Peace Conference, Paris, 1919. Editor of *A History of the Peace Conference of Paris*. Contributor to *The Cambridge Modern History* and *The Cambridge History of Foreign Policy*.	Ambassadors, Conference of; Eupen and Malmedy; etc.
I. A. E. E.	LIEUT.-COL. IVO ARTHUR EXLEY EDWARDS, C.M.G. Staff Officer, British Air Ministry, 1918–9. Sometime Deputy Director Air Transport Department of Civil Aviation, Air Ministry, London.	Aerodrome.
I. F.	IRVING FISHER, PH.D. Professor of Political Economy at Yale University. Author of *The Nature of Capital and Income*; *The Purchasing Power of Money*; *The Rate of Interest*; *Stabilizing the Dollar*; etc.	Dollar Stabilisation.
I. F. D. M.	IAN F. D. MORROW. Formerly Senior Moderator, Trinity College, Dublin.	Capitulations; Europe (*in part*).
I. W. S	I. W. SHKLOVSKY. Formerly regular contributor to the Russian periodicals *Russko Bogatsvo* and *Russkia Viedomosti*. Author of *Literary Characteristics*; etc.	Andreyev, L. N.
J. A. A.	J. A. ARKWRIGHT, M.D., F.R.C.P., F.R.S. Bacteriologist at the Lister Institute, London.	Bacteriology (*in part*).
J. A. F.	JOHN AMBROSE FLEMING, M.A., D.Sc., F.R.S. Formerly Professor of Electrical Engineering, University College, London. Fellow of University College. Inventor of the thermionic valve which made wireless telephony possible. Hughes Gold Medallist of the Royal Society. Author of *The Wonders of Wireless Telegraphy*; *Fifty Years of Electricity*; etc.	Electricity: *Nature and Uses*.
J. A. Fi.	J. ALFRED FISHER. Member of the Grand Council of the Federation of British Industries.	Asbestos.
J. A. R. M.	SIR JOHN ARTHUR RANSOME MARRIOTT. M.P. for Oxford City, 1917–22; M.P. for York since 1923. Chairman of the House of Commons Select Committee on Estimates, 1924 and 1925. Secretary to the Oxford University Extension Delegacy, 1895–1920. Author of *English Political Institutions*; *The Eastern Question: a Study in European Diplomacy*; *England under the Tudors*; etc.	Baldwin, Stanley; Conservative Party.
J. A. S.*	JOHN ALEXANDER SMITH, M.A. Waynflete Professor of Moral and Metaphysical Philosophy, Oxford. Fellow of Magdalen College, Oxford.	Croce, Benedetto.
J. A. T.	JOHN ARTHUR THOMSON, M.A., LL.D. Regius Professor of Natural History in the University of Aberdeen. Gifford Lecturer, St. Andrew's, 1915. Terry Lecturer, Yale University, 1924. Author of *The Study of Animal Life*; *Outlines of Zoology*; *Heredity*; *Darwinism and Human Life*; *What is Man?*; *Concerning Evolution*. Joint Author (with Professor Patrick Geddes) of *Evolution*; *Sex*; *Biology*.	Biology.
J. B. C.	JOHN BRIAN CHRISTOPHERSON, M.D., F.R.C.P., F.R.C.S. Physician for Tropical Diseases, Freemasons Hospital and Nursing Home, Chelsea, London. Consultant to the Tropical Diseases Clinic, Ministry of Pensions. Author of *Antimonium Tartratum, a Specific Cure for Bilharziosis*; etc.	Bilharziosis.
J. B. C. K.	JOHN BAKER CANNINGTON KERSHAW, F.I.C., F.S.S. Consulting Chemist and Chemical Engineer. Author of *The Electric Furnace in Iron and Steel Production*; *Electrometallurgy*; *Electrothermal Methods of Iron and Steel Production*.	Electrochemistry; Electrometallurgy.
J. B. F.	JOHN B. FIRTH. Editorial Staff of *The Daily Telegraph* (London). Author of *Augustus Caesar*; *Constantine The Great*; etc.	Burnham, 1st Viscount; Burnham, 1st Baron; Chamberlain, Sir J. Austen.
J. Bro.	JOHN BROWNLEE, D.Sc., M.D., D.P.H. Director of Statistics, National Institute for Medical Research, London.	Epidemiology (*in part*).
J. B. W.	JOHN B. WATSON, PH.D. Editor of *The Psychological Review*. Late Professor of Psychology, Johns Hopkins University. Author of *Behaviour—An Introduction to Comparative Psychology* (1914); *Psychology from the Standpoint of the Behaviourist* (1919); *Behaviourism* (1925).	Behaviourism.

J. C. D.	JACK CECIL DRUMMOND, D.Sc., F.I.C. Professor of Biochemistry, University College, University of London.	**Biochemistry.**
J. C. G. L.	JOHN CHARLES GRANT LEDINGHAM, C.M.G., M.B., F.R.C.P., D.Sc., F.R.S. Professor of Bacteriology and Chief Bacteriologist, Lister Institute, University of London; formerly in charge of Bacteriological Department, King George Hospital, London. Consulting Bacteriologist in Mesopotamia, 1917. Joint-author of *The Carrier Problem in Infectious Diseases.*	**Bacteriology** (*in part*).
J. Ci.	JAROSLAV CISAR, PH.D. Secretary on Special Mission, Czechoslovakian Legation, London. Author of *The Czecho-Slovak Republic.*	**Czechoslovakia** (*in part*).
J. C. M.*	COLONEL J. C. MATHESON. Assistant Director of Fortification and Works at the War Office, London.	**Coast Defence.**
J. C. Sq.	JOHN COLLINGS SQUIRE, M.A. Editor of *The London Mercury.* Chairman of the English Association. Chairman of the Architecture Club. Author of *Tricks of the Trade*; *Essays onPoetry*; *Grub Street Nights*; *The Comic Muse*; etc.	**English Literature.**
J. C. W. R.	J. C. W. REITH. Managing Director of The British Broadcasting Co. Ltd.	**Broadcasting** (*in part*).
J. Dv.	JAN DVOROCEK. Foreign Minister of Czechoslovakia; Head of the Economic Section, Economic Committee of the League of Nations.	**Czechoslovakia** (*in part*).
J. E. C.	JANET ELIZABETH COURTNEY (Mrs. W. L. Courtney), O.B.E., J.P. Author of *Free Thinkers of the Nineteenth Century*; *Recollected in Tranquillity.* Joint-author of *Pillars of Empire.* Joint-author of Index to the 11th edition of *The Encyclopædia Britannica.*	**Alexandra, Queen**; **Chisholm, Hugh.**
J. E. W.	JAMES EDWARD WEST, LL.M. Executive Officer of the Boy Scouts of America, 1911; later, Chief Scout Executive.	**Boy Scouts:** *United States.*
J. F. C. F.	COLONEL JOHN FREDERIC CHARLES FULLER, D.S.O. Military Assistant to the Chief of the Imperial General Staff. Chief General Staff Officer, Tank Corps, 1917-8. Formerly Chief Instructor, Staff College, Camberley. Author of *Tanks in the Great War*; *The Reformation of War*; *Sir John Moore's System of Training*; etc.	**Arras, Battle of.**
J. F. Da.	JOHN FORD DARLING, C.B.E. Director Midland Bank Ltd. Formerly General Manager, London Joint Stock Bank Ltd.	**British Commonwealth:** *Finance.*
J. G. H.	JOSEPH G. HORNER, A.M.I.Mech.E. Author of *Plating and Boiler Making*; *Practical Metal Turning*, etc.	**Automatic Machinery.**
J. Gr.	JAMES GREIG, R.B.A. Art Critic of *The Morning Post* (London). Author of *Sir H. Raeburn, His Life and Works*; *Life of Thomas Gainsborough*; etc.	**Art Sales.**
J. Gr.*	JOSEF GRUNTZEL, PH.D. Professor of Economics in the School of Economics, University of Vienna. Author of *Handelspolitik*; etc.	**Commercial Treaties.**
J. H. T.	RIGHT HON. JAMES HENRY THOMAS. M.P. for Derby General Secretary of the National Union of Railwaymen, England. Formerly Secretary of State for the Colonies. Acting Chairman of Executive Council, British Empire Exhibition, 1924-5. Author of *When Labour Rules.*	**Exhibition, British Empire.**
J. H. van A.	J. H. VAN ALSTYNE. President of the Otis Elevator Co., New York.	**Elevators and Escalators.**
J. J. C.	BRIG.-GEN. JOHN J. COLLYER, C.B., C.M.G., D.S.O. Late Chief of the General Staff, Union of South Africa.	**Cameroons, Operations in**; **East Africa, Operations in.**
J. K. H.	JOSEPH KINMONT HART, PH.D. Lecturer in Education at the New School for Social Research, New York City. Formerly Associate Editor of *The Survey.* Formerly Professor of Education, Reed College, Portland, and Director of the Pennsylvania School for Social Service. Author of *Community Organization*; *Discovery of Intelligence*; etc.	**Adult Education:** *United States.*
J. Kn.	JOSEPH KNOX, D.Sc. Lecturer in Chemistry in the University of Glasgow.	**Cyanamides.**
J. L. Co.	JOHN L. COPE. Member of the staff of *The Encyclopædia Britannica* (13th edition).	**British Legion.**
J. L. G.	JAMES LOUIS GARVIN, LITT.D. Editor-in-chief of *The Encyclopædia Britannica.* Editor of *The Observer* (London). Formerly editor of *The Pall Mall Gazette.* Author of *The Economic Foundations of Peace*; etc.	**Capitalism.**
J. L. M.	JOHN LINTON MYRES, M.A., D.Sc., F.B.A., F.S.A., O.B.E. Wykeham Professor of Ancient History and Fellow of New College, Oxford. Vice-President, Anthropological Institute of Great Britain and Ireland, 1921. Author of *The Dawn of History*; etc.	**Archaeology:** *General Survey.*

J. Ma.*	Sir James Marchant, K.B.E., F.R.S. (Edin.). Director of the British National Council for the Promotion of Race Regeneration. Secretary of the National Birth Rate Commission and Editor of its *Reports*. Author of *Birth Rate and Empire*; etc.	Birth Control.
J. Mat.	Julius Mattfeld. Organist in Fordham Lutheran Church, New York; music librarian of the New York Public Library and Radio Broadcasting Station WEAF. Author of *The Folk Music of the Western Hemisphere*; etc. Associate American editor of Hull's *Dictionary of Modern Music and Musicians*.	Choral Singing (*United States*).
J. M. H. McL.	John McLeod Hendrie McLeod, M.D., F.R.C.P. Lecturer on Skin Diseases, London School of Tropical Medicine. Physician for Diseases of the Skin, Charing Cross Hospital. Late Editor of *The British Journal of Dermatology*. Author of *Textbook on the Diseases of the Skin*.	Burns and Scalds.
J. M. M.	John Malcolm Mitchell, M.C., F.S.A. (Scot.). Secretary, Carnegie United Kingdom Trust. Vice-President, Library Association. Author of *The Public Library System of Great Britain and Ireland*. Editor of *The Rural Libraries Handbook* (1922).	Carnegie Trusts.
J. M. M.*	J. Merritt Matthews. Head of the Department of Chemistry and Dyeing, Philadelphia Textile School, 1898-1907. Editor of *The Colour Trade Journal*, 1917-25.	Dyeing (*in part*).
J. M. R.*	Colonel John Markham Rose, D.S.O. Royal Marine Artillery. Commanded Heavy Artillery in South West Africa, 1914-5. Raised and commanded South African Heavy Artillery for service in France, 1915–6.	Bombs.
J. M. Ri.	J. M. Ritchie, M.A. Superintendent and Secretary, London Society for Teaching and Training the Blind.	Blind, Training of the (*in part*).
J. M. Sp.	J. M. Spaight, O.B.E. Member of British Delegation, Commission of Jurists on the Laws of War, The Hague, 1922-3. Author of *Aircraft in War; Aircraft in Peace and the Law*; *Air Power and War Rights*; etc.	Aerial Law (*in part*).
J. Mt.*	Jean Martet. Private Secretary to M. Clemenceau.	Clemenceau, Georges.
J. N. F.	John Nicol Farquhar, Litt.D., D.D. Professor of Comparative Religion, University of Manchester. Author of *An Outline of the Religious Literature of India*; etc.	Buddhism.
J. O. S.	John Obed Smith. Formerly Chief Officer, Canadian Government Emigration Department. Dominion Immigration Commissioner for Western Canada, 1901.	Canada: *Immigration and Settlement*.
J. P. A.	James Pryer Allen. Secretary, National Association of Amateur Billiard Players (U.S.A.).	Billiards (*in part*).
J. Re.	Josef Redlich. Lecturer in Public Law and Administration at the University of Vienna.	Austria: *Political History*.
J. R. Fi.	Joseph R. Fisher. Barrister-at-law. Member of Irish Boundary Commission, 1924–5. Formerly Editor and Managing Director of *The Northern Whig* (Belfast). Author of *The Last Irish Parliament*; *Ulster in Irish History*; etc.	Craig, Sir James.
J. R. R.	Right Hon. Sir James Rennell Rodd, G.C.B., G.C.M.G., G.C.V.O. Formerly British Ambassador to the Court of Italy. Member of Lord Milner's Mission to Egypt, 1920. British Delegate to League of Nations, 1921 and 1923. Author of *Social and Diplomatic Memoirs*; etc.	Egypt: *Political History*.
J. Sh.	John Shapley. Morse Professor of the Literature of the Arts of Design, New York University. President of the College Art Association of America. Editor of *The Art Bulletin*. Associate Editor of *The American Journal of Archaeology*.	Art Treasures.
J. S. H.	Julian Sorell Huxley, M.A. Professor of Zoology at King's College, London. Formerly Fellow of New College and Senior Demonstrator in Zoology, Oxford University. Author of *The Individual in the Animal Kingdom*; *Essays of a Biologist*; etc.	Evolution: *Introduction*.
J. S. M. W.	John Sebastian Marlow Ward, M.A., F.S.S., F.R. Anthrop. S. Head of the Intelligence Department of the Federation of British Industries. Author of *Textile Fibres and Yarns of the British Empire*; *An Outline History of Freemasonry*; etc.	Dyeing (*in part*).
J. Sn.	Sir John F. C. Snell, G.B.E., M. Inst. C.F. Chairman of H. M. Electricity Commission; Chairman, Water Power Resources Committee, Board of Trade, London. Formerly President of the Institution of Electrical Engineers. Chairman, Committee on Electroculture, Ministry of Agriculture and Fisheries, London. Author of *Distribution of Electric Energy*; *Power House Design*; etc.	Electric Power, Generation of.

J. St.	Sir Josiah Charles Stamp, G.B.E., F.B.A., D.Sc. President of the Executive, London, Midland and Scottish Railway. Vice-President, Joint Hon. Secretary and Editor, Royal Statistical Society, London. Member of the British Royal Commission on Income Tax, 1919; of the Committee on Taxation and National Debt, 1924. British Representative on the Reparation Commission's Committee on German Currency and Finance, 1924. Author of *Wealth and Income of the Chief Powers*; *Wealth and Taxable Capacity*; etc.	**Capital Levy.**
J. St.*	J. Stewart. Author of *Bread and Breadmaking.*	**Bread Making** (*in part*).
J. St. L. S.	John St. Loe Strachey. Formerly Editor and Proprietor of *The Spectator* (London). Editor of *The Cornhill Magazine* (London), 1896–7. Author of *Problems and Perils of Socialism*; *The Adventure of Living*; *Economics of the Hour*; etc.	**English Speaking Peoples, Relations of.**
J. Th.	Jocelyn Field Thorpe, D.Sc., F.I.C., F.C.S. Professor of Organic Chemistry, Imperial College of Science and Technology. Member of Councils of the Royal Society and the Institute of Chemistry and of the Dyestuffs Development Committee of the Board of Trade. Author of *The Synthetic Dyestuffs*; *Vat Colours*; etc.	**Colour.**
J. T. H.	John Theodore Hewitt, M.A., D.Sc., Ph.D., F.R.S. Formerly Professor of Chemistry, East London College, University of London. Author of *Synthetic Colouring Matters*; etc.	**Ammonia;** **Carbon, Syntheses of.**
J. Wa.*	J. Walch. Lecturer on Drama, University of Leyden, Holland.	**Dutch Literature, etc.**
J. W. G.	John Walter Gregory, D.Sc., F.R.S. Professor of Geology in the University of Glasgow. Author of *The Great Rift Valley*; *The Dead Heart of Australia*; *The Menace of Colour*; etc.	**Colour and Race, Problems of.**
J. W. Go.	James Winder Good. Assistant Editor, *The Irish Statesman.* Irish Correspondent of *The New Statesman* and *The Manchester Guardian.* Author of *Ulster and Ireland*; *Irish Unionism.*	**Dublin.**
J. W. H.-M.	James Wycliffe Headlam-Morley, C.B.E., M.A. Historical Adviser to the Foreign Office, London. Late Fellow of King's College, Cambridge; Assistant Director, Political Intelligence Department of the Foreign Office, 1918–20. Member of the Political Section of the British Delegation to the Peace Conference at Paris, 1919. Author of *The History of Twelve Days*; *The Issue*; *The German Chancellor and the Outbreak of War*; etc.	**Europe** (*in part*).
J. W. Hy.	John William Hinchley, F.I.C., M.I. Chem.E. Assistant Professor of Chemical Engineering, Imperial College of Science and Technology, University of London. Author of *Chemical Engineering*; etc.	**Chemical Engineering.**
J. Wi.	James Williamson, M.I.C.E. Member of the firm of Sir Alexander Gibb and Partners.	**Aqueducts; Dams.**
J. W. O.	Rev. John Wood Oman, D.D. Principal and Professor of Systematic Theology, Westminster College, Cambridge. Formerly University Lecturer on the Philosophy of Religion. Author of *The Church and the Divine Order*; etc.	**Christianity.**
J. W. S. S.	Colonel J. W. S. Sewell, C.M.G. Assistant Director of Fortifications and Works, War Office, London.	**Engineers, Military** (*in part*).
K. K. D.	Karl K. Darrow, Ph.D. Member of Research Staff of the Bell Telephone Laboratories, New York City.	**Conduction, Electric** (*in part*).
K. M. A.	Her Grace The Duchess of Atholl, D.B.E. M.P. for Kinross and West Perthshire and Parliamentary Secretary to the Board of Education. Formerly Vice-President of the Association of Education Authorities in Scotland.	**Elementary Education:** *Great Britain.*
K. S.*	Karel Šedivý. Czech Publicist. Pen name of Josef Chmelar. Editor of *The Zahranicni Politika* (Prague).	**Czechoslovakia** (*in part*).
K. S. L.	Kenneth Scott Latourette, M.A., Ph.D., D.D. Professor of Missions, Yale University. Formerly Professor of History, Denison University, Granville, Ohio. Author of *Development of China*; *History of Early Relations Between the United States and China, 1784–1844*; etc.	**China;** **Chinese Eastern Railway.**
L. C. A.	Brig.-Gen. Lincoln Clark Andrews. Assistant Secretary of the Treasury, in charge of U.S. Customs Service, U.S. Coast Guard and the Prohibition Unit, charged with enforcing the Volstead Act. Deputy Provost Marshal General at G.H.Q., France, after the Armistice. Author of *Fundamentals of Military Service*; etc.	**Bootlegging and Smuggling**
L. E. H.	Leonard Erskine Hill, F.R.S. Director of the Department of Applied Physiology, National Institute of Medical Research, Hampstead, London. Formerly Professor of Physiology, London Hospital. Author of *Manual of Physiology*; etc.	**Aerotherapeutics.**
L. F. B.	Lewellys Franklin Barker, M.D., LL.D. Emeritus Professor of Medicine in Johns Hopkins University, Baltimore. Author of *Endocrinology and Metabolism*; etc.	**Endocrinology.**

L. H. B.*	L. H. Bakeland, Sc.D., Ch.D. Hon. Professor of Chemical Engineering, Columbia University. Past President, American Chemical Society, American Institute of Chemical Engineers, American Electrochemical Society; Inventor of Bakelite and President of the General Bakelite Co.	**Bakelite.**
L. H. D. B.	L. H. Dudley Buxton, M.A. Lecturer on Physical Anthropology, University of Oxford. Author of *Peoples of Asia.*	**Archaeology:** *China and Southeastern Asia.*
L. Hs.	Lewis Hodous, D.D. Head of the Chinese Department of the Kennedy School of Missions, Hartford Seminary Foundation, Hartford, Conn. Formerly President of Foochow Theological Seminary.	**Confucianism.**
L. J. B.	Lawrence Johnston Burpee, F.R.S.(Can.). Secretary, Canadian Section, International Joint Commission. Formerly Librarian of the Ottawa Public Library. Author of *Bibliography of Canadian Fiction*; *Canadian Humour*; etc.	**Canadian Literature:** *English.*
L. J. S	Leonard James Spencer, Sc.D., F.R.S. Assistant Keeper, Mineral Department, Natural History Museum, London. Editor of *The Mineralogical Magazine.* Author of *The World's Minerals.*	**Crystallography.**
Ll. J.	Lloyd Jackson. Senior Fellow, Mellon Institute for Industrial Research, Pittsburgh.	**Dry Cleaning.**
L. Ma.	Leonard Warburton Matters. Editor of *The Review of South America*; formerly managing editor *The Buenos Aires Herald.*	**Argentina** (*in part*); **Bolivia** (*in part*); **Colombia** (*in part*).
L. M. E.	Leon Moyer Estabrook. Director of World Agricultural Census, International Institute of Agriculture, Rome. Formerly Chief of Bureau of Crop Estimates, Associate Chief of Bureau of Agricultural Economics, and Agricultural Commissioner, U.S. Department of Agriculture.	**Agriculture, Census of.**
L. M. S.	Lucy Maynard Salmon, A.M., L.H.D. Professor of History, Vassar College, Poughkeepsie, New York. Author of *The Newspaper and the Historian*; *The Newspaper and Authority*; etc.	**Censorship:** *United States.*
L. Ro.	Sir Leonard Rogers, C.I.E., M.D., F.R.S., F.R.C.P., F.R.C.S. Member of Medical Board, India Office, London. Physician and Lecturer, London School of Tropical Medicine. Late Professor of Pathology, Medical College, Calcutta.	**Cholera.**
L. R. W.	L. R. Wentholt. Chief Engineer of the *Water-staat* of the Kingdom of the Netherlands.	**Coast Protection** (*in part*).
L. S. C.	Lee S. Crandall. Curator, Department of Birds, New York Zoological Park. Member of collecting expeditions to British Guiana and Costa Rica. Author of *Pets and How to Care for Them.*	**Birds, Migration of:** *United States.*
L. U.	Louis Untermeyer. Author, and occasional lecturer at the universities of Yale, Princeton, etc. Author of *Challenge*; *The New Adam*; *American Poetry since 1900*; etc.	**American Literature:** *Poetry.*
L. V.*	Luigi Villari. Member of the Staff of the League of Nations, 1920–3. Subsequently attached to the Emigration Department of the Italian Foreign Office. Commendatore of the Crown of Italy. Author of *Italian Life in Town and Country*; *The Awakening of Italy*; etc.	**D'Annunzio, Gabriele; etc.**
L. van V.	L. van Vleit. Chess Correspondent of *The Sunday Times* (London).	**Chess.**
L. Wa.	Lina Waterfield. Italian Correspondent of *The Observer* (London). Author of *The Story of Assisi*; *The Story of Rome*; etc.	**Duse, Eleanora.**
M. A. C.	Maurice Arthur Canney, M.A. Professor of Semitic Languages and Literature, University of Manchester. Author of *An Encyclopaedia of Religion*; etc.	**Arabic Literature.**
M. B. B.	Mabel B. Brooks.	**Alaska** (*in part*).
M. Bo.*	Moritz Julius Bonn. Professor of Economics at the School of Commerce, Berlin. Author of *Die englische Kolonisation in Irland; Amerika als Feind*; etc.	**Ebert, Friedrich; Erzberger, Matthias.**
M. C. B.	Miles C. Burkitt, M.A., F.S.A. Lecturer for the Board of Archaeological and Anthropological Studies, Cambridge University. Author of *Prehistory.*	**Archaeology:** *Continental Europe and Great Britain.*
M. C. S.*	Malcolm Charles Salaman. Formerly dramatic and art critic of *The Sunday Times* (London). Author of *Old English Colour-Prints*; *The Charm of the Etcher's Art*; *Modern Masters of Etching*; etc.	**Etching.**

M. C. W.*	MILTON C. WHITAKER. Vice-President of the Industrial Alcohol Co.; Professor of Chemical Engineering, Columbia University, 1911-7.	**Alcohol** (*in part*).
M. G.*	MAJOR GREENWOOD, F.R.C.P., M.R.C.S. Medical Officer (Medical Statistics), Ministry of Health, London. Reader in Medical Statistics, University of London.	**Epidemiology** (*in part*).
M. H. Co.	MONTAGU H. COX. Clerk of the London County Council.	**City Government** (*in part*).
M. H. S.*	MARSHALL HOWARD SAVILLE. Professor of American Archaeology, Columbia University, and Member of the Staff of the Museum of the American Indian, Heye Foundation. Formerly honorary curator of Mexican and Central American Archaeology, American Museum of Natural History, New York.	**Archaeology:** *South America.*
M. L.	MATTHEW LUCKIESH, M.S. Director of Applied Science, Nela Research Laboratories, National Lamp Works of the General Electric Company. Author of *The Language of Colour*; *Artificial Light*; *Ultra Violet Radiation.*	**Electric Lighting.**
M. L. S.	M. L. SHEPHERD. Official Secretary in London of the Commonwealth of Australia.	**Australia** (*in part*).
M. M. W.	MERTON M. WILNER. Editorial Writer on *The Buffalo Express.*	**Buffalo.**
M. R. T.	MRS. M. R. TRAGETT. Winner, with Miss Hogarth, of the Badminton Ladies' Doubles Championship, 1925.	**Badminton.**
M. S. M.	COLONEL MERVYN SORLEY MACDONELL. Formerly High Commissioner, League of Nations, at Danzig. Governor of the Western Desert Province, Egypt, 1920-3.	**Danzig.**
M. W.	MAURICE H. WOODS. Member of staff of *The Daily Express* (London).	**Beaverbrook, Lord; Birkenhead, Earl of.**
M. W. D.	M. WILLSON DISHER. Dramatic critic. Author of *Clowns and Pantomimes.*	**Circus.**
N. A.	HENRIETTA (NETTIE) ADLER, J.P. Late member of the London County Council. Member of the London Advisory Council for Juvenile Employment.	**Children's Courts:** *European.*
N. Bo.	NIELS HENRIK BOHR. Head of the Institute for Theoretical Physics at Copenhagen. Nobel Prizeman for Physics, 1922.	**Atom.**
N. G. G.	LIEUT.-COL. NICHOLAS GEORGE GEDYE, O.B.E., B.Sc., M.INST.C.E. Consulting Engineer to the Ministry of Agriculture and Fisheries and the Development Commission. Formerly Chief Engineer, Tyne Improvement Commission; Acting Director, Civil Engineer-in-Chief's department, Admiralty; responsible for reconstruction of Belgian ports after the War; Chief Civil Engineer for Docks, Harbours and Inland Waterways, Ministry of Transport.	**Coast Protection** (*in part*).
N. M. B.	NICHOLAS MURRAY BUTLER, PH.D., LL.D. President of Columbia University. Author of *True and False Democracy*; *Education in the United States*; *Philosophy*; *The Faith of a Liberal*; etc.	**Columbia University; Education:** *United States* (*in part*).
N. Mu.	NEIL MUNRO, LL.D. Author and journalist. Author of *The Lost Pibroch*; *Gilian, the Dreamer*; *The Shoes of Fortune*; *The Clyde*; *Ayrshire Idylls*; etc.	**Conrad, Joseph.**
N. Mu.*	NADEJDA STANCIOFF, LADY MUIR. Daughter of the former Bulgarian Minister in London, M. Stancioff, and formerly member of Bulgarian Diplomatic Service.	**Bulgarian Literature.**
N. R. C.	NORMAN ROBERT CAMPBELL, Sc.D. Physicist on the Research Staff of the General Electric Co., Watford, Hertfordshire. Author of *Modern Electrical Theory*; *Principles of Electricity*; etc.	**Electric Radiation.**
N. W.	NORMAN WILKINSON, O.B.E., R.N.V.R. Marine Painter and Etcher. Originator of Dazzle Painting (Naval Camouflage) as used by the Allied Powers in the World War. Author of *The Dardanelles*; *Colour Sketches from Gallipoli.*	**Camouflage** (*in part*).
O. C. C.	OWEN C. COY, M.A., PH.D. Director of California State Historical Association. Associate Professor in University of Southern California. Author of *Guide to the County Archives of California.* Editor of *Pictorial History of California.*	**California.**
O. D.	OZORA STEARNS DAVIS, PH.D., D.D., LL.D. President of the Chicago Theological Seminary. Author of *John Robinson, the Pilgrim Pastor*; *International Aspects of Christianity*; etc.	**Congregationalism** (*in part*).
O. D. Y.	OWEN D. YOUNG, LL.D., D.H.L. Chairman of the Board, General Electric Co.; Chairman of the Board, Radio Corporation of America; Chairman, American Section, International Chamber of Commerce; Member of the Dawes Committee.	**Dawes, Charles G.**

O. G. S. C.	O. G. S. Crawford, F.S.A. Archaeology Officer of the British Ordnance Survey. Author of *Man and His Past.*	**Archaeology:** *Air Survey.*
O. H. L.	O. H. Larsen. Professor in General Agriculture and Agricultural Costings at the Royal Veterinary and Agricultural College, Copenhagen. Director of the Bureau of Agricultural Costings.	**Denmark:** *Agriculture.*
O. J.	Owen Jones. Continental Manager and formerly Textile Editor of *The Manchester Guardian Commercial Supplement.*	**Cotton.**
O. J. R. H.	Osbert John Radcliffe Howarth, O.B.E., M.A. Secretary of the British Association. Member of the Geographical Section, Naval Intelligence Department, London, 1915–9. Author of *Commercial Geography of the World.* Joint-editor of *The Oxford Survey of the British Empire.*	**Birmingham; Bombay; Brussels; Delhi; etc.**
O. L.	Sir Oliver Joseph Lodge, D.Sc., F.R.S. Principal, University of Birmingham, 1909–19. Professor of Physics, University College, Liverpool, 1881–1900. President of the Physical Society of London, 1899–1900. President of the British Association, 1913–4. Awarded the Albert Medal of the Royal Society of Arts, London, for pioneer work in Wireless Telegraphy, 1919. Author of *The Ether of Space*; *Ether and Reality*; *Electrical Precipitation*; etc.	**Ether.**
O. R.*	Major Owen Rutter, F.R.G.S., F.R.A.I. Formerly Magistrate and District Officer in the British North Borneo Civil Service. Author of *British North Borneo;* etc.	**Borneo.**
P. A.*	Leslie Patrick Abercrombie, M.A., F.R.I.B.A. Professor of Civic Design, University of Liverpool. Editor of *The Town Planning Review.*	**City Planning.**
P. B.	Pierre Francis Bernus. Foreign editor of the *Journal des Débats.* Paris correspondent of the *Journal de Genève.* Chevalier of the Legion of Honour.	**Briand, Aristide.**
P. B. I.	Percy B. Ingham. Director of the London School of Dalcroze Eurhythmics.	**Eurhythmics.**
P. C. Mo.	P. C. Morgan. Secretary, Brewers' Society, London.	**Beer.**
P. Di.	Paul Dieudonné. Editor on the staff of the International Institute of Agriculture, Rome.	**Dairying.**
P. E. L.	P. Evans Lewin, M.B.E., F.R. Hist.S. Librarian of the Royal Colonial Institute, London. Author of *The Germans in Africa*; *A Geography of Africa.*	**Ashanti.**
P. F. W.	Pelham Francis Warner, M.B.E. Barrister-at-law. Formerly Captain of the Middlesex Cricket Eleven. Captained M.C.C. Team in Australia and South Africa. Editor of *The Cricketer*; cricket correspondent of *The Morning Post.* Author of *The Book of Cricket*; *Cricket Reminiscences*; *My Cricketing Life.*	**Cricket.**
P. Hu.	Percy A. Hurd. M.P. for the Frome division, 1918–23. M.P. for the Devizes division since 1924. London editor of *The Montreal Star.* Author of *Canada, Past, Present and Future;* etc.	**Canada:** *Industry and Trade.*
P. J.*	P. Jacobssen. Member of Economic and Financial Section, League of Nations. Geneva.	**Budget, National.**
P. J. B.	Philip J. Noel Baker, M.A. Sir Ernest Cassel Professor of International Relations, London School of Economics; late Fellow of King's College, Cambridge. Author of *The Geneva Protocol.*	**Disarmament.**
P. J. H.	Sir Philip Joseph Hartog, C.I.E., M.A., B.SC., L-ès-L. Late Vice-Chancellor of the University of Dacca, Bengal, and Academic Registrar of the University of London. Author of *Examinations in their Bearing on National Efficiency.*	**Calcutta, University of; Examinations** (*in part*).
P. L.	Paul Lambotte. Director of Fine Arts for Belgium. Government Commissioner for Fine Art Exhibitions. Author of two volumes in the *Collection des artistes belges contemporains.*	**Claus, Emile.**
P. Ln.	Paul Léon. Director of Fine Arts, Paris. Officer of the Legion of Honour.	**Decorative Art** (*in part*) **Exhibition.**
P. Q.	Pierre Quesnay. French representative on the Austrian Reconstruction Commission, 1919–20. Director of Economic Studies, Reparations Commission, Vienna, 1920–2. Assistant to the General Commissioner of the League of Nations in Austria, 1922–5.	**Austria:** *Financial and Economic History.*

R. Bo.	RALPH BOWN. Vice-president of the Institute of Radio Engineers. Member of the Department of Development and Research, American Telegraph and Telephone Company.	**Broadcasting** (*in part*).
R. B.-P.	LIEUT.-GEN. SIR ROBERT STEPHENSON SMYTH BADEN-POWELL, BART. Chief Scout. Founder of the Boy Scout and Girl Guide Movements. Author of *Scouting for Boys*; *Girl Guiding*; *Aids to Scouting*; etc.	**Boy Scouts.**
R. C. B.	ROBERT CLARKSON BROOKS, PH.D. Professor of Political Science, Swarthmore College, Pennsylvania. Author of *Corruption in American Politics and Life*; *Political Parties and Electoral Problems*; etc.	**Baker, Newton Diehl, etc.**
R. C. F.	R. C. FARMER, O.B.E., D.Sc., PH.D., F.I.C. Late Chief Chemist, Explosives Department, Ministry of Munitions. Author of *Manufacture and Uses of Explosives*; *Industrial and Power Alcohol*; various scientific papers on explosives and general chemical subjects.	**Explosives.**
R. Cr.	DAME RACHEL ELEANOR CROWDY, D.B.E. Chief of Social Questions and Opium Traffic Section, Secretariat, League of Nations. Principal Commandant of V.A.D.'s in France and Belgium, 1914–9.	**Child Labour and Child Welfare** (*in part*).
R. de C. W.	ROBERT DE COURCY WARD, A.M. Professor of Climatology, Harvard University. Author of *Climate Considered Especially in Relation to Man.*	**Climate and Climatology.**
R. D. O.	RICHARD DIXON OLDHAM, F.R.S. Formerly President of the Geological Society, London. Author of various papers on Geology and kindred subjects.	**Earthquakes.**
R. E.	RALPH ENFIELD. Ministry of Agriculture and Fisheries, London.	**Agriculture:** *Economics*; **Co-operation, Agricultural.**
R. F. A.	ROBERT FRANZ ARNOLD, PH.D. Professor of German Literature in the University of Vienna.	**Austrian Literature.**
R. F. B.	RICHARD F. BACH. Associate in Industrial Arts, Metropolitan Museum of Art. Extension Secretary of The American Federation of Arts.	**Decorative Art** (*in part*).
R. G. H.	R. G. HAWTREY. Assistant Secretary to the Treasury, London. Author of *Currency and Credit.*	**Currency.**
R. G. P. H.	MAJOR R. G. P. HUNTER, O.B.E. Royal Engineers. Deputy Assistant Director of Fortification and Works, War Office, London.	**Barracks.**
R. Ha.	ROBERT HAAS. Member of the Communications and Transport Section of the League of Nations, Geneva.	**Aerial Law** (*in part*).
R. H. Co.	ROBERT HAMILTON COATS. Chief of the Bureau of Statistics, Canada. Author of *The Labour Movement in Canada.*	**Canada:** *Area and Population.*
R. H. Cr.	SIR REGINALD HENRY CRADDOCK, G.C.I.E., K.C.S.I. Lieutenant-Governor of Burma, 1917–22. Member of the Royal Commission on the Civil Services of India, 1923–4.	**Burma.**
R. H. G.	RALPH HENRY GABRIEL, PH.D. Associate Professor of History, Yale University. Author of *The Evolution of Long Island.*	**Connecticut.**
R. Hu.	ROBERT HUTCHISON, M.D., F.R.C.P. Physician to the London Hospital and to the Children's Hospital, London. Author of *Food and the Principles of Dietetics.*	**Alimentary System, Diseases of the.**
Ri.	THE RIGHT HON. LORD RIDDELL. Chairman, Periodical, Trade Press and Weekly Newspaper Proprietors' Association. Director, News of the World, Ltd.; George Newnes, Ltd.; C. Arthur Pearson, Ltd.; Newnes and Pearson Printing Co., Ltd.; Country Life Ltd.; Western Mail Ltd.; Represented British Press at Peace Conferences, 1919–22, and at Washington Conference on Disarmament, 1921. Author of *Some Things that Matter*; *More Things that Matter*; etc.	**Censorship:** *Great Britain.*
R. J. S.	R. J. STOPFORD. Intelligence Department of the British Overseas Bank, London.	**Debts, Inter-Allied.**
R. L. B.	RIGHT HON. SIR ROBERT LAIRD BORDEN, G.C.M.G., K.C. Prime Minister of Canada, 1911–20. Representative of Canada at the Imperial War Cabinet and at the Imperial War Conference, 1917 and 1918. Author of *Canadian Constitutional Studies.*	**Canada:** *Constitution.*
R. L. H.*	ROBERT LOCKHART HOBSON. Keeper of Department of Ceramics and Ethnography, British Museum. Author of *Worcester Porcelain*; *Chinese Pottery and Porcelain*; *The Later Ceramic Wares of China.*	**Ceramics.**
R. Ln.	ROBERT LIEFMANN. Professor of Economics and Finance, University of Freiburg, Germany. Author of *Kartell und Trusts.*	**Cartel.**

R. Lo.	ROBERT MORSS LOVETT. Member of the editorial board of *The New Republic*. Formerly Professor of English in the University of Chicago. Author of *A History of English Literature* (with W. V. Moody).	**American Literature** (*in part*).
R. Ly.	ROBERT LYND. Literary Editor of *The Daily News* (London). Contributor to *The New Statesman*. Author of *The Art of Letters*; *Books and Authors*; etc.	**Barrie, Sir J. M.**
R. N. R. B.	R. N. RUDMOSE BROWN, D.Sc. Lecturer in Geography, University of Sheffield. Member of the Scottish National Antarctic Expedition, 1902–4, and of the Scottish Arctic Expeditions, 1909, 1912 and 1914. Author of *Spitzbergen*.	**Arctic Regions** (*in part*).
R. Pe.	RAYMOND PEARL, PH.D., SC.D., LL.D. Director, Institute for Biological Research, and Professor of Biology, Medical School, Johns Hopkins University. Formerly Professor of Biometry and Vital Statistics, Johns Hopkins University. Author of *Modes of Research in Genetics*; *The Biology of Death*; *Studies in Human Biology*; *The Biology of Population Growth*; etc.	**Death: Why and Wherefore.**
R. Pi.	RUDOLF PINTNER. Professor of Education, Teachers College, Columbia University, New York. Author of *Intelligence Testing*.	**Examinations** (*in part*).
R. P. R.	ROBERT PUGH ROWLANDS, O.B.E., M.S., F.R.C.S. Joint-author of *The Operations of Surgery*, and contributor of articles on surgery to *The British Medical Journal*, etc.	**Appendicitis.**
R. R.*	SIR ROBERT ROBERTSON, K.B.E., D.Sc., LL.D., F.R.S. Government Chemist, Government Laboratory, London. Director of Explosives Research, Research Department, Royal Arsenal, Woolwich.	**Alcohol** (*in part*).
R. Re.	SIR RICHARD A. S. REDMAYNE, K.C.B., M.I.M.E., etc. Consulting Mining Engineer. H.M. Chief Inspector of Mines, 1908–20. Late President of the Institute of Mining and Metallurgy, London, and member of the Fuel Research Board, Coal Conservation Commission and other bodies. Author of *Coal, Its Occurrence, Value and Method*.	**Coal.**
R. R. L.	RUSSELL R. LARMON. Executive Assistant to the President, Dartmouth College, New Hampshire.	**Dartmouth College.**
R. Rn.	R. ROMEIN. Member of Transit Section, League of Nations, Geneva.	**Danube; Elbe.**
R. T. G.	SIR RICHARD TETLEY GLAZEBROOK, K.C.B., D.Sc., F.R.S. Chairman of the Aeronautical Research Committee, London. Zaharoff Professor of Aviation and Director of the Department of Aeronautics at the Imperial College of Science and Technology, London, 1920–3. Fellow of Trinity College, Cambridge.	**Aeronautics.**
R. Van O.	MAJOR R. VAN OVERSTRAETEN, D.S.O. Member of the Order of Leopold and the Legion of Honour. Aide-de-Camp to His Majesty the King of the Belgians. Graduate of the Belgian Staff College.	**Antwerp, Siege of; Belgium, Invasion of.**
R. V. L. H.	R. V. L. HARTLEY. Of the Bell Telephone Laboratories, New York.	**Amplifier.**
R. W. Re.	ROBERT WILLIAM REID, M.D., F.R.C.S. Emeritus Professor of Anatomy, University of Aberdeen. Member of the Council of Royal Anthropological Institute of Great Britain and Ireland.	**Anatomy.**
R. W. S.-W.	ROBERT WILLIAM SETON-WATSON, LITT. D. Masaryk Professor of Central European History at King's College, University of London. Founder and Joint-editor of *The New Europe*, 1916–20. Joint-editor of *The Slavonic Review*. Author of *The Rise of Nationality in the Balkans*; *The New Slovakia*; *Sarajevo*; etc.	**Alexander I., King of Serbia; Dalmatia; etc.**
S. A. M.	S. A. MUSSABINI. Author of *A Billiard Player in the Making*.	**Billiards** (*in part*).
S. B.	STEPHEN BONSAL. Newspaper correspondent. Author of *The Real Condition of Cuba*; *The Fight for Santiago*; *The American Mediterranean*; etc.	**Caribbean, The.**
S. G.	STEPHEN LUCIUS GWYNN. Irish Correspondent of *The Observer* (London). Member of the Irish Convention, 1917–8. Author of *Irish Books and Irish People*; *The Irish Situation*; *The History of Ireland*; etc.	**Collins, Michael; Cosgrave, W. T.**
S. H.*	SIGFRID HANSSON. Member of the Swedish Parliament. Editor of *Fackförenings rörelsen* (Trades Union Movement). Has edited a series of works on the history of Trade-Unionism including *Den Svenska fackförenings rörelsen* (The Swedish Trades Union Movement).	**Branting, Hjalmar.**
S. L.*	JOHN RANDOLPH SHANE LESLIE. Editor of *The Dublin Review*. Author of *Life of Cardinal Manning*; *Life of Sir Mark Sykes*; *The End of a Chapter*; *The Oppidan*; etc.	**Bourne, Francis (Cardinal); Cardinals, College of.**

S. M.	SHAILER MATHEWS, A.M., D.D. Dean of the Divinity School and Professor of History and Comparative Theology, University of Chicago. Author of *The Spiritual Interpretation of History*; etc.	**Baptists** (*in part*).
S. P. C.	SAMUEL PAUL CAPEN, A.M., PH.D., LL.D. Chancellor of the University of Buffalo. Vice-President in America of the British Society for Experiment and Research in Education. Formerly Editor of *The Educational Record*. Author of *Resources and Standards of the Colleges of Arts and Science*.	**Education, Experiments in** (*in part*).
St. J. E.	ST. JOHN GREER ERVINE. Dramatist and Novelist. Dramatic Critic of *The Observer* (London). Author of *The Magnanimous Lover*; *Mixed Marriage*; *Jane Clegg*; and other plays.	**Drama.**
T. Ba.	SIR THOMAS BARCLAY. Member of the Institute of International Law. Vice-President of the International Law Association. Author of *International Law and Practice*; *Law and Usage of War*; *New Methods for Adjustment of International Disputes*; etc.	**Arbitration, International.**
T. B. W.	THOMAS BARLOW WOOD, C.B.E., F.I.C., F.R.S. Drapers' Professor of Agriculture, Cambridge University. Monro Fellow of Gonville and Caius College, Cambridge. Joint-editor of *The Journal of Agricultural Science*. Author of *The Chemistry of Crop Production*; *Animal Nutrition*; etc.	**Agriculture:** *Scientific Developments* (*in part*).
T. C. McC.	THOMAS CHALMERS MCCORVEY, LL.D. Professor of History and Political Science, University of Alabama. Author of *The Government of the People of the State of Alabama*.	**Alabama.**
T. E.	THOMAS EWAN, M.Sc., PH.D., F.I.C. Chief Chemist to the Cassel Cyanide Co. Ltd., Glasgow.	**Cyanides.**
T. E. G.	T. E. GREGORY, D.Sc. Cassel Reader in Banking and Currency, London School of Economics. Author of *Tariffs: a Study in Method*, etc.	**Banking; Canada:** *Banking.*
T. E. L.	THOMAS EAST LONES, M.A., LL.D. Formerly Senior Examiner in H.M. Patent Office, London. Author of *Aristotle's Researches in Natural Science*; *Zinc and Its Alloys*.	**Calculating Machines; Casein; Celluloid; etc.**
T. E. P.	THOMAS ERIC PEET, M.A. Brunner Professor of Egyptology, University of Liverpool, Author of *The Mayer Papyri*; *Egypt and the Old Testament*; etc.	**Akhenaten; Archaeology:** *Egypt.*
T. Fr.	TENNEY FRANK. Professor of Latin, Johns Hopkins University, Baltimore, U.S.A. Author of *Roman Imperialism*; *A History of Rome*; etc.	**Archaeology:** *Italy and the Western Mediterranean.*
T. G. M.	THOMAS GARRIGUE MASARYK. President of the Republic of Czechoslovakia. Principal organiser of the Czechoslovak movement for independence. Author of *The Problem of Small Nations in the European Crisis*; *The New Europe*; *The World Revolution*; etc.	**Czechoslovakia:** *Political History* (*in part*).
T. H. M.	THOMAS HUNT MORGAN, M.S., PH.D., LL.D. Professor of Experimental Zoology, Columbia University, New York. Formerly Professor of Biology, Bryn Mawr College, Pennsylvania. Author of *Evolution and Adaptation*; *Heredity and Sex*; *Mechanism of Mendelian Heredity*; *Critique of the Theory of Evolution*; *The Physical Bases of Heredity*; etc.	**Evolution** (*in part*).
T. K.*	THÉODORE KOMISARJEVSKY. Theatrical Producer. Formerly Producer and Art Director of the Moscow State and Imperial Theatre.	**Acting.**
T. S. A.	THOMAS SEWALL ADAMS, PH.D. Professor of Political Economy in Yale University. Adviser on Taxation, U.S. Treasury Department. Author of *Taxation in Maryland*; etc.	**Excess Profits Duty** (*in part*).
T. W. A.*	SIR THOMAS WALKER ARNOLD, C.I.E., LITT.D., F.B.A. Professor of Arabic, University of London. Formerly Professor of Philosophy, Government College, Lahore. Educational Adviser to the Secretary of State for India, 1917-20. Author of *The Preaching of Islam*; *The Caliphate*; etc	**Caliphate, The.**
T. W. R.	THEODORE WILLIAM RICHARDS, PH.D., LL.D., CHEM.D., M.D. Professor of Chemistry and Director of the Wolcott Gibbs Memorial Laboratory, Harvard University. Nobel Prize for Chemistry, 1914.	**Atomic Weights.**
V. B.*	VÁCLAN BRDLIK, PH.D. Professor at the Czech Polytechnic, Prague.	**Czechoslovakia** (*in part*).
V. B. C.	VELICO B. CHRISTOFF. Member of the Bulgarian Society of Economics. Official of the National Bank of Bulgaria.	**Bulgaria:** *Financial and Economic History.*
V. C. R.	LIEUTENANT-COLONEL V. C. RICHMOND, O.B.E. Head of the Design and Research Section, Royal Airship Works, Cardington, Bedford	**Airship** (*in part*).

V. P.*	VILEM POSPIŠIL, PH.D. Governor of the Czechoslovakian National Bank.	**Czechoslovakia** (*in part*).
V. S.	VILHJALMUR STEFANSSON, A.M., LL.D. Commander of the Canadian Arctic Expedition, 1913-9; of the Arctic Expedition under the auspices of the American Museum of Natural History and the Geological Survey of Canada, 1908-12; and of several other expeditions to Arctic regions. Author of *My Life with the Eskimo*; *The Friendly Arctic*; *The Northward Course of Empire*; etc.	**Arctic Regions:** *Climate and Resources.*
W. A. Ho.	HON. WILLIAM ARTHUR HOLMAN, K.C. Premier of New South Wales, 1913–20. Treasurer of New South Wales, 1914–6.	**Australia:** *Constitution.*
W. A. M.	REAR-ADMIRAL WILLIAM ADGER MOFFETT. Chief of the U.S. Bureau of Aeronautics. Formerly Commandant, U.S. Naval Training Station, Great Lakes, Illinois, and Commandant, 9th, 10th and 11th Naval Districts.	**Air Forces:** *United States*; **Air Ministry:** *United States.*
W. A. P.*	W. A. PROPERT. Author of *The Russian Ballet in Western Europe.*	**Ballet.**
W. A. R.	WILLIAM ALFRED REID, LL.M. Foreign Trade Adviser of the Pan American Union. Lecturer on Latin American Commerce at the School of Foreign Service, Georgetown University; Lecturer on International Commerce at the School of Diplomacy, American University, Washington, D.C.	**Amazon; Bahia; etc.**
W. B.-A.	W. BROUGHTON-ALCOCK, M.D. Director of the Central Laboratory, Ministry of Pensions, London.	**Dysentery.**
W. B. H.	WALTER B. HARRIS. F.S.A., Moroccan Correspondent of *The Times* (London). Author of *The Land of an African Sultan*; *Travels in Morocco, 1888-9*; *Morocco that Was*; etc.	**Abdel-Krim.**
W. B. Se.	REV. WILLIAM BOOTHBY SELBIE, M.A., D.D. Principal of Mansfield College, Oxford. Editor of *The British Congregationalist*, 1899–1909. Chairman of the Congregational Union, 1914–5. President of the National Free Church Council, 1917. Author of *The Life and Teaching of Jesus Christ*; *Nonconformity*; etc.	**Congregationalism** (*in part*).
W. Cl.	SIR WILLIAM HENRY CLARK, K.C.S.I., C.M.G. Comptroller-General of the Department of Overseas Trade, London. Member for Commerce and Industry of the Council of the Viceroy of India, 1910–6. Comptroller-General of the Commercial Intelligence Department of the Board of Trade, London, 1916–7.	**Export Credits.**
W. D. B.	WILLARD DELL BIGELOW. Director of the Research Laboratory, National Canners' Association. Formerly Chief of the Division of Foods, U.S. Department of Agriculture.	**Canning:** *United States.*
W. E. B.*	CAPTAIN WILLIAM EDMUND BARBER. Formerly Editor of *The Political Review* and *The Economic Review* (London) and Literary Editor of *The Morning Post* (London).	**Censorship:** *General.*
W. E. B. DuB.	WILLIAM EDWARD BURCHARDT DUBOIS, PH.D. Director of Publications and Research of the National Association for the Advancement of Coloured People. Editor of *The Crisis*. Author of *The Souls of Black Folk*; *The Negro*; *Dark Water*; etc.	**American Literature** (*in part*).
W. E. C.	WILLIAM ERNEST CASTLE, A.M., PH.D., SC.D., LL.D. Professor of Zoology, Harvard University, and Research Associate of the Carnegie Institution of Washington. Author of *Heredity in Relation to Evolution and Animal Breeding*; *Genetics and Eugenics.*	**Eugenics.**
W. Go.*	SIR WILLIAM A. M. GOODE, K.B.E. Unofficial Adviser to the Hungarian Government. President of, and British Representative on, the Austrian Section of the Reparation Commission, Vienna, 1920–1. Author of *Economic Conditions in Central Europe*; etc.	**Bethlen, Count.**
W. Gr.*	W. GRAHAM. Of the Board of Trade, London.	**Dyeing** (*in part*).
W. G. W.	WILLIAM GILLIES WHITTAKER, D.MUS., F.R.C.O. Reader in Music and Conductor of Choral and Orchestral Societies, Armstrong College, Newcastle-on-Tyne.	**Choral Singing** (*in part*).
W. Ha.*	W. HASTINGS, M.B., B.Ch. Former Deputy Director, Public Health Administration of Egypt.	**Egypt:** *Public Health.*
W. H. C.	W. H. COATES, LL.B. Secretary of Nobel Industries, Ltd. (London).	**Excess Profits Duty** (*in part*).
W. H. D. R.	WILLIAM HENRY DENHAM ROUSE, LITT.D. Headmaster, Perse Grammar School, Cambridge. Author of *Latin on the Direct Method*, and editor of numerous works on the Classics.	**Classical Education** (*in part*).
W. H. L.-W.	W. H. LOWE-WATSON, D.S.O., D.C.M. Employment and Insurance Department, Ministry of Labour, London.	**Apprenticeship.**

W. H. Wi.	W. H. Willson (London). Member of staff of *The Encyclopædia Britannica* (13th edition).	**Argentina** (*in part*); **Channel Islands**; etc.
W. K. McC.	William Kidston McClure, C.B.E. Formerly Correspondent of *The Times* (London) in Rome. War Correspondent of *The Times* on the Italian Front, 1915–7. Author of *Italy's Part in the War*; *Italy in North Africa*; etc.	**Asiago, Battle of**; **Cadorna, General**; **Caporetto, Battle of**; etc.
W. L. M.	Lieut.-Col. W. Lockwood Marsh, A.F.R.Ae.S. Head of Equipment Branch, Admiralty Airship Department, 1918. Formerly Editor of *The Aeronautical Weekly*; Secretary Royal Aeronautical Society, 1920; General Secretary and Sole Organiser of International Air Congress, 1922. Joint Author of *The History of Aeronautics*.	**Air, War in the.**
W. L. R.	Rear-Admiral William Ledyard Rodgers. Commander-in-Chief of the U.S. Asiatic Fleet, 1918–9.	**Battleship.**
Wm. A.	Sir William James Ashley, Ph.D., M.A., M.Com. Formerly Vice-Principal and Professor of Commerce in the University of Birmingham. Member of numerous British committees on economic questions. Author of *Introduction to English Economic History and Theory*; *The Rise in Prices*; *The Economic Organisation of England*; etc.	**Economics.**
W. M. H.	Walter Morris Hart, Ph.D. Dean of the University of California. Author of *Ballad and Epic: A Study in the Development of the Narrative Art.*	**California, University of.**
W. Mi.	William Miller. Correspondent of *The Morning Post* (London) in Athens and Rome. Author of *The Latins in the Levant*; *The Ottoman Empire and Its Successors*; *A History of the Greek People* (*1821–1921*); etc.	**Adriatic Sea**; **Corfù**; **Dodecanese**; etc.
W. Pa.	Woodford Patterson. Secretary of Cornell University.	**Cornell University.**
W. P. Py.	W. P. Pycraft. Assistant Keeper of Zoology, Natural History Museum, London. Author of *A History of Birds*; *Story of Bird Life*: *A Book of Birds*; etc.	**Birds, Migration of** (*in part*).
W. R. I.	Walter Renton Ingalls. Consulting Mining and Metallurgical Engineer, New York City. Author of *Metallurgy of Zinc and Cadmium.*	**Copper.**
W. S. F.	William Scott Farren, M.B.E., M.A. Consultant in Aeroplane Design. Lecturer in the Engineering Department, Cambridge University, and at the Royal College of Science, London.	**Aeroplane.**
W. S. L.-B.	Walter Sydney Lazarus-Barlow, M.D., F.R.C.P. Member of Cancer Committee, Ministry of Health, London. Late Professor of Experimental Pathology and Director of Cancer Research Laboratories, Middlesex Hospital, London. Author of *A Manual of General Pathology.*	**Cancer Research.**
W. S. Ro.	William Spence Robertson, Ph.D. Professor of History in the University of Illinois. Author of *Francisco de Miranda and the Revolutionising of Spanish America*; *Rise of the Spanish American Republics*; etc.	**Bolivia** (*in part*); **Colombia** (*in part*); **Ecuador.**
W. S. S.	W. Stanley Sykes, M.B., B.Ch., D.P.H. Anaesthetist to the General Infirmary, Leeds, and to the Leeds Dental Hospital.	**Acetylene**; **Ethyl Chloride**; etc.
W. St.	William Stocking, M.A. Historian and Statistician, Detroit Board of Commerce, 1903–21. Author of *Under the Oaks*; *History of the Republican Party*; etc.	**Detroit.**
W. T.	Walter John Turrell, M.D., B.Ch. Consulting Physician, Oxford County Asylum. Electro-Therapeutic Physician, Radcliffe Infirmary, Oxford. Author of *The Principles of Electro-Therapy.*	**Electrotherapy.**
W. T. S.	William T. Shanahan, M.D. Medical Superintendent of Craig Colony, Sonyea, N. Y.	**Epilepsy.**
W. T. St.	W. Tetley Stephenson. Cassel Reader in Transport, London School of Economics, University of London.	**British Empire**: *Communications.*
W. T. W.	Rev. William Thomas Whitley, LL.D. Hon. Secretary and Editor, Baptist Historical Society. Recording Secretary, Baptist World Alliance. Author of *History of British Baptists.*	**Baptists** (*in part*).
W. v. B.	Wilhelm von Blume, D. Juris. Professor of Law, Tübingen University, Germany. Co-operated in the drafting of the constitution of Württemberg, 1919.	**Baden**; **Bavaria.**

THE ENCYCLOPÆDIA BRITANNICA

VOLUME 29

THE FIRST OF THE THREE NEW VOLUMES

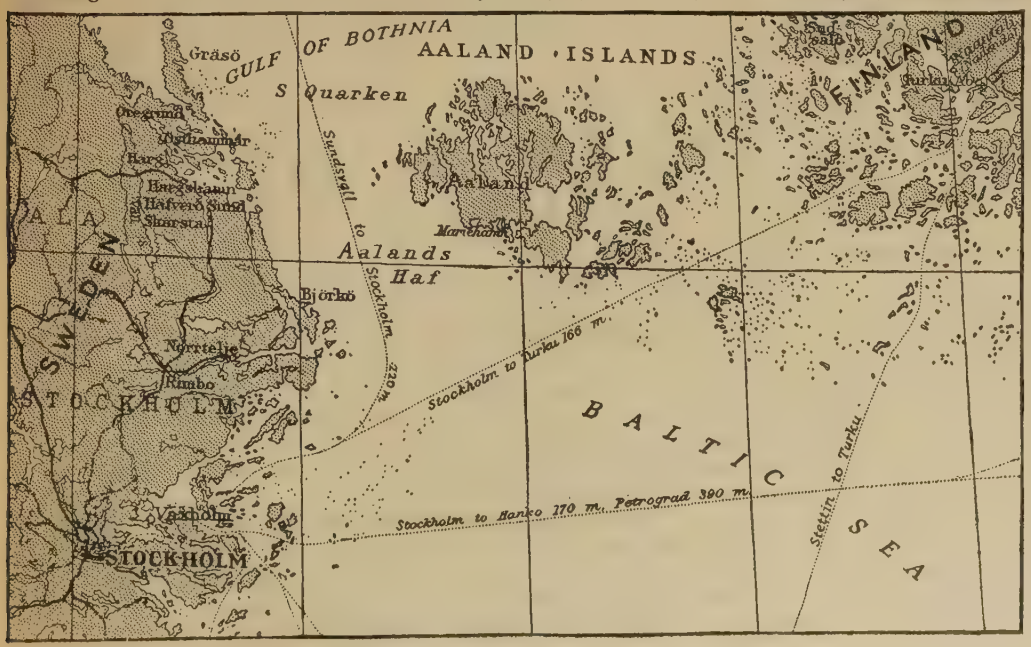
AALAND ISLANDS TO EYE

AALAND ISLANDS (*see* 1.469).—An archipelago in the Baltic Sea, including about 300 islands, forming a bridge across the mouth of the Gulf of Bothnia, between Sweden and Finland. Population 26,000. The islands are nearer to the Finnish shore, and in winter are joined to it by an ice-sheet. Their position gives them some strategical importance. The population, 27,123 in 1922, is Swedish in language and national feeling.

After belonging to the Swedish Crown since the Middle Ages, the islands were ceded to Russia, together with Finland, on Sept. 17 1809. Under the Tsardom they were united with Finland until the latter country declared her independence in 1917. In Dec. of that year the Aaland Islanders claimed the right of self-determination on their own account, and unofficial plebiscites showed a vote in favour of reunion with Sweden. Finland granted the islands autonomy on May 7 1920 but refused to contemplate their secession. In June the leaders of the secession movement were arrested for high treason, and Finnish troops were sent to the island. As this situation was producing a state of serious tension between Finland and Sweden, Great Britain, with the aim of ending it, drew the attention of the Council of the League of Nations to the movement on June 19 1920.

With the consent of the two interested governments, the council consulted a special commission of jurists as to whether the question was international or was the exclusive concern of Finland. This commission declared the question international, whereupon the council dispatched a special commission of inquiry to the spot. This commission reported against the claim of the islanders to secede from Finland, but declared that the islanders formed a distinct group within the Finnish body politic, and suggested that the maintenance of Finnish sovereignty ought to be made conditional upon the incorporation in the autonomy law of May 7 1920 of five specific guarantees. The commission also reported in favour of a new convention, to be signed by all the Baltic powers, for the neutralisation and demilitarisation of the Aaland Islands, to replace the earlier international convention of March 30 1856.

This report was accepted by the council and the two interested governments. An agreed text of the five guarantees was subsequently inserted in the Finnish law, and was placed under the supervision of the council of the League. The new neutralisation convention was negotiated at a conference held at Geneva from Oct. 10–20 1921, and it came into force on April 6 1922.



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ABBAS II. (1874–1923), Khedive of Egypt (*see* 1.9), died at Vienna on April 4 1923.

ABBE, CLEVELAND (1838–1916), American meteorologist and astronomer, was born in New York Dec. 3 1838. His training as astronomer under B. A. Gould, Brünnow and Struve (Pulkova, 1865–6) and work at the U.S. Naval Observatory developed his interest in weather changes. As director of the Cincinnati Observatory, 1869–73, he demonstrated the practicability of weather forecasts based on daily telegraphic synoptic charts, and in 1870 joined the U.S. Signal Corps

to organise and direct its weather forecasts. When this greatly expanded service was transferred to the Department of Agriculture in 1891, he went as senior professor of meteorology. Abbe was often and justly called the " Father of the Weather Bureau." *The Monthly Weather Review*, which he edited, and the introduction of the system of Standard Time, were both due to his initiative.

Among his works are: *Report on Standard Time* (1879); *Mechanics of the Earth's Atmosphere* (1892–1910); *Preparatory Studies for Deductive Methods* (1890); *Relation between Climate and Crops* (1901); *Physical Basis of Long-range Forecasting* (1902).

ABBEY, EDWIN AUSTIN (1852–1911), American painter (*see* 1.11). The last years of his life were devoted to mural paintings for the Capitol at Harrisburg, Pa., his native state. Of these he completed three, one for the House of Representatives, another for the Senate Chamber and the third for the ceiling of the dome. In 1910 there was completed under his supervision the decoration of the Peers' corridor of the Houses of Parliament at Westminster. He left bequests of his work to the Metropolitan Museum of Art in New York, the Boston Museum of Fine Arts and the National Gallery, London. He died in London Aug. 1 1911.

ABBOTT, GRACE (1878–), American social worker, was born Nov. 17 1878 at Grand Island, Nebraska. She graduated from Grand Island College in 1898, and, after teaching for nine years, became in 1908 director of the Immigrants' Protective League and a resident of Hull House, Chicago. She received the degree of M.A. from the University of Chicago in 1909. From 1917 to 1920 she was director of the child labour division of the Children's Bureau at Washington, D.C., and subsequently executive secretary of the Illinois Immigrants' Commission, returning to Washington in 1922 as chief of the Children's Bureau. She served in 1923 as unofficial representative of the United States on the advisory committee of the League of Nations on traffic in women and children, and also as president of the National Conference of Social Workers. She wrote *The Immigrant and the Community* (1917) and *Federal Aid for the Protection of Maternity and Infancy* (1923).

ABBOTT, LYMAN (1835–1922), American divine and author (*see* 1.26), continued after 1910 to take an active part in the discussion of public questions. On the sinking of the " Lusitania " in 1915 he urged that the United States should break off diplomatic relations with Germany. He died in New York City Oct. 22 1922. He was the author of *The Spirit of Democracy* (1910); *America in the Making* (1911, Yale lectures on the responsibilities of citizenship); and *Reminiscences* (1915).

ABDEL-KRIM.—Mohomed ben Abdel-Krim el-Khatabe, a Moroccan chieftain, was the son of a kaid of the Beni Uriaghel tribe inhabiting the mountainous country that extends inland from Alhucemas Bay on the Rif coast of Morocco. His father was a person of no particular importance or family, but, being a man of progressive ideas and in contact with the Spaniards at Melilla, he gave his two sons an education to which few of the Rifi tribesmen aspire. While Mohomed, the future Rifi leader, was taught Spanish and a smattering of European knowledge, his brother, Muhammed, was sent to Spain and educated as a mining engineer. Mohomed was employed in the office of native affairs at Melilla, while his brother worked in the interests of certain mining groups.

In 1919 a quarrel between Mohomed and Gen. Silvestre, of the Spanish Army, led to the former's flight from Melilla. He took to the mountains of his tribe, where his brother joined him. Both swore revenge and instituted a fierce resistance to the occupation of the Rif by the Spaniards. In 1921 Mohomed ben Abdel-Krim avenged himself of the slight he had received from Silvestre. With only a few hundred tribesmen he attacked the Spanish advanced post of Anual and captured it. Silvestre was killed, or committed suicide. The fall of Anual spread panic through the Spanish army of 19,000 men. The Spanish posts were deserted and the troops fled in disorderly retreat. Before the fighting was over 16,000 men out of the 19,000 had been massacred. The remainder mostly crossed into the French zone. The Rifi tribesmen were guilty of every kind of treachery and atrocity, but it was their revenge for acts of which they accuse the Spaniards, more especially that of forcible interference with their women, an unpardonable offence in their eyes. The Rifis reached the walls of Melilla, and had they chosen they could have captured the town and massacred its population of 50,000 civilians. But glutted with bloodshed and loaded with loot they desisted.

This signal defeat of the Spaniards vastly increased Abdel-Krim's reputation amongst the tribes. The Jabala, inhabiting the western portion of the Spanish zone, joined his cause and in 1924 the Spaniards were obliged to abandon all their inland positions and retreat on Tetuan and the sea, suffering heavy losses in the retirement. By the end of that year Abdel-Krim, having rid himself by capture of his only rival, Raisuli, was master of the situation and set to work to prepare a fresh campaign against the Spaniards. But a new danger threatened him from the south. The French, gradually occupying the zone to which they laid claim under existing treaties, were advancing northward, and Abdel-Krim was forced to go to the aid of the threatened tribes. His army and the revolted tribesmen invaded the French Protectorate and by June 1925 threatened Fez.

French reinforcements were hurriedly despatched from France and Algeria and by Oct. the French Protectorate territory was clear of the enemy, and a French army of 160,000 men, under Marshal Pétain, was on the borders of the Rif. In September the Spaniards had successfully disembarked a force in Alhucemas Bay and Ajdir had been taken. By Nov. 1 1925 the French and Spanish armies had been obliged by the weather to abandon an active campaign and were digging themselves into winter quarters, but Abdel-Krim, though weakened and threatened, was by no means beaten. This man of great ability and astounding energy fortified his mountain fastnesses and collected new forces to continue his campaign against two European armies, but in vain. He surrendered to France in May 1926. (*See* MOROCCO, CAMPAIGNS IN.) (W. B. H.)

'ABDULAZIZ IBN SA'UD, King of Hejaz and Sultan of Nejd, was born at Riyadh about 1880, the eldest son of 'Abdul Rahman, who was the youngest of the four sons of Faisal Ibn Turki Ibn Sa'ud, the Wahhabi Amir of Nejd during the middle of the 19th century. Consequent upon the civil war which prevailed on the latter's death, the early years of 'Abdulaziz were passed in exile at Bahrei and Kuwait. At the latter place 'Abdul Rahman and his sons were hospitably received by the ruling Sheikh, Mubarak Ibn Subah, and it was to this astute statesman that 'Abdulaziz owed his political training. Mubarak, apart from a feud with Ibn Rashid who had usurped the amirate of Nejd, was always in difficulties with the Turks, and in self-defence developed the most cordial relations with Great Britain—a factor which accounts for the confidence in the British which has always marked the reign of Ibn Sa'ud. By his father, a sincere and austere Wahhabi, Ibn Sa'ud was instructed in the principles of a simple creed, and never allowed to forget his duty to avenge his family. By 1900 he was ready for action and led a band of 200 devoted followers into the desert. With 15 of these he entered Riyadh secretly by night. Next morning he slew the Rashidian governor and was master of the city. And the rest of his life story is the history of Arabia (*q.v.*), culminating in his proclamation as King of Hejaz in Jan. 1926. A man of uxorious temperament, Ibn Sa'ud is believed to have married 125 wives.

ABDUL HAMID II. (1842–1918), ex-Sultan of Turkey (*see* 1.35), died Feb. 10 1918. On his deposition in April 1909 he was sent to Salonika as a state prisoner, but when that town capitulated to the Greeks during the Balkan War (1912) he was brought back to Constantinople. In 1915 it was judged prudent to exile him from Turkey in Europe and consequently he was removed to Magnesia, near Smyrna.

ABERCORN, JAMES HAMILTON 2ND DUKE OF (1838–1913) British politician (*see* 1.43), died in London Jan. 3 1913. He was succeeded as 3rd duke by his eldest son, JAMES ALBERT EDWARD HAMILTON, born Nov. 30 1869. The latter was made Governor of Northern Ireland in 1923.

ABERDEEN, Scotland (*see* 1.47), had a population in 1921 of 158,963, a decrease of some 5,000 on the 1911 figure. In 1924, however, the population was estimated at 159,900. The city continues to extend, particularly to the west and northwest. In 1910 a Masonic temple, a grey, granite building in Renaissance style, was erected in Crown street, and new operating theatres, etc., were installed in the Royal Infirmary. In the same year a Roman Catholic church was built at Torry, a fishing village now within the city boundaries, and in 1911 the John Knox Parish Church in Spital was rebuilt. After the War an orthopaedic hospital was installed in the city. In Sept. 1925 King George V. opened the city's War Memorial. This consists of a domed court, or Hall of Remembrance, attached to the art gallery and museum. Other extensions opened at the same time include Cowdray Hall, used for lectures, with the Cowdray Museum of Applied Arts beneath it. New rooms were also provided for the pictures.

ABERDEEN, UNIVERSITY OF (*see* 1.48).—Great progress has been made in every direction since 1909 when the Very Rev. Sir George Adam Smith became principal. Seven chairs and eleven lectureships have been founded. Handsome new buildings have been erected and equipped. The flow of private munificence has been steadily maintained by gifts for the institution of chairs in political economy, geology and engineering, and for library purposes and research. An important addition to the resources of the university was the foundation, in 1913, of the Rowett Institute for Research in animal nutrition. Donations have been received for scholarships and bursaries, and the Carnegie Trust has made generous grants for building purposes. Students are increasing in number. The principal benefactors during the period were Sir Thomas Jaffrey, Dr. Alex. Kilgour, Dr. William Dey, Miss A. H. Cruikshank's Trustees, William Jackson and Mrs. Jackson. Information about the progress of the university will be found in the annual publication *The Universities Year Book.*

ABRAHAM, WILLIAM (1842–1922), British Labour politician, was born in the Afon Valley. He was better known by the name of Mabon, a name originally adopted by him in Eisteddfod competitions. Educated at a national school in Carnarvonshire, he was earning his living as a pit boy at the age of 9 and worked underground till he was 30. In 1871 he became a miners' agent, and rose to be president of the South Wales Miners' Federation. Up to the 1911 strikes he was a power in South Wales—a trade-union leader of the old type; but with the rise of the new trade unionism his influence declined, though he remained a respected figure to the end. Elected to Parliament in 1885 as a Liberal-Labour M.P. for the Rhondda division, he kept this seat till 1918; after the 1918 redistribution he was returned for Rhondda, West, retiring in 1920. Made a privy councillor in 1911, he died on May 14 1922.

ABRUZZI, DUKE OF THE (1873–), Italian vice-admiral and explorer, son of Amadeo, Duke of Aosta (*see* 1.804), was born at Madrid Jan. 29 1873 and named Luigi Amadeo. Although he had a distinguished naval career he achieved fame also as a traveller and mountaineer. He was the first to ascend Mt. St. Elias in Alaska (1897) and in 1899 he organised a North Pole expedition (*see* 21.952) part of which reached lat. 86° 34′, at that time the record of northern exploration, he himself being forced to remain behind owing to frostbite. In 1906 he was the first to ascend the Ruwenzori in East Africa, reaching the twin summits (16,800 ft.) which he named Margherita and Alexandra, and made the first detailed map of the Ruwenzori. In 1909 he explored the Central Karakoram in the Himalayas and by ascending peak K_2 achieved the record for height. During the World War he commanded the naval forces in the Adriatic, but he resigned in 1917 owing to disagreements with Adml. Thaon di Revel, his chief of staff, and retired from the service. Afterward he undertook to carry out an important colonisation scheme in Italian Somaliland.

ABYSSINIA (*see* 1.82).—No change was made in the international status of Abyssinia between 1910 and 1925; but boundary commissions have in part delimited its Sudanese and Somaliland frontiers. The area is about 350,000 sq. m. and the population approximately 10,000,000.

I. POLITICAL HISTORY

In the years under review Abyssinia, owing to misgovernment and civil war, fell from a state of comparative prosperity to a condition bordering on chaos. The Emperor Menelek, who had converted a congeries of semi-independent kingdoms into a powerful state, died in 1913, but for some four or five years before his death he had taken no active part in the government. Although the stricken Emperor had in 1908 nominated his grandson Lej Yasu, born in 1896, as his successor, under the regency of Ras Tessama, a step confirmed 12 months later by the Council of Ministers, no government worthy of the name was possible owing to the constant intrigue and strife between the Empress Taitu, the Regent and other powerful nobles. In 1910 the Empress Taitu was finally driven into retirement, and in 1911 Ras Tessama died.

Lej Yasu then took the reins of government into his own hands, although he was never crowned, and the state of the country became steadily worse. By his misgovernment, his tyrannical and dissolute conduct, and particularly by his inclination to Islam, he mortally affronted his own subjects, intensely proud as they were and are of their 15 centuries of Christian tradition. His support of the "Mad Mullah" of Somaliland, who claimed him as a cousin, and his efforts to build up a federation of Moslem states, anti-ally in its sentiments, also estranged the sympathies of the three great Powers with possessions bordering on Abyssinia. In Sept. 1916, he was excommunicated by the Abouna, the head of the Abyssinian Church. The great Rases, thus relieved of their oath of fealty, formally deposed him, and proclaimed Zauditu, a daughter of the Emperor Menelek, born in 1876, as Empress, and Djazmach Tafari, born July 17 1891, son of Menelek's nephew Ras Makonnen, as Regent of the Empire, Heir to the Throne and Ras of Rases. Heavy fighting followed. Lej Yasu's father, Ras Michael of Wollo Galla, raised large Galla forces to aid his son, but the troops of the deposed ruler were defeated with great slaughter at Sagalle on Oct. 27 1916. Ras Michael was taken prisoner, and Lej Yasu became a wanderer, first of all in the Dankali country and later in Tigre.

New Rulers.—The coronation ceremonies of the new rulers took place in Feb. 1917, but Zauditu and Tafari succeeded to a troubled heritage. Freed from Menelek's iron rule and abandoned to their own devices during Lej Yasu's unfortunate tenure of office, the great Rases and provincial governors had begun to fall back into semi-independence. Sporadic fighting with the followers of Lej Yasu, who was not finally captured until 1921, continued for some years. Law and order were weakened, and the authority of the government hardly existed outside the central provinces. The dual nature of the governing régime, moreover, made it difficult to exercise really strong and effective control, and stimulated intrigue both domestic and foreign; it seemed indeed as though Menelek's impetus to development was spent. Nevertheless, little by little the Regent gathered together the reins of government, and improvements in administration, both central and local, were slowly achieved.

During this difficult period, in which he was criticised by the more reactionary Abyssinians for going too fast, and by European observers for not going fast enough, Ras Tafari exhibited many of the qualities of his father, Ras Makonnen, who had been not merely a fine soldier but a skilful diplomat, having conducted official missions to Paris, London and Rome. Tafari was aided in his task by the completion, in 1918, of the railway from the coast of French Somaliland to the capital, Addis Ababa. This link with the outside world undoubtedly played a considerable part in maintaining and strengthening the Regent's position and in stimulating intercourse with Europe, so much interrupted by the World War as well as by internal events.

Ras Tafari married Waizero Manin, granddaughter of Ras Michael, in 1912, and by her has two sons and three daughters. His position was so far consolidated by 1922 that he was able to

leave the country for a short visit to Aden, and in 1924 he visited the principal countries of Europe with an imposing retinue of over 20 Rases and officials, his absence lasting nearly five months. His greatest triumph was the admission of Abyssinia to the League of Nations on Sept. 28, 1923, subject to certain conditions as to the control of slavery and of the arms traffic. Progress, though slow according to European ideas, has since been made; the Regent opened a school at Addis Ababa into which he introduced European teachers, and a number of young Abyssinians were sent to America, England, and France for their education to be completed. A large American hospital has been erected and many roads have been made in and around Addis Ababa. European enterprise is beginning to take an interest in the country, and the infiltration of European ideas, though very slow and gradual, is real.

Much yet remains to be done. The illiteracy of the people, very few of whom can read or write, the existence of slavery, the authority and bigotry of the priesthood, and most of all the power of the great provincial chief, are obstacles to progress; the financial and general administration and also that of justice leave much to be desired, while the general condition of the peasantry, especially in those parts inhabited by conquered races, is far from satisfactory. But the guarantee of independence involved by admission to the League of Nations should tend to set at rest internal fears of foreign international rivalries and aspirations, and thus facilitate domestic reform.

II. ECONOMIC CONDITIONS AND TRADE

The small progress in the economic and commercial development of Abyssinia during the years 1910–25 may in part be attributed to the disturbed political condition of the country, and in part to the World War and the trade depression which followed it. Other causes which have retarded development are lack of communications, bad methods of taxation, suspicion of foreign enterprise and currency difficulties.

The principal industries are agriculture and cattle-raising, but in spite of the fertility of the soil (in places three crops a year are raised) and the vast herds of cattle, estimated at from 10,000,000 to 15,000,000 head, production is only sufficient to feed the population and provide a few thousand tons of coffee and hides for export. Manufacture and industrial enterprise are almost non-existent. Some European commercial enterprises have been started, and there are indications that the Govt. will be able to give more sympathetic attention in the future to this aspect of the country's welfare. A Belgian company has acquired the alcohol monopoly, a Franco-Belgian company has been formed for cotton cultivation, two Belgian companies are developing coffee plantations on a large scale, and an English company commenced trading operations in 1925.

The total trade of the country approximates £2,500,000 in value annually. The chief exports are coffee and hides, and the principal imports salt, cotton fabrics, and hardware. The main channel of trade is the Franco-Ethiopian Railway, from Addis Ababa to the port of Jibuti in French Somaliland. The principal trade routes with the Sudan are via Gambela, Gallabat, and Roseires: the total annual value of the trade along these routes increased from about £50,000 in 1910 to £372,000 in 1924. Other trade routes are through the Italian colony of Eritrea to Massawa, and through Harar to Berbera in British Somaliland.

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ACCOUNTANCY: *see* BOOKKEEPING; COST ACCOUNTING.

ACETYLENE, IN MEDICINE.—Acetylene, which when pure loses its usual offensive smell, is an anaesthetic when inhaled and was first used as such in 1924. Like ethylene (*q.v.*) it is in the experimental stage at present. Its efficiency is between that of gas-oxygen and ether. Ether may be used with it to deepen the anaesthesia. It has the advantage that far greater amounts of oxygen can be given with it, up to about 50%, than with ethylene or nitrous oxide. *See* ANAESTHETICS. (W. S. S.)

ACHENBACH, ANDREAS (1815–1910), German painter (*see* 1.142), died March 31 1910.

ACHESON, EDWARD GOODRICH (1856–), American inventor, was born at Washington, Pa., March 9 1856. He was compelled to earn his living at an early age, but devoted his leisure to mechanical invention and experiment. Becoming interested in electricity, he entered the employ of Thomas A. Edison. In 1881 he assisted in the preparation of the Edison Exhibit at the Paris International Exposition and later, for the Edison interests, installed the first electric lights in Italy, Belgium and Holland. On returning to the United States, he resumed his experiments. He discovered a new abrasive substance of great cutting power, which he named carborundum. Inventing a method of producing a remarkably pure synthetic graphite, he organised in 1899 the Acheson Graphite Co. to handle the patent therefor. This company met with great success. His numerous patents cover methods of producing metallic silicon cheaply; the lubricants known as oildag, aquadag and gredag; the treatment of clay to increase plasticity (Egyptianised clay).

ACOUSTICS: *see* SOUND.

ACROSTIC (*see* 1.156).—A 20th-century development of the acrostic is the quadruple acrostic. The following, taken from R. A. Knox's *Book of Acrostics*, is a good example.

Uprights: Since there's no A, B, let us C and D.
Lights: 1. Reverse the name a schoolboy might apply, for briefness, to his weekly subsidy.
2. A lady thus (but with an S)
In Southern lands you might address.
3. Initials seen on many a truck.
4. To cattle breeders brings bad luck.

SOLUTION

Uprights: "Since there's no help, come, let us kiss and part."
Lights: 1. HsaCteKcoP (Reverse of Pocket Cash).
2. (s) En Or It A.
3. L.M.S.R.
4. P E S T.

Acrostics may be very simple and also very intricate. The modern acrostic seems to hit the happy medium and, whilst giving the reader plenty of food for thought, sends him occasionally to his Cruden, his Classical Dictionary, or his Encyclopædia.

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ACTING.—In the course of the period 1910–26, several new and different theories of acting have appeared. Different schools, academies of acting and theatres, mostly repertory, have done a great deal towards improving the standard of acting and team work or ensemble acting, on the stage. Of such are, in England, the Repertory Theatre in Birmingham, and the Liverpool Repertory Theatre; in Ireland, the Abbey Theatre, Dublin. Such English producers as Gordon Craig, Granville Barker, J. B. Fagan, Lewis Casson, Nigel Playfair and others, have done very important work in improving the quality of acting, and creating stage ensembles, not only directly by their stage work, but also by their writings on the subject. In the United States, David Belasco, the Theatre Guild of New York, the Washington Square Players, the Provincetown Playhouse and such producers as Hopkins, R. E. Jones, the Reichens and others contributed to this improvement. Moreover, the Little Theatre movement in America must not be overlooked.

In reviewing the general style of acting during this period, it will be noticed that everywhere on the stages of the theatres where there is no leading producer who has a definite theory or system of acting, and who trains his company without having a definite system or theory, there is a mixture, not only of modern, but of very many different styles of acting. In the so-called commercial theatre, with star actors, the typical style of acting is generally, not an art of creation of imaginary characters, but a kind of repetition of themselves by the actors in every part and in every play. These stars are not really acting, but merely showing themselves off to the public, using their personality and certain peculiarities of that personality, and trying to please and to obtain the sympathy of the audience.

Producers such as Max Reinhardt in Germany and Firmin Gémier in Paris use, for the most part, the methods of acting created by the naturalists, André Antoine in France, and Kronig, the producer of the Meininger, in Germany, and developed by Otto Brahm in Germany and Stanislavsky in Moscow. Sometimes these producers introduce, in this naturalistic acting, ideas of the formalists, Georg Fuchs in Germany, Meyerhold and Tairof in Russia, Gordon Craig in England and others. Sometimes they introduce touches of the synthetic theories of acting advocated by Komisarjevsky since 1910. The majority of the French actors trained in the Conservatoire in Paris remain still under the influence, not only of the old romantic school, but also of the pseudo-classical school of acting of the 18th century. The most complete example of that mixture of romanticism with its false "theatrical," effective pathos and the conventional, cold, learned and refined technique of the pseudo classicism, was seen in the acting of Mounet Sully at the Comédie française.

Naturalism.—The best known of all the new theories of acting which have appeared since 1910 is the system of Stanislavsky, the leading producer and director of the Moscow Art Theatre. His system is founded on the principle that an actor, having to be natural and sincere on the stage, could be so only by means of reproducing emotions experienced at some time or other in his life. That form of "psychical naturalism" became part of Stanislavsky's system as a result of "outer naturalism," which he advocated before he turned to psychology in the endeavour to find out a scientific system of acting.

The "inner naturalism" in acting is not a new feature in Stanislavsky's theory. Some French theatrical theorists had already, in the 18th century, founded their systems of acting on the same ideas. They held that an actor can represent himself on the stage only if it is desired that he should be sincere (Batteux, *Les Beaux Arts réduits à un même principe*, Paris, 1746). Remond de Sainte Albini in his book *Le Comédien* (Paris, 1747) wrote that, "love scenes are much better played by actors who are in love in real life." In a similar manner to that of the followers of Racine, Stanislavsky believes that contemporary actors living in their own time, and each one in his special atmosphere are unable to produce other emotions than those that are applicable to the time and to the surroundings in which they lead their everyday life. To be sincere, they must place, beneath the lines and stage directions of the author, their own emotions already experienced in real life. Nemirovitch-Danchenko, another producer of the Moscow Art Theatre, and the collaborator of Stanislavsky, wrote: "An actor must live on the stage only with emotions, and not with words. The meaning which the dramatist wishes to convey is not in the lines of the characters."

It is quite clear that this type of acting destroys the form created by the author of the play and the rhythm of his lines, which express the inner content and the inner movements of the play. The actor who acts by the power of his imagination passes from the form and the rhythm of the play to the inner content of it. The idealistic and emotional content of the play, which he obtains through the form and rhythm of the play, exists in his imagination and produces the necessary working of his intellect to create a stage character with all its peculiarities. The pupil of Stanislavsky neglects the form and rhythm of the play and substitutes his own remembered, intellectual states in place of those of the author.

The Formalists.—Another system, opposite to Stanislavsky's ideas, was advocated during the last years of symbolists, the formalists and the expressionists. Here we have a complete negation of sincerity and lifelikeness; the less the acting is sincere and lifelike the better. Here the actor must not try to create any definite characters; he must represent abstract ideas and convey these through his speeches delivered in a formal way, and through his movements and gestures, again produced in a formal, unlifelike and "picturesque" or marionette-like style. The Russian formalists, for instance Meyerhold and Tairof, during the last years of the revolution, became very much interested in acrobatics and circus business; the movement of the actors in their productions became something akin to a *perpetuum mobile*, dominating both the psychology of the play and the meaning of the lines. Thus the acting on their stages resembled very much a mixture of circus and cubistic ballet performance. Later, Meyerhold, in his manner of making his actors act, came back to the more or less naturalistic style. The German expressionists, such as Jessner, use the formal methods, interspersed with psychological touches. More or less in the same way the actors work on the French *avant-garde* stages, for instance at the Atelier, directed by Dulain, in the productions of Pitoef and Jouvet. In the closed Vieux Colombier they used the same methods of acting. Copeau, the director of the above theatre, must be considered as a pioneer in France in the fight against naturalism and the old fashioned Conservatoire acting. He definitely introduced such new methods of acting as the psychological and the formal on the French stage.

Views of Diderot.—There are, and always have been, very many discussions around the question as to whether an actor should really "feel" or, as some theatrical writers say, "live through" his part. This question was first raised by the French encyclopaedist, Denis Diderot (*Paradox sur le Comédien*): Diderot thought "the possibilities of a good actor lie in the complete absence of sensibility," and recommended to the actor that he should watch himself during the performance, that he listen to his voice and give only "recollections of his emotions." That kind of acting he called *singerie sublime*. It is proved now that an actor cannot move the audience, or be in any way creative on the stage, if he watches himself acting. Instead of being concentrated on the images he has to create, on his inner self, he becomes concentrated on his outer self, becomes self-conscious, and loses the power of imagination.

On the other hand it seems that it is impossible for an actor to get excited by the dramatic situation, and not to lose control of himself. Dr. Johnson said that an actor who, even for a moment, could work himself up to feel like a murderer should be executed after the play was over. It is certainly necessary to be able to feel a passion in order to be capable of depicting it successfully, but as Sir Henry Irving once said, "the actor must keep the passion in hand," or according to the words of the great French tragedian Talma "Il faut que chez les acteurs l'intelligence soit toujours en éveil, agissant de concert avec sa sensibilité pour enrégler les mouvements et les efforts." (*Mémoires de Talma*, A. Dumas.)

What does it mean, that an actor should keep the passions and emotions in hand? How can the reason walk hand in hand with the emotions and not kill these emotions? The way is to act only with the help of the imagination; to create, and not to imitate or reproduce one's own life experiences. An imaginative actor is in no danger of being overcome by his emotions and of being controlled by them. He is controlling these emotions because he has created them according to a plan which he has himself devised. He does not need to give, according to the advice of Diderot, "recollections of his emotions" instead of real emotions for fear of killing his partner, or breaking his own neck on the stage. The "imagination" or "phantasy" unites in itself all the different sides of our psychical life. And when the actor playing a part is living in a world of images created by his own phantasy, he cannot and need not watch and control himself. The images created by the actor's phantasy, and obedient

to his will, control, guide and direct his emotions and actions during the performance. (*See* DRAMA; STAGE.)

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ADAM, PAUL (1862–1920), French novelist (*see* 1.172), published in his later years various novels, including *Le Trust* (1910), *Stéphanie* (1913), and shortly before his death *Reims dévastée and Le Lion d'Arras*. He died in Paris Jan. 2 1920.

ADAMS, HENRY (1838–1918), American historian (*see* 1.175), died in Washington, D.C., May 27 1918. In 1910 his *Letter to American Teachers of History* appeared, and in 1911 his *Life of George Cabot Lodge*. In 1913 his *Mont Saint Michel and Chartres* (privately printed in 1904) was published by authority of the American Institute of Architects. In 1918 his autobiographical work, *The Education of Henry Adams* (privately printed in 1906) was issued for the public. No book of its decade evoked more discussion in America. In 1919 *The Degradation of the Democratic Dogma*, consisting of several essays previously published together with one hitherto unpublished, was issued, with an introduction by his brother, Brooks Adams.

His brother, CHARLES FRANCIS ADAMS (*see* 1.175), died in Washington, D.C., March 20 1915. In 1911 he published *Studies Military and Diplomatic* 1775–1865 and in 1913 *Trans-Atlantic Historical Solidarity* (lectures delivered at Oxford). In 1916 Worthington C. Ford edited *Charles Francis Adams; an Autobiography*, from papers deposited in 1913 with the Massachusetts Historical Society.

ADAMS, HENRY CARTER (1852–1921), American economist (*see* 1.175), died Aug. 11 1921. His later books include *Description of Industry* (1918) and *American Railway Accounting* (1918).

ADAMS, MAUDE (1872–), American actress, was born in Salt Lake City, Utah, Nov. 11 1872. The family name was Kiskadden, but she adopted the maiden name, Adams, of her mother, an actress. From an early age she played juvenile parts, and at the age of 16 went to New York. From her appearance in Hoyt's *A Midnight Bell*, in 1889, her popularity grew steadily. In 1897 Charles Frohman gave her her first leading part as Lady Babbie in *The Little Minister:* and in *Peter Pan* she achieved a great success. She introduced Rostand to the American stage, taking the title-rôle in *L'Aiglon* in 1901, and in *Chantecler* in 1911. Other plays in her repertory were *Romeo and Juliet, The Pretty Sister of José, The Jesters*, and *As You Like It.*

ADAMSEN, AMANDUS HEINRICH (1855–), Estonian sculptor, was born in Port Baltic, Estonia, on Nov. 13 1855, his father being a sea-captain. While still at school Adamsen managed to earn a livelihood by producing carved work of considerable artistic value. In recognition of his talents, and on the recommendation of Count Lütke, president of the St. Petersburg Academy of Sciences, he was admitted as a student to the Academy of Art. He finished his studies at that academy in 1879, when he was awarded the silver medal. He received many commissions from leading members of St. Petersburg society. In 1887 he produced a portrait in relief of Tsar Alexander III.; he then went to Paris where he lived for several years. In 1891 he returned to his native land and lived alternately in Port Baltic and St. Petersburg.

Adamsen's technique in marble and wood has been moulded on classical lines. His small wood carvings are incomparable; and he executed a series of war memorials erected in memory of those who fell in the Estonian War of Independence. His most important works are an allegory, shown at the Paris Exhibition in 1889, entitled "Liebe, Tod und Wissenschaft"; "Die Welle" and "Hunger"; also "Befreiter Genius" and "Sieg der Arbeit" which were executed for the Nijni-Novgorod Exhibition. Mention should likewise be made of "Tod des Hyakinthes," "Leukothea," "Meeresrauschen," etc.

ADDAMS, JANE (1860–), American sociologist (*see* 1.183), became an ardent supporter of the cause of women's suffrage. She was chairman of the International Congress of Women held at The Hague in 1915. A permanent organisation was then established, the Women's International League for Peace and Freedom, of which she became president. Her later books include *Twenty Years at Hull House* (1910); *A New Conscience and an Ancient Evil* (1912); *The Long Road of Woman's Memory* (1916); *Peace and Bread in Time of War* (1922).

ADDING MACHINE: *see* OFFICE APPLIANCES.

ADDRESSING MACHINE: *see* OFFICE APPLIANCES.

ADE, GEORGE (1866–), American author, was born at Kentland, Ind., Feb. 9 1866. After graduating from Purdue University, he took up newspaper work, serving on the Chicago *Record* from 1890 to 1900, after which he devoted himself to writing. He belongs to the school of American vernacular philosophers and humorists, which includes Artemus Ward, Mark Twain and Mr. Dooley, his best-known work being *Fables in Slang* (1899). Ade also wrote a number of musical comedy librettos, motion-picture scenarios, including *Back Home and Broke* (1922), and plays, the best known of which are *The County Chairman* (1903), *The College Widow* (1904) and *Father and the Boys* (1908).

ADELAIDE, South Australia (*see* 1.188), had in 1923 a population, including its suburbs, of 278,856. Electric tramways were started in 1909, and by 1923 71½ m. were open. A building was erected at the back of the Town Hall for city offices in 1915, when a new wing was added to the Natural History Museum. The water supply has been augmented by the construction of a large new reservoir at Milbrook, opened in 1925. A War Memorial has been erected in Lower North Adelaide. An all-Australian exhibition, the largest ever held in Australia, was opened there in March 1925. The inner harbour at Port Adelaide has 4 m. of wharfage, and the outer 2,400 feet. The building of dry docks was contemplated in 1925. The chief magistrate was made a lord mayor in 1919.

ADEN (*see* 1.190).—The frontier of the protectorate was demarcated in 1902–4, and in 1905 a convention was signed by the British and Ottoman commissioners determining the boundary from Sheikh Murad on the Red Sea coast to the Bana river, and thence in a north-easterly direction into the desert. By an Anglo-Turkish Convention of 1914 the boundary was prolonged to a point on the shores of the Persian Gulf opposite Bahrein Island. During the World War, the Turkish forces encroached on Aden territory and approached to within a short distance of the town; they occupied Lahej and Sheikh Othman, but at no time was the safety of Aden itself very seriously threatened. In 1917 the defensive line of Aden described an arc of about 11 m. radius and continued so until the Armistice. At the end of the War the Turks withdrew from the Yemen. The neighbouring territories of the Iman of San'ā conform, theoretically, with the 1905 line, though encroachments had been made at some points which, in 1925, were the subject of dispute.

For administrative purposes Aden is under the control of the Govt. of Bombay and, ultimately, of the Govt. of India. The political relations of Aden with the rest of Arabia and relations with the tribes of the protectorate were taken charge of during the War by the High Commissioner of Egypt. In 1920 political control was transferred to the Political Resident, who was directly responsible to the British Foreign Office. In 1921 this responsibility was taken over by the Colonial Office. For military purposes, the General Officer Commanding is subordinate to the C.-in-C. in India, but the British War Office also exercises a certain measure of control.

The total population in 1921 of the settlement and Perim I. was 54,923 (including some 500 Europeans), as compared with 46,165 in 1911. The trade of Aden is largely a transhipment trade. In 1923–4, the total value of imports was Rs. 7,87,68,225, of which Rs. 31,81,845 was land-borne; and of exports Rs. 6,90,60,316, of which Rs. 45,12,725 was land-borne. In 1924–5 imports totalled Rs. 9,00,36,458 in value and exports Rs. 7,73,49,165, exclusive of government stores and treasure, as compared with imports valued at Rs. 6,56,62,230 and exports at Rs. 6,62,36,935 in 1913–4. The total tonnage of merchant

vessels of over 200 tons entering the port in 1924–5 was 4,223,633 tons. During the World War a metre-gauge railway was constructed for military purposes from Aden to Lahej, 26 miles. Later it was extended to Habil, a further eight miles. The National Bank of India has a branch in Aden.

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ADENOIDS: *see* EAR, NOSE AND THROAT, DISEASES OF.

ADLER, FRIEDRICH (1879–), Austrian politician, was born in Vienna, July 9 1879, the son of Viktor Adler (*q.v.*). From 1907 to 1911 he was lecturer in physics at the University of Zurich, but he was soon immersed in politics. From 1911 to 1916 he was secretary of the Austrian Social Democratic party and editor of the monthly *Kampf*. During the World War he was in close sympathy with the Socialists of the Left. In despair over the break-up of the International, he shot the Austrian Prime Minister, Count Stürgkh, on Oct. 21 1916, hoping that the deed would be a signal for the rising of the proletariat against the War. On May 19 1917 he was condemned to death by a special tribunal, a sentence later commuted to 18 years' imprisonment. He was, however, amnestied on Nov. 1 1918. In 1919 he was elected to the National Assembly, and became vice-president of the committee of the Social Democratic party and of the Union of the Social Democratic deputies. He became secretary of the International Labour Assn. of Socialist Parties which he had helped to found.

Adler's chief works are: *Die Erneuerung der Internationale* (1918); *Ernst Mach's Ueberwindung des mechanischen Materialismus* (1918); *Ortszeit, Systemszeit, Zonenzeit und das ausgezeichnete Bezugssystem der Electrodynamik, eine Untersuchung über die Lorentzische und die Einsteinsche Kinematik* (1920).

See *Friedrich Adler vor dem Ausnahmegericht* (1919).

ADLER, VIKTOR (1852–1918), Austrian politician, was born at Prague, June 24 1852. He began to occupy himself early with political and social questions. In 1883 he went to study in Switzerland and in London, where he came into close touch with Engels. On his return to Vienna, however, he turned entirely to politics. The Workmen's party had sunk into political insignificance, so Adler undertook to restore unity in the ranks of labour. In 1886 appeared his paper *Gleichheit*, eventually succeeded by *Die Arbeiterzeitung*., the principal organ of the Social Democratic party, which Adler continued to conduct till his death. In July 1889 he appeared at the first congress of the Second International, of which he became an official, as the representative of the united Austrian Labour party and was from that time the acknowledged leader of the party.

Adler regarded it as his first task to secure for the workmen representation in Parliament, but it was not until 1907 that he was able to secure universal and equal suffrage. The Social Democratic party increased their representation from 11 deputies to 87. Adler himself entered the Diet of Lower Austria in 1902, and in 1905 was elected to the Reichsrat, where, until his death, he played an important part.

In the congresses and in the secretariat of the International, Adler, with Jaurès and Bebel, played the most prominent part, whether as leader, adviser, or mediator. After the collapse of Austria in 1918, at the constituent session of the provisional German-Austrian National Assembly, he read the declaration of the Social Democrats, in which they expressed their willingness, in association with the other German-Austrian parties, to build the new state on the basis of democracy and self-determination, without prejudice to a possible association with the German Empire. He held for a few days the office of Foreign Minister, but he broke down and died Nov. 12 1918, the day on which the state council had decided to proclaim German Austria a democratic republic, and an integral part of the German Reich.

His works include articles scattered in various newspapers, in the *Neue Zeit; Kampf; Deutsche Worte* (Vienna), in addition to those in the *Arbeiterzeitung;* pamphlets, among which are *Die Fabrikinspektion, insbesondere in England und der Schweiz* (1884); *Die Arbeiterkammern und die Arbeiter* (1886); *Die Gleichheit vor dem Ausnahmegericht* (1889); *Das allgemeine, gleiche und direkte Wahlrecht und das Wahlunrecht in Oesterreich* (1893); *Schwurgerichtsprozess gegen Doktor Viktor Adler wegen Verbrechens der Störung der öffentlichen Ruhe* (1894); *Alcoholismus und Gewerkschaft* (many editions) (1907).

ADMIRALTY, BOARD OF (*see* 1.195).—The history of the British Admiralty since 1909 is the history of a steady increase in departments growing out of the vast multiplication and development of technical and applied sciences, and the problem of admiralty administration is to co-ordinate these multifarious activities into a single whole. This is peculiarly difficult in a war service where one is constantly preparing for one's work without actually performing it. The solution must be sought in freeing those responsible for larger questions from the crushing load of merely administrative business by imposing a clear distinction between fighting and supply, between the science of using the weapon and science of maintaining it in efficiency.

Up to 1909 the Intelligence Dept. was the thinking department of the Admiralty. Both Lord Fisher and Sir Arthur Wilson were opposed to a staff, and the idea found little favour at sea. In 1910 the Intelligence Dept. split into the two departments of Intelligence and Mobilisation of which the latter gradually became immersed in details of manning and mobilisation. The First Sea Lords of the time had no use for a staff; the navy was wedded to methods of centralisation, and there was a tendency to regard the conduct of a war as a simple business, which each flag officer must perform in his own way.

This happy faith received a rude shock at the Agadir crisis in the summer of 1911 when Sir Arthur Wilson was unable to produce any clear plans for war. Opposed to the idea of a staff, he resigned, and it was left to Mr. Churchill, in his memorandum of Jan. 1912, to institute the beginnings of a staff system. The new War Staff, as it was called, consisted of three divisions: Operations, Intelligence, and Mobilisation. Its deficiencies were serious. The Chief of the War Staff was not a member of the board and could not act with the authority of the board. When in 1914 war broke out, the work of the staff fell largely into the hands of a small group of admirals, senior to the Chief of the Staff and working independently of him.

War Period.—The Admiralty Board at this time, under a patent of Dec. 1 1913, consisted of the First Lord, Mr. Winston Churchill (from Oct. 24 1911); the First Sea Lord, Adm. Prince Louis of Battenberg (since Dec. 9 1912); the Second Sea Lord, Vice-Adm. Sir Frederick Hamilton (succeeded Vice-Adm. Jellicoe, July 30 1914); Third Sea Lord, Rear-Adm. Archibald Moore (since May 29 1913); Fourth Sea Lord, Capt. Cecil Lambert (since Dec. 1 1913); Civil Lord, Mr. George Lambert (since Dec. 21 1905); Parliamentary and Financial Secretary, Sir Francis Hopwood, afterwards Lord Southborough (since Jan. 18 1912); and the Permanent Secretary, Sir W. Graham Greene. Rear-Adm. Sir Doveton Sturdee was Chief of the War Staff, but there were at least two flag officers senior to him, Sir Arthur Wilson and Sir Henry Jackson, also acting in an advisory capacity to the board.

Although the Admiralty achieved a master stroke in the battle of the Falkland Is., the deficiencies of the system, which were felt at Coronel, became gravely manifest in 1915; Lord Fisher was then First Sea Lord, having succeeded Prince Louis of Battenberg (afterward Marquis of Milford Haven) on Oct. 30 1914, when Rear-Adm. Sir Henry Oliver became Chief of the War Staff. Lord Fisher was immersed in a plan for a great landing in the Baltic. The First Lord, in the case of the Dardanelles, over-estimated the power of the "Queen Elizabeth's" 15-in. guns and the War Staff could neither supply an element of strong independent criticism, nor grip the problem and transform it into a practicable proposition. Lord Fisher pulled down his blinds and left the Admiralty without a word on May 15. Mr. Churchill ceased to be First Lord some days later when the Govt. was reconstructed. These two were succeeded by Adm. Sir Henry Jackson and Mr. Arthur Balfour (May 28 1915).

At the end of 1916, Adm. Sir John Jellicoe came from the Grand Fleet to succeed Sir Henry Jackson (Dec. 4 1916); Sir

Edward Carson succeeded Mr. Arthur Balfour (Dec. 12) and an anti-submarine division was instituted; then on Jan. 31 1917 the Chief of the Royal Naval Air Service, Com. Godfrey Paine, was added to the board as Fifth Sea Lord, but it was not till May 1917 that the staff was thoroughly re-organised to meet the pressing danger of the German submarine campaign. (Order in Council May 19 1917.)

The office of Chief of the Naval Staff was then merged in that of First Sea Lord, while the appointment of a Deputy Chief (Vice-Adm. Sir Henry Oliver) and Assistant Chief (Rear-Adm. Alex. Duff), both with seats on the board, gave the Naval Staff a predominant weight of board authority. Sir Eric Geddes at the same time became Controller, and all questions of supply were concentrated in his hands till he succeeded Sir Edward Carson as First Lord (July 20).

On Sept. 6 Adm. Sir Rosslyn Wemyss was appointed Deputy First Sea Lord to deal with questions of foreign policy and operations abroad. Finally, in Oct. 1917, the development was carried a step further when two committees were formed in the board, one of Operations, the other of Supply, both under the chairmanship of the First Lord, and by an important Order in Council of Oct. 23 1917, the Chief of the Naval Staff was authorised to issue all orders relating to operations and movements of the fleet, signing them in his own name. Three new divisions of the staff had been formed, viz: Plans (Rear-Adm. Roger Keyes), Minesweeping (Capt. Lionel Preston), and Mercantile Movements (Capt. Whitehead), the latter having evolved from the convoy section.

In Dec. 1917 Rear-Adm. Roger Keyes went to Dover to put in force a new and drastic plan of closing the Straits to submarines and under the pressure of events some sweeping changes took place. Acting Adm. Sir Rosslyn Wemyss succeeded Adm. Sir John Jellicoe as First Sea Lord (Jan. 10 1918), and Rear-Adm. Sydney Fremantle took Vice-Adm. Sir Henry Oliver's place as Deputy Chief of the Naval Staff. When peace was declared Adm. Sir Rosslyn Wemyss, afterward Lord Wester Wemyss, was still in the post which four admirals had held in turn and was succeeded by Earl Beatty on Nov. 3 1919.

Organisation in 1925.—The board as constituted in 1925 consisted of ten members, viz: First Lord, First Sea Lord, and Chief of the Naval Staff (policy and war), Second Sea Lord (personnel), Third Sea Lord (material), Fourth Sea Lord (supplies and transport), Deputy Chief of the Naval Staff (operations and intelligence), Assistant Chief of the Naval Staff (design and development of material), Civil Lord, Financial Secretary, and Permanent Secretary.

The Admiralty office may be classified under the heads of:

I. Secretary's Dept., five branches, viz: M. (Military) dealing with political and diplomatic questions; C.W. (Commissions and Warrants) personnel of officers; N. (Navy) personnel of men; C.E. (Civil Establishment); N.L. (Naval Law); Discipline and King's Regulations; Library and Record Office.

II. Naval Staff, seven divisions, viz: Operations, Intelligence, Plans, Trade, Training, Gunnery, and Torpedo.

III. Personnel departments, seven, viz: Mobilisation, Recruiting, Medical, Physical Training, Paymaster, Chaplain of Fleet, Royal Marines.

IV. Technical, viz: Hydrography and Navigation, Naval Construction, Naval Engineering, Electrical Engineering, Naval Ordnance, Torpedoes and Mining, Naval Equipment, Compass, Dockyards, Civil Engineering, Signal, and Scientific Research.

V. Supply, viz: Victualling, Stores, Sea Transport.

VI. Finance, viz: Dockyards' Accounts, Contract and Purchase, Accountant General. (A. C. D.)

ADOR, GUSTAVE (1845–), Swiss statesman, was born at Geneva, Dec. 23 1845, of a Vaudois family established there in 1814. He studied law at the Academy and in 1868 became an advocate. In 1871 he started his political career as member of the communal council of Cologny and was elected mayor in 1878 and 1883. In 1878–9 he represented Geneva in the Swiss National Council and became a member of the executive of the canton of Geneva, being in charge of the Dept. of Justice and Police. He resigned, however, in 1880, after an unfavourable election, but returned to this post in 1885 and was president of the cantonal executive in 1892 and 1896. From 1889 to 1917 he was a member of the Swiss National Council, of which he was president in 1901.

Ador gained an international reputation for the hard and disinterested work he did for the International Red Cross. He had become president of the committee four years before the World War, and when it broke out he founded an association at Geneva for facilitating communications between prisoners of war and their families and for alleviating their condition. This other achievement included the establishment of the central agency for forwarding parcels and letters.

In June 1917, after the enforced resignation of Arthur Hoffmann, Ador became a member of the executive of the Swiss Federation with the portfolio of Foreign Affairs. Toward the end of 1918 he was elected President of the Swiss Federation; he retired at the end of his year of office. He headed the Swiss delegation which visited Paris and London in January–February 1920 to secure a reservation of the principle of the neutrality of Switzerland when she joined the League of Nations. He did important work for the league itself, first as president of the Brussels Conference of 1920 and then as president of the Economic and Financial Commission.

ADRIANOPLE or EDIRNEH (*see* 1.217), now again a Turkish city, has changed hands several times in the succession of military operations since 1912. The population in 1924 was given as only 56,347, as compared with about 80,000 in 1905 and 65,454 in 1911. This diminution is due to the emigration of the population, with the exception of the Jews, after the successive occupations of the city. The south-western portion of the city, burnt down in 1905, was rebuilt with comparatively broad streets. The railway station across the Maritza at Karagatch, which stands among ruins, is being rebuilt.

In 1912, during the first Balkan War, Adrianople was invested by the Bulgars and it was taken from the Turks, with Serbian assistance, in 1913, after a siege of 155 days. During the second Balkan War, in June of the latter year, the Turks retook the town and, by the Treaty of Constantinople, signed on Sept. 29 1913, it was ceded, together with Karagatch, to Turkey by Bulgaria. After the World War, the Greek Army, having been commissioned to restore order in Thrace in May 1920, entered Adrianople in July, and it was ceded to them, on Aug. 10 1920, by the Treaty of Sèvres. During the Greco-Turkish War of 1923 the Greeks occupied the suburb of Karagatch, the railway station of which is very important for the traffic to Dedeagatch and had therefore been abandoned by Turkey to Bulgaria in 1915. On leaving it they destroyed many buildings and removed the machinery from the mills. After the War Adrianople was again restored to Turkey by the Mudania Convention of Oct. 1922 and its restoration was confirmed by the Treaty of Lausanne of July 24 1923. A protocol attached to the treaty subjected the Greek inhabitants of Karagatch to the exchange of populations, and compelled them "to emigrate six months after the re-establishment of peace."

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ADRIATIC SEA (*see* 1.218), the arm of the Mediterranean lying between Italy and the Balkan Peninsula. Before the World War the Adriatic littoral belonged to four states—Italy, Austria-Hungary, Montenegro and Albania and in practice to the two first. The object of the Italian Govt. in negotiating the "secret" Treaty of London of April 26 1915, was to secure, in return for Italy's entrance into the War on the side of the Allies, the conversion of the Adriatic into an Italian lake—*il nostro mare.*

Article 4 of that treaty provided that "all Istria up to the Quarnero and comprising Volosca, just beyond Abbazia and the Istrian islands of Cherso, Lussin . . . and the adjoining islets" with Castua and Mattuglie, the station for Abbazia, should become Italian. Article 5 declared that Italy "shall equally receive the province of Dalmatia . . . comprising Lisarica and Tribanj in the north" to a line as far south as Cape Planca (Ploče), between Sebenico and Traù (Trogir), on the mainland, with "all the islands . . . from Premuda, Selve (Silba) and Pago in the north to Meleda in the south, comprising

Lissa, Lesina, Curzola, Lagosta (Lastovo) and Pelagosa, with the solitary exception of Great Zirona (Voli Drvenik) and Small Zirona (Mali Drvenik), Bua (Ciovo), Solta and Brazza." The whole coast from Cape Planca to the "southern root" of the peninsula of Sabbioncello and from a point 10 km. to the south of Ragusa Vecchia (Cavtat) to the river Viosa (north of Valona), except Montenegro, and all the non-Italian islands were to be neutralised. The rest of the Dalmatian coast, besides Fiume and the islands of Veglia and Arbe in the north, were to go to Croatia, Serbia and Montenegro, besides the Albanian roadstead of San Giovanni di Medua (the landing-place for Scutari); but Durazzo was to be Albanian.

Article 6 further conferred upon Italy "the entire sovereignty over Valona, the island of Saseno and a territory sufficiently extended to assure the defence of those points (from the Viosa . . . approximately to the northern frontier of the district of Chimara). Article 7 neutralised the coast south of the above as far as Cape Stylos opposite Corfu. This treaty violated every principle of nationality; it assigned to Italy provinces overwhelmingly Slav (for the Italian population of Dalmatia was only 3·5%), it dismembered Albania and would have created a new Irredentism far more powerful than that which Italy had fought to cure. The entrance of the United States into the War made the treaty a dead letter, although Baron Sonnino, then Italian Minister of Foreign Affairs, still clung to it, for President Wilson refused to be bound by it, and even some Italians, notably Bissolati and Prof. Salvenum, disapproved of it.

Thus began the wearisome "Adriatic question," which at times threatened war between Italy and the Yugoslavs, and attempts were made by British publicists, notably Messrs. Steed and Seton-Watson, to bring about an agreement, the "Pact of Rome," between the two races. The departure of Sig. Orlando, then the Italian Premier, and Baron Sonnino from the Paris Conference was due to this question, which was not regulated till the Treaty of Rapallo between the Italians and the Yugoslavs on Nov. 12 1920, largely the work of Sig. Giolitti and Count Sforza, who had meanwhile become Premier and Minister of Foreign Affairs. In Dalmatia, Italy obtained only Zara—the one overwhelmingly Italian town—with an enclave which included the Albanian settlement of Borgo Erizzo and the island of Lagosta. Italy kept the whole of Istria (despite its large Slav minority) with the islands of Cherso and Lussin and that of Pelagosa. "All the other islands which belonged to the former Austro-Hungarian Monarchy" were "recognised as forming part of the Kingdom of the Serbs, Croats and Slovenes."

By article 4, both States recognised the full liberty and independence of the State of Fiume (*q.v.*), consisting of the *corpus separatum* (the city) and a corridor south of Castua (which became Yugoslav) connecting it with Volosca and Abbazia. Sig. Giolitti evacuated Albania, where Italy retains only the island of Saseno. Sig. Mussolini observed the Rapallo Treaty and settled the question of Fiume, though his wilder followers have proclaimed their intention of annexing Dalmatia.

Zara's Italian patriotism has cost her dear. In Austrian days the capital of Dalmatia and the seat of the local Diet, where numerous officials resided, she is now a small provincial town, the population of which is dwindling, with only one industry—the manufacture of Maraschino—with no railway communication, and much in the same isolated position of Calais or Boulogne when they were English.

Yugoslavia has already the nucleus of a navy in the Adriatic, which is described at Belgrade, no less than in Rome, as "our sea," and the Dalmatian Slavs are famous seamen. Still, the keys of the mouth of the Adriatic, Brindisi and Saseno are in Italian hands. But Saseno is waterless and dominated by the Acroceraunian Mountains.

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ADULT EDUCATION.—Since 1910 adult education has, especially in England, acquired a new meaning. The phrase originally meant education of adults who have not been properly educated as children. As the educational system improved, the need for such education diminished, but as democratic government developed, it brought with it the need, felt by everyone, for education in citizenship. Adult education in this sense has been described as "an inseparable aspect of citizenship" and the new movement which dates from the beginning of this century, has extended to democratic countries all over the world, including such countries as Germany and the United States, which, because they had early possessed a comprehensive system of elementary and secondary education, have not felt the need for adult education in its original sense.

Variety of Type.—The new movement has taken many forms and is carried on by many different organisations. These are divided between such as definitely adhere to a particular school of thought or political party and those, of which the Workers' Educational Assn. in Britain and the Danish People's High Schools are conspicuous examples, which aim at giving an education which is not subservient to any political programme. The latter aim sharply distinguishes education from propaganda. There is a great variation also in the extent to which these various organisations use the help of the public educational system of the country.

Workers' Educational Association.—Behind the difference of aim, however, there is very substantial identity in the problems and methods of recent adult education, and a short account of the new movement, inaugurated in England by the foundation of the Workers' Educational Assn. by Mr. Albert Mansbridge in 1903, will bring these out. That association aimed at bringing together working-class organisations to provide for an education, designed not to take men out of their class or trade, but to equip them, whatever their occupation in life should be, for the work of citizenship. It was to be a highway and not a ladder. The education it desired to bring into being was to be broad, impartial and scholarly, was to aim at a higher university standard and was to enlist the aid of the universities and of public authorities.

The association from the first insisted that the distinctive feature of adult education is that it must be controlled by the students, as the education of the young cannot be. The universities were asked to help in maintaining the standard of education, but the choice of subjects and of tutors were to be with the students. It was recognised from the first that adult students bring an experience of life and an understanding of practical problems which are, in their way, as important a contribution as the more theoretical knowledge of the teachers, and that therefore adult education requires a technique and organisation of its own in which both students and university trained teachers have their part to play.

Tutorial Classes.—In 1907 the University of Oxford organised the first tutorial class, the characteristic educational instrument of the new movement. These classes were small, between 20 and 30 persons, meeting once a week in the winter over a period of three years. Each class consisted of an hour's lecture and an hour's discussion, the students undertaking from the start to attend for the full period of three years and to do written work. The classes were under the control of a joint committee consisting of equal numbers of representatives of the university and of working class organisations. The quality of work done in these classes was often of a good university honours standard. All the other universities of England and Wales followed, and in 1925 there were over 500 tutorial classes with 12,000 students.

The total amount of education of this kind now given in democratic countries is very considerable and is rapidly increasing. The movement is still young and its future organisation is still uncertain. Its great strength in the past was that it has been run by voluntary associations and has in a real sense been a university controlled in the main by its students. It suffers, however, from the weakness of administration and the fluctuating enthusiasm characteristic of all voluntary organisations. Its success in the future will depend on how far it can be connected more closely with public educational institutions on the one hand and organised labour on the other, without losing its voluntary character.

See *Final Report* of the Adult Education Committee (Cmd. 321, 1919). (A. D. L.)

United States.—The term adult education has been used in the United States since about 1916, although there is a lack of agreement as to what the term should include. Some think of it as work for illiterates, or for immigrants; others employ it to mean the making up of deficiency in the earlier education of mature men and women; still others use it in the broader sense of the means by which adult men and women shall be released from the thrall of custom and tradition and prepared for intelligent participation in the current of the world's life.

This vagueness of meaning reflects the various origins of the movement, which include the lyceums, workmen's institutes and "literary societies" of the previous century; the "Chautauqua Movement," dating from 1873; social settlements in cities, dating from about 1890; university extension, which has carried college classes into every corner of the land; people's institutes; open forums, church forums and summer forums for educational purposes; women's clubs and parents' congresses; young people's organisations, of many sorts; "moonlight schools" for illiterate Kentucky mountaineers, who after the work of the day, gather in groups on moonlight nights to learn to read; "Americanisation work," promoted by many types of agency since the World War; and the growing efforts of public libraries to diffuse knowledge and promote intelligence. Mention should be made also of evening schools and other forms of educational extension, in which nearly a million and a half young people between the ages of 14 and 25 were enrolled in 1926. Most of this work points definitely to vocational interests and uses. "Correspondence schools" have an enrolment of some 2,500,000 students, with about 1,500,000 new enrolments each year. Not more than 10% of these students, however, finish the courses for which they register and pay. Since 1918, the term "workers' education" has come into use, workers' universities having been established in many cities from Boston to Seattle; a Workers' Education Bureau was established in New York City to promote the movement. In aim it wavers between the objectives of producing *better workers* and *better human beings*—a defect common to most American educational thinking.

The first important step toward the co-ordination of the various movements for adult education in the United States was taken under the initiative of the Carnegie Corp., in Oct. 1925, when an American Assn. for Adult Education was organised, at Cleveland, Ohio. The purpose of this national association is stated, in part, as follows: "To promote the development and improvement of adult education in the United States and to co-operate with similar associations in all parts of the world." At its first meeting it took steps to make available information regarding the various types of adult education, arranging also for future regional conferences and for a national conference on adult education to be held annually. (J. K. H.)

ADULTERATION: *see* FOOD, PURE.

ADVERTISING (*see* 1.235).—Advertising as we know it is a development substantially of 75 years, beginning about the middle of the 19th century. However, advertising has existed in one form or another as far back as there has been any method of recording ideas by means of visual symbols.

I. A HISTORICAL SKETCH

Speaking broadly, the development of advertising may be traced through four stages of growth: (1) Pre-printing period prior to 1450. (2) Early printing period from 1450 to about 1850. (3) Modern period of expansion from 1850 to 1911. (4) The period of development of standards of practice and the introduction of research methods from 1911 to the present.

Pre-Printing Stage.—Some form of advertising has probably existed since the time when men lived in communities and competed with one another for the necessities of life. Advertising on a large scale was of course impossible without a convenient, rapid method of reproducing visual symbols such as was made possible by the invention of the printing press. Prior to that time there were forms of handwritten and inscribed announcements corresponding to advertisements. There were inscriptions on walls and announcements on sheets of papyrus. Perhaps the oldest known advertisement of this type is in the British Museum, and was written on a sheet of papyrus found in the ruins of ancient Thebes, in Egypt. This announcement offered a reward for a runaway slave. It was written possibly about 5000 B.C.

In Rome, during the time of the Caesars, there were similar bulletins written by slaves and displayed on the boards erected for that purpose about the city. In both Greece and Rome advertisements of gladiatorial exhibitions were posted, giving an appearance probably not unlike that of a modern town when it is filled with circus posters. There was an early interest in the development of trade-marks but only in a very limited manner. These trade-marks were put on vases, pieces of crockery and the like. One form of attracting attention, in some respects a forerunner of advertising, was that employed by the Carthaginians, who, when they arrived with a cargo of goods on the Phoenician shores, built a fire to attract the attention of the inhabitants, who then gathered to examine and purchase the goods.

At first the merchant cried his wares on the streets, carrying them with him as he did so. Later, when shops were established, the professional town-crier appeared on the scene. There were during the pre-printing period many town-criers in the various larger cities of Europe. While their method of announcing or selling was oral, it was nevertheless a forerunner of present-day advertising in the sense of mass selling. It is stated that in 1641 there were 400 town-criers in Paris.

The Early Printing Stage.—The second stage arose when modern methods of printing were invented. This made possible the rapid and unlimited duplication of writing by means of print which is the necessary medium of advertising. With this development there came about the publication of newspapers and periodicals corresponding to our modern magazines. It is said that the first newspaper was published in Strasbourg in 1609. In America, the first newspaper was entitled *Publick Occurrences both Foreign and Domestick*, published in Boston in 1690. This was succeeded in 1704 by *The Boston News Letter*, a weekly publication. The first issue of *The Boston News Letter*, published April 26 1704, contained advertisements. It was 40 years before this publication reached a circulation of 300 copies per issue. The early history of advertising, together with numerous sample advertisements of this early period, is well presented in Sampson's *History of Advertising*.

The Modern Period.—This period may be dated from 1850 to 1911. The reason for putting the dividing point between the second and third periods at 1850 is the rapid appearance of newspapers and magazines, which made possible the development of modern advertising on a large scale. Advertising was impossible until printing developed and until people generally learned to read. One reason for the rapid increase in the number and distribution of advertising media at this time is probably to be found in the development of transportation systems—railways and waterways. Prior to that time railway lines were limited to restricted areas. There was no national transportation system. To illustrate the difficulties of transportation before that time, and even up to 1870 or 1875, we may quote the following announcement of the Kenosha (Wisconsin) *Telegraph* in Rowell's Directory in 1869:—

> The town is renowned for the manufacture of wagons, which find a market all the way to the Rocky Mountains, and even to Oregon, being shipped by way of New York.

This shows how difficult it was to distribute goods generally over the country. It is obvious, then, that without the possibility of transporting goods there was no need of advertising media of wide circulation, and furthermore media could not develop a wide circulation because they could not be distributed conveniently or rapidly. During the middle and latter part of the 19th century the development of a national transportation system made possible the ready distribution of goods and publications. Another reason for placing the dividing point between the second and third periods at 1850 is that about this time advertising agencies arose whose primary purpose was to serve as brokers of advertising space. They were rather different in this respect from the present advertising agency, which, in

addition to contracting for space, is, in its best form, an organisation giving expert counsel and service regarding marketing and advertising plans and methods.

During this period the number of magazines and newspapers grew very rapidly, so that in 1861 there were 5,203 magazines, papers and periodicals of all kinds in the United States. Yet advertising was relatively limited as compared with the present day. *Harper's Magazine* had its first advertisement in 1864; *Scribner's* in 1872. Magazine advertising on a large scale did not begin until about 1860 to 1870. It was stated in 1926 that *Harper's Magazine* had approximately as many pages of advertising in one year as it had in its first 24 years. At first it was used chiefly as a medium for advertising the Harper publications. Advertising rates at that time began to assume real proportions. *Harper's Weekly* was receiving $35 an inch for its back page in the 'sixties.

The first advertising agency was established in Philadelphia in 1840 by Volney B. Palmer. Later, offices were established in Boston and New York. Rates and contracts were unstandardised at that time. The agent contracted for a certain amount of space with a publication and then sold it for whatever he could, receiving sometimes as high as 50% of the cost of the space as his commission. Among the better known early advertising agents were V. B. Palmer, S. M. Pettingill and George P. Rowell. In 1926 the United States had about 1,200 advertising agencies. Some 140, including most of the larger ones, were members of the American Association of Advertising Agencies.

Development of Higher Standards and Practices.—The fourth period in the development of advertising may be said to have begun in 1911. Since that time advertising has developed most rapidly as a standardised business. The date 1911 is chosen because it was in that year that definite organised steps were taken to forward the movement of truth in advertising. In 1911 counsel for *Printers' Ink*, a leading advertising journal in the United States, formulated what has become known as "The Printers' Ink Model Statute," which has been adopted in a large number of states. This statute makes dishonest advertising a misdemeanour.

It (*a*) places the responsibility for deception upon the advertiser, (*b*) deals with questions of facts about goods rather than opinions and (*c*) designates the making of untruthful, deceptive or misleading statements a misdemeanour. Up to Nov. 1921 this statute had been adopted in 22 states in substantially the form in which it was originally prepared by counsel for *Printers' Ink*, and in 15 states in modified form.

In these 15 states the modification which was made in the statute consisted for the most part of the insertion of the words "knowingly" or "with fraudulent intent." It is obvious that this change very considerably weakens the forcefulness of the statute. Nevertheless, the adoption of this statute has been a powerful force in bringing deception, misrepresentation and dishonesty in advertising under legal control. The Associated Advertising Clubs of the World, the national and local advertising clubs and other organisations have been active in pushing the adoption of this or similar legislation, which has been a powerful influence toward the remedying of objectionable practices. In addition to state legislation a number of larger cities have ordinances intended to check certain undesirable advertising practices.

About 1912, the Associated Advertising Clubs of the World at their annual convention adopted the motto "truth in advertising," and established a National Vigilance Committee, now called the National Better Business Commission, with the purpose of forwarding higher standards of honesty and reliability in advertising. This committee organised, in connection with the various local clubs throughout the United States, local vigilance committees or Better Business Commissions to eliminate objectionable, untruthful advertising. The purpose of these commissions has been to carry on locally in each city active efforts, similar to those of the National Commission, toward the elimination of dishonest and objectionable advertising and related business methods. Up to 1925, such commissions had been established in over 40 cities, including Boston, St. Louis, Cleveland, Indianapolis, Kansas City, Des Moines, Minneapolis, St. Paul, Spokane, Portland, Ore., and New York City.

About this same time the Associated Advertising Clubs of the World undertook definite educational activity in outlining courses of study and discussions to be conducted by the various local clubs, for the purpose of studying advertising methods and of improving them. A distinct service has been rendered in this connection by the several educational activities of the different local organisations. Colleges and universities began to give serious attention to the study of advertising by establishing well-defined courses of instruction.

Facts About Circulations.—In 1914 there was organised the Audit Bureau of Circulations. This has become the leading agency for securing reliable information about the circulation and distribution of publications. The work of this bureau came about as the result of several organisations which were interested in the endeavour to develop a generally acceptable means of obtaining reliable, standardised statements of circulation. It was felt that the time was ripe for devising such means, and that the advertiser had a right to know what he was buying when he bought space in publications. It was desirable to know not only the total circulation but also something about the various aspects of this circulation, facts which are as important as the statement of the total amount of the circulation.

About 1870 the only facts generally available regarding circulation were the statements in George P. Rowell's *Directory;* and after that time the Ayer *Directory* was the chief source of information. In order to bring about a somewhat more reliable statement of circulations at that time, Mr. Rowell added a gold mark to the name of the publication if the publisher made an affidavit concerning his circulation. This was accompanied by an offer of $100 to anyone who could disprove the claim made. In general, the A B C reports attempt to answer three main questions: (*a*) How large is the circulation? (*b*) Where does it go? and (*c*) How was it obtained? The bureau operates by requiring from its publisher members a so-called publisher's statement every six months. The bureau itself makes an audited report once a year.

The Audit Bureau of Circulation became of great value to advertising, because it made available reliable statements of circulation covering many different phases. In case of error, either intentional or unintentional, the bureau established certain rules. In case of error, a publisher or advertiser member of the bureau could ask for a re-audit of any publication, if he so desired. If the re-audit proved that the publisher had misrepresented the facts the expense was to be borne by the publisher. This fact being then bulletined to the other members of the bureau, the publisher became subject to suspension and expulsion from the bureau. Up to Jan. 1926, 184 general magazines and periodicals were members of the bureau, 72 farm publications, 240 business publications and 925 newspapers. In addition to publications, 137 national advertisers, 120 local advertisers and 181 advertising agencies were members.

About 1913 there was organised in the United States the Association of National Advertisers, another important influence in the study and development of advertising practices. Likewise, during that period publishers developed a distinct consciousness of censorship of advertising. A considerable number of publishers took a definite stand with regard to the advertising which they would or would not accept. The announced or stated policy might not be fully lived up to in practice in all instances but the best evidence of actual progress made in this regard lies in a comparison of the present issues of leading magazines and newspapers with issues of the early years of the century. The improvement is marked. In addition to the elimination of objectionable and doubtful advertising, a considerable number of media went a step further by guaranteeing their advertising in the sense that they would either themselves make good on any misrepresentation or deception which appeared in connection with an advertisement, or would see that the advertiser in question made good. With most of the high-grade media a policy

of guaranteeing is substantially implied, and is almost unnecessary in view of the commendable care which is exercised in rejecting questionable commodities or irresponsible business houses.

In 1917 the American Association of Advertising Agencies was organised. It contributed materially toward the establishment of standards of practices and uniform methods of procedure. In 1925 it inaugurated a department of research for studying fundamental problems of advertising and marketing. Finally, and perhaps most important, an increasing use of research methods developed. At least here and there these methods appear to be thoroughgoing in finding the facts on which marketing and advertising plans may be based, scientific research and planning taking the place of guesswork.

II. DEVELOPMENTS SINCE 1850

Considering the last two periods together the chief developments, in addition to those mentioned, may be designated as follows:—

Growth in Quantity.—There has been a tremendous growth in the number of firms employing advertising in one form or another. In 1926 there were about 10,000 firms doing more or less national advertising. The report entitled *Leading Advertisers*, prepared each year by the Curtis Publishing Co., mentions 1,302 firms, which spent $10,000 in 1921 in 36 leading national magazines. In this list there were 50 firms which spent $264,500 or more in 36 leading national publications in 1921. There has been likewise an enormous growth in the number of media. In 1830, it is estimated that there were approximately 800 magazines and newspapers in the United States, of which some 50 were daily publications. Their combined annual circulation was estimated at about 60,000,000 copies, or a circulation of approximately 950,000 copies per issue. In 1830 the total population of the United States was 23,500,000.

In 1861 there were 5,203 papers and magazines for a population of approximately 30,000,000. In 1922 there were 22,353 magazines and newspapers in the United States for a population of about 106,000,000. In other words, there has been an increase of magazines and newspapers since 1861 of approximately 5 times, whereas the population during the same period of time has increased approximately 3½ times. Since 1830 the population has increased approximately 4½ times; the number of magazines and newspapers has increased almost 30 times. A more striking increase has taken place in the total combined circulation. The estimated combined circulation per issue of the magazines was (1925) approximately 50,000,000 copies, and the total combined circulation of the newspapers approximately 45,000,000. Thus since 1830 there has been a growth in total combined circulation of all magazines and newspapers from less than 1,000,000 to from 95,000,000 to 100,000,000 per issue. Besides the marked increase in the number of media and in the extent of their circulation, there has been an equally marked increase in the amount of advertising carried in a given issue of a publication. Two representative newspapers in the United States show an increase in advertising space of 5 times and 13 times respectively from 1850 to 1918.

During that period, also, there developed entirely new media of advertising, including street-car cards, posters, direct-mail, motion-picture and radio advertising. Street-car advertising did not come into general use until about 1890, when the change was made from horse-drawn cars to electric cars. The mail-order field developed rapidly. Not only did mail-order houses spring up in large numbers during the period, but also business firms of all kinds developed a very extensive use of direct-mail material in the form of circulars, catalogues, letters and so on. The large mail-order houses commonly sent out twice a year upwards of 4,000,000 large catalogues in addition to numerous smaller departmental catalogues issued. Figures obtained in 1920 estimated the total approximate amount spent in direct-mail advertising to be $300,000,000; in 1926 the amount was greater, probably much greater.

Advance in Quality.—During the periods under consideration there was a distinct improvement in the quality of advertising. Methods of printing, typography, colour printing, art work and the like, greatly improved. Besides the mechanical improvements there were likewise distinct advances in such essential qualities as accuracy of statement and descriptions, reliability and truthfulness.

Increase in Variety of Uses.—A widening of the scope of advertising developed rapidly. There was a marked increase in the variety of advertising used. Perhaps the dominating types of advertising which flourished originally—that is, about the middle and latter half of the 19th century—were patent-medicine advertising and circus bills and in general much unreliable, dishonest and objectionable advertising. As developed there is hardly a business or type of commodity for which the printed word is not used as a means of selling. Banks and financial institutions of high grade turned to advertising, finding it profitable to employ in a dependable manner the methods which had been found profitable by unreliable financial houses. Advertising suffered because of the objectionable features which were so prominent in its earlier development. For this reason, undoubtedly, high-grade financial houses and to some extent other types of business were slow to take advantage of the possibilities which it offered. High-grade financial houses have a distinct responsibility to the community in guiding the savings of the people into the right channels. The unsound and unethical solicitor of investments has taken advantage of the use of the printed word, and has misdirected untold amounts into unsafe channels. High-grade institutions feel that it is perhaps a duty to use all legitimate sales methods equally effectively, thus guiding the investments of the community into proper channels.

Public service institutions use advertising to place themselves before the public in the proper light, to secure the co-operation of the community and to offer their securities to customers and to others. What is termed institutional or good-will advertising is widely used, not only by banking or similar institutions, but by large firms of all kinds, retail stores and manufacturers. Causes of one kind or another—local, national and international—use advertising to secure publicity and to gain adherents. Churches, charitable institutions, schools, educational endowments, public health bureaux, political parties, candidates and even governments find advertising a suitable and dignified means of publicity. In industrial disputes, employers and employees alike use advertising as a means of influencing public opinion, securing sympathy and moral support.

Trade Marks.—The development of trade marks is likewise a conspicuous characteristic of the periods mentioned, particularly of the first quarter of the 20th century. A large proportion of the trade marks known throughout the United States and all over the world developed during this time. Of the somewhat more than 150,300 valid trade marks registered in the U.S. Patent Office up to 1922 practically none were used prior to 1870, and only a small handful go back to 1885 or 1890. The development of national and international business made trade marks virtually a necessity; and advertising became an important means, perhaps the chief means, of making them known to the public.

Volume of Advertising.—Advertising in 1926 played an important rôle in the operation of business. It assumed such large proportions that it is difficult to estimate its magnitude and to calculate its exact place in commercial affairs. We may gain some notion of its immense proportions from the amount of money expended and from the amount of space used each year for printed advertising in the United States. It has been estimated that in the neighbourhood of a billion dollars is spent annually for this purpose. Approximately $500,000 is spent annually for advertising any one of a score or more of well-known commodities, as high as $3,000,000 and $4,000,000 being spent in exceptional cases. Or we may gain a concrete idea of the immensity of advertising from the cost of space for single advertisements in some of the leading media. Thus, for example, a page in a well-known monthly magazine in a single issue may cost $350, and the back outside cover $800. A page in a well-

known weekly publication would run to $7,000, and the back outside cover $12,000. A page in the large metropolitan newspapers cost as high as $1,400 to $1,500. From still another angle the immensity of advertising is indicated by the fact that from two-thirds to three-fourths of the cost of maintaining a newspaper or a magazine comes from its advertising space.

The outsider naturally wonders whether advertising with such high rates for space can really be a profitable aid in selling; or whether it may not be an expensive luxury indulged in by large business concerns. The extent to which advertising plays a justifiable rôle in the distribution of goods is an important and intricate problem which must be dealt with in any important consideration of the subject.

III. ADVERTISING IN BUSINESS

There often occurs in the mind of the layman the thought: Is not advertising an economic waste? Two common opinions with regard to advertising, which are held by a considerable number of people, are that enormously large sums of money are expended for it, and that much of this expenditure must be an economic waste. Rumours are spread about that a page in this magazine or in that newspaper costs so many hundreds or thousands of dollars for a single issue. Or it is learned that the manufacturer of a certain breakfast food spends so many thousands or perhaps so many millions of dollars for advertising in one year. The inference at once is that the consumer must pay for it in the form of a considerably higher price than the breakfast food or the soap or the suit of clothing would otherwise cost. These impressions usually do not get at the fundamental functions which efficient advertising performs in the distribution of goods.

There are wastes in advertising, but there are wastes everywhere in production, in distribution, in personal selling. Economy in the distribution side of business has lagged behind, but distinct advances have been made. Probably the chief sources of waste in advertising are:—

(1) The lack of proper co-ordination between advertising and the other phases of a business—lack of co-ordination with distribution, personal sales, plans and production—advertising where there is no distribution, and the like.

(2) The use of inefficient methods—weak, unconvincing and ineffective appeals, poor presentation, ineffective technique, the use of too large space or too small space due to guessing instead of finding the facts on which to build and plan. It has been estimated that if every piece of advertising material were made 10% more effective it would mean a saving of $100,000,000 to the business interests of the United States.

(3) The use of advertising for commodities in circumstances in which returns are highly uncertain or for business ventures which are too hazardous.

(4) The excessive use of advertising in over-keen competition.

(5) The failure to make all advertising literally truthful and dependable. Even if 96% or 97% of advertising were in the main trustworthy and meritorious, the remaining 3% or 4% would weaken the effectiveness of the rest.

(6) The use of advertising for illegitimate business, highly speculative investments, financial frauds or for commodities of doubtful value or actually injurious to mankind.

Improvements are proceeding in all these directions. Fundamentally, these sources of waste are not peculiar to advertising, but due to the waste and inefficiency in business as a whole. The same sources of waste exist in oral selling—making plans on guesses instead of on facts, not being literally truthful and dependable in every instance, a lack of proper co-ordination with other phases of a business, the waste of time on the part of salesmen and excessive personal expenditure. Preliminary time studies show that the average salesman uses only about 15% to 50% of his working time in actual selling. Fundamentally these wastes in oral as well as in printed selling are not to be laid upon these two aspects of business, but are due to conditions in business as a whole, to mistaken judgment, to ignorance and moral weakness.

The Case against Advertising.—The actual total amount of money spent on advertising is large. The probable amount spent in the United States in one year is in the neighbourhood of one billion dollars. The question is, Who pays for it, and how much different would the price of commodities be if this expenditure were absolutely and entirely eliminated, and in what way would the methods of distribution and the cost of distribution be different? The critic assumes that this money is an economic waste and that prices are higher because of it.

A second argument is that advertising has considerably increased the demand for, and the purchase of, luxuries and semi-luxuries, such as cameras, beverages, automobiles, pianos, phonographs, vacuum cleaners and so on.

A third argument is that advertising has been responsible to a considerable extent for the increasing and widespread use of packages, cartons, wrappers and labels for a large variety of products. Advertising has been responsible to a very large extent for the development of standardised brands and trade-marked articles. These wrappers and containers cost money which supposedly is not a part of the price paid for commodities bought in bulk. The argument is that all of this expenditure is added to the price of the product.

Relative Cost.—It is found that the amount actually spent for advertising specific commodities differs widely from the amount which the average person thinks is spent for advertising specific products. Almost every person who makes a general statement that the prices of commodities are higher because of the advertising, or that the money expended for advertising is wasted, knows little about the actual facts of the relative amount of money expended for advertising a specific commodity. People quite generally have a greatly exaggerated notion of the amount of money spent for printed advertising. An investigation was made to determine the amount which people think is spent for advertising certain commodities. The results of the investigation showed that people generally over-estimate from four to five times the amount spent for advertising specific products. For example, the amount spent for advertising a package of breakfast food retailing at 15 cents was estimated by this representative group of persons as two cents, whereas the actual amount spent by the manufacturer of this food for advertising a single package was three-tenths of a cent, an over-estimation of about eight times. The average person believes that approximately five times as much money is expended for this purpose as is actually the case.

Averages of expenditures for advertising by a considerable number of firms in various lines of business show that actual figures are relatively small. Figures obtained by the Harvard Bureau of Business Research, and based on a considerable number of stores in each case, give the percentages of net sales expended for advertising for the years 1919 and 1920 in several lines of business. The accompanying table furnishes the percentages.

Percentages of Net Sales Expended for Advertising, 1919 and 1920, in Retail Stores

		Common Figure[1] %
	General stores	0·2
	Retail groceries	0·2
187	Retail drug stores (1919)	0·7
130	Retail shoe stores (1919)	1·3
397	Retail shoe stores (1920)	1·9
182	Retail jewellery stores (1920)	2·0
190	Retail jewellery stores (1921)	2·5
266	Department stores (1920)	2·0
301	Department stores (1921)	2·4

The average expenditure for advertising on the part of retailers is approximately 2% or less. Certain types of stores, in particular department stores, expend over that amount, and, on the other hand, a very considerable proportion of retailers spend under that amount. Figures supplied by reliable sources show that the amount spent by manufacturers for advertising is from 2% to 3%, and that therefore the expenditure for advertising as a whole is probably not over 4% to 5%. It is therefore evident that while the total expenditure for advertising runs into large figures, the relative expenditure in proportion to the cost of a commodity is small. In other words, if advertising played no part whatever in stimulating the sale of commodities, and if the

cost of advertising were therefore directly added to the price of a commodity to the consumer, the price of an article would be almost inappreciably higher than it now is. An article selling at $1.00 would have to be sold at $1.04 or $1.05 if advertising were purely a dead expenditure of money. Although the actual expenditure for advertising is relatively small—probably not over 4% to 5% in the aggregate—even this expenditure would be a serious waste if it produced no economic or social value. The 1% to 2% spent by retailers, or the 2% to 3% spent by manufacturers, would in many instances serve to make the difference between success and failure.

Effects of Advertisement.—In 1925 a National Distribution Conference was held in Washington under the auspices of the Chamber of Commerce of the United States. The report of the committee appointed to investigate "Market Analysis—Advertising and Advertising Mediums," gives some information with regard to the point just brought up. The investigation consisted of a survey of articles which had appeared in publications, giving specific data about the effects of advertising on costs and prices to the ultimate consumer; and in addition of a questionnaire which was sent out to a group of national advertisers, requesting specific data showing the effects of their advertising on their costs and prices. The results were tabulated and summarised in part as follows:—

From the data available it is hardly possible to make a non-disputative demonstration. Nevertheless, we believe that it can safely be said that the use of effective advertising by national distributors as a general rule produces one or more of the following results:—

(1) Decreases the cost of selling.
(2) Lowers the cost of production on account of increased volume.
(3) Lowers prices to the consumer and thereby raises the standard of living.
(4) As a by-product, aids in the education of the general public.

Data have been obtained from a number of national advertisers to show the effects advertising has had upon the cost of production and the cost of selling, and prices to the consumer. It is realised that changes in business conditions during the past few years and changes in distribution policies within the individual companies make it very difficult to eliminate the variable factors and to prove the effects of advertising. The data which have been collected, however, seemed to indicate conclusively that the first three results named above are brought about by advertising. . . .

In addition to the four results obtained by advertising which have been mentioned above, advertising often has the following beneficial effects for the manufacturer, dealer or consumer:—

(1) Advertising aids in stabilising production.
(2) Advertising aids in standardisation and quality.
(3) Advertising aids in the simplification of products. (Elimination of unnecessary items in the line.)
(4) Advertising helps to prevent fluctuation in prices.

Summary of Advantages.—A beneficial effect of advertising has been the reduction of seasonal fluctuation in the volume of business. In certain fields of business, the seasonable fluctuation, if not entirely eliminated, has been greatly reduced. The two seasons of buying men's clothing have been greatly extended, and the sale of toys, formerly largely confined to the holiday season, is more evenly distributed throughout the entire year. The same is true of fountain pens, millinery, arms and ammunition, oranges and lemons and other products. The result has been a reduction in the cost of doing business.

Advertising has aided materially in the standardisation of products and quality of goods. This has been brought about through the establishment of brand names and trade-marks, which have become associated with uniform quantities and qualities in the mind of the public, until the recollection of a brand name of any number of specific products calls up the picture of a certain definite quantity and a certain recognised standard of quality, which the public has been educated to receive when it calls for a product by a specific trade-name. Although the establishment of standard packages has probably added to the cost of commodities to some extent, it has had certain other advantages. It has facilitated retailing, requiring less time on the part of assistants in the preparation of products for delivery to the consumer, and it has secured a more hygienic handling of goods, particularly foods.

The noteworthy advances made in the general level of living, in public taste, in personal and domestic conveniences, in the general use of cultural agencies, must be attributed in part to the use of the printed word in the form of advertising. Such products as phonographs and radios and the development in musical taste generally, vacuum cleaners, better-fitting clothes, better-constructed and designed houses, better-painted houses, evidence the advance made in the level of living, due in a considerable measure to the insistent and continuous force of advertising. There is no doubt that we should very likely have most if not all of these improvements and conveniences without advertising, but probably not so many people would have had them so soon. Printed publicity has no doubt helped to educate people to want more and better things in food, clothing, housing, personal comfort and enjoyment.

The almost universal reading of magazines and newspapers has been made possible largely, if not solely, through advertising, since approximately three-fourths of the income of a periodical is derived from its advertising space. In this sense, the newspaper or magazine is practically a by-product of advertising. The trifling sum which is now charged for a newspaper or magazine—in comparison with the large sum which such magazine or newspaper would cost if it were not for the advertising which it carries—has made some form of reading matter available to even the poorest classes of persons. Advertising revenue has made possible the large-scale production of newspapers, magazines and periodicals of all kinds the social and educational value of which is beyond estimate.

It seems to have been found from experience that some products may be sold most economically primarily through personal salesmanship, that some products may be sold to certain classes of people most economically primarily through printed salesmanship, but that probably the great majority of products may be distributed most economically by varied proportions of personal and printed selling. So long as competition is believed to be a desirable factor in human welfare, just so long will competitive means be used. Critics of advertising perhaps may neglect the fact that if advertising were eliminated or abolished other competitive methods would necessarily be substituted for it. If the use of advertising were eliminated, it is quite likely that its place would be taken in most instances by some form of personal selling, with its accompanying expense. The fact that numerous firms which have consistently and continuously used printed salesmanship over a long period of years have survived from early periods of business activity may be taken as some indication that advertising has been found to be a fairly effective agency of business progress. (D. St.)

IV. BRITISH AND EUROPEAN ADVERTISING

The conditions under which advertising is conducted in Great Britain and other European countries differ in many directions from those prevalent in the United States. For this reason British practice diverges in certain important respects from American practice. Both advertising as such, and the newspaper, appeared slightly earlier in Great Britain than in the United States. The first advertisements published were handbills for the sale of goods, printed by Caxton late in the 15th century.

The first daily newspaper printed was *The London Gazette*, founded in 1665, which is still published. But Nathaniel Butter had produced his historic *Weekly Newes* in 1622. Probably the first trade advertisement to appear in a newspaper was one advertising tea, published in *Mercurius Politicus* in 1658. The great national newspaper, *The Times*, was first published in 1678 as *The Daily Universal Register*. Quite a number of existing provincial newspapers, including *The Nottingham Journal*, *The Bristol Times and Mirror*, and *The Hereford Journal*, were founded between 1710 and 1713.

Fifty years later, Dr. Johnson was complaining that advertisements were "so numerous that they are negligently perused: it is therefore becoming necessary to gain attention by magnificence of promises and by eloquence, sometimes sublime and sometimes pathetick." So early as 1712 a duty was placed on

advertising. For many decades it yielded the Exchequer little revenue. In the 19th century, however, it had become a valuable source of income. The tax amounted at first to 1/- on each advertisement. In 1815 it was raised to 3/6, and in 1833 it was reduced to 1/6. In June 1853, the advertisements carried in *The Times* averaged 1,500 each day; and in one day in June there were 2,250 inserted—the greatest number that had ever appeared in one paper. The duty on advertising was finally repealed in 1853.

Generally speaking, advertising did not make any great headway in Great Britain until about the year 1850. Modern advertising came into existence about 1890, while the organisation of advertising entered its national phase only in the year 1920. The introduction of research methods dates from about the same year. At every stage of development Great Britain has tended to follow 10 to 20 years behind America, while other European countries tend to lag behind British development and practice by an even wider margin. Between 1920 and 1926 British advertising entered on a period of intensified activity. In these years standards of practice were improved enormously. The national organisation of advertising was not merely initiated but developed with remarkable energy.

Expansion of British Advertising.—Some idea of the expansion of advertising in Great Britain may be gathered from a few figures based on extensive researches. There were in 1926, 2,150 individual newspapers published in Great Britain, and roughly 1,500 journals and magazines. Whereas in 1900 there were scarcely 100 advertising agencies existing in Great Britain, no fewer than 500 agencies were in active business in 1926. In the same year 340 national and regional bill-posting contractors were at work; 67 firms engaged in outdoor publicity of other types; 168 firms in sign writing and in window dressing; and almost 400 in the making of cartons and containers. There are over 50 commercial art studios in London and the provinces; 39 commercial photographers; and several hundred free-lance commercial artists. All these concerns and individuals give service to the advertiser. At the same time, seven concerns and individuals devote their energies to market research—a service which had scarcely been heard of in this country prior to 1920. Expansion has been no less remarkable in the colonies.

Influence of Conditions on Practice.—The divergence between American and British advertising methods may be seen clearly by considering a factor which influences marketing practice in every country, viz., transport. Transport finally determines the distribution of the various advertising media. In the United States the distribution and influence of the newspaper is purely local. In Great Britain the distribution of the London newspaper is national. This makes it possible for the advertiser to broadcast his message from one end of the country to another in 24 hours. Since distances in Great Britain are comparatively short, and since several of the great London newspapers print simultaneously in London and a northern city (Manchester or Leeds), complete national distribution of a paper printed on Monday evening is secured by Tuesday morning. Circulations and advertising rates must be correspondingly high.

Circulation.—The circulation of the best American daily newspapers was in 1926 roughly 200,000 to 600,000; the price of a page advertisement usually ranged from £200 to £300. In the same year the circulation of *The Daily Mail*, on the other hand, was over 1,700,000, and the price of the front page £1,400. *The Times* achieved the remarkable revenue of £5,000 per day. One popular Sunday newspaper actually exceeded all American circulations. *The News of the World* was bought weekly by over 3,000,000 readers, the page rate being normally £2,200. The magazines of Great Britain do not represent, therefore, as American magazines do, the sole means of securing national circulation, nor have they so large a population to tap. Yet the unique humorous journal *Punch* with a circulation of over 200,000 copies, carried over £8,000 worth of advertising every week. *Good Housekeeping*, a successful associate of the American journal of that name had an average monthly revenue of over £12,000, while its Christmas numbers carried over £18,000 in advertisements.

Mail Order Business.—Owing to the compactness of the country and the transport facilities available a second variation occurs. The British public is much less susceptible to mail-order advertising than the American. The spread of motor-bus services to the remotest hamlets may have had much to do with this. The shop window has been brought within reach of the secluded rural populations. The United States Post Office made it easy for the mail order advertiser by collecting the amount of the purchase through its postmen. On the other hand the mail order advertiser in Great Britain, had until 1926, to bear the expense of collection by post, as it was not until March of that year that cash on delivery was introduced. Further, facilities for securing lists of prospective buyers, graded as to income or trade, did not exist in English cities. It was impossible to buy what are known in America as lists of tested and guaranteed names. Nor did the postal authorities assist by charging low rates for the carrying of sales literature.

Scarcity of Statistics.—Two further factors tended to make all advertising in Great Britain or in other European countries more of a " hit or miss " business than in the United States. The first of these was the absence of statistical data on which to assess the market available for any goods either in terms of what competitors are doing or of the consuming public concerned. The British Board of Trade, in particular, reduced its statistical records to the barest minimum. The taking of a new census of production, which must be the basis of all sound market estimates, was delayed by the World War and had had its potential value considerably reduced by the disinclination of manufacturers to give certain essential facts concerning their output.

The United States Govt., on the other hand, made advertising more scientific by presenting to the advertiser the finest statistical material available in any country. When the report by the Bureau of Efficiency on the statistical work of the United States Govt. was completed in 1922 it ran to more than 400 pages. A condensed report, published later, gave no fewer than 700 subjects on which that government compiled statistics, with details as to where and how to secure the facts.

Unless statistics of production are made available annually or bi-annually; unless sales records are obtained from every considerable industry; unless exhaustive researches into the consumer habits are made in every area, it is not possible for the British advertiser to approach the scientific accuracy or the technical skill of the American. Finally, the British public, being homogeneous and speaking one tongue, is less accessible to the magic of the printed word. In other words, it is more sophisticated. Added to this sophistication is a keener buying sense, particularly on the part of women, due chiefly to the possession of a shorter purse.

The resulting influence of all these factors is remarkable. It must mean too often that an advertising campaign successful in America fails completely in Great Britain. A reconsideration of the marketing and advertising channels available is necessary, along with a modification of copy, illustrations and methods generally, if advertising is to achieve its purpose in Great Britain or in any other part of Europe.

Law.—Up to 1926 no act had been passed in Great Britain corresponding to the Printers' Ink model statute formed in 1911 by *Printers' Ink* and passed in a large number of American states. On the other hand, no such general statute seemed necessary, since many of the interests of the advertiser and of the reader of advertisements were already protected in English law by existing statutes; while a body of case law was being built up by test cases in the King's Bench and Chancery divisions of the High Court of Justice. The Indecent Advertisements Act (1889) made it a punishable offence to exhibit or deliver advertisements of an indecent nature. Later rulings confirmed the fact that, under the Advertising Station (Rating) Act (1899), ground used for advertising is rateable.

Legislation was certainly required to define the extent to which the statements in an advertisement may be binding on the advertiser. In an important case (Carlill *v.* the Carbolic Smoke

Ball Co.) a preventive against influenza was advertised, and the makers stated in print that if anybody using the carbolic smoke ball as directed caught influenza within a certain number of days they would pay him £100. The plaintiff used the remedy, and contracted influenza, winning the sum of £100 as the result of his suit. Under English law any statement of a specific fact as to the quality or nature of an article in an advertisement amounts to a warranty, the breach of which gives rise to a right of action. As evidence of this we may take the case of a gunsmith who advertised a gun of first-class quality capable of reasonable wear and tear for several years. When the gun was first used it burst and injured the plaintiff, who successfully brought an action against the vendor for fraud in inaccurately describing the gun.

The position of the advertiser under the Copyright Act (1911) was, in 1926, still the subject of litigation. Perhaps the most important ruling on the subject was that of Lord Romilly:—

Copyright exists in published books, periodicals, pamphlets, prints and designs. If you copy the advertisement of another you do him no wrong, unless in so doing you lead the public to believe that you sell the articles of the person, whose advertisements you copy. Wherever the letterpress bears the traces of original composition it is entitled to protection, but not where it simply describes the contents of a warehouse, the exertion of the proprietor or the common mode of using familiar articles.

In general it may be said that the plaintiff must prove damage in a British court of law in order to prove that a competitor has transgressed the law by imitating an advertisement or design.

Organisations.—The organisation of British advertising on a national scale was first actively undertaken in the year 1920. The stimulus to action probably lay in the great advertising exhibition held at the White City, London, in that year, which first brought all the advertising interests together for common action. Soon after the holding of this exhibition British advertising men began to attend the annual conventions of the Associated Advertising Clubs of the World in America. As the result of these visits, it was decided to hold the convention of 1924 in London. About this time most of the chief advertising bodies in Great Britain became members of District 14 of the Associated Advertising Clubs of the World.

In Jan. 1926, District 14 of the Associated Advertising Clubs of the World became the Advertising Association of Great Britain. This body had on its committees representatives from all the advertising interests in the country. Under its auspices annual advertising conventions are held. As a result of these conventions, an impulse has been given to every phase of advertising in Great Britain. In particular the club movement has grown up throughout the provincial cities. In 1926 there were over 20 advertising publicity clubs affiliated to the Advertising Association. These clubs decided to meet together frequently for discussion on technical subjects connected with advertising; they undertake arrangements for the local delegates attending the annual convention of the Advertising Association, and do much work of an educational character both within their own ranks and among the outside public.

Probably the advertising club movement in Great Britain is the most remarkable instance of craft interest shown by any industry or profession. The clubs included the Women's Advertising Club of London, whose membership was to be confined to women in executive positions. It is to the clubs that the success of the annual advertising conventions is largely due. In 1920 there came into being the Incorporated Society of British Advertisers. This body was designed to safeguard the interests of the advertiser, its general objects being to increase sales at reduced costs of selling; to make advertising a more profitable proposition; to make collective expression and action possible to advertisers.

The association corresponded exactly with the Association of National Advertisers of America. Following two conferences with representatives of the latter body, it was definitely decided in 1924 that the Incorporated Society of British Advertisers should make its organisation as nearly as possible, an exact counterpart of the Association of National Advertisers of America. The association represented directly nearly 300 national advertisers, and, through the affiliation of trade organisations, over 2,000 firms which advertise. The association had on file all procurable information regarding upwards of 6,000 publications of interest to national advertisers. It campaigned consistently for the institution in Great Britain of an audit bureau of circulation, but hitherto without immediate success.

Advertising Agencies.—Advertising agents were represented by the Association of British Advertising Agents, of which nearly all the leading agencies in Great Britain became members. It was registered as an Incorporated Company in 1917. The definition of an "advertising agent" laid down by the association is as follows: "Accredited advertising agents are independent persons, firms or companies of good repute and training, engaged solely in the advertising agency business and possessing the equipment and organisation necessary for the carrying on and development of advertising."

Advertising agents are usually remunerated by a commission on the appropriation, ranging up to 15% according to the size of the appropriation and the amount of work entailed. This commission is usually provided by the special agency commission allowed to recognised advertising agents by newspapers and periodicals. Important papers and groups of papers have lists of recognised agents, and do not allow advertising agents' commission to firms who have not first been placed on their list. The policy of the Association of British Advertising Agents was directed to encourage its members to improve the service which they were able to offer to their clients and to make the minimum agency remuneration 10%, below which figure the association did not consider it possible for an advertising agency to render adequate service to its clients.

The Scapa Society.—Possibly the most characteristically British movement associated with advertising was one to restrain its activities. This was the Scapa Society, formed in 1893 as "the society for checking the abuses of public advertising." The association was concerned with advertising only where the display injuriously affected the amenities of outdoor life. In 1907 the society secured the passage of the Advertisements Regulation Act, and in 1925 of a supplementary Act. The original Act authorised local authorities to make bylaws for the control of hoarding over 12 ft. high, and for the regulation or prohibition of advertisements affecting the amenities of a public park, pleasure promenade or landscape. The extended powers included some for the protection of the view of rural scenery from a railway or highway, the amenities of any village within the district of a rural district council, and those of any historic or public building or monument.

A remarkable evidence of a fine spirit on the part of the advertising profession was the way in which great advertisements were withdrawn by mutual agreement between the Scapa and those concerned. The association virtually abolished the sky sign. In 1923 three great oil and tyre concerns removed their roadside advertisements in deference to the desires of Scapa. The fraudulent advertiser is dealt with by a National Vigilance Committee, under the auspices of the Advertising Association.

(C. Ch.*)

ADY, ENDRE (1877–1919), Hungarian poet, was born Nov. 21 1877 at Ermindszent, Transylvania. He was a leader of the modern school and one of the greatest lyrical poets of Hungary. During his youth he lived in the country and became intimate with the publicists and politicians of the Radical and Socialist parties. When he settled down in Budapest, he turned his attention toward revolutionary politics and contributed to several Radical papers. He also made prolonged visits to Paris and the Riviera but returned finally to Hungary owing to ill-health, and lived there quietly until his death on Jan. 27 1919. During the World War he adopted a pacificist attitude and prophesied the Karolyi revolution of 1918. During his lifetime he published about 20 books, poems, novels and essays, but this number was increased year by year by the publication of posthumous works.

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AE: *see* RUSSELL, G. W.

AEHRENTHAL, ALOYS LEXA VON, COUNT (1854–1912), Austro-Hungarian statesman, was born Sept. 27 1854 at Gross-Skal, Bohemia. In 1899 he became ambassador in St. Petersburg, where he remained until his appointment as Foreign Minister in October 1906. Determined to preserve the interests of Austria-Hungary in the Balkans, he also showed himself willing to meet the Russian wishes on the Dardanelles question. After the outbreak of the Young Turk revolution in 1908, he negotiated, in accordance with his previously conceived policy, with Isvolski, an agreement for the annexation of Bosnia and Hercegovina to Austria-Hungary and for the opening of the Dardanelles to Russian warships.

Isvolski's proposals were, however, wrecked by the opposition of Great Britain, and he protested against the annexation of Bosnia and Hercegovina; Aehrenthal, therefore, abandoned the idea of a friendly accommodation with the Russian Government. He held, however, with tenacious energy to his purpose with the result that the annexation was acknowledged by the Powers; an agreement was reached with Turkey; Serbia, after long hesitation, was obliged to submit. For this achievement Aehrenthal was rewarded by the rank of Count (Aug. 18 1909). He held fast by the Triple Alliance, as the surest bulwark of peace, and sought to form the most intimate relations with the German Empire although he insisted on the independence of the Habsburg Monarchy and energetically repulsed all efforts on the part of the German chancellery to set limits to that independence.

One of his most difficult tasks was to adjust the ever-recurring conflicts with Italy, who, while officially supporting the political action of the Triple Alliance, often embarked on courses directly opposed to the interests of Austria-Hungary. A succession of agreements which he concluded with the Italian Foreign Minister, Tittoni, justified his efforts, and enabled him to maintain correct relations with the Italian Government. Yet, by the maintenance of his peace policy, which had the full approval of Francis Joseph, he came into serious conflict with the party led by the chief of the general staff, Conrad von Hötzendorf, which championed an energetic, warlike policy. The battle, carried on with tenacious endurance on both sides, ended in 1911 with the victory of Aehrenthal and the resignation of Hötzendorf. Aehrenthal died Feb. 17 1912 in Vienna.

See B. Molden, *Alois, Graf Aehrenthal: Sechs Jahre auswärtiger Politik Oesterreich-Ungarns* (1917); The article "Aehrenthal" in the *Deutsche Nekrologer* (vol. 18, 1917, pp. 230 *et seq.*); A. F. Pribram, "Der Konflikt Conrad–Aehrenthal" *Oesterreichische Rundschau* (August 1920). (A. F. PR.)

AERIAL LAW.—Aerial law must be considered under its two headings, international (subdivided into peace and war) and national The international law of the air in peace is to be found in the (multilateral) Air Navigation Convention of Oct. 13 1919, and in the (bilateral) agreements which certain states have concluded as between themselves. The international law for war is not the subject of any general convention; the few references to air warfare in the conventions and declarations of The Hague of 1899 and 1907 are now obsolete. The national or municipal law of the air is to be found in the statutes, decrees and regulations of the various states.

The Convention of 1919.—The Air Navigation Convention, 1919, the present parties to which are the British Empire, Belgium, Bulgaria, Czechoslovakia, France, Greece, Italy, Japan, Persia, Poland, Portugal, Rumania, the Serb-Croat-Slovene State, Siam and Uruguay, begins by affirming the sovereignty of each state over the air above its territory. This principle affirmed, the convention goes on to provide for freedom of innocent air passage over the territory of the contracting states for each party to the convention, provided the conditions laid down in it are observed. Such freedom of passage does not apply to "prohibited areas" which states may desire for military reasons to close to all private aircraft, including those in their own territory.

The "nationality" of an aircraft is made to depend upon the country in which it is registered; to be registered in a particular state the aircraft must belong to a national of that state or to a company of which the chairman and two-thirds of the directors possess that nationality. Double registration is prohibited. Every aircraft engaged in international navigation must possess a certificate of airworthiness issued or rendered valid by its state of nationality, and the pilot and other members of the crew must be provided with certificates of competency and licences similarly issued or validated. The documents (certificates, licences, log-books, passenger lists, manifests) which aircraft must be provided with are laid down.

Foreign aircraft may be required to land at aerodromes fixed by the state whose territory they enter; and each state has the right to reserve in favour of its national aircraft the carriage of persons and goods for hire between any two points in its territory. Provision is made for the rendering of assistance to aircraft in landing or in distress, for the application, to aircraft wrecked at sea, of the principles of the maritime law of salvage, for the use of aerodromes at a common tariff of charges, and for certain other matters. The convention is not applicable to military aircraft nor to state non-military aircraft employed on customs and police service; other state aircraft, *e.g.*, postal, are subject to its provisions. A military aircraft is defined as one commanded by a person in military service detailed for the purpose, and such an aircraft may fly over another contracting state's territory only in virtue of a special authorisation.

Rules in regard to the marking of aircraft (to show nationality and identity), certificates of airworthiness, log-books, lights and signals, "rules of the road," licensing of personnel, aeronautical maps and ground markings, the collection and dissemination of meteorological information, and customs procedure, are contained in annexes to the convention.

International Commission.—A permanent International Commission for Air Navigation, composed of representatives of the contracting states, is established and charged with certain powers, including the amendment of the annexes, the receipt or initiation of proposals to amend the convention itself and the inter-communication of information affecting air navigation, etc. The office of the secretary-general of the commission is at 20, Avenue Kléber, Paris. The convention may be denounced by one year's notice. States which did not take part in the World War may adhere to it at any time; those which took part in the War may adhere under certain specified conditions.

Other Arrangements.—A number of important Powers, it will be seen, are not as yet parties to the convention, and international air traffic is regulated, so far as they are concerned, by a series of special agreements between themselves and with other states. The terms of these agreements are in general conformity with those of the convention. The obstacle to a more general acceptance of the convention has been, first, the provision therein forbidding contracting states to permit, except by special and temporary authorisation, the flight above their territory of the aircraft of non-contracting states; secondly, the "weighted" vote which was allowed to the British Empire, France, Italy and Japan. Protocols of amendment of both these provisions have been signed but, not having been ratified by all the parties, are not yet in force.

The convention of 1919 does not bind the contracting parties as belligerents or neutrals (though it would continue to apply in war as between two neutrals), and an attempt to frame a corresponding code for war was made at The Hague in 1923. A commission of jurists, representing the United States, Great Britain, France, Italy, Japan and The Netherlands, under the chairmanship of Judge Bassett Moore, drew up rules which, though they have not been embodied in a convention, are a valuable indication of international opinion, as it stood in 1926, upon the law of air warfare.

The municipal legislation which has been passed to regulate internal flying and to give effect to the international obligations of each country under the convention of 1919, or the separate bipartite agreements, is contained in laws, decrees, ordinances and regulations of many different kinds. It is of great volume and any full survey of it would be impossible here. An indication of

its general scope and one or two of its more important features is all that can be attempted.

National or Municipal Legislation.—One usually finds in such legislation (*lato sensu*) provisions for ensuring the safety of air navigation as affecting both air travellers and the general public; provisions, that is to say, for registration and certification of aircraft, licensing of personnel, inspections and tests precedent to such certification and licensing, maintenance and overhaul and renewal of certificates and licences, inspection, licensing and use of aerodromes, carriage of explosives and arms, dropping of articles in flight, jettison of cargo, minimum height of flight over populated areas, investigation of accidents and so on. For defence reasons " prohibited areas " are usually defined, and in many cases corridors of entry for foreign aircraft are prescribed, as well as the general conditions in which such entry is allowed; and the carriage of radio apparatus and cameras is usually restricted. Conditions for the grant of concessions for the operation of commercial air lines and the establishment of international airways are occasionally included. Penalties (fine, imprisonment, suspension of licence) for the infringement of the rules are invariably laid down.

Liability for Damage.—The important question of liability for damage occasioned by aircraft to persons or property on the ground is legislated for in many of the codes. In the absence of special provision the liability of the owner or pilot would be dependent ordinarily on proof of actual negligence or intention. Proof would often be very difficult to obtain and hence it has generally been considered equitable to impose upon the owner or pilot an absolute liability to pay compensation for all such damage, save in so far as he can show that the person damnified was himself to blame. It is also sometimes provided that the owner of an aircraft, or the organisers of an air navigation company must cover themselves by insurance against possible claims for compensation or else must deposit security that will be sufficient to cover their liability.

Occasionally it is provided that legal relations between parties on board a foreign aircraft in the air are governed by the law of the aircraft's nationality, *i.e.*, the country in which it is registered. The French law qualifies such a provision by adding that a crime or misdemeanour committed on board a foreign aircraft is within the competence of the French courts, if the guilty party is a French national, or if the aircraft lands in France after the occurrence of the offence. (J. M. Sp.)

Conference of 1925.—The International Commission for Air Navigation, like other specialised organisations of the League of Nations in their several spheres, by its debates and by its labours will be able to give form to the new principles of air traffic regulation and to evolve the international aerial law of the future, ll the more surely when all the states concerned participate in this work.

In Oct. 1925, after only a few years actual experience of international air traffic, at a conference in Paris of the European and certain other governments, a draft convention was framed regarding the responsibility of carriers by air which is the counterpart, so far as concerns air traffic, to the Berne Convention of 1890 on transport by rail. An international committee of experts is to continue the work of this first conference, and to study a series of questions, connected with unification of private law, of the very greatest practical importance for the development of air traffic, such as damage caused by aircraft to property and persons on the ground, compulsory insurance, establishment of air registers, rights of property and ownership, mortgages in respect of traffic by air, etc. Air law is already grappling with the practical problems which arise owing to the advance of technical science and commercial organisation.

There are in existence permanent international bodies to co-ordinate the efforts of the governments concerned and at the same time to keep in touch with the requirements of those engaged in the traffic. A system of law will thus develop progressively by the solution of individual questions, perhaps, without being guided by preconceived principles. The true principles will be embodied in specific regulations which, many years hence, when air traffic has acquired a stable economic régime, will appear as the fruit of long and patient international co-operation in air matters—a co-operation as yet in its infancy. (R. Ha.)

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AERIAL NAVIGATION.—The practical development of the art of flying has reached the stage at which flights of several hundred miles, without landing, are of frequent occurrence. The Trans-Atlantic crossing made in 1919 with a Vickers-Vimy aeroplane, involved, in fact, a non-stop flight of 1,900 m. entirely over sea. In order that such long-distance flights may be made practically independent of meteorological conditions and devoid of the fortuitous element associated with pioneer effort, it has been considered important to enquire how far the existing methods and instruments used for maritime navigation may be applied to navigation in the air, and, where necessary, to devise new methods and instruments for aeronautical purposes.

The most elementary method of navigation is the recognition, either from maps or from previous experience, of the country over which the aircraft is flying; for this purpose, maps have been made which give prominence to railways, rivers and other objects conspicuous from aircraft. Maps are naturally of no assistance when the craft is flying over sea, desert or uncharted country; moreover, their use necessitates visibility of the ground over at least a considerable proportion of the air route.

Dead Reckoning Navigation.—The basic method of navigating an aircraft is known as dead reckoning (D.R.); other methods, such as the use of wireless beacons or the determination of the altitude of heavenly bodies, serve only to check the D.R. position. Dead reckoning necessitates that a record shall be kept of the speed of the aircraft over the ground and the " track," the latter being the actual direction along which the aircraft is passing over the ground. These values may be obtained from a knowledge of (*a*) the speed and direction of the wind, derived either by observation from the aircraft or from meteorological reports; (*b*) the true speed through the air, obtained by correcting the air-speed indicator for height; and (*c*) the compass course.

If a vector triangle be drawn such that one side represents (*a*) above, and another side represents (*b*) and (*c*), then the length of the third side represents the ground speed and its direction represents the track of the aircraft over the ground. Sometimes the third side of the triangle is found by taking observations of the ground, without first determining the wind speed and direction, but the latter values are always recorded, since, if they remain constant, the ground speed and the track may be found for any values of the air speed and compass course, without making further observations of ground objects. The ground speed may be determined by noting the time taken for a ground object, viewed through a " sight " set at the appropriate position on a vertical bar calibrated in terms of height, to appear to traverse the distance between two timing beads fixed on a horizontal wire which is set along the track of the aircraft. The distance between the two timing beads is made to represent a certain distance on the ground (usually ½ m.) over which the aircraft passes in the observed time.

The angle between the fore and aft line of the aircraft and the track is called the drift angle; it may be determined by observing the direction in which an object on the ground appears to move with reference to the fore and aft axis of the aircraft. If the aircraft were flying directly up or down wind, the drift angle

would be zero. The true air speed being known, the wind speed and direction may be found, without timing a ground object, by observing the drift angle on two different compass courses, preferably separated by a fairly large angle.

Graphical construction cannot conveniently be employed in the limited accommodation afforded by an aeroplane cockpit and it is much preferable to solve the vector triangle by instrumental means. Moreover, it is but natural that, where possible, the means for observing ground speed and drift, and the mechanism for solving the vector triangle should be incorporated in one instrument.

Instruments and Methods

The following are the most important of the instruments used for D.R. navigation. Each enables the ground speed to be determined in the manner described above, and incorporates means whereby the vector triangle may be solved on the instrument itself. They differ somewhat, however, in the method by which the drift is determined.

The Aero Bearing Plate.—In this instrument the drift angle is determined by sighting on a ground object ahead of the aircraft and turning a horizontal drift bar so that the ground object appears to move along the bar.

The Wind Gauge Bearing Plate.—This instrument enables the drift angle to be determined by taking tail bearings of objects over which the aeroplane passed some minutes previously. These observations cannot conveniently be taken by the pilot and a navigator must be carried.

The Course-Setting Sight.—In this instrument the drift angle is determined by sighting ahead. The incorporation of a compass and a link mechanism renders the operation of the instrument to some extent automatic.

Altimeters.—The most convenient method of determining the height of an aircraft above the ground is by the use of a form of aneroid barometer, known as an altimeter, which is calibrated in terms of height. The pressure on the earth's surface, due to the weight of the atmosphere above it, is well known to be less on a mountain than it is at sea-level. If, at any particular height above sea-level, the atmospheric pressure was invariable, its measurement would be an ideal means of determining height. The variation of the atmospheric pressure at ground level is, however, a matter of common observation; moreover, the decrease of pressure with increase of height is governed by the temperature distribution of the atmosphere. All altimeters are, therefore, set at zero when the aircraft leaves the ground, and, in future, are to be calibrated in accordance with a standard atmosphere, which has been adopted internationally. The standard atmosphere assumes that, at sea-level, the temperature is 15° C. and that the barometric height, reduced to 0° C., is 760 mm. of mercury. The decrease of temperature with increase of height is assumed to be 6·5° C. per kilometre. The altimeter, thus graduated, is sufficiently accurate for most purposes, and other possible methods, such as the timing of a sound wave emitted from an aircraft and reflected from the ground, have not yet shown that the greatly increased complexity of the apparatus and its use, is justified by additional accuracy, except, perhaps, at very low altitudes.

Speed Indicator.—The speed of the aircraft through the air, at any height, is deduced from the reading of an air speed indicator. This instrument has a diaphragm, the movement of which is controlled by the difference of pressure in two tubes, which are set parallel to the fore and aft axis of the aircraft, and as far as possible from the effect of irregularities of airflow due to the aircraft structure. One of the tubes registers the static pressure of the atmosphere by means of a series of small holes drilled circumferentially in the tube, whilst the other has an open end facing the direction of motion of the aircraft and registers the sum of the static pressure and the pressure due to the motion of the aircraft. The movement of the diaphragm is, therefore, due only to the kinetic effect of the movement of the aircraft relative to the air, and is a function of the product of the air density and the square of the speed through the air. Since, however, the air density decreases with increase of height, the reading of the air speed indicator must be multiplied by a factor depending upon the height in order to determine the true speed through the air. This is most conveniently performed by the use of a circular calculator fitted circumferentially round the dial of the air speed indicator.

The Aircraft Compass.—The desiderata of any type of compass are (*a*) that there shall be a datum line indicating a known direction; (*b*) that a restoring force shall be set up if the direction of this line is altered by some agency external to the system; and (*c*) that the oscillations natural to the system after a disturbance shall be damped. The magnetic compass is particularly suitable for aircraft, since these requirements can be provided without prejudicing lightness and simplicity. When first adopted for aeronautical purposes, however, it proved far from satisfactory, owing to the considerable oscillation of the needle in approximately straight flight and its apparently erratic behaviour on turns from north and south.

Northerly Turning Error.—The explanation of the latter phenomenon, known as the Northerly Turning Error, was given by Keith Lucas at the Royal Aircraft Factory. Except near the equator, a compass needle will not lie horizontally if pivoted at its centre of gravity and, in the latitude of London, a small weight must be added to the south end of the needle in order to balance the tendency of the vertical component of the earth's magnetic field to make the north end dip. If an aeroplane commences to turn from a northerly course, the effect of the centrifugal force on the unbalanced weight is to rotate the compass card in the same sense as that in which the lubber line of the compass is rotating in azimuth. If the angular velocity of the card is greater than the rate at which the aeroplane is changing course, the compass will indicate a turn in the opposite direction to that actually occurring. The unbalanced weight may be dispensed with by double-pivoting the compass needle so that it is horizontal when the aeroplane is level, but the Northerly Turning Error will still be present on a banked turn, since the vertical component of the earth's magnetic field will be unbalanced and the north end of the needle will dip unless the aeroplane is on an even keel. The error can be reduced by choosing a long period and a high degree of damping for the magnetic system; since, however, both these factors increase the time of settling down to the true reading after a displacement, there is a limit to the extent to which they can be employed as correctives.

The oscillations of the compass card, when the aeroplane is executing a series of small banked turns in approximately straight flight, is also due to the presence of the unbalanced weight. If the damping coefficient is low, and the periodic time of the compass is approximately equal to the period of the aeroplane oscillation, the amplitude of the compass card oscillation may be very large; but it has been found that if the damping exceeds 60% of that corresponding to a periodicity, the oscillations are small, whatever value the period of the aeroplane oscillation may have. Provided that its exact reading is disregarded during and shortly after a turn, and that it is not installed in close proximity to magnetic material, the magnetic compass is now sufficiently reliable for use in aircraft.

Effect of Steel.—The increasing use of steel in aeroplane structure and equipment would, however, appear to render inevitable either the installation of the magnetic compass in the tail of the aircraft or its substitution for another type, though probably not for all types of aeroplane. For one particular magnetic condition of the aircraft a simple and sufficient deviation correction may be made (*see* 6.805). If, however, any moving component is constructed of steel, or if, owing to vibration or other cause, the magnetic condition of the steel parts varies during a long flight, the reading of the compass may be quite unreliable. Installation of the compass in the tail of the aircraft would necessitate means for communicating the reading to an instrument fitted on the dashboard. One such device is the Selenium compass, which records whether the pilot is maintaining a predetermined course but cannot conveniently be used for taking bearings.

Earth Inductor Compass.—Another instrument, the earth inductor compass, developed in America, depends upon the measurement of the electromotive force induced by the earth's magnetic

field in a coil rotating about a vertical axis. One development of the principle utilises an armature rotated by a cup anemometer, the current being collected by four brushes so connected to a galvanometer on the dashboard that a null reading is given when the pilot is flying on a predetermined course. An advantage of this instrument consists in its having practically no "memory," *i.e.*, the compass behaves normally almost immediately after a turn. It weighs much more than the magnetic compass, however, and suffers from lack of sensitivity.

The Gyro Compass.—Another possible alternative to the magnetic compass is the gyro compass (*see* GYROSCOPE), which is now being used for the navigation of large ships. It is improbable, however, that the type suitable for maritime navigation will ever be employed on aeroplanes. An alternative type, which may well prove suitable for aeronautical purposes, has been made by S. G. Brown. In this instrument no means are employed whereby a restoring force is set up if the direction of the axle of the gyro, relative to the earth, is displaced, and its efficacy is dependent upon the extent to which disturbing forces, such as friction, can be eliminated.

Position Finding.—The utility of dead reckoning navigation is limited by the need of at least occasional observation of the ground, and, unless it is possible definitely to recognise some landmark from time to time, the method is subject to accumulative error. In fog, or when an airman is flying above cloud, the ground is not visible and alternative means of navigation must be provided. One such means, direction finding by wireless, (*see* WIRELESS) is still the subject of experiment; while another, navigation by astronomical observation, has been used at sea since the 16th century.

Wireless Direction Finding.—All methods of direction finding by wireless have one underlying principle. If a rectangular coil, capable of symmetrical rotation about a vertical axis, be so placed that the plane of the coil is at right angles to the direction from which the wireless waves are transmitted, no current is set up in the coil; in any other position an oscillating current flows having a maximum value when the coil is set "edge on," *i.e.*, when the two vertical sides and the sending station are in the same straight line. If, therefore, the coil be rotated until the current is observed to be a maximum or minimum, the bearing of the sending station can be determined. In practice, telephonic detection is employed and the position of the minimum or zero signal is preferred to that of maximum strength owing to the much greater sensitivity obtainable. For ground reception the Bellini-Tosi system is usually employed; this consists of two small fixed coils, mutually at right angles, each being connected to an aerial loop, and a rotatable search coil symmetrically arranged with respect to the two fixed coils.

Ground Station D.F.—This is the only method at present regularly employed on commercial air routes. The aeroplane carries a transmitting set, and, by wireless telephony, calls for its position. Two or more ground stations observe the bearing of the aircraft, and one of them plots the position on a chart and communicates the information to the aeroplane. This method is fairly satisfactory for day use, but reception by a ground station at night is subject to inaccuracies known as "night-effects." Moreover, it is for many reasons desirable that the position should be determined by the aircraft itself and not by a ground station. For this purpose it is sufficient if the ground station transmits signals and the aircraft carries a receiving set, together with means for detecting the direction of the wireless waves. The following are various modifications of this system; each has been the subject of experiment but none is yet in regular use.

Wing Coil D.F.—This method has undergone successful air tests and can be operated by the pilot. Two sets of coils mutually at right angles are fitted in the aeroplane wings and connected to a receiver. One set, the main coils, is directed fore and aft, and the other, the auxiliary coils, is athwartships. When the aircraft is headed toward the sending station the auxiliary coil receives no current but the main coil receives maximum energy. Under these conditions reversal of the auxiliary coil has no effect upon the signals received by virtue of the current set up in the main coil. If now the aircraft be turned so that its fore and aft axis is no longer toward the station, a current is set up in the auxiliary coil, and alternate reversals of the auxiliary coil will, under these conditions, result in unequal strengths of signals; the aircraft must then be turned until equality of signal strength is obtained. The disadvantage of the method is that it is convenient only when the sending station is the objective or lies on the desired track of the aircraft; moreover, the time taken to fly to the sending station when navigating by wing coils will not, in general, be the shortest possible time, though this is not a very serious objection. The method cannot conveniently be employed to determine position; "homing" by wing coils merely ensures that the aircraft will eventually reach the sending station.

Fuselage Coil D.F.—An alternative method is to use two coils mounted on frames suitable for fitting in the fuselage of the aircraft; these coils are mutually at right angles and may be rotated about a vertical axis. With this arrangement the bearing of a sending station may be obtained, without change of course, by the method described for wing coils. Two or more such bearings on different sending stations, of known positions, would enable the position of the aircraft to be determined. This method necessitates special apparatus and requires the attention of a skilled observer.

Directional Transmission.—In this method the ground station apparatus consists of a fairly large loop which rotates at a speed of about one revolution per minute. No energy is radiated in a direction at right angles to the plane of the coil, and by "tuning in" to the station and observing the time between two consecutive points of silence, the exact speed of rotation can be estimated. Further, if the station emits a distinctive signal when the loop is directed, say, due north, the bearing of the sending station can be calculated by observing the time interval between the distinctive signal and the next zero signal. In practice it would be necessary to use two distinctive signals, preferably 90 degrees apart.

When fully developed, position finding on the aircraft itself will probably be more satisfactory than the existing system of ground reception, particularly for night use. It seems fairly well established that errors due to "night-effects" are confined chiefly to ground reception and are quite small when the aeroplane itself is used for reception.

Navigation by Astronomical Observation.—The determination of the position of an aeroplane by astronomical observation is attended by many difficulties and is hardly likely to be employed on a developed air route along which it is convenient to erect wireless beacons. For long distance pioneer flights over undeveloped country, or, for example, for Trans-Atlantic flights, astronomical observation remains the only method of checking the D.R. position. The principles employed are essentially those used for maritime navigation (*see* NAVIGATION), but both the accuracy needed and the accuracy attainable are considerably less on aeroplanes. Determination of the altitude of a heavenly body necessitates either that the horizon shall be visible, or that the true horizontal or vertical be otherwise known. The horizon is often indefinite from an aircraft, and this fact has led to the development at the Royal Aircraft Establishment, Farnborough, of an ingenious instrument known as the Bubble Sextant.

The R.A.E. Bubble Sextant.—The image of a bubble, contained in a chamber having a spherical glass cover, is observed by reflection from a pentagonal prism and subsequent transmission through a collimating lens and an index glass. The optical distance of the bubble from the lens and the radius of curvature of the glass cover are both chosen to be equal to the focal length of the lens. This arrangement provides that if an image of the sun, obtained by reflection from the index mirror, is brought into coincidence with the bubble image and the instrument is rocked in the hand, the bubble remains in focus, and bubble and sun appear to move together. When measuring the altitude of a star it is more convenient to observe the bubble image by reflection from the under-side of the index mirror and the star by

direct transmission through the mirror. The bubble is, of course, subject to displacement if the aircraft experiences an acceleration which is not truly vertical and, in practice, an average of 10 readings is taken. The degree of accuracy essential for maritime navigation is greater than that required for air navigation and it has been found convenient to substitute reduction of observations by logarithmic tables for more rapid methods, the most important being a compact cylindrical slide rule, devised by L. C. Bygrave, which is capable of giving an accuracy of at least two minutes of arc. For airship navigation the conditions approximate more to those appertaining to maritime navigation and there is no reason to suppose that navigation by astronomical observation will not generally be employed on airship routes.

Navigation in Fogs and at Night

Flying in Fog.—The safety of an aeroplane flying near the ground depends largely upon the pilot's ability to maintain, within certain limits, an even keel. Moreover, for navigational purposes it is desirable that a straight course should be maintained. Under normal conditions this presents little difficulty, but in fog, when visual connection with terrestrial and celestial objects is not possible, means should be provided to enable a pilot instantly to recognise any involuntary change of course. It is not at first obvious why the natural gravitational force is not a sufficient indication of the vertical. Imagine an aeroplane to be at rest on the ground, with its wings horizontal, and an ordinary spirit level to be mounted laterally, so that the bubble is in the centre of the tube. If now the aircraft be tilted so that one wing is higher than the other, the displacement of the bubble from the centre of the tube will indicate the nature of the tilt of

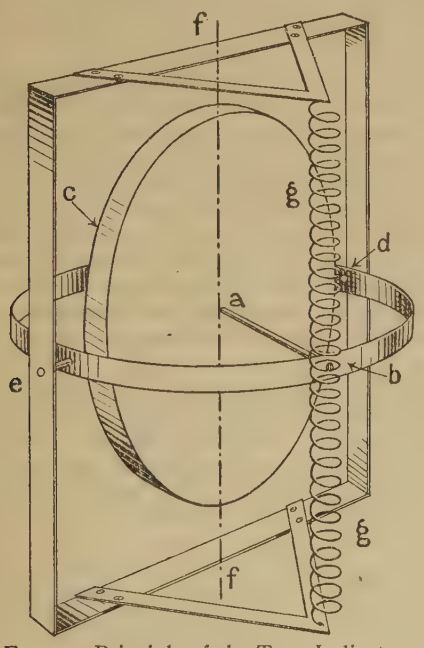

Fig. 1.—Principle of the Turn Indicator.

the aircraft. Change of course of aircraft in flight is normally associated with a lateral tilting of the wings, and, if a bubble level indicated the tilt, or bank, as it does on the ground, departure from straight flight would be shown by a displacement of the bubble.

When an aircraft is turning, however, it is flying on a curved path and the centrifugal acceleration, which acts at right angles to the direction of flight, needs to be considered. It is naturally not possible for a bubble level to distinguish acceleration due to one cause from that due to any other, and the liquid in the level is acted upon, not by the earth's gravitational force alone, but by the resultant of the centrifugal force and the earth's gravitational force. This resultant acts at right angles to the "floor" of the aircraft and the bubble consequently seeks, not the true vertical, defined by gravity, but the apparent vertical, defined by the direction of the resultant of the accelerations. If, therefore, the aircraft executes a banked turn in flight, the bubble remains in the centre of the level and does not indicate a change of course. In fog or cloud a pilot may be unaware that his craft is turning and the magnetic compass affords him little

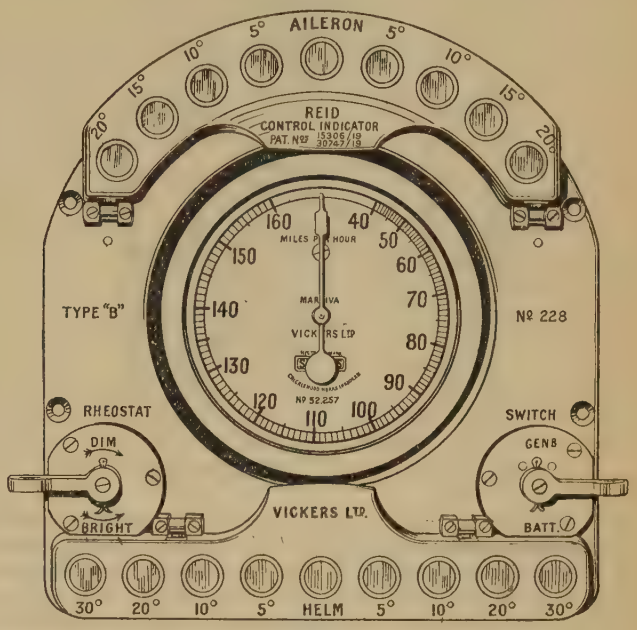

Fig. 2.—The "Reid" Turn Indicator.

aid, since, as already explained, it is unreliable under these conditions. The need for an instrument which will indicate that the aircraft is changing course has led to the development of the Gyro Turn Indicator.

The Gyro Turn Indicator.—The gyro turn indicator provides a pilot with a continuous indication either of the maintenance of straight flight or, if the aircraft is turning, of the direction and approximate rate of the change of course. The action of the instrument may be understood by referring to fig. 1. A gyro wheel, a, rotates about an axis, b c, which is horizontal in level flight, and is usually arranged to be athwartships on the aircraft. The frame carrying the wheel and its axle is free to rotate about another horizontal axle, d e, at right angles to b c (*i.e.*, in the fore and aft line of the aircraft). The axle, d e, supports the wheel and the inner frame in an outer frame which is fixed to the aircraft. If the aircraft changes course, the whole system is rotated about a vertical axis, f f, and, in accordance with the laws governing the behaviour of a gyroscopic system (*see* 12.769) the wheel and the axle, b c, commence to rotate about d e.

This rotation, which is known as precession, is controlled by springs, g g, so that the deflection of b c is a measure of the rate of change of course and so that the axle, b c, may return to a horizontal position when the aircraft is again flying on a straight course. The deflection of b c may be indicated to the pilot by any suitable means. The instrument has proved of the greatest use for flying in fog or cloud; it has been developed in a number of countries, but all types depend upon the principle outlined above and differ chiefly in the methods of indicating the turn and driving the gyro wheel. One type, the Reid turn indicator, is shown in fig 2. This instrument employs two rows of electric lamps, each row consisting of four red and four green lamps on each side of a central white lamp. The upper row is controlled by the position of mercury in a U-tube and indicates whether the aircraft is correctly banked. The lower row is controlled by the gyro and indicates the rate of turn. To maintain straight flight the pilot must fly so that no coloured lights are visible.

The Gyro Rudder Control.—Another device, making use of the gyrostatic principle, is the gyro rudder control developed at the Royal Aircraft Establishment, Farnborough. The primary object of this instrument is to relieve a pilot from the strain

consequent upon the maintenance of a straight course for a long period of time. The principle is shown in fig. 3. The gyroscopic system consists of a rotor, a, mounted in an inner gymbal ring, b, which is pivoted about a horizontal axis to the outer gymbal

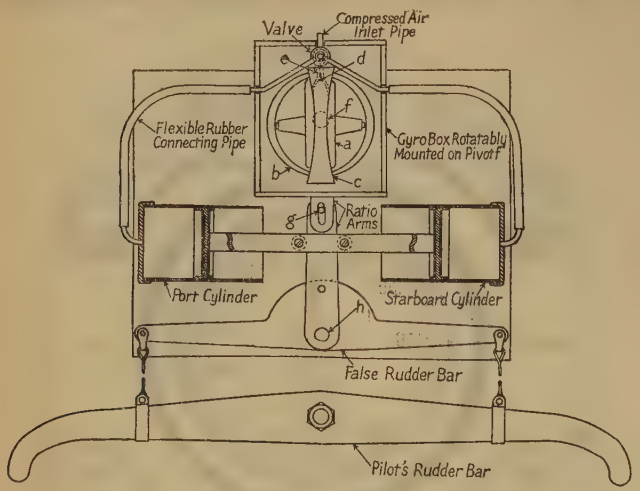

FIG. 3.—R.A.E. Gyro Rudder Control.

ring, c. The latter carries a pin, d, and rotates about a vertical axis, thus operating a valve by means of the lever, e. The system is mounted on a vertical pivot, f, and two ratio arms, one attached to the false rudder bar and one to the gyro box, engage at g. If the aircraft turns, for example, to starboard, air is admitted to the port cylinder, shown in fig. 3, and the starboard cylinder is put into communication with the atmosphere. The pistons consequently move and operate the false rudder bar pivoted at h, which in turn operates the pilot's rudder. Movement of the false rudder bar, however, causes a rotation of the gyro box on its pivot, f; the valve then closes and the rudder bar returns to its neutral position. This instrument has proved very satisfactory during air tests and is likely to reduce considerably the strain of piloting an aircraft over a long distance.

Landing in Fog.—The problem of effecting an aeroplane landing in fog is still the subject of research and experiment. Apart from the necessity of navigating and controlling the aircraft, connection with the ground must be established in such a manner that a landing can be effected. One promising method, which, however, has not yet reached the stage of full scale experiment, is the use of a cable, laid just beneath the ground, excited by alternating current. This cable forms a closed circuit on the aerodrome, and a convenient size and shape would be two parallel sides of about $\frac{3}{4}$ m., joined at the ends by two semi-circles of $\frac{1}{4}$-m. radius. The magnetic field above the cable will consist of circular magnetic lines of intensity varying approximately inversely as the height above the cable. Vertically over the cable the lines will be horizontal, and if instruments are carried enabling this condition to be detected, the pilot will be able continuously to fly vertically over the cable and by gradually decreasing his height to effect a landing.

The instruments carried on the aircraft may consist of two search coils oriented in such a manner that when the aircraft is vertically over the cable the resultant electromotive force induced in them is zero, but if the aircraft departs from the desired course, the E.M.F. induced in one coil will be greater than that induced in the other and the instrument will indicate this condition. The height can be determined by a suitable calibration of an instrument which measures the intensity of the magnetic force. Here is no reason to suppose that this method, when fully developed, will not be largely adopted for the landing of aeroplanes in fog, but the system is, of course, limited to prepared aerodromes. Another promising method is the employment of "lanes" of neon lamps laid on the aerodrome; under conditions of low visibility neon lamps have been found, by experiment, to have a greater visibility range than any other form of illumination.

Flying and Landing at Night.—Navigation at night presents far less difficulty than do flying and landing in fog. There will usually be no difficulty in navigating by D.R. methods, and the problem of night landing is mainly one of supplying sufficient and suitably placed illumination at aerodromes. It is probable that a night-operated air route will have a number of light beacons at suitable distances apart and, unless visibility is very poor, the pilot's task will be merely to fly from beacon to beacon.

The United States has a lighted airway of 1,900 m. from New York to Rock Springs, consisting of a number of terminal aerodromes about 250 m. apart, each having two electric arc beacons of 500,000,000 candle-power each, one circling the horizon every 20 seconds and the other providing flood lighting for landing purposes. In addition there are emergency fields about 15–30 m. apart, each provided with a light beacon; acetylene gas beacons have been installed every three miles over a considerable proportion of the route. A thousand million candle-power beacon near Dijon, France, having a normal range of about 300 m. has been built mainly to assist aircraft flying at night between Paris and Algiers.

An interesting method of facilitating night landing, known as the Hoenig circles, originated in Germany. The installation consists of two vertical lighted circles of different sizes, placed one behind the other, mounted on a trolley and so arranged that the common axis of the circles indicates the direction of landing. The pilot manoeuvres his craft until he observes two concentric circles; by preserving this orientation of the circles a correct landing can be effected.

Navigation of Airships.—Whilst the principles underlying the navigation of aeroplanes apply also to the navigation of airships, the foregoing description of navigational methods and of the peculiar advantages and disadvantages associated therewith, applies chiefly to heavier-than-air craft.

An airship is much steadier than an aeroplane, and instruments, particularly the magnetic compass, are more reliable. Under suitable conditions, astronomical observation can be taken and reduced without difficulty and the accommodation for wireless equipment is greater than in an aeroplane. It will be seen that the conditions obtainable for airship navigation are substantially those employed in maritime navigation. It is important to note, however, that the navigation of airships over long distances will render the availability of accurate meteorological information of primary importance, since an airship, unlike an aeroplane, can land only at prepared aerodomes.

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(A. P. R.)

AERODROME (Gr. *aēr*, air; *dromos*, a course).—At the conclusion of the War 1914–8 the International Commission for Air Navigation, which was a sub-commission of the Peace Conference and is now a part of the organisation of the League of Nations, was appointed, and drafted regulations, which are known as "The Convention Relating to International Air Navigation."

Provisions of the Convention.—By virtue of this Convention, each contracting state undertakes, in time of peace, to provide aerodromes equipped with ground organisation, to include customs posts where required for the operation of international air transport. Every aircraft engaged in international transport must, before proceeding to a foreign country, be cleared for customs, and therefore depart either from a customs aerodrome in the first place or land at a customs aerodrome before leaving the country; similarly, aircraft arriving from abroad must make their first landing at a customs aerodrome. Although it is not definitely stated in the regulations that hangar accommodation, etc., should be provided, the custom has been universally adopted that each state shall erect, at its own expense, aerodromes fully equipped in every respect. Details as to the greater part of this equipment are laid down in the regulations so as to obtain as nearly as possible international uniformity.

National Regulations.—The majority of contracting states have issued their own regulations. In the British regulations, which are laid down in the Air Navigation Order, 1922, and the Air Navigation (Consolidation) Order, 1923, an aerodrome is defined as follows:—

> An aerodrome means any definite and limited ground or water area intended to be used either wholly or in part for the landings and departures of aircraft.

Aircraft in this connection include all balloons, whether fixed or free, kites, airships or flying machines.

All aerodromes in Great Britain and Northern Ireland, which are used as regular places of landing or departure by aircraft carrying passengers for hire or reward, must be licensed for the purpose by the Secretary of State for Air, and, further, every aerodrome which is licensed for public use, or which is open to such use by British aircraft upon payment of charges, shall to the same extent and on the same conditions be open to use by aircraft possessing the nationality of a contracting state to the Convention for the Regulation of Aerial Navigation. Other countries have regulations with regard to the aerodromes which exist in their territory.

Definition.—Although the origin of the word aerodrome only refers to the area to be used for the purposes of alighting and taking-off and is supported in this by the definitions in the regulations, in general practice the word aerodrome is used to include, not only the ground or water, but also the buildings and installations required for the proper operation of air traffic.

Provision of Aerodromes.—On a recognised air route for the operation of land machines, such, for example, as that from London to the Continent, a series of aerodromes is provided at an average distance apart of 25 m. and these are classified, according to the purpose which they serve, as terminal aerodromes, aerodromes, landing grounds and emergency landing grounds. These are situated at Croydon (terminal aerodrome), Penshurst (landing ground), Marden (emergency landing ground), Lympne (aerodrome) and Littlestone (emergency landing ground). Lympne and Littlestone are approximately 5 m. apart and the reason for the existence of the latter, which is sited about sea-level near the coast, is that the former, being on high ground formed by the cliffs overlooking Hythe, is liable to be obscured by low clouds which drift in from the sea. It is essential that aircraft flying over the Channel shall have a landing ground near the coast for use in case of emergency; hence the provision of alternate grounds, one at high and the other at low level, both of which are unlikely to be obscured by cloud or fog at the same time. Of the above, both Croydon and Lympne are provided with customs facilities and in consequence are further classified as "customs aerodromes."

Equipment.—A terminal aerodrome normally is equipped with hangars for the housing of aircraft, workshops, bonded and technical stores, administrative and booking-offices for the companies operating services from the stations, as well as for travel and transport agencies, petrol and oil companies, etc. In addition facilities normally exist for dealing with customs and for carrying out inspection by the immigration authorities. Such aerodromes are further provided with wireless and meteorological facilities, together with government personnel to operate them. Various types of illuminating beacons for the assistance of aircraft flying by night, in addition to some form of device for indicating the direction of the wind both by day and by night, are installed. Accommodation is provided for an official belonging to the Aeronautical Inspection Dept., whose duty it is to ensure that aircraft are being properly maintained, for traffic hands who carry out porterage duties and assist in handling machines on the ground, and for the officials appointed by the govt. for controlling air traffic, the aerodrome and the government personnel employed there.

Landing Grounds.—Landing grounds may, or may not, be equipped with hangar accommodation, but are normally provided with beacons for indicating their position by night and wind indicators to show the direction of the wind both by day and night. Telephones are generally installed, but no personnel other than a caretaker will be found there. Emergency landing grounds are rarely equipped with any form of hangar accommodation and may, or may not, have any form of installation for indicating their position by night or the direction of the wind. Each of the above-named stations, with the exception of Marden, has its name in large capital letters marked on the surface of the aerodrome in chalk and the good landing area is outlined with automatic red flashing lamps which operate day and night.

Sea Traffic Aerodromes.—Aerodromes for the use of sea-going aircraft, such as flying boats or seaplanes, differ from those already alluded to mainly in having an open-water site from which to depart and on which to alight, and slipways leading from this water site to the hangar accommodation and to the prepared passenger departure and arrival platforms. For aircraft of this nature emergency landing grounds are unnecessary since the whole of a water route is itself an emergency landing ground.

Airship Aerodromes.—Aerodromes for the use of airships will in general be provided with all the facilities outlined above as requisite for the operation of land aircraft, but in addition will be equipped with a mast at which an airship can be moored, known as a "mooring mast," and a gas plant for the production of the gas required for inflating the ship. Under normal conditions an airship will only be berthed in a hangar for purposes of overhaul or repair in the same way as a ship goes into dry dock; at other times it will invariably be moored at a mast. The modern mooring mast consists of a steel girder structure rising to the height of approximately 195 feet. The head of the mast is fitted with a receiving arm into which a cone on the bow of the airship engages; this allows free movement in any direction. The mast is supplied with lifts for the use of the crew, passengers, goods, etc., and with pipes for the supply of fuel and water. A passenger mounting in this lift will, on emerging from it, find himself in a small compartment from which a covered way leads into the nose of the airship and thence down the passenger accommodation. This covered way may be likened to the connection between two railway coaches on a corridor train.

Aerodrome Conditions.—Leaving out of consideration emergency landing grounds, which require as a minimum two landing runs at right angles to each other of not less than 400 yd. long by 200 yd. wide, an aerodrome for the use of aeroplanes should normally consist of an area not less than 800 by 800 yards. The surroundings should be as free as possible from all obstructions, such as high buildings, trees, chimneys, wireless masts, etc. The surface should be level and the soil not liable to become boggy or marshy after heavy rain. In Europe aerodromes are invariably grass-covered; in tropical climates, however, they frequently consist of hard sandy surfaces or bare earth.

In the choice of a site for an aerodrome several factors must be considered, but as it is rarely found possible to combine all the desirable qualities in one place the final selection is generally largely a matter of compromise. Accessibility to the centre which an aerodrome serves is of primary importance, but in the neighbourhood of a populous area such as, for example, London, a large open space of the size required can normally only be obtained on the outskirts of the city. Under these circumstances, it is highly desirable that rapid and easy means of communication

shall exist connecting the aerodrome with the city. A consideration of paramount importance, in the present stage of development of air transport, is that an aerodrome designed for its use should be sited in such a position as to be as free as possible from fog, town smoke or local mist. For preference the country surrounding an aerodrome should be as open as possible. Two examples of main terminal aerodromes may be quoted:

London Terminal Aerodrome.—The London terminal aerodrome which is situated at Croydon, a distance of approximately 13 m. from Hyde Park Corner. The distance to the centre of London is far too great, there is no direct thoroughfare which leads from the centre of London to the aerodrome, and it is not fed with direct rail or bus communication. On the other hand it is freer from fog and mist conditions than almost any other locality in the immediate neighbourhood of London. Before Croydon was finally decided upon, exhaustive investigation was made into many other sites. An aerodrome in the north of London, unless having overwhelming attractions, was undesirable owing to the fact that aircraft proceeding overseas would find it necessary, either to fly over London or else make a circuit of it, in either case adding appreciably to the distance of the journey and rendering machines liable in foggy weather to be unable to reach their destination, owing to having to traverse the smoky and prevalent fog area extending east and west following the general line of the run of the Thames. In other districts investigated, in some cases it was found to be impossible to obtain sufficiently large areas, in others fog was prevalent, while in others the nature of the ground did not permit of their being satisfactorily converted into an aerodrome.

Berlin Terminal Aerodrome.—The terminal aerodrome at Berlin is situated at Tempelhoferfeld and is probably one of the most perfectly sited aerodromes in the world. This city had the advantage of possessing an enormous parade and review ground which is on high ground, is free from fogs, is almost perfectly flat, is fairly clear of obstructions surrounding it, is on a main road, along which trams pass, and is within ten minutes drive of the heart of the city, a perfect siting for the main terminal aerodrome of the country. (I. A. E. E.)

AERODYNAMICS.—The word aerodynamics refers to those branches of dynamics which form the foundation of the study of aeronautics; it thus applies to two distinct branches of this subject, which relate respectively to the reactions between air and solid bodies moving through it and to the movements of bodies under those reactions and the force of gravity. The former is a development of a mathematical study which has generally been known as "Hydrodynamics," because, although it applies equally to all fluids, it was developed originally with the object of throwing light upon the movements of water; the latter is a branch of "rigid dynamics," the study of the movements of rigid bodies of appreciable size under the action of external forces.

In no single instance has the reaction between a fluid such as air and a body moving through it been deduced directly from the laws of motion. The equations of motion can be formulated, but they have not yet been solved precisely. Aeronautics therefore relies primarily upon direct measurement of these reactions, but unfortunately their precise measurement upon the full scale requires, in general, experiments in free flight, which are difficult, costly, and sometimes hazardous to carry out.

For these reasons nearly all the detailed data available for the study of aeronautics have been obtained from small models of the parts concerned, suspended in artificially induced currents of air, which may either flow down large pipes, called wind tunnels, or take the form of a spout of air directed through the experimental chamber. The technique of the measurement of reactions upon models in a current of air has reached a high development in many countries, and the world's output of data relating to such experiments is now very large. The main function of the theoretical study of fluid dynamics in its relation to aeronautics has been therefore to indicate the extent to which such experimental data can be applied with confidence to the full scale, and to extend the range of phenomena over which a single experiment can be made to give useful information.

Principles of Dynamical Similarity.—These considerations lead at once to the study of similarity in fluid motion. To what extent will the flow round a large body moving fast through air possibly of low density, such as is found at great heights, be similar to that about a small model of that body moving at a slower speed through air of greater density, such as is found near the ground? Experiment has led to the conclusion that the motion of a fluid past a body of given form, moving through it at a given speed, is dependent only upon three physical properties of the fluid: density, viscosity and compressibility. No other property of the fluid is known to have any appreciable influence upon the motions with which aeronautics is concerned, nor does it appear to matter whether the fluid is a liquid or a gas. These perhaps surprising conclusions have results of immense importance, for from them can be deduced the laws governing the application of model data to full scale problems, and it becomes possible to carry out model experiments in any fluid which may be most convenient; moreover, the accumulated knowledge of "hydrodynamics" becomes directly applicable to aeronautics. The precise statement of the laws of similarity, which can be deduced from these premises, is as follows:—

Let l be some length defining the size of the body, V the velocity of the body through the fluid, and ρ, μ and E, the density, viscosity and bulk elasticity of the fluid.

Then strictly similar motions can occur round two bodies of the same shape moving similarly, only when the two quantities $\rho\frac{Vl}{\mu}$ and $\frac{E}{\rho V^2}$ are the same for both motions.[1] Quantities of this nature, which must not change if dynamical similarity is to be possible, are called "criteria of similarity"; they are always non-dimensional, and hence have the same numerical value, no matter in what system of units they are expressed, provided that the system is dynamically consistent.[2]

The criterion $\frac{E}{\rho V^2}$ constant, expresses the fact that in similar motions the volume strains in the fluid at similarly situated points must be the same. It may be re-written $\frac{V}{a}$ constant, where a is the velocity of sound in the fluid, for a^2 is proportional to $\frac{E}{\rho}$. In general, such strains are small, unless the velocity of some of the bodies concerned rises above about $\frac{a}{2}$, which in air is about 550 ft. per sec.; it is therefore usual in practical aeronautics to treat air as incompressible, unless velocities exceeding about 500 ft. per sec. are present. Such velocities have hitherto occurred in aeronautics only near the tips of high speed air-screws, hence it is in this connection only that the criterion, $\frac{V}{a}$ constant, has had any practical significance.[3] When this criterion is of importance it leads to the conclusion that model experiments in air should be carried out at the same speed as the full scale motion represented, but that, so far as compressibility is concerned, the size of the model is immaterial.

The magnitude of the criterion $\rho\frac{Vl}{\mu}$—called the "Reynolds Number"—determines the part played by viscosity in the motion. If two motions about similar bodies have the same Reynolds number the effect of viscosity in the two motions will be the same. If the Reynolds numbers are not the same, viscosity will play a more important part in that motion for which the number is the smaller. Thus the effect upon a motion of increasing either the density, the velocity or the scale, is the same as that of decreasing the viscosity. A fluid which appears relatively viscous to the slow passage of small bodies, may therefore appear to be very inviscid to the rapid passage of large bodies. Air, from the point of view of a gnat, is a somewhat viscous fluid; to an aeroplane it is much more mobile, whilst in relation to the general movements of the winds over the earth it is extremely inviscid.

The aeronautical engineer may be more interested in the forces generated by air motions than in the form of the motions themselves, but when a series of motions are known to be similar, the

[1] These conclusions can be reached solely from Newton's laws of motion and from considerations of the meaning of similarity.

[2] A dynamically consistent system of units is one in which Newton's law—force proportional to mass acceleration—can be expressed as an equality.

[3] For experiment on air-screws with tips moving above the speed of sound see *Reports Aeronautical Research Committee*, No. 884, 1903-4, vol. 1, p. 345.

laws governing the variations of force from motion to motion are easily deduced from the fact that all quantities, or combinations of quantities, having the same dimensions, vary in the same way. Forces upon similar areas will thus vary in proportion to $\rho v^2 l^2$, or to μVl, or to $\mu^2\rho$, because all these combinations of the independent variables have the dimensions of force. If, as in most aeronautical problems, the Reynolds number $\rho\frac{Vl}{\mu}$ is the only criterion of similarity which need be considered, and if it has the same value for a series of motions of fluids past bodies of the same shape, then these motions will be strictly similar, and the forces acting upon similar areas will vary as above. If, however, the criterion varies from motion to motion, strict similarity is impossible, because viscosity will play a more important part in one motion than in the other; nothing can then be ascertained as to the mode of variation of the forces, except by detailed calculation or experiment.

This condition can be expressed[1] by the equation $F=\rho V^2 l^2 f\left[\rho\frac{Vl}{\mu}\right]$ where F is the force under consideration and $f\left[\rho\frac{Vl}{\mu}\right]$ stands for any function the form of which can be determined either by detailed calculation or by experiment upon the effect of altering any one of the four variables concerned. The effects of a change in any one of the four independent variables can thus be ascertained by experiment upon the effects of varying any other of the variables,[2] always provided that there is, as is generally true in aeronautics, no other criterion of similarity than the Reynolds number to be taken into account.

For such values of ρ, V, l and μ, as occur in practical work with man-carrying aircraft, $f\left[\frac{\rho Vl}{\mu}\right]$ is very insensitive, even to considerable changes in the value of the Reynolds number, and calculations relating to free flight are generally made on the assumption that this function may be treated as a constant, so that we have $F=k\rho V^2 l^2$ where k is dependent only on the shape and mode of motion of the body through the air. When, however, deductions have to be made from small scale model experiments, this assumption is not always sufficiently accurate. With values of l and V which are practicable in wind tunnels, small though appreciable variation in k with change of Reynolds number are the rule rather than the exception, and the experimental data are then said to be subject to "scale effects." The Reynolds number of a motion on the full scale is generally very much larger than that of the corresponding model experiment, even in the largest and most powerful wind tunnels available,[3] and some uncertainty in the prediction of the behaviour of aircraft from wind tunnels data thus occurs; for there is, as we have seen, no known method of predicting the changes in k consequent upon a change of the Reynolds number. A long series of carefully selected experiments, carried out in free flight upon the full scale, has shown that much of the data of importance in aeronautics is not subject to serious "scale effects" between the highest Reynolds numbers conveniently obtained in ordinary wind tunnels and the full scale; those types of data which are subject to serious scale effects are becoming more and more clearly defined as research proceeds.

The coefficient k above, is called a non-dimensional coefficient[4] of force, and the force to which it refers is indicated by a suffix. Thus $k_F=\frac{F}{\rho V^2 l^2}$.[5] Non-dimensional coefficients of other quantities, such as pressure per unit area (ρ), and moment about an axis (M) are formed in a similar manner.

Thus:—

$$K\rho=\frac{\rho}{\rho V^2} \qquad k_m=\frac{M}{\rho V^2 l^3}$$

All such coefficients are constant for strictly similar motions, and being non-dimensional their value is not affected by changing from one consistent system of units to another. They are therefore much used in theoretical calculation, and for recording the results of experiments.

Air Reactions in Relation to the Theory of Inviscid Fluids.—Let us consider the motions which occur when bodies of various shapes move through otherwise undisturbed air. Bodies not specially shaped for low resistance generally drag behind them a quantity of air which, relative to themselves, is nearly motionless. This is called "dead air"; the boundaries of the region which it occupies are well defined near the body, but become ill-defined at some distance behind where the dead air gradually merges into a turbulent wake of irregular eddies. The pressure in this "dead" region is always lower than that of the surrounding atmosphere. Such bodies experience a high resistance to motion and are therefore avoided in the design of aircraft.

Certain shapes called "streamline" shapes, do not drag dead air behind them, and experience much less resistance to motion than those which do so; these shapes are therefore much used in aeronautics. The fish, the modern airship hull and the wing are typical examples of streamline shapes. The air-flow around moving bodies cannot yet be calculated from first principles, hence our precise knowledge of the air reactions upon these streamline shapes is drawn from direct experiment; but much light has been thrown upon their action by the theoretical study of the movement of a hypothetical fluid having absolutely no viscosity. The mathematics of this hypothetical fluid, unlike that of the real slightly viscous fluid air, is in many instances within the powers of modern mathematicians; and had been brought to a high state of development before aeronautics began to attract attention.

When a streamline body has been moving steadily through air for some time, the motion of the air relative to it becomes steady and substantially obeys the laws appropriate to inviscid fluids, except in regions containing air which has passed very near to the surface of the body. Very near this surface the motion is powerfully affected by viscosity, the velocity falling off as the surface is approached until, according to best authorities,[6] it reaches zero at its surface. The layer of fluid appreciably influenced by viscosity appears to decrease in thickness with decrease of viscosity until, in the conditions of interest in aeronautics, it becomes very thin indeed. The viscous layer is responsible for the tangential drag or "skin friction" upon the surface of the body, which constitutes the major part of the resistance of the best streamline shapes, and is, in some as yet unknown way, associated with the development of dead air behind bodies which are not of good streamline shape. The study of the dynamics of this region influenced by viscosity is proceeding vigorously in most of the aerodynamic laboratories of the world.

Returning to a consideration of the region in which viscous forces are negligible, which in most aeronautical problems includes by far the greater part of the whole region in which the fluid is appreciably disturbed by the body, Bernoulli's well-known theorem, relating to the steady motion of an inviscid incompressible fluid, indicates that if the motion is such that the velocity at all points far from the body is uniform, then the pressure (p) and the velocity relative to the body (q) at any point in the fluid, are connected by the relation $p+\frac{1}{2}\rho q^2=$constant. If P and V be the uniform pressure and velocity far from the body, this leads to $p-P=\frac{1}{2}\rho V^2\left[1-\left(\frac{q}{V}\right)^2\right]$; from which the pressure at any point can be deduced from the velocity, or vice versa. The maximum pressure rise is seen to be $\frac{1}{2}\rho V^2$ and to occur when q is zero.

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[1] This condition might equally well have been expressed by either of the equations $F=\mu Vl\phi\left(\rho\frac{Vl}{\mu}\right)$ or $F=\frac{\mu^2}{\rho}\psi\left(\rho\frac{Vl}{\mu}\right)$ where ϕ and ψ represent other functions; each of these forms is useful in certain circumstances, but that given in the text is generally used in aeronautics, for a reason which appears below.

[2] For example, should it be found that $F\propto V^n$ then $f\left[\frac{\rho Vl}{\mu}\right]=\left(\frac{\rho Vl}{\mu}\right)^{n-2}$ and $F\propto\frac{\rho^{n-1}V^n l^n}{\mu^{n-1}}$.

[3] In America a wind tunnel has been made which works in compressed air for which $\frac{\rho}{\mu}$ is many times greater than in air at atmospheric pressure. This allows a Reynolds number equal to that on the full scale to be obtained in many instances. At the time of writing the accuracy with which this tunnel faithfully represents full scale conditions in free flight in still air, is under discussion.

[4] Also called an "Absolute coefficient."

[5] The symbol l^2 may be replaced by any other quantity which defines the size of the body and is of the dimensions of area, thus $\frac{F}{\rho V^2 S}$, where S is the wing area, is used in relation to aeroplanes and $\frac{F}{\rho V^2 A^{\frac{2}{3}}}$, where A is the total volume, is used in relation to airships.

[6] Report of Aeronautical Research Committee No. 720 (Stanton) Proceedings of the First International Congress for Applied Mechanics (Delf). (Von Karwan and Burgers), p. 98, et. seq.

There are certain definite ways only in which an absolutely inviscid fluid can flow past a given body, with the restriction that the motion is to be uniform at all points far from the body. One of these flows only can be generated from rest; the others, if generated by some agency not contemplated in the theory and then left to themselves, will continue indefinitely without change. The flow which alone can be generated from rest has the property that, whatever the shape of the body, the pressures generated upon its surface exactly balance, so that no resultant force is exerted. Certain streamline shapes—for example, the airship hull moving axially and the wing moving in its attitude of no lift[1]—develop close approximations to these flows; hence the pressures upon their surfaces, being in close agreement with theory, approximately balance. The resistance to motion is then very low, being due merely to skin friction and to a very slight imperfection of balance of the pressures.

When the attitude of a streamline body in a current of air changes from that which gives rise to the unique flow which alone can be generated from rest, the flow changes progressively to a new form, which may be a close approximation to one of those flows which are appropriate to an inviscid fluid, but could not be generated in it. The precise analysis of these flows in the hypothetical inviscid fluid, is particularly tractable to modern mathematics when the motion is two-dimensional,[2] and a general analysis then leads to the conclusion that the resultant force upon the body is exactly perpendicular to the direction of motion of the undisturbed fluid, and is larger the further the flow departs from that one which can alone be generated from rest. In the corresponding real two-dimensional flow the reaction is *nearly* perpendicular to the direction of motion, but has a small component opposing the motion. If the magnitude of this reaction can be measured, it is easy to identify the particular theoretical flow to which the real flow approximates; the details of this theoretical flow can then be calculated, and are generally found to agree well with the results of detailed experiment.

In the absence of some such measurement of force, no precise method has yet been devised for deciding to which of the possible theoretical flows the real flow will approximate, but Joukowski, observing that for a wing of conventional shape there is only one of the theoretical flows which will not give rise to very large velocities at the trailing edge, advanced the hypothesis that this particular flow will occur. Applied with discrimination, this hypothesis gives results closely in accordance with experience.

Joukowski has, in addition, developed very beautiful methods for obtaining wing sections from mathematical formulae which lend themselves well to analysis of the type under discussion, and since wings with these sections are found by experiment to give results at least as good as any that have been obtained from arbitrarily designed wings, it is becoming common practice to use Joukowski profiles, as they may be called, in actual design. A feature of many of these profiles is that their centre line forms a segment of a circle; if γ be the camber[3] of this segment, C its chord, α the incidence[4] of the chord and $t \cdot c$ the maximum thickness of the profile, Joukowski's analysis leads to the following remarkably simple approximations to the lift per unit length (L) of the cylindrical wing.[5]

$$L/\rho V^2 c = (1 + \cdot 8t)\pi \sin(\alpha + 2\gamma) \qquad M/\rho V^2 c^2 = \tfrac{1}{2}\pi\gamma$$

Where M is the moment exerted by the lift about a point on the chord distant $c/4$ from the leading edge, ρ is the density of the air and V the velocity relative to undisturbed air. These formulae agree fairly well with the results of experiment upon two-dimensional wings, but are liable to give the lift slightly too high; a small component force opposing motion, called "profile drag," has also to be added. This profile drag has, as yet, to be determined experimentally; it may in favourable circumstances be less than $\frac{1}{50}$ of the lift.

The two-dimensional aerofoil in free space must be supposed to extend to infinity in two directions perpendicular to the direction of motion, but the span of a real wing is not infinite, hence the flow about it cannot be strictly two-dimensional. No exact method of calculating the flow around a finite wing has yet been devised, but Lanchester suggested that, provided the aspect ratio[6] is large, as in real wings, the effect of changing from an infinite to a finite aspect ratio might be represented by supposing the finite aerofoil to be working in a down current superimposed upon the motion appropriate to two-dimensional conditions. Prandtl has developed this idea into an approximate quantitative theorem, and has shown that if the distribution of lift over the span of the finite wing is elliptic, this superimposed down current will, to a first approximation, be uniform across the span and will be equal to $\frac{2}{\pi}\frac{K_L}{A}V$. A is the aspect ratio and the average lift coefficient over the whole wing.[7] He arrives at the conclusion that the finite wing will generate the same lift as the two-dimensional wing when its incidence relative to the undisturbed air stream is increased by $\frac{2}{\pi}\frac{KL}{A}$ radians, and that the resistance will be increased by an amount appropriate to a rotation of the resultant force through this angle. The distribution of lift over the span of a real wing, which is generally nearly rectangular in plan form, is not exactly elliptical, but is approximately so, and in practice the Prandtl formulae for conversion from a two-dimensional wing to a finite wing, namely:—

$$A\alpha = \infty\alpha + \frac{2}{\pi}\frac{KL}{A}\,[8]$$

$$A^k D = \infty^k D + \frac{2}{\pi}\frac{kL^2}{A}$$

give results which are sufficiently accurate for most practical purposes. By further extensions of these methods, estimates can be made of the mutual interference of a number of wings—as in a biplane or triplane—of the effect of placing the wings in a wind channel or near a plane surface, and of the mutual interference of the various blades of an airscrew.

By combining the hypotheses of Joukowski and Prandtl, it is possible to make a fair estimate of the performance of most practicable wings or airscrews, whilst subject to many types of interference from external bodies, the only special experiment required being that to determine the "profile drag" of the section or sections from which the wings or airscrew are built up. Somany approximations and hypotheses are, however, involved in these calculations, that they can only be applied safely in circumstances for which direct experiment has shown them to be applicable. If, for example, the wing incidence is too great, or the wing is not of a good streamline shape, "dead air" may form, and the motions cease to approximate even roughly to any flow which has yet yielded to analysis. The wing is then said to be "stalled," and on account of its high resistance becomes an unsatisfactory organ of flight. Little or nothing is known about the causes which make a wing stall and the stalling angle has still to be determined by direct experiment. Various methods of delaying the stall have, however, been found empirically; these are discussed in the section dealing with design.

Free Flight of Heavier-than-Air Craft.—The motions of aeroplanes under the influence of air reactions and gravity have been extensively studied. An aeroplane is a body upon which the air can be made to exert a large force nearly perpendicular to the direction of motion.

The magnitude of this force (R) can be represented by the equation $R = k_R \rho V^2 S$ where S is the wing area. k_r is here a function of the shape and attitude of the aeroplane[9]; it has a maximum value occurring at incidences in the neighbourhood of 18°.[10] When flying at a given speed in air of given density, the pilot, who has control over incidence, can thus call into play reactions up to a definite limiting value, but no greater; if he increases his incidence beyond that which gives the maximum reaction his aeroplane is said to be stalled. The principal use of the reaction R is to balance the weight of the aeroplane in steady straight flight, but it is also used to generate the large accelerations which are required in a rapid turn at high speeds.

[1] Lift is defined as the component of the air reaction perpendicular to the relative motion of the body and the undisturbed fluid.

[2] By two-dimensional motion is meant motion in which all velocities are parallel to a given plane and in which the flows in all planes parallel to the given plane are the same. For such a motion to be possible the solid body must be in the form of a cylinder, which may, however, have any desired cross section.

[3] $\gamma \cdot c$ = maximum distance of segment from chord.

[4] Incidence is the angle made by the chord with the direction of the undisturbed air stream.

[5] These formulae are first approximations, considering t and γ as small quantities.

[6] Ratio of span to chord.

[7] k_L is here defined as $\frac{L}{\rho V^2 S}$ where S is the wing area.

[8] $A\alpha$ is the incidence of a wing of aspect ratio A required to give the same lift coefficient (K_L) as a two-dimensional wing at incidence ∞. A^k, AK_D is the drag coefficient of the finite wing and ∞K_D is the drag coefficient of the two-dimensional wing, when the lift coefficient is K.

[9] Variations of k_r with change of Reynolds number are here neglected.

[10] It is at this incidence that "dead air" forms behind the wing, as described in the previous paragraph.

If the speed falls so low that the maximum value of R is less than the weight of the aeroplane, steady flight becomes impossible, so that there is a minimum speed of steady flight for a given aeroplane in air of given density; this is called the stalling speed and is equal to $\sqrt{\frac{w}{v\,kr}}$(max.) where w is the loading of the wings per unit area.

In the absence of any propulsive force, such as that provided by an engine and airscrew, the reaction (R) is always inclined backwards, through some angle γ, from a plane perpendicular to the direction of motion, hence steady horizontal flight is impossible without the expenditure of power, and in the absence of such power the aeroplane must descend along a path inclined below the horizontal through an angle equal to γ.

When the aeroplane flies in a curved path, the reaction (R) is required both to provide the necessary accelerations and to balance the attraction of gravity. The magnitude and direction of the reaction may now be expressed in the form mg', where m is the mass of the aeroplane and g' is the vectorial sum of the gravitational field and the inverse of the accelerations of the centre of gravity,[1] g' is described as the "apparent gravitational field," because the sensations of the pilot are those which he would experience in a field of this magnitude and direction. It is usual to adjust the aeroplane so that its symmetrical plane is parallel to g', when it is said to be correctly "banked"; the stresses in its main structure are then approximately g'/g times those in straight flight. The magnitude of g'/g has been measured in many manoeuvres, a value 3 is common in violent manoeuvres, values greater than 7[2] have been recorded for very short periods, but values in excess of 4·5, continued for more than a few seconds, have been found by independent investigators to cause temporary loss of sight and other faculties. When g' is greater than g the aeroplane will stall at a higher *speed* than in straight flight, though at the same angle of incidence.

If the aeroplane is to be in equilibrium, the reaction (R) must pass through its centre of gravity. If it does not do so, angular accelerations will occur. The moments of inertia of the aeroplane about axes through the centre of gravity are in general so small that these angular accelerations may be very large, so that rapid rotations would be quickly generated were it not that so soon as appreciable angular *velocities* occur, additional moments are generated which tend to stop them. The limiting rate at which an aeroplane can be rotated is thus determined by equating the moments which can be brought to bear about the centre of gravity, to the opposing moments generated by the rates of rotation. The three control systems, by which moments about three axes through the centre of gravity can be generated, are described in the article AEROPLANE.

When an aeroplane is disturbed from an attitude of balance, moments will be generated even when the "controls" are not moved; it is important to determine whether or not these will be of a kind to restore the equilibrium attitude. If the aeroplane be imagined suspended in an air current, so that it can rotate about a fixed axis through its centre of gravity, then it is said to be "statically stable" about that axis if any small rotation results in a moment which opposes the rotation. To achieve "static" stability in conventional aeroplanes, it is usual to fasten certain fixed areas, called the tail plane and the fin,[3] to the end of the body, at some distance behind the centre of gravity; these act in the same manner as the feathers of an arrow. "Static" stability can be increased either by enlarging these areas, by increasing their distance behind the centre of gravity, or by moving the centre of gravity forward, in relation to the wings.

Stability.—In free flight an aeroplane is said to be *completely* stable when, however it may be disturbed, it will eventually settle down to steady straight flight on an even keel. It is possible to make an aeroplane which will do this, but complete stability does not necessarily follow from the possession of "static" stability. A statically stable aeroplane, if disturbed from steady straight flight on an even keel by a motion in the vertical plane containing the direction of flight, will generally execute an oscillation of long period—20 sec. or more—about the equilibrium path, and this oscillation may increase or decrease in magnitude in accordance with factors which may be independent of the static stability. In the majority of aeroplanes such oscillations decrease, but occasionally, particularly in models, an increasing oscillation is observed. The principal factor which causes an increasing oscillation is a large longitudinal moment of inertia. Again a statically stable aeroplane, disturbed laterally from steady straight flight, may execute a slowly increasing banked turn, requiring however many seconds for the increase to be serious. This form of instability is *intensified* by high directional static stability, but can be eliminated by a sufficiently large dihedral angle.[4] The study of the complete stability of an aeroplane for small disturbances from steady flight has been taken up by Bryan, Bairstow and others, who have reduced the mathematics to a tractable form.

It is not essential for successful flight that an aeroplane should be completely stable, nor even statically stable; unstable aeroplanes have been very successful, particularly as fighters. Much misconception has existed in the past as to the relation between stability and safety. The danger of flying, apart from breakage or fire in the air, is almost entirely associated with the manoeuvres of getting off and landing, when the desirable quality is controllability rather than stability. Provided that static instabilities are not too great, the disturbances to which they give rise in normal flight are slow enough for the pilot to deal with them instinctively and without serious strain, and the question has been much debated amongst experienced pilots, whether or not an unstable aeroplane is easier and safer to bring to earth than a stable one.[5]

An advantage of complete stability is that the pilot, in a long straight flight, can remove his attention from control, and either rest himself or attend temporarily to other duties, but this advantage has been largely offset in the past by the fact that it is hard to balance an aeroplane so accurately that it will not then fly on a slightly curved path. This difficulty can now be overcome by the use of a gyroscopic control on the rudder, which keeps the aeroplane on a given course; with the help of this device a stable aeroplane can be made to fly for many miles on a straight course without any attention whatever from the pilot. Even should the power to fly without human control be unimportant, the designer should, however, know the degrees of static stability which his aeroplane will have, for its characteristic behaviour in the hands of the pilot depends upon this factor. It is becoming the practice to design aeroplanes to have a small measure of static stability both longitudinally and directionally, but over-stability may be as bad a fault as instability.

Control Problems.—The control of the aeroplane by the pilot involves problems of great complication. Apart from the needs of war, powerful control is required mainly for the purpose of manoeuvring for a landing in a restricted area; these manoeuvres are generally carried out at the slowest practicable speed, when the aeroplane is as near the stalling point as the pilot thinks safe, and since the pilot may accidentally stall his aeroplane in these circumstances it is of great importance to give him adequate control when flying at incidences both less and greater than the stalling incidence. Unfortunately certain violent forms of instability may occur when flying above the stalling incidence, and considerable difficulty is experienced in providing means whereby these can be controlled. This whole matter has been studied extensively during the last few years and some progress has been made towards an understanding of the problems and the elimination of the dangers involved.

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[1] This procedure may be expressed by the statement that the resultant force upon the aeroplane is obtained by combining the weight mg with the centrifugal force $\frac{mv}{r}$, where v is the velocity and r the radius of curvature of the path of the aeroplane. With this notation $g' = \sqrt{g^2 + \left(\frac{v^2}{r}\right)^2}$.

[2] N.A.C.A. 203.

[3] *See* AEROPLANE.

[4] *See* AEROPLANE.

[5] These remarks do not apply to stalled flying in which violent unstable motions may occur, which are definitely dangerous.

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(B. M. J.)

AERO ENGINES.—All aero engines in use up to the present time work upon the four-stroke constant-volume-ignition cycle and the thermodynamic theory of them is similar in all essentials to that of any other petrol engine. (*See* INTERNAL COMBUSTION ENGINE.)

I. ELEMENTS OF THE PROBLEM

The great problem with which the designer of aero engines is faced is reduction of the ratio weight to horsepower, or as it is customarily expressed the "pounds per horsepower," to the smallest possible value consistent with reliability. But pounds per horsepower in the air cannot be taken simply as a figure obtained on the test-bed; an aeroplane must carry its own fuel, so that economy of fuel consumption is also of primary importance. If we take, in order to fix our ideas, the example of a 450 H.P. engine which weighs itself, say, 900 lb. then the weight of fuel used per hour would be of the order of 225 lb., depending of course at what height the flight was made.

If we consider, not the weight of the engine alone, which is 2 lb. per H.P., but the weight per H.P. of the "power unit (engine and fuel) for a four hours' flight," then the value of this when the aircraft leaves the ground will be not 2 but 4, and it becomes at once clear that the effective weight to power ratio of an engine in flight will be materially affected by its fuel economy. In 1915 there was no water-cooled engine which weighed, complete with water and radiator, less than about 4 lb. per H.P., and no air-cooled engine of less than 3 lb. per horsepower. In the decade 1915–25, these figures have been reduced to the neighbourhood of 2 and 1·6 respectively. The greater net weight of the water-cooled type is discounted, especially for long flights, by better fuel economy.

Tendency of Design.—For an engine of given size (bore and stroke) both the power and economy are increased by an increase of the compression ratio. The tendency of design has therefore been toward the use of higher and higher ratios of compression: from the figure 4·5 of the average motor-car the compression in aero engines has been pushed up to 6 to 1 and higher. The limit to which it can be raised depends largely on the physico-chemical properties of the fuel available. With some fuels, such as Benzol, an engine of 7 to 1 compression ratio will run quite smoothly. With others which differ only in chemical analysis and not at all in appearance, volatility or specific gravity, it would be impossible to run the engine at all. Owing to the high degree of compression of the combustible gas, the ignition, when the spark is passed at the sparking plug, would take place with such violence as to cause "detonation" or "knocking" in the cylinders. In order that the compression ratio may be pressed to the highest possible point, therefore, the supply of suitable fuels for aero engines is a matter of great importance.

The Factor of Head Resistance.—The aero engine designer must also bear constantly in mind the factor of "head resistance." When an aeroplane is flying level, the whole available power of the engine is used up in overcoming the "drag" on body and wings as the machine tears forward through the air. In practically all machines nowadays the engines are at the front of the body or fixed between the wings, and if the drag is to be kept down, the area presented by the engine and accessories, when viewed from the front, must be as small as possible. A most important accessory, in this connection, is the radiator necessary with water-cooled engines.

II. EVOLUTION IN DESIGN

Bearing in mind the four considerations of power, weight, fuel economy and head resistance, their effect upon aero-engine design will now be traced. The designer must be a master of compromise. Compactness, rigidity, revolutions, inertia forces, piston speed and area, bearing loads, valve area, effective cooling and the rest . . . each member of this complex company must be harmonised with all the others and at the same time consideration of each must be pressed to the farthest limit in the service of the two great aims of power and lightness. It is appropriate in the first place to point out the main sub-division into water-cooled and air-cooled types.

Arrangement of Cylinders.—With our primary concern for weight to power ratio the advantages of the air-cooled type are not far to seek; there is the clear gain in weight of all the circulating water, besides the elimination of the weight and drag of the radiator. But the air-cooled engine designer cannot have it all his own way. For minimum head resistance of the engine itself a design of the "cylinders-in-line" type with the crankshaft fore-and-aft will clearly have the advantage; but if for cooling we rely wholly upon a high velocity airstream it is imperative that no cylinder should be seriously more screened from this airstream than any other.

Hence, although a few air-cooled engines of the cylinders-in-line type have been built, the two types which have been widely successful have been those in which the cylinders are arranged radially in one plane, or sometimes in two parallel planes, perpendicular to the axis of the machine; so that all cylinders share equally in the cooling air. Such engines, whether of the "rotary" or "static radial" types, present a large frontal area and offer very serious head resistance.

WATER-COOLED ENGINES

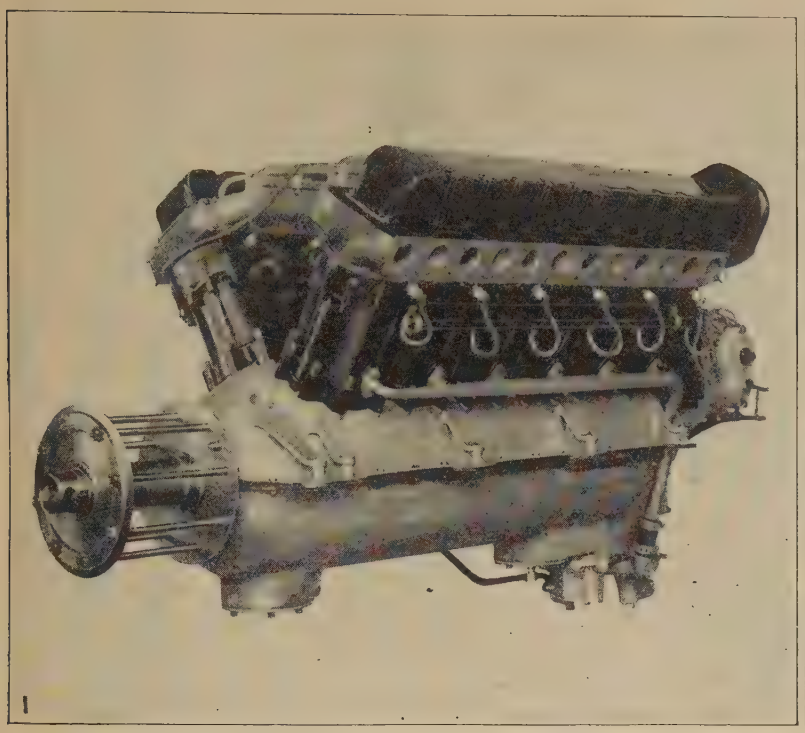
The power developed by an engine depends upon the mean piston speed, the total piston area and the mean-effective pressure in the cylinders. As to the first two the question at once arises: "Shall the requisite piston speed and area be achieved with a few large or many small cylinders, and what in each case are the limiting factors in regard to speed?"

Cylinder Design.—The answer given by designers has been "many and small"; largely on account of the resulting compactness and of the rigidity obtainable with light construction. A long stroke means a heavy crankshaft and a cylinder reaching out a long way from the shaft centre-line and upsetting the slip stream from the propeller. For getting adequate piston speed, therefore, the tendency is toward a short stroke and high revolutions. Large-bore cylinders in line, again, would lead to a long crankshaft, involving both weight in itself and in the resulting crankcase; besides the danger of non-rigidity in a big engine of light crankcase construction. A further advantage of small cylinders is the reduced danger of distortion due to uneven heating while in service.

With many small cylinders in line we get less piston area to the same length of crankshaft, but it is possible to make two or more cylinders operate on one crank and so the balance is redressed. Considerations of this kind have led to the development of the "Vee" and "Broad-arrow" types of engine with two and three banks of cylinders. Fig. 1 on plate shows one of the most successful modern water-cooled engines of the Vee type, the Curtiss D.12 which develops 400 B.H.P. at a total weight of 724 pounds. This engine has a crank throw of only 3 in. and the compactness of the resulting design is evident.

A short stroke means high revolutions to get adequate piston speed, and this in turn involves big inertia forces (since they increase as the square of the revolutions) which become most serious in their effect on the bearing loads at the crankpins. The limit to the closeness of spacing of the cylinder centre lines, with these high-speed engines, is largely a matter of the provision of adequate lengths for the main bearings and for those between connecting-rods and crankpins.

Valve Problems.—The combination of high piston speed with good volumetric efficiency involves ample valve area and the freest possible form of induction system. This, combined with the need for a compact and symmetrical combustion chamber to diminish detonation, has resulted in the almost universal



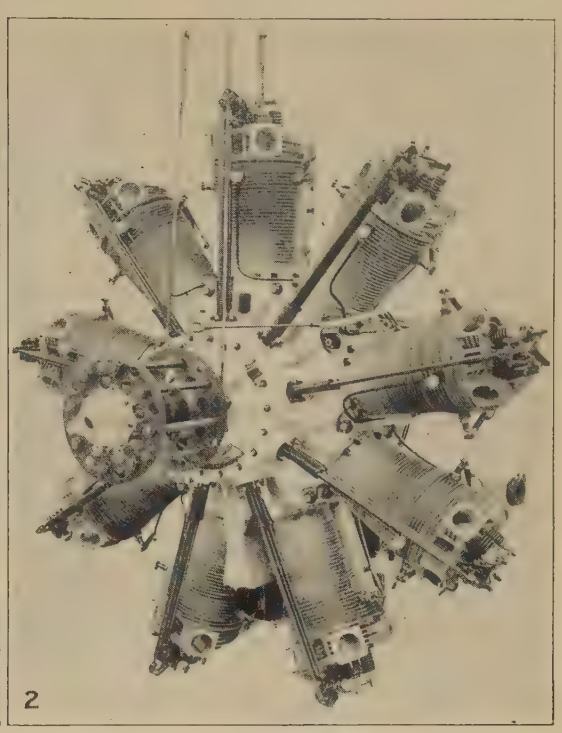


FIG. 1. Curtiss D-12 engine, of 400 B.H.P., weight 724 lb. FIG. 2. Jupiter air-cooled radial engine, 450 H.P., weight 730 lb.
(Fig. 1. Courtesy of "Aero Digest")

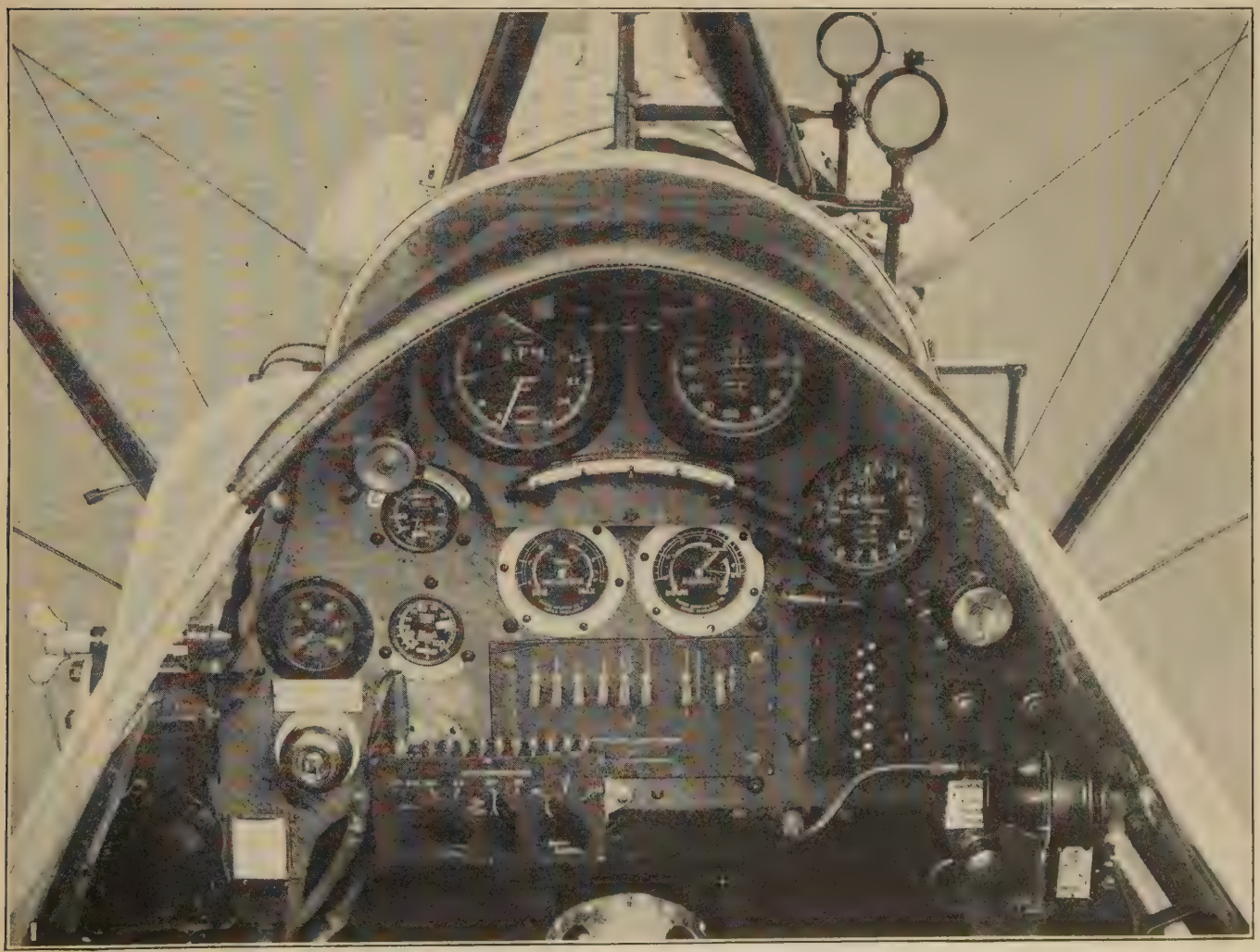


FIG. 1. View of cockpit of modern aeroplane, from the observer's seat.
(Royal Air Force photograph. Crown copyright.)

adoption of four valves in the cylinder head, two inlet and two exhaust, the inlet being rather larger than the exhaust. By this arrangement an effective inlet valve area is obtained equal to about 20% of the piston area. The maximum permissible gas velocity through the valve is about 170 ft. per sec. if good volumetric efficiency is to be maintained, and this therefore, with the valve area available, limits the mean piston speed to about 2,000 ft. per minute.

Next to the big-end bearing loads, valve operation is most critically affected by high revolutions. To get sufficiently rapid opening and closing of a poppet valve for an engine speed of 2,500 r.p.m. the accelerations involve very heavy springs and terribly severe stresses in the cams and in the valve spindles. This difficulty of high-speed poppet valve operation makes the sleeve valve so attractive a possibility.

Fuel Distribution.—With a number of cylinders in line the equal distribution of the fuel between them is a difficulty. Two or more carburetters must be used and the cylinders drawing from each carburetter must be arranged, so far as possible, to do so at equal time intervals. No one arrangement has been standardised as the best: on most 12-cyl. Vee engines one carburetter serves one whole bank of cylinders, but another arrangement divides the engine into two groups of the front six and rear six cylinders, and each group is served by one carburetter. In at least one design some weight is sacrificed for the sake of good distribution in the provision of a carburetter to every two cylinders.

Air-Cooled Engines

The two main classes of air-cooled engines are the Rotary and the Static Radial types. In each the cylinders are arranged radially in one or two planes round the circumference of a circular crankcase. Thus all cylinders are satisfactorily exposed to the cooling airstream, but at the cost of presenting a large frontal area. The rotary engine, in which the cylinders and crankcase rotate with the airscrew, besides the fore and aft airstream, gets the extra cooling due to the rotational speed of the cylinders, but at the expense of considerable waste of power in air friction.

Kinematically the two types are identical. In each there are two parallel axes: viz., that of the main shaft, round which the cylinders are symmetrically arranged, and that of the crankpin, to which the connecting rods are attached. In a rotary engine the crankpin axis is fixed and the cylinders rotate with the propeller, while in the static radial type the cylinders and crankcase are fixed and the crankpin axis rotates round the main shaft in the usual manner.

The speed, and therefore the power, of the rotary engine is limited to about 1,200 r.p.m. by the enormous centrifugal forces on the rotating cylinders, and in consequence recent development of air-cooled engines has been wholly along the line of the static radial.

One of the chief attractions of this type is the possibility of a very compact and rigid crankcase construction. This takes the form, very roughly, of a drum, with cylinders fixed radially round its circumference. Only one crank is employed for all the cylinders which lie in one plane; one piston having a connecting rod with a " big-end " as ordinarily understood, while all the other pistons have " articulated " connecting rods, which are attached by pin joints around the circumference of the big-end of the one master-rod. The loading on the one crankpin is very severe and special designs of big-end bearing are necessary to stand up to it. One of the most successful is the " floating bush " type in which a light bronze sleeve, free to rotate, is interposed between the crankpin and big-end bearing surfaces. A bearing of this kind, of course, is only possible with a crank of the " built-up " type.

Valve Design.—Valve opening is contrived by push-rods and rocker-arms which are carried on the cylinder heads; the rods being operated from a cam ring which is driven at the speed appropriate to the number of cylinders by an epicyclic gear on the main shaft. Since the cylinders of a large, air-cooled, radial engine may undergo an expansion while running of as much as 70/1000ths of an inch, which is not shared by the push-rods, very careful design and proportioning of the rocker-arms are necessary if valve operation is not to be upset.

Fig. 2 on plate is an illustration of the Jupiter engine, one of the most successful of the air-cooled radials. Its nine cylinders, $5\frac{3}{4}$x$7\frac{1}{2}$ in. bore and stroke, are arranged in one plane and the engine develops 450 H.P. at its normal speed of 1,700 r.p.m. and at a weight complete of 730 pounds.

III. MATERIALS

With the cutting down of weight and the ever more severe conditions as regards temperature and compression ratio the problem of design is bound up with that of materials.

Aluminium Alloys.—The introduction of the light alloys of aluminium was the first great advance in regard to materials. It is now possible to make extremely complex castings and drop forgings for a complete crankcase in this material, and, even before this had been successfully achieved, the introduction of the aluminium piston had largely reduced the mass of reciprocating parts and so brought relief in crankpin bearing loads due to inertia. The high conductivity, too, of aluminium as compared with cast iron has made for cooler pistons and less tendency to carbonisation of the lubricating oil. The same property has led to extensive use of aluminium for making the cylinder heads of air-cooled engines, and, in combination with a steel liner, for complete cylinder construction of water-cooled types. It has even been tried to run a steel or iron piston direct in an aluminium cylinder. The two critical points in regard to high temperatures in a high-duty engine are the centre of the piston, and the exhaust valve, if this is of the poppet type.

Exhaust Valve Materials.—Exhaust valves are called upon to run continuously at a bright red heat and to resist scaling or burning under these severe conditions. The only steels which can successfully do this are certain of the nickel and chromium alloys and these in their turn introduce new problems: they are much more troublesome to machine than carbon steels and also they develop what is known as " temper-brittleness," a condition brought about by the high temperatures at which they are used, and their subsequent slow cooling after use. Alloys of magnesium with copper and zinc are both lighter and stronger than the aluminium alloys. They cast well and machine easily and have been used to some extent for crank-cases with a saving of weight of about 35%. Their disadvantages are a cost of about double that of aluminium and excessive liability to corrosion.

IV. THE SPECIAL PROBLEM: ALTITUDE

Effect on Engine and Airscrew.—Under comparable conditions the pressure developed in the cylinder of an internal combustion engine will be proportional to the weight, and therefore to the density, of the combustible mixture drawn in. At heights above ground level the atmospheric pressure falls off at a rate of roughly 1 in. of mercury per 1,000 feet. At the same time the average temperature of the air becomes lower at a rate and in a manner which varies from day to day. The density of the air will therefore fall off less rapidly with height than the pressure, and the relation between density and height may be very variable.

It is now possible to measure the indicated power of an engine in flight, and experiments on these lines have shown that the indicated power is very nearly proportional to atmospheric density, provided a proper air-fuel ratio is maintained. This, however, is a matter of some difficulty. The " depression " produced in the choke tube of a carburetter and hence the quantity of fuel normally supplied through the jets will, for the same engine speed, be proportional to the square root of the air density. The weight of fuel supplied by a carburetter will therefore fall off less rapidly, as an aircraft rises, than the weight of air drawn in, and the mixture will become too rich. To compensate for this an " altitude control " must be fitted which usually consists of a connection between the float chamber and

a point of low pressure in the choke tube. By the gradual opening of this passage the flow of petrol is reduced and the correct mixture maintained.

Engine and Screw.—The useful performance of an aircraft engine cannot be considered apart from its airscrew. These two must be regarded together as the power unit, for the power and efficiency of an engine may be largely thrown away if combined with an inefficient airscrew. Moreover, the efficiency of the airscrew is affected by the revolutions maintained by the engine. Since both indicated engine power and airscrew resistance are proportional to air density, at constant speed, it follows that they both fall off at the same rate as the aircraft climbs. The B.H.P. of the engine, friction losses being approximately constant, will fall slightly more rapidly; but the difference is not large, except at great heights, and since airscrew resistance is also proportional to the square of the revolutions the difference between available engine torque and airscrew resistance will produce only a slight drop in the speed of rotation. A fixed bladed airscrew, therefore, combined with a normal engine will, as the machine climbs, continue to work at nearly constant revolutions and efficiency.

Variation of B.H.P. with Altitude.—Although the indicated power falls off, the mechanical losses in the engine as a whole will not vary much as a machine rises, so that B.H.P. may be expected to fall off more rapidly than indicated horsepower and air density. To determine by direct observation just how fast the B.H.P. falls off with increasing altitude in any given case would be a research of the highest interest. Its accurate determination would involve the two measurements of the speed, and the torque actually delivered to the airscrew. Several attempts have been made to design a torque meter for use in the air, but the mechanical difficulties are so great that so far these attempts at direct measurement have been only partially successful.

The alternative is to deduce how the B.H.P. varies from observations of the performance of the aircraft. This again is a difficult calculation to make with certainty from figures for speed and rate of climb, since the necessary reduction from actual observations must rest upon an answer to the question we are asking: how the altitude has affected engine B.H.P. and airscrew efficiency. It is probably impossible, by tests in the air, to arrive at any satisfactory general law for diminution of engine B.H.P. with height, applicable to all engines, for the simple reason that the mechanical efficiency, which must always vary from engine to engine, and may even vary from day to day with the same engine, has so large an effect on an aircraft's performance as to produce very discordant results. Take for example an engine giving 500 I.H.P. on the ground, and assume that the I.H.P. will fall off in proportion to air density and the friction losses remain nearly constant. If we calculate the B.H.P. at 20,000 ft. where the I.H.P. is halved, this will be 200 or 175, a difference of $12\frac{1}{2}\%$, according to whether the mechanical efficiency is 90% or 85% on the ground. Even 1% variation of mechanical efficiency would have an appreciable effect on performance.

The position may be summed up by saying that although such direct observations as have been made indicate that the B.H.P. falls off nearly in proportion to the reduced pressure, irrespective of temperature variation, nevertheless the assumption made above is sufficiently close to justify its use in the prediction of aircraft performances considering the inevitable uncertainties of individual tests. This assumption makes the B.H.P. depend upon the density (and therefore temperature), diminishing in a linear manner with it, but more rapidly than the density itself.

Maintenance of Ground Power at Altitude.—Since the power delivered by an engine will be roughly halved at a height of 20,000 ft., any plan for counteracting this effect of reduced air pressure holds out great opportunities for improved performance. But here the airscrew problem comes in. If the ground power of the engine should be delivered with the airscrew in low density air, then the engine will race away and burst, for unless the inclination of the airscrew blades can be altered the resistance to rotation must fall off with the air density. The usefulness of maintaining ground power at altitude is therefore entirely dependent upon our being able so to vary the pitch of the airscrew blades as to prevent excessive engine speed and at the same time retain a good airscrew efficiency. This problem of providing a variable pitch airscrew is one which is at present occupying our designers and cannot be said yet to have been satisfactorily solved.

Supercharging for Maintaining Ground Power.—To maintain ground power, combustible mixture must be compressed so as to be delivered to the cylinders always at normal atmospheric density whatever the height. This would mean, at 25,000 ft., compressing in the ratio of 2·7 to 1 and then cooling through about 60° C. The necessary cooler involves additional head resistance and, if a piston compressor is used, the displacement will have to be about three times that of the main engine. All this means considerable additional weight, and every added pound is a dead loss at low altitudes and a serious handicap in getting off the ground. For this reason very high-speed rotary blowers offer the best chance of success. Such a blower might either be gear-driven from the engine shaft, or some of the energy of the exhaust gases might be used through the medium of an exhaust-gas turbine. The difficulty attending a blower, if gear-driven from the main shaft, is that, with the exceedingly high gear ratio necessary, about 10 to 1, the inertia of the blower rotor is enormous, and unless some slipping clutch device is provided the gears will be stripped on the very sudden starting up of the engine.

The exhaust turbine drive is very attractive, for, whereas with a gear-driven blower the entire horsepower needed for compressing the air has to be supplied by the main engine, this type makes use of what would otherwise be largely wasted energy. The difficulties are chiefly those of providing turbine rotor blades which will stand the constant exposure to the hot exhaust gases and at these temperatures will retain a strength adequate for a speed of rotation of 2,500–3,000 revolutions per minute. Scarcely less serious is the problem of a shaft-bearing at these speeds when the high temperature makes oil lubrication impossible.

V. MINOR PROBLEMS

Wireless Interference.—While the engine designer has been improving the power and efficiency of his magneto and ignition system to suit high-compression engines, great strides have been made by the wireless branch in short wave-length instruments which can do without the trailing aerial. The magneto and high-tension leads produce waves which upset the sensitive wireless sets, and methods must be devised of so screening off the effects of the ignition system as to allow advantage to be taken of the improvements in signalling apparatus. The high-tension leads are therefore enclosed throughout their whole length in a woven metal sheath which is "earthed" to the engine body and at the same time the plug-heads and contact-breaker are enclosed in small metal cowls which are likewise earthed. But the hard-won improvement in ignition efficiency is cut down by the added electrical capacity introduced by the new screening arrangements, the effect of which, and the additional weight involved, are a dead loss to the engine designer.

Oil Temperature Control.—The functioning of a system of forced lubrication, in which oil is delivered by a pump to all parts of the engine, is very greatly affected by the viscosity of the lubricant. Since the viscosity of the lubricating oil will fall to about 1/10th of its value for a rise in temperature from 40° C. to 100° C., some control of oil temperature is necessary. During the cold period at starting, excessive pressures will be developed by the pump; and although these can be dealt with by relief valves, the flow to the bearings will be very small, and a long period of warming up is necessary until the flow is sufficient to allow full loading to be imposed on the bearings. When flying at low altitudes and in warm climates, and more especially with airship engines which are usually not open to any cooling airstream, it is necessary to provide for cooling of the oil after it has left the engine and before it is redelivered by the pump.

The problem is a peculiar one, for although the amount of heat to be abstracted is comparatively small, the rapid rise of viscosity as the oil is cooled has the effect of producing a thick coating of viscous oil on any surface where cooling is effective. The conductivity of this viscous layer being very bad, the remainder of the hot oil passes on out of the cooler with a very inadequate reduction of its temperature. The problem is to prevent the oil, as soon as it is cooled, from remaining in contact with the cooling surfaces and so preventing the cooling of that which comes after. The problem will not be solved until a cooler has been designed which is light, which cools effectively and can deal with the high pressures developed while the oil is cold.

Water Recovery.—A problem peculiar to airships is that of compensating for the weight of fuel used during a long flight. In flying to Egypt a large ship would burn some 25 tons of fuel oil, and unless this weight can be made up in some way an equivalent quantity of hydrogen will have to be allowed to escape. An alternative is, while drawing liquid fuel from the tanks, to use less of this and to make up the balance of fuel required by drawing from the gas bags the corresponding weight of hydrogen necessary to maintain balance in regard to buoyancy. Research upon the use as fuel in an engine of a mixture of oil and hydrogen has yielded most promising results and this may prove the most workable solution of the problem.

The alternative of maintaining the dead load on the airship by condensing and storing the water in the exhaust gas from the engines is a matter of considerable difficulty, but it should not prove insuperable. In the combustion of a hydrocarbon fuel the water formed is 9 times the weight of the contained hydrogen. Now an oil fuel contains about 14% by weight of hydrogen, so that in addition to any moisture carried into the engines with the air there will be $9 \times 14 (= 1{\cdot}26)$ lb. of water for every pound of fuel burnt. This is by no means all recoverable, but with a water recovery apparatus capable of cooling the exhaust gas to within 10° C. of whatever may be the surrounding atmospheric temperature and of collecting all the water formed, the possible recovery should be from 0·9 to 1·0 times the weight of fuel burnt.

VI. FUTURE DEVELOPMENTS

Increase of Size v. Increase of Gas Pressures.—Apart from piston area and piston speed the only way of increasing the power of an engine is to increase the mean effective pressure. This can be done either by raising the pressure or lowering the temperature of the combustible mixture drawn in. The latter alternative has obviously only limited possibilities, but within these limits the use of fuels with high latent heat of evaporation, which therefore give more cooling of the charge, has been successfully applied in racing motor-car practice and may be also in aircraft engines. To raise the pressure of the mixture drawn in means the provision of a blower, not only to maintain ground pressure at altitude but to raise this pressure throughout above atmospheric. Under such conditions an engine of the same bore and stroke would have to have a heavier crankshaft, connecting rods, pistons, etc., to stand up to the larger gas forces developed; the necessary blower and driving gear will be larger and heavier, the air coolers will be heavier and give more drag, so that it might be suggested that the extra power could be got at once by means of a bigger engine (*i.e.*, by more piston area), while leaving the gas pressures the same. Only the detailed calculation of weights and estimates of drag in the two cases can settle the question of which plan will produce the most effective engine, but the small engine with high gas pressure starts with an initial advantage so far as its own head resistance is concerned.

The Two-Stroke Cycle.—To design for a working stroke every revolution is not the easy way toward reducing weight per H.P. which at first sight it appears. The getting of the charge into the cylinder with only the limited area available for inlet valves is, at high speeds, one of the limiting conditions even when the time of half a revolution is available. If it has to be accomplished in one-third of the time, or less, the problem is proportionately greater. Any lowering of engine speed, if combined with all the extra weight of the necessary compressors for scavenging and delivering the fresh charge, may very soon bring down the extra horsepower per pound from a two-stroke cycle to a very narrow margin. It is unlikely, moreover, that the same thermal efficiencies will be achieved as with the four-stroke cycle. Nevertheless the two-stroke cycle is a possible line of advance, more especially with the greater perfection of compressors for supercharging and in combination with the Diesel type of fuel injection.

Sleeve Valves.—One of the most difficult aero engine problems is the satisfactory operation of poppet valves at high speeds and high temperatures. The drawback to the use of sleeve valves has been in the past a tendency toward gas leakage, excessive oil consumption and large mechanical loss due to friction; but with the single-sleeve valve it is possible, by skilled design to minimise these troubles, and this type of valve holds out extremely attractive possibilities. The absence of all springs in the first place and of the excessive accelerations which are so detrimental to cams, would at once eliminate a constant source of trouble. Moreover the sleeve would necessarily be cool, so that tendency to detonation would be reduced; further, it would be possible to provide ample and unobstructed port area so that volumetric efficiency could be maintained at high speed, for apart from the absence of obstruction due to poppet-valve stems in the port, with sleeve valves we are no longer limited to the cylinder end in providing valve port area.

The Compound Engine.—Forty per cent or more of the heat energy of the fuel is at present thrown away in the exhaust of a high-duty engine; where weight is no consideration some of this can be used for raising steam, as in the Still engine designs, but such methods of improving efficiency are probably out of the question for aircraft. The question remains, "Can some of this waste heat be saved by expanding the hot gases much further in a low-pressure cylinder?". The difficulty lies in the transfer of the hot gases at 1,000° C. or more from the high- to the low-pressure cylinder. So long as this has to be controlled by poppet valves the difficulties are probably insuperable; no valves could be expected to stand up to such treatment, when it is remembered that they would need to be operated from outside, and that therefore there would be continuous leakage of hot gas down the valve stems where they slide in the guides. The only hope for the compound engine seems to be through the development of the sleeve valve. It is a possibility, but much research will be required before the difficulties inherent in such a scheme can be met or their magnitude even satisfactorily settled.

The Diesel Engine.—The use of this engine is hardly more than a pious aspiration so far as aircraft are concerned, in spite of its manifest advantages. Not only would it give a very high fuel economy on account of its high compression ratio of 12 or 14 to 1 instead of 5 or 6; but it would burn a fuel of one-third of the price of petrol to-day, and all the weight and complication of magnetos and sparking-plugs would be swept away. There is no fundamental reason why the advantages of compression ignition should not ultimately be achieved without excessive weight; but since present-day aero engines can be built at a weight of less than 2 lb. per H.P. and the corresponding figure for a Marine Diesel engine is of the order of 30 lb. per H.P., it is clear that a long road of patient research has to be traversed before a Diesel type engine can be seriously considered for heavier-than-air machines.

Jet Propulsion.—More than one proposal has been made that the force for propelling an aircraft forward should be obtained by shooting out a jet of air behind on the principle of the rocket. To obtain efficiency, however, when using this principle, it would be necessary that the forward speed of the aircraft should be of the same order as that of the jet backwards, while at the same time the drag due to air resistance has to be overcome by the reaction between the aircraft and the jet. The two conditions are incompatible. But even under the best conditions an airscrew which is rotated by jets at the blade tips and eliminates other driving mechanism could never hope to achieve more than a very poor fuel economy when compared with a present-day heat engine. (D. R. P.)

AERONAUTICS (*see* 1.260).—From the early experiments of S. P. Langley and the Wright Bros. until the beginning of the World War the progress in aeronautics was not marked. Through the efforts of Lord Haldane, which resulted in the establishment of the Advisory Committee for Aeronautics in 1909, research had made a start in England at the National Physical Laboratory and at Farnborough, while in Germany the Pöttingen School had been founded and the importance of a study of fundamental principles was being recognised.

Aircraft, as we know them, were a creation of the War, and military requirements dominated design and practice; the importance of civil aviation was barely recognised; the history of aeronautics, as the reader of Sir W. Raleigh's *War in the Air* realises, formed no small part of the history of the War. The five years (1920–5) have shown a rapid advance in many directions; the theory of the aerodynamic action between a flying-machine and the medium in which it flies has been put on a new basis which has already, as the subsequent pages will show, borne good fruit, which promises to be still more fruitful in the future.

Aircraft are now being designed for the definite purposes for which they are required; that to some extent was true in the earlier period, but the purposes were military, not civil, and the knowledge at the designer's disposal was far less than he now possesses, thanks to investigation and research. Now, as then, to combine strength and lightness is the problem which confronts the designer; metallurgists have realised this and are giving him new materials to work with and in this way they are raising new problems in design.

The internal combustion engine, without which aviation could not exist, is being studied from every point of view with the object of increasing efficiency, of discovering methods to make it as effective at 20,000 ft. as at sea-level, of lessening the number of failures in the air and rendering it as immune from accident as a locomotive or marine turbine.

Methods of navigation are being devised to render air transport safe and certain; wireless has been enlisted in the effort; the Neon beacon and the leader cable illustrate the manner in which aviation, in its desire to put safety first, calls other sciences to its aid. The meteorologist is asked for frequent weather forecasts and is told that there is an urgent need for information as to the nature of gusts in the wind, their intensity, and the rapidity with which they change both in direction and amount. In all directions aeronautics rests on investigation and research.

Aerodynamics

Since a sound theory is the basis of good practice, we commence the detailed study of our subject with aerodynamics, dealing with the laws which regulate the flow of air and the motion of bodies through the air. Here the advances have been marked; not that the practice of flight has lagged behind, as will be clear when we come to treat of the design and structure of aircraft, their navigation and their use as a means of transport ever growing in importance. But in England and indeed throughout the world, theory and practice have gone hand in hand, pilots have appreciated the work done in laboratories and, by the aid of wind tunnels, have been ready to test the conclusions of the theorist, and have dared unhesitatingly to carry out the manoeuvres required for the verification of his theories.

Aerodynamics is a branch of the larger subject of hydrodynamics, which deals with the motion of fluids in general, but as its name indicates has been concerned with the properties of the all-pervading fluid, water, or rather with those of a simplified water, identical in some of its main properties with water, but still differing from it sufficiently to allow the mathematician to solve his otherwise intractable equations.

The main difference is the assumed absence of any action of a frictional nature either between the particles of the fluid themselves or between those particles and the surface of any solid which may be moving through the fluid; the fluid is said to have no viscosity.

Now one of the results of this assumption is that if a solid, of which the surface is free from sharp edges or entering angles, be moved uniformly through such a fluid it will experience no resistance, unless the velocity exceeds a certain limit depending on the shape of the solid; the fluid moves smoothly round the surfaces of the solid and the lines of flow, the streamlines, unite where they meet and pass off together; the resultant pressures balance and there is no force on the solid. But if the velocity be too great, or if the body have a sharp edge, theory shows that the pressure at some point of the surface becomes negative; now a fluid cannot support a tension or negative pressure, the motion therefore breaks down. Streamlines leave the body at different points enclosing a mass of dead water which is dragged along by the solid; the surface pressures no longer balance and the solid experiences resistance. A streamline shape, *e.g.*, an airship hull or a fish's body, is a shape in which this failure to maintain streamline motion and to avoid the dead water does not occur at the velocities at which the body is required to move and which therefore would experience no resistance.

Viscosity, etc., of Air.—But real air and water differ from the hydrodynamical fluid in that they have viscosity; air, moreover, can become pressed into a smaller volume, though this property does not greatly modify the motions with which we are concerned; the viscosity, however, is all important and the enquiry as to its effect on the conclusions just drawn is vital. It is here that aerodynamics has made some of its most marked advances during the period since the World War.

In a narrow band close to the surface of the body which we are considering (*e.g.*, an aeroplane wing) moving at right angles to its edge, the motion is modified greatly by viscosity; the layer of air adjacent to the surface sticks to it and is drawn forward with it, and the motion thus caused is communicated to the adjacent layers and superposes on the streamline motion a circulation round the wing opposite to the direction of motion above the wing, and with it below. The velocity above the wing is thus increased, and the pressure reduced relative to the streamline flow, while below the wing the reverse is the case; thus the circulation which we may regard as a vortex or whirl round the wing causes an upward forced lift on the wing.

Friction Factor.—Again, the friction between the layers of air adjacent to the surface shows itself as a drag on the wing, while eddies are set up in the boundary of the dead water, due in part to the friction between it and the rapidly moving streams by which it is surrounded, and these add to the drag. If we consider the case of a wing the span of which is very long (infinite in a mathematical sense) in comparison with its chord, the motion will all take place in planes at right angles to the front edge, and will be the same in any such plane; the loading on the wing will also be uniform. In this case expressions have been found for the lift and drag.

We owe to Lanchester the original conception of this vortex motion round the length of the wing, and to Prandtl and his school the original development of the mathematics, while the problem has been carried further by other workers, notably Glauert at the R.A.E. and Monk in America.

The fact that the wing is finite in length modifies the conditions near the ends; in consequence the simple expressions for the lift and drag need corrections and these have been evolved by making an assumption as to the manner in which the loading falls off as the wing tips are approached. Experiments at the National Physical Laboratory and elsewhere have shown a good agreement with the theory which thus constitutes one of the most notable advances of the past few years. But many more are described in some detail in the section on Aerodynamics and the rest of the articles; among these we may pick out as vital the growth of our knowledge in the means of controlling an aeroplane in flight, especially when at or above the stalling incidence, or when performing difficult manoeuvres, such as spinning.

Spin Factors.—The spin is a method developed during the War for causing an aeroplane to lose height rapidly; its nose is pointed downward and as it descends it spins about an axis approximately vertical. At the same time a method of bringing the machine out of the spin was devised. But in some cases the method failed. Why? This question has led to a whole series of

investigations, in part theoretical or on models in the wind tunnels, in part, full-scale, involving daring flights by skilled pilots, aimed in both cases at the measurement of the forces on an aeroplane when spinning and the discovery of the laws which govern that motion; as a result we know now far more about the dynamics of a spin.

Or again accidents occur most frequently as a result of forced landings. As the speed drops there comes a point at which the controls cease to act; the machine is said to be stalled. How does its condition differ from that of a machine in ordinary flight, what are the peculiarities of the motion of the air about the machine which lead to this disastrous result? It is a problem on which many keen minds have been exercised in the near past, both from the theoretical and practical side, and, though a complete solution has not been reached and there is much to learn, work resulting in a larger rudder and a combination of wing-slots and ailerons has shown that experimental machines can be controlled with safety at speeds considerably below the stall.

The Langley Field Wind Tunnel.—In concluding this description of the more purely theoretical advances reference must be made to the high pressure wind tunnel at Langley Field, Virginia, U.S.A. The meaning of the term Reynolds number is explained in the article AERODYNAMICS and the necessity, if model experiments are to be compared with those of full scale, that they should be concluded either at the same Reynolds number or under conditions where the effect due to a change in the number is not marked. This result the high pressure tunnel has enabled us to reach and the detailed conclusions of the work carried out by the able staff employed at Langley Field were eagerly awaited in 1926.

DESIGN AND STRUCTURE

And so we pass on to matters concerning design and structure. Here we notice at once a marked difference between air and land transport. The railway wagon or the motor-lorry rests on the ground; their weights are carried thus. Ships and aircraft are supported by the medium through which they travel and in the case of aircraft heavier than air the motor must provide not only the means of propulsion but also support. This it does as a consequence of the speed at which the aeroplane travels, but it follows that light-weight construction is essential. Strength too is needed and the problem of the designer is to combine strength and lightness in a form which will experience small resistance to rapid motion. In this his problem differs from that of the bridge-builder or the engineer; they, it is true, do not wish to waste material but at the same time a reduction of the weight of the structure they are designing by a few pounds is rarely important; to the aero engineer it is essential. Thus a host of new problems arise. Five years ago an aeroplane almost without exception was built of wood and wire and canvas; while wood is still the rule, all-metal aircraft exist and promise to replace the wood. Metal construction renders desirable new designs and methods of construction and the demand for a light but strong metal calls for difficult and accurate research into metallurgical problems (*see* ELECTROMETALLURGY; METALLURGY).

Lift and Drag.—Again, the lift and drag depend on the speed of the aeroplane, varying as the square of the speed; so that if with a given wing we increase the speed to obtain a greater lift we are met also with a greater drag. But the proportion the lift bears to the drag depends on the shape of the wing; thus we are confronted by the problem of selecting a form of wing which has a high ratio of lift to drag and is free from such other disadvantages as a large displacement of the centre of pressure (the point through which the resultant lift acts), the variations in the angle which the wing makes with the direction of motion.

Safety First.—Once more safety is of the first importance and thus the aircraft must be controllable, completely under the command of the pilot, but it must also be stable within limits, *i.e.*, it must, if for any reason it is caused to deviate from its desired course, tend to return to that course and not require the unison between the eye and hand of an ever-watchful pilot in order to prevent disaster.

In early days the attainment of many of these desiderata was a matter of chance; now the designer sets before himself a definite aim and usually reaches it in his completed machine.

Special Purposes and Design.—And that aim includes the special purpose for which the machine is to be used; in years past a machine which could fly could be utilised for many diverse purposes, *e.g.*, bomb-throwing or passenger transport; now specifications are drawn giving in minute detail all that is required. In this connection an extract from the first Report of Imperial Airways—the company working the traffic from England to the Continent—which has been published is of great interest to all concerned.

After referring to the difficulties and to the high maintenance costs involved in the use of machines not specially designed, the report continues:—

> There is a prospect that the modern machines now coming along will be simpler in construction, require less expenditure of man-hours on maintenance, spend more of their time in the air earning, and being of more advanced design will not become so quickly out of date.

Airscrew and Engine.—We come now to the method of propulsion, the airscrew and the engine which drives it. The airscrew is used exclusively for this purpose and probably will continue to be so employed; it is of interest to notice the difference in this respect between a bird and an aeroplane; the wings of a bird both support and propel it; an aeroplane has wings to carry its weight, but an airscrew in rotatory motion is needed to give it speed. Nature has not fashioned an organ which can be maintained in continuous rotation about an axis.

The Airscrew and its Problems.—The airscrew of to-day is made of metal more often than in the past, but its shape and its efficiency, which is very high, have not been greatly modified. Much more, however, is now known of the theory of an airscrew and the mechanism of the air motions by which the rotational energy driving the screw is transformed into the translational energy which propels the aircraft. It is now fully realised that the blade of a propeller is an aerofoil or aeroplane wing in rapid circular motion about one end. An aeroplane wing is ordinarily driven forward in a straight line in a direction at right angles to its length, and lift and drag forces result; the one acting at right angles to the wing and lifting it, thrusting it upward in a direction perpendicular to that of its motion, the other dragging it back and requiring the action of an external force to maintain the motion.

If now the wing be spun about an axis perpendicular both to its chord and its span and passing through one tip, similar results follow; each section is moving forward, though with a speed which varies as its distance from the axis; each section experiences a lift and a drag, varying of course from section to section, but the lifts combine to form a force thrusting the wing parallel to the axis, while the resultant of the drags is a torque or twisting force about the axis which requires to be balanced by an impressed torque if the motion is to continue.

Thus the torque about the axis, produced by the engine, becomes a thrust parallel to the axis driving the wing in that direction. An airscrew has two or four such blades placed symmetrically round the axis and shaped suitably to produce, for a given speed of revolution, the maximum thrust.

The great advance of the last few years has consisted in the fuller appreciation of this similarity and the realisation of the fact that the methods of calculation outlined above as applicable to the wings of an aeroplane, the circulation theory of the lift, apply also to the action of the airscrew. Vortices are formed around the blades of the screw and it is to these vortices that the thrust is due.

Engine Problems.—But power must be supplied to the airscrew if the machine is to fly, and it was the advent of the internal combustion engine that made flying possible. And here again weight is the essence of the problem; weight includes not only that of the engine itself but that of the fuel it burns and of the oil which makes its motions possible. A comparison of the data as to engines given in any of the earlier text books with those

printed in the present article shows what the advance has been, an advance due to many causes. Metallurgical research has given strong metals capable of standing the high temperatures requisite, while at the same time it has provided us with lighter metals of strength sufficient for the purpose with improved thermal conductivity and other advantages. Thermodynamic reasoning points out the need for a high compression ratio in the cylinder and experiments of great delicacy are guiding us to understand more clearly the nature of the combustion which takes place there, the meaning of detonation and some of the means of avoiding it. The valve mechanism has its own difficulties and some of these may perhaps be overcome by the use of a sleeve valve type of construction; in all directions there has been advance, and some engines are far superior for their purpose to those left us by the World War.

Navigation Problems.—And now, having described the machine, its structure and its methods of propulsion, we come to the consideration of its navigation through the air, the difficulty of knowing the vertical when flying out of sight of land, the mysterious behaviour of the compass under certain conditions, first unravelled at Farnborough by Keith Lucas, the new compasses much improved by recent work, the problem of straight flying in a fog, turn indicators, gyro controls and the like, wireless direction-finding and the methods devised for night landing at an aerodrome. In all these directions advances of no small amount have been made, and while there is much to learn the progress has been great.

Commercial Aviation.—Commercial aviation is almost a new idea since the War and embraces a wide field of enquiry. Air transport began under serious difficulties, but from the day when, in 1919, the Air Transport and Aviation Co. dispatched its first aeroplane to fly on a regular commercial service to the present time the progress on the whole has been one of marked advance—advance accompanied by setbacks due to ignorance of the problems to be solved and want of experience as to the methods of meeting the difficulties (*see* FLYING).

Airships (*q.v.*) are described in a separate article drawing attention to two important assets distinguishing airships from aeroplanes. The one is the advantage derived from increase of size, the other the ability to remain aloft without use of power. A clear account of the principles which must guide airship development follows and then we have details of construction of a modern sized ship with particulars of its possible performance and carrying capacity. The advantages which follow from mast-mooring are fully pointed out. The article on SEAPLANES (*q.v.*) deals with flying boats and seaplanes. The problems calling for solution when seacraft are in the air do not differ essentially from those which have to be solved for land-craft. Rising from and alighting upon water, however, involve fresh considerations. The boats and floats are so constructed that when, after starting from rest on the water, a certain speed is attained—the tramp speed it is called—the craft rises in and planes or skims over the water. Up to this point the resistance has increased with increasing speed; as the "tramp speed" is passed there is a marked drop in resistance, for the same expenditure of power the craft begins to move more rapidly, attaining finally its flying speed when it rises in the air. The determination of the "tramp speed," and the proper adjustment of airscrew and engine to attain a full efficiency at this speed, constitute a difficult problem for the designer. Again the impact caused by landing on the water sets up serious stresses in the hull calling for most careful design to combine the necessary strength and lightness. (R. T. G.)

AEROPLANE.—The main problem that confronts the designer of any means of transport is to find a working compromise between the various demands of those who maintain and use the service. There is no conflict between the interests of the operator and those of the user. Their common requirements are safety, speed, comfort and adherence to a published time-table. These all influence the cost of the service, but the measure of each which will enable a service to pay its way can be found only after more experience than is yet available in air transport. The way in which the need for safety reacts on the design of aeroplanes[1] is referred to below, and for information on what has been achieved the article FLYING should be consulted.

Adherence to a time-table involves, from the point of view of design, a general robustness of details and attention to the facility with which minor replacements can be made. Comfort requires a certain minimum space and weight of equipment for each passenger, and an improvement in general means simply a fall in the paying load per aeroplane and hence a rise in fares.

The main advantages which air transit has to offer as a compensation for a reduced measure of safety, comfort and reliability, are speed and freedom from interruption. The air is the only medium of transport which connects, without interruption, all places on the globe, and it may be anticipated that the consequent possibility of transit free from "changes" may prove to be nearly as valuable as the speed which can be maintained.

Stalling Speed.—For reasons which are explained in the article AERODYNAMICS a normal aeroplane, such as those illustrating the article FLYING, cannot be maintained in flight below a certain minimum stalling speed, which, for a modern commercial aeroplane, with fixed wings,[2] varies between 50 and 65 m. per hour. On the other hand, it is possible to give it an engine powerful enough to drive it at between 90 and 120 m.p.h. while leaving a margin of some 25% of its total weight for passengers or goods.

The impossibility of steady flight *below* the stalling speed constitutes the chief danger of air travel. Many attempts have been made to avoid this source of danger by devising an aeroplane which would be capable, as a whole, of remaining stationary in the air. Such machines have generally employed either flapping or rotating wings, the so-called ornithopters and helicopters. The former have shared the legendary fate of Icarus. Of the latter there is at the moment only one example which offers a prospect of success. This, the de la Cierva Autogiro, is, however, fundamentally similar to an aeroplane with fixed wings, in that the rotation of its wings depends on a forward movement of the whole machine through the air, which in turn is attained by means of an ordinary engine and propeller, or airscrew, with horizontal axis. Hence the machine cannot "hover," but its minimum speed is much lower than that of any existing aeroplane. On the other hand, it seems to be inherently less economical of power than an ordinary aeroplane. It appears therefore that its application will be rather to circumstances where the very low minimum speed which at the moment of touching the ground may be as low as 10 m.p.h. and consequent ability to land safely in emergency in confined spaces are of special value, than to normal commercial aviation.

Minimum Speed of Flight.—There is no fundamental obstacle to reducing the minimum speed of a normal aeroplane to some 25 m.p.h., instead of the 50 to 65 m.p.h. quoted above as typical of modern practice. In fact the earliest flying machine had minimum speeds of this order. But the general proportions of such a machine would be uneconomical from every other point of view. In particular almost the whole of the available weight would be absorbed by the structure and power plant, leaving no margin for paying load.

The relation between the total weight (W lb.), the area[3] of the wing (S sq. ft.) and the aerodynamic coefficient (k_L) which determines their lift at any given speed (V ft./sec.) (*see* AERODYNAMICS) is

$$W = k_L \rho S V^2,$$

ρ being the density of the air.

This may be put in the form[4]

$$V = 14\sqrt{\frac{W}{k_L}} \text{ miles per hour}$$

[1] This article deals only with aircraft which are "heavier than air."

[2] The movable flaps or ailerons at the tips of the wings of such an aeroplane are control surfaces and are referred to below.

[3] The area of the wings of an aeroplane is the sum of the areas of each separate plane (if there are more than one). The area of each plane is the area of its projection on a plane (in the strict sense of the word) through its front and rear edges.

[4] For standard ground level density.

where $w = W/S$ and is called the wing loading, in pounds per square foot. Fig. 1 shows the possible combinations of w and k_L which will give any selected speed. Fig. 2 shows the cross section by a vertical plane parallel to the direction of flight of some modern wing sections. For these the maximum value of k_L (which in virtue of the above relation corresponds to the minimum flying speed) is between 0·55 and 0·65, represented by the shaded band in fig. 1. Modern commercial aircraft using such wings have loadings between 9 and 14 lb. per square foot. A reduction in the stalling speed can be made only by reducing the wing loading or by using a shape of wing section which

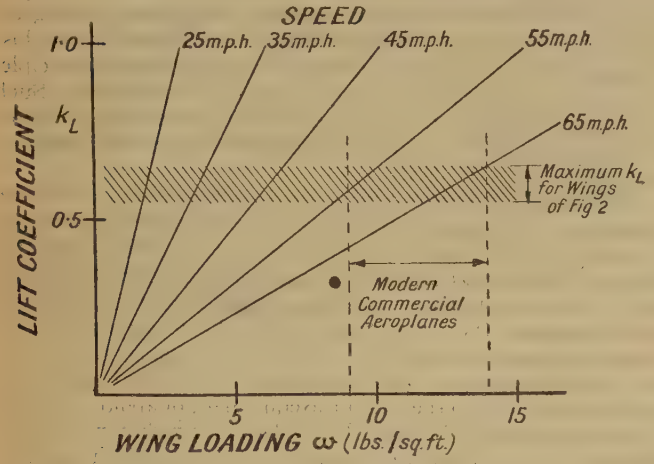


FIG. 1.—Diagram showing the possible combinations of wing loading and lift coefficient which will give any selected speed.

will give a higher maximum value of k_L. The former course leads to a reduction in the paying load. Much attention has therefore been devoted to the latter method.

The most effective of the high lift wing sections which have been devised as yet is the slotted wing of F. Handley Page (fig. 3). With this the maximum lift coefficient can be increased some 50% or more. The action of the device is, broadly speaking, to cause the flow characteristic of stalling (*see* AERODYNAMICS) to occur at a larger angle of incidence.[1] The increase in lift is dependent on the relative position of the main and auxiliary wings, *i.e.*, on the size and shape of the slot between them, which can be varied in flight. With the slot closed the characteristics are nearly the same as those of a normal wing. In this respect form, a, (fig. 3) is superior to form, b, but in practice there are, with both, constructional difficulties in the way of ensuring a smooth and unbroken surface when the slot is closed.

Another method which has been widely used, is to vary the curvature, or camber, of the wing (fig. 4). In general, the greater the curvature of a wing section the higher is the maximum lift, but the lower the efficiency at high speeds. This device attempts to secure both high lift and high efficiency by enabling the pilot to alter the curvature to suit the conditions of flight. The increase of lift attainable in this way is much less than can be

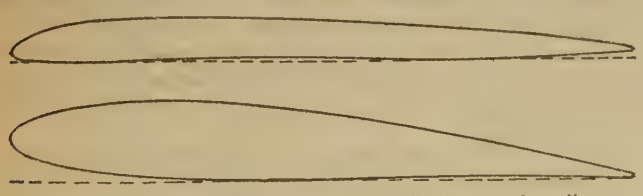


FIG. 2.—Cross sections of modern " wing sections."

achieved with a slot, the maximum being about 10%. An automatic form of this device has also been used, the trailing flap being held down by elastic cord and therefore rising as the air pressure increases, *i.e.*, as the speed increases. By combining both these methods very high maximum lifts have been obtained, and it is probable that such a combination will be used on civil aircraft in the near future.

The chief obstacles to the use of these variable wings in commercial aircraft are, first, the increase in weight involved, not only in the devices themselves, but also in the larger control surfaces which they require; second, the lack of a clear demand on the part of those who travel by air for a reduction in stalling speed. The increase in weight is not as great as the increase in lift (at the same speed), but the whole aeroplane is appreciably more costly, and in the absence of adequate credit for the benefits derived it is natural that designers should hesitate to adopt such devices.

[1] Angle of the chord to the direction of flight. The chord of the wing sections in fig. 2 is indicated by a broken line.

POWER REQUIRED FOR FLIGHT

When an aeroplane of conventional design and normal proportions is flying horizontally[2] the power of the engine is disposed of in the following ways:—

(*a*) About 25% is lost owing to the inefficiency of the airscrew.
(*b*) From 30% to 45% is used in overcoming the resistance of the air

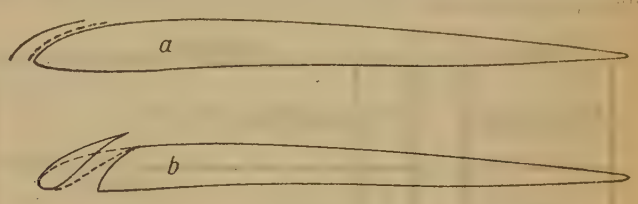


FIG. 3.—Handley-Page " slotted wing."

to the passage of the body, including the engine itself, the undercarriage and the exposed part of the wing structure, etc. (*c*) From 45% to 30% is similarly absorbed by the resistance of the wings.

The choice between the alternative figures in (*b*) and (*c*) depends on the speed of flight, the former corresponding to low, and the latter to high speeds. The resistance of the parts included in (*a*) varies practically as the square of the speed of flight, and the corresponding power therefore as the cube. The resistance of the wings (*c*) may be further subdivided as follows:—

(*c*)1. From a third to three-quarters is due to the equivalent of friction of the air on the surface of the wings. (See the profile drag.) This varies as the square of the speed, and the power as the cube. If the area of the wing is changed, the profile drag changes in proportion. Each wing section has a typical coefficient of profile drag, and, apart from maximum lift, this is in fact nearly all that distinguishes one section from another.

(*c*)2. From two-thirds to a quarter is due directly to the action of the wings as generators of a lifting force, the induced drag of Prandtl (*see* AERODYNAMICS). This varies inversely as the square of the speed, and the power therefore inversely as the speed. It does not depend on the shape of the wing section, or on the area of the

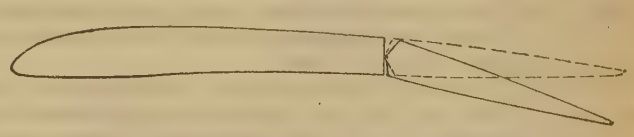


FIG. 4.—Method of varying curvature of wing.

wings, but (for a given lifting force, *i.e.*, weight) only on their overall width or span, being inversely proportional to the square of the span. This induced resistance is the essential feature in which transport by aircraft heavier-than-air differs from all other methods, for in no other form is it necessary to expend energy in order to sustain the vehicle. About 8% of the fuel used by a normal aeroplane is used in this way (fig. 5).

This division of the resistance of the wings into two parts, one of which increases with the speed of flight, while the other decreases, the former dependent (broadly speaking) only on the section and shape of the wings, the latter independent of these factors and governed by the extent to which the span of the wings allows the aeroplane to " grip " the air (*see* AIRSCREW), was originally suggested by F. W. Lanchester. It lay dormant for some years, largely because there was not forthcoming any adequate theory by means of which it would be given quantitative expression in terms of the dimension of the wings. This expression has been rendered possible by the work of L. Prandtl of Göttingen and his collaborators, with great advantage to the technique of aeroplane design. Its chief merit is that it enables a designer to examine the economics of wing proportions without continual resort to model experiments. It has been abundantly verified by comparison with experiments, both in Great Britain

[2] In air of a given density.

and elsewhere, and its applications have been extended by workers in Great Britain, in particular H. Glauert.

The experiments made have not enabled its fundamental ideas to be verified directly, but have shown that it adequately accounts for very varied observations. Many engineering theories stand on a similar footing.

In normal flying conditions, as opposed to the special conditions characteristic of arising from and alighting on the ground, the speed of an aeroplane may vary from 1·2 to 2·0 times its stalling speed. The upper nine of these two figures can be raised by the provision of more power, that given corresponding to a machine having about 60 B.H.P. for each 1,000 lb. of total weight, which is a normal figure for a commercial aeroplane. At its top speed the engine is working at its full power, which is not an economical condition from the point of view, either of the life of the engine or of fuel consumed per ton-mile. The most

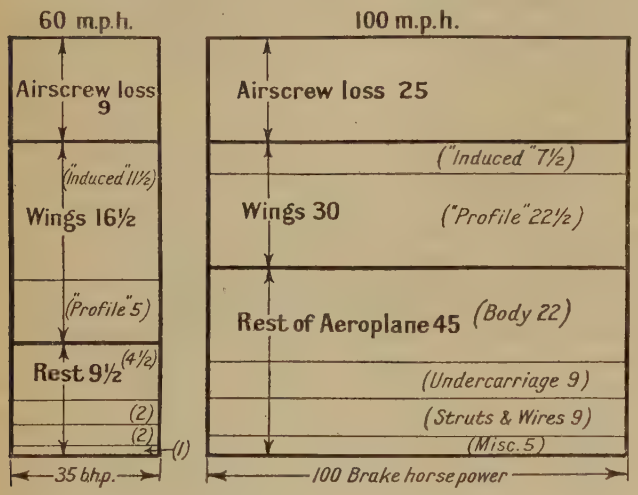


FIG. 5.—Diagram showing how the power required for flight depends on the speed.

economical speed, taking into consideration all the various factors, is about 1·5 times the minimum speed. The diagrams in fig. 5 show the way in which the power required for flight depends on the speed, and incorporate the figures given above relating to the distribution of the power among the various parts. The maximum B.H.P. of the engine has been taken to be 100 and the minimum speed 50 m. per hour.

These diagrams illustrate the rapid rise of power required with the speed of flight. For such an aeroplane the most economical speed would be about 75 m.p.h., requiring about 50 brake horsepower. If the engine throttle is fully opened at the lower of the two speeds considered above, the aeroplane will climb. The angle of climb for modern commercial aeroplanes is from 1 in 10 to 1 in 15. For high-powered war machines it may rise to 1 in 6, or more.

When the engine is cut off, the aeroplane will lose height, its path being inclined downwards at a corresponding angle, and the necessary power will be supplied by gravity. The angle of descent for a modern aeroplane is from 1 in 6 to 1 in 8. Thus a passenger in an aeroplane will not in general be subjected to greater changes of inclination of the direction of motion than one who travels by road.

Improvement of Performance

The above proportions apply without material change to most modern commercial aeroplanes. The main directions in which improvements in the efficiency of the machines are being sought are as follows:

Airscrew Efficiency.—A loss of between a quarter and a third of the power of the engine in the transmission gear would hardly be tolerated in road or rail transport. Transport by water, however, is burdened by a loss identical in character and of similar amount. It arises from the fact that the propulsive force is obtained by driving a fluid backwards. (*See* AIRSCREW.)

Resistance of the Body.—The majority of aeroplanes have in the nose of the body either an air-cooled engine, or a water-cooled engine with a radiator. With this arrangement the resistance of the body cannot be separated from that which is incurred in cooling the engine. This latter is equivalent to a reduction in the power of the engine of from 15% to 25% at the cruising speed of a normal commercial aeroplane. At higher speeds the loss is greater.

It is natural to endeavour to recover some of this by placing as much as possible of the load carried (fuel, crew, passengers) behind the radiating surfaces. But a large part of the loss remains, because such parts as these could, at least in principle, be placed in a stream-line body of very low resistance. Such bodies would, however, be heavy, and the conventional tractor aeroplane is by no means a bad compromise, especially when an air-cooled engine is used.

When a very high speed is required, as for example in racing aeroplanes, the cooling resistance can be completely eliminated by using a water-cooled engine in combination with a radiator whose cooling surface is part of the smooth surface of the wings. Such a radiator is heavy and is exposed to damage, reasons which prevented the development of the scheme during the War. It has, however, been used in the United States, by the Curtiss Co., and the success of their aeroplanes in the recent speed contests is largely due to the use of the equivalent of about one-third of the wing surface of a normal aeroplane as a radiator. But the consensus of the opinion of designers in Great Britain appears to be that it is as yet unsuitable for employment in commercial aeroplanes.

Resistance of the Undercarriage.—The undercarriage of an aeroplane has a high resistance, mainly due to the wheels. If the wheels could be withdrawn into the body in flight an appreciable gain would result. Mechanical difficulties are involved owing to their large bulk, but the problem is worthy of attention.

Resistance of the Bracing of the Wings.—There has been a tendency, more noticeable in American, Dutch, French and German than in British designs, to eliminate external wing bracing entirely. There is little doubt but that this results in a heavier structure and a relatively less economical aeroplane than one in which a less extreme construction is adopted—an example of a general principle of all engineering design that extremes are seldom economical. The matter is dealt with below. But it may be remarked that there has been apparent for some time a tendency to reduce the amount of exposed bracing, of all kinds, without entirely eliminating it.

Distribution of Weight

Fig. 6 illustrates the relative proportions of the total weight taken up by the various sections into which it is convenient to divide the component parts. The figures apply to an average commercial aeroplane of moderate size. The distribution of weight varies little from one machine to another, even over a considerable range of size, provided the minimum speed, the cruising speed and the duration of flight are kept fixed.

Structure.—The "structure" includes a great deal which is not part of the essential structure of the aeroplane. A change in the specified strength affects about 60 to 70% only of the nominal structure weight.

Weights.—The weight of the power plant depends mainly on the desired maximum speed of the aeroplane, and on the weight of the engine and its equipment per brake horsepower. There is generally a notable reduction in this item if an air-cooled engine is used instead of a water-cooled engine. The weight of fuel and tanks is dependent on the speed and duration of flight specified, and on the standard of fuel economy reached by the engine. The latter factor varies little for modern engines, both air- and water-cooled engines now giving one B.H.P. hour for about ½ lb. of petrol. The crew and equipment tend naturally to absorb a progressively smaller proportion of the total weight as the size of the aeroplane increases; this is an important advantage possessed by the large aeroplane.

Paying Load.—The paying load, being the balance after the

above items have been accounted for, is from 20 to 30% of the gross loaded weight of the aeroplane. Compared with other means of transport this is a high proportion. For example, a modern motor-car of medium power, weighing some 2,500 lb. empty, will carry four passengers and a driver, equivalent to a paying load of some 650 lb. or 20% of the whole. Both a railway train and a ship carry a much smaller percentage of paying load. That all

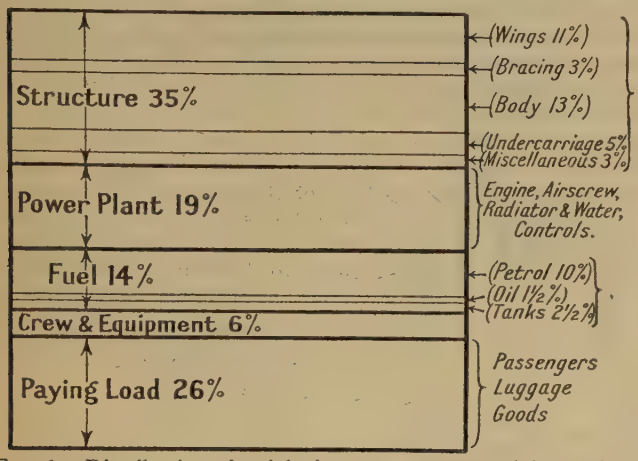


FIG. 6.—Distribution of weight in average commercial aeroplane.

these means of transport are able to offer lower fares than aircraft is due partly to the high running costs of an aeroplane per passenger mile, but mainly to the fact that the majority of travellers are not yet convinced that air transport is safe, and therefore do not use it.

The essential need for economy of weight in aircraft is due, not to the fact that only one-quarter of its weight is available for paying load, but to the high cost of carrying this load by air, as compared with other ways. A saving in the weight of some part of the aeroplane of 1% of the whole allows a reduction of the cost of transport by 4%.

External Form of Aeroplanes

There is a striking lack of variation in the appearance as seen in plan of all modern aeroplanes. The main wings have a large span (fig. 7) in relation to their chord, the average ratio of span to chord being about seven. This is a direct consequence of the fact that the resistance due to the generation of lift varies inversely as the square of the span. In some aeroplanes the chord diminishes towards the tip of each wing (fig. 7b) and occasionally the wings, although of uniform chord, are "swept back" (fig. 7c). Neither of these modifications affects the aerodynamic efficiency appreciably.

Ailerons.—Near the tip of each wing is an aileron or wing flap hinged about axes 1·1 (fig. 7a) and interconnected so that an upward movement of one is accompanied by a downward movement of the other. They are operated by a sideways movement of the pilot's control column, and are the means by which the wings are kept level in straight flight, or banked for a turn, as may be required.

Tail Plane.—At a distance of some three chords behind the leading edge of the wings is the tail plane, in area about one-ninth that of the wings. In steady flight its function is to balance or trim the aeroplane, *i.e.*, to ensure that the resultant of all the air forces on the aeroplane passes through the centre of gravity. (*See* Aerodynamics.) It is generally in two parts. The front part, some 60% of the whole, is normally fixed, though means are provided by which the pilot can alter its angle of incidence by rotating it about an axis such as 2·2 (fig. 7a), thus enabling the aeroplane to be trimmed for flying at various speeds. This operation is analogous to trimming the sails of a ship so that it carries no weather or lee helm. In a modern aeroplane a movable tail plane is generally considered indispensable.

The Elevator.—The rear part of the tail, or elevator, is hinged on an axis such as 3·3 (fig. 7a), and connected to the control column in such a way that a forward movement of the pilot's hand depresses the trailing edge of the elevator and causes the machine to dive, and vice versa. The elevator is the primary control organ of an aeroplane, since by it the pilot alters the angle of incidence of the wings and hence controls the speed. Fig. 8 shows these and other control organs in more detail, and the forms which they take in more modern machines will be seen in the plate with the article on Flying.

The appearance of aeroplanes in front and side elevation is more varied than that in plan, owing mainly to the use of one or more planes. As many as four planes have been used on comparatively modern aeroplanes, but the great majority of existing machines have either one or two planes.

Monoplanes and Biplanes.—An analysis of the aeroplanes described in Jane's *All the World's Aircraft* for 1925 shows that,

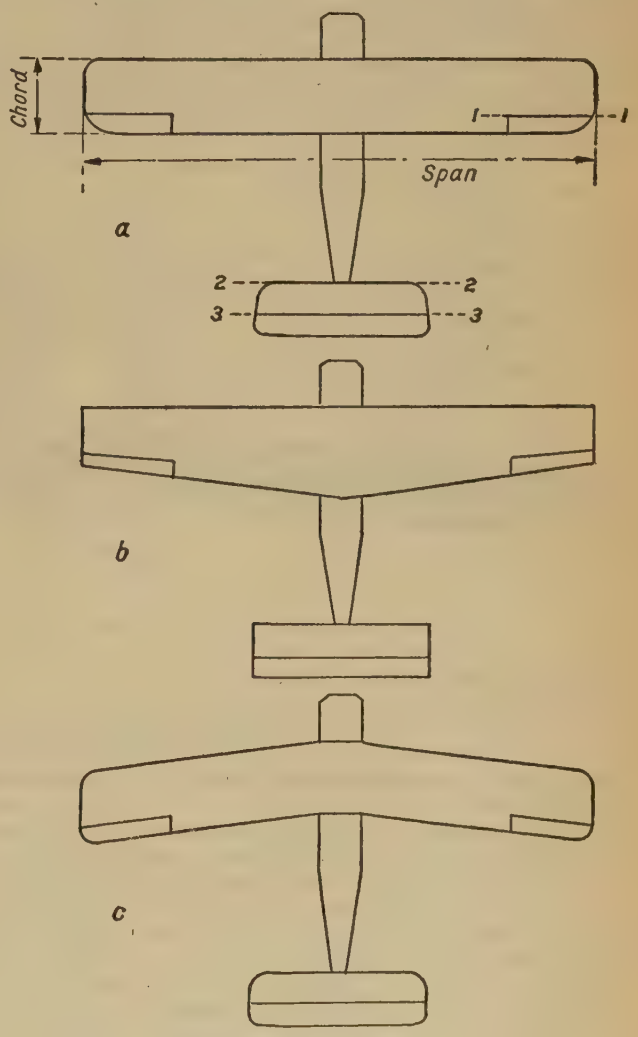


FIG. 7.—Comparison of plans of modern aeroplanes.

out of a total of nearly 400 types, 32% are monoplanes and 68% biplanes, with two triplanes and no quadruplanes. A similar analysis for 1922 gives, for rather more than half the number of aeroplanes, 22% monoplanes, 74% biplanes, with eight triplanes and one quadruplane. These figures show that the biplane is still the preponderating type, but that the proportion of monoplanes is increasing. The increase during the three years covered is divided between biplanes and monoplanes in the ratio of 9 to 7 approximately. This trend is due partly to the development of wing sections of great depth in relation to their chord, and partly to a desire to eliminate external wing bracing. It is much more conspicuous in foreign than in British design, as will be seen from fig. 9, in which separate analyses are shown diagrammatically for aeroplanes produced in Great Britain, France, Germany, the United States and other countries. It should be noted that the figures given above refer to types and include

both commercial and war aeroplanes and seaplanes. Some of these naturally exist only in small numbers, and some may be confined even to one experimental machine, but there is evidence that all have actually been made and flown. There is no room for doubt that had the above analyses dealt with numbers of aeroplanes, instead of types, the preponderance of the biplane would have been much greater.

The Monoplane.—Confining attention to monoplanes and biplanes, the chief variations in front elevation are shown in fig. 10. The parasol monoplane (a) is used mainly where it is desired to have some of the advantages of external bracing. The monoplane with body above the wing (b) has rather less resistance and is less liable to damage by wind when on the ground, an important advantage. The former type is the more numerous, and the ratio about 3 to 1, but the latter is favoured by the German firm of Junkers which has supplied a large proportion of the machines used on German air lines.

The Biplane.—The biplane with wings of equal span (c) is the most common form of aeroplane, but wings of unequal span (d) (sometimes called sesquiplane, *i.e.*, $1\frac{1}{2}$ plane) have many advantages. The proportion between types (c) and (d) is about 3 to 1. Fig. 10 (e) shows a large biplane with two or more engines.

In all these the right and left hand wings are not in line, but form a very flat upward Vee. This dihedral angle (which is generally given as the angle between either wing and the horizontal, and varies from 0° to 5°) is introduced in order to improve the lateral stability of the machine.

The corresponding side elevations of these aeroplanes are given in fig. 11. In a biplane the relative position of the planes as seen in this view varies as shown in (c), (d) and (e). In (c) and (d) the planes are staggered, *i.e.*, the line joining the leading edge of the upper and lower planes is not perpendicular to their chords. The angle of stagger is generally between 0° and 30° and a variation over this range has little if any effect on the efficiency of the wings. In (d) the chord of the lower wing is smaller than that of the upper wing, a common variant, especially when the spans are also unequal (fig. 10). In (e) the wings have equal chords and no stagger. The tail plane is here shown as a biplane, in which form its weight can be made low for a considerable area.

Set of the Wings.—The angle at which the chord of the wings is set in relation to the centre line of the body is generally about 5 degrees. Though often termed the angle of incidence, it has no connection with the accepted sense of that word. Its magnitude is the result of a compromise between a number of conflicting requirements, a not unimportant one being the comfort of the passengers. The true angle of incidence being determined by the speed of flight, it is desirable that the relative position of wings and body shall be such that in horizontal flight at cruising speed the body may be nearly horizontal. But the attitude of the body in relation to the wings has no effect whatever on their angle of incidence relative to the direction of flight. Failure to realise this has been responsible for many fruitless inventions of wings whose angular position on the body can be varied. The vertical stabilising and controlling surfaces, a fixed fin and a movable rudder, connected to a rudder bar on which the pilot's feet rest, are situated near the tail plane. They perform practically the same function as the rudder of a boat and can be seen in more detail in fig. 8.

Position of Airscrews and Engines.—In the above sketches the airscrews indicate the position of the engines. In modern aeroplanes the pusher position of the airscrew is seldom used except in single-engined flying boats, the vast majority of modern aeroplanes using tractor airscrews. When two or more engines are used, it is customary to distribute them along the wings, as the transmission of their power by means of shafts and gearing from a central engine-room to airscrews in suitable positions involves a prohibitive weight, which is generally not less than $1\frac{1}{2}$ lb. per H. P. transmitted, or about half the weight of the engine itself. As seen in front elevation the arrangements shown in fig. 12 have been used.

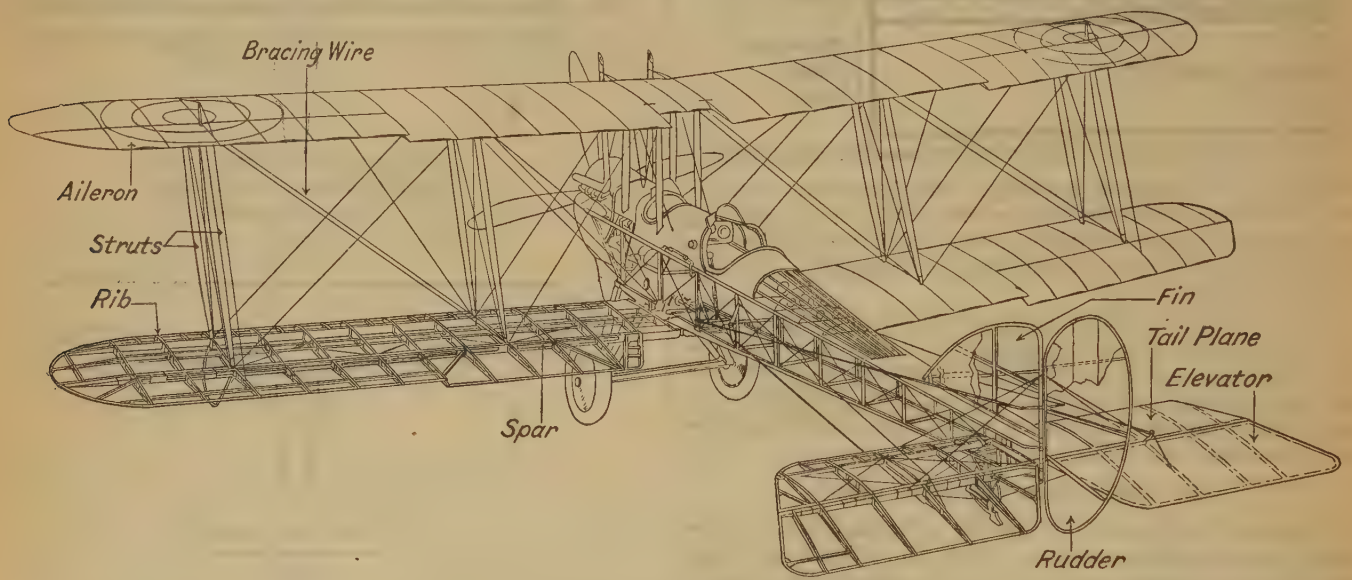


FIG. 8.—Tractor biplane of typical composite (wood and steel) construction. (Part of the covering of the wings, body and control surfaces is removed to show the internal construction.)

Considerations of rudder control in the event of the failure of one engine make it desirable to place the engines as near to one another as the airscrews permit. Overlapping airscrews have been used, but have generally given rise to troublesome vibrations. It is also desirable that the axes of the airscrews should be, as far as possible, on the same horizontal level as the centre of gravity, in order to avoid giving rise to couples tending to make the aeroplane rotate in a vertical plane when the throttles are altered.

STABILITY AND CONTROL

The general principles of stability and control are dealt with in the article AERODYNAMICS and the stabilising and controlling surfaces have been referred to above. The necessary disposition and dimensions of these surfaces are decided in practice chiefly by direct comparison with previous designs. Since, however, aeroplanes are not merely scale copies of one type, some rational means of using the accumulated experience of previous work is essential, and it is this that research into the fundamentals of stability and control is able to supply. Needless to say, even these methods break down when the aeroplane in question is not broadly similar to those from which the data are derived, and then nothing short of a thorough investigation, assisted by model

experiments, will suffice. Very often, even with the best that can be done in this way, uncertainties remain, and the designer is forced, as in other branches of engineering design, to rely upon his ability to draw conclusions from insufficient premises.

Stability.—Stability, the property of returning to a steady state of motion when deliberately or accidentally disturbed, implies as a necessary preliminary the existence of equilibrium of trim in that state. An aeroplane is trimmed for a stated steady condition of flight by an adjustment of its tail plane, the elevators being left free. The degree of stability generally considered desirable for a commercial aeroplane can be attained by arranging the size of tail plane and the fore and aft position of the centre of gravity within certain limits. The further back the centre of

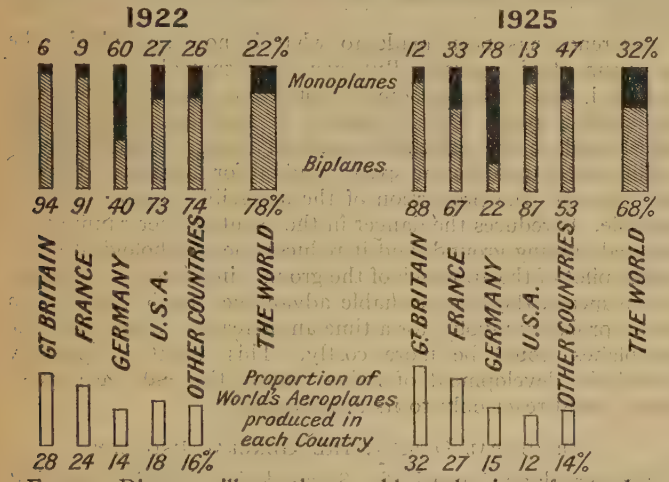


FIG. 9.—Diagram illustrating world production of aeroplanes. (N.B. The analysis refers to *types* of aeroplanes, not numbers of machines.)

gravity, the larger is the necessary tail area. The fore and aft position of the centre of gravity in relation to the wing is defined by its distance from a plane passing through the leading edge of the wing perpendicular to the chord for a monoplane; for a biplane an equivalent monoplane wing is substituted. In normal aeroplanes this distance is usually about one-third the chord, though it has varied between one-quarter and one-half. The height of the centre of gravity of an aeroplane in relation to the wings has a secondary effect on its stability. In particular a low position of the centre of gravity is not necessary for stability. With the first position stability will be secured providing the product of the ratios

$$\frac{\text{area of tail plane}^1}{\text{area of wings}} \text{ and } \frac{\text{distance of tail plane from centre of gravity}}{\text{chord of wings}}$$

is greater than about 0·35. The latter ratio is usually about 3, and the former one-eighth.

The fore and aft control required can generally be obtained if the ratio $\frac{\text{area of elevator}}{\text{area of fixed tail plane}}$ is about two-fifths.

Lateral stability depends mainly on the provision of an adequate fin and dihedral angle. While desirable for the comfort of the pilot, lateral stability is of minor importance compared with lateral control.

Aileron Control.—Ailerons of an area between $\frac{1}{12}$ and $\frac{1}{8}$ of that of the wings are usually provided, and give adequate control at all normal flying speeds. At low speeds, however (more accurately, at angles of incidence of the wings in the neighbourhood of stalling), not only are normal ailerons ineffective, but they may actually be a source of danger, their use aggravating an inherent tendency of the stalled wings to force the aeroplane into a spiral dive or spin. This has undoubtedly been a prolific cause of accidents, of a type which generally involves the deaths of all on board. As the result of research carried out in Great Britain under the auspices of the Aeronautical Research Committee means of curing this vice are now available. The most successful device so far developed involves the principle of the Handley Page slotted wing (see fig. 3).

[1] Including that of the elevator.

Rudder Control.—An effective rudder is as essential for safety at low speeds as effective ailerons. The efficiency of any given rudder depends on its being arranged so that the body does not shield it, but it is generally found that when the product of the ratios

$$\frac{\text{area of rudder and fin}}{\text{area of wings}} \text{ and } \frac{\text{distance of rudder from centre of gravity}}{\text{semi-span of wings}}$$

is above 1/20, a satisfactory control is obtained. The latter ratio is usually about 1, so that the former should not be less than one-twentieth. The area of the rudder is generally about ⅔ that of the rudder and fin combined.

Origin of Aerodynamic Data of Design

The designer bases his calculations on data derived from four main sources:

(1) Theoretical investigations, such as the Lanchester-Prandtl theory of the action of wings. (2) Experiments on

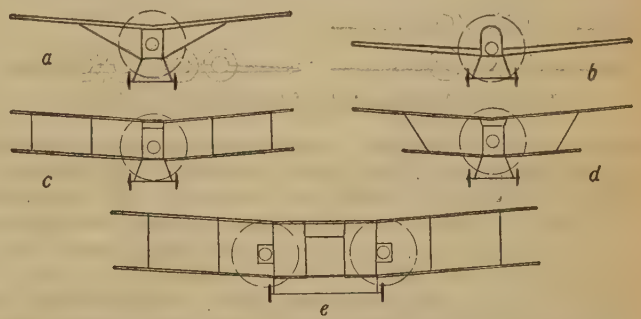


FIG. 10.—Variation in front elevation of monoplanes and biplanes.

models in wind tunnels. (3) Experiments on full scale aeroplanes in flight. (4) Analysis of the measured performance of aeroplanes. References to the first of these divisions will be found in the article on AERODYNAMICS, where also the principles underlying experiments on models are dealt with.

The Wind Tunnel.—The wind tunnel has played a great part in the development of aeronautics. Many manufacturing firms possess their own tunnels, used mainly for measurements of the resistance of aeroplane bodies, etc., with a view to improving performance. National wind tunnels exist in many countries, generally reserved in principle for research on problems of wide

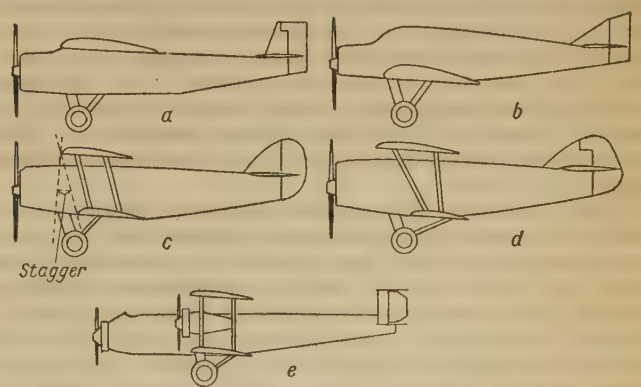


FIG. 11.—Side elevations of aeroplanes shown in Fig. 10.

interest and application. In Great Britain such tunnels exist at the National Physical Laboratory and the Royal Aircraft Establishment, while, as part of the equipment of university institutions where the scientific problems of aeronautics are investigated, wind tunnels were constructed as at East London College in 1910.

The main advantage of model experiments is the ease with which the experimenter can control the conditions. They enable suggestions for improvements to be developed to the stage at which a trial on the full scale is possible.

Most of the leading aircraft-producing countries carry out full scale experiments. In Great Britain they are made at the Royal Aircraft Establishment under the control of the Director of Scientific Research at the Air Ministry. Owing to the expense involved, private firms can do little work of this kind, but there is active co-operation between them and the Air Ministry, with great benefit to aeronautics. The results of such work will be found in the annual Technical Reports of the Aeronautical Research Committee.

The measurements of speed and climb which are made during the acceptance tests of all aeroplanes are a valuable source of

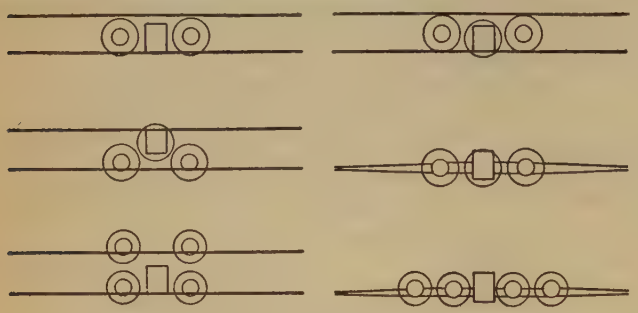


FIG. 12.—Arrangements of two or more engines.

information for the designer. Their analysis enables an overall comparison between various types to be made on a rational basis, but necessarily lacks something in precision. For each type differs from the others in many features, so that, for example, an observed difference in speed cannot safely be ascribed to any one peculiarity. But with suitable precautions reliable information can be obtained in a convenient form. It is found that the factors which have the greatest influence on the speed and climb of an aeroplane are the horsepower per unit of total weight and the total weight carried per unit of wing surface. For further details of the method, and its limitations, references given should be consulted.

SAFETY OF AIR TRAVEL

The risks to which those who travel by air are exposed are probably the chief influence which hinders the development of air transport. These risks are associated with the following causes: (1) physical failure of the pilot, (2) fire when in flight, (3) collision when in flight, (4) breakage of the structure, (5) forced landing. Dangers of the first four types are not peculiar to aircraft and the precautions they involve are common to transport by road, rail and sea. The measures adopted in air transport have practically eliminated them. It is mainly the dangers which may arise when an aeroplane is forced to land that loom large in the minds of those who might otherwise travel by air. While it cannot be said that these fears are unwarranted, yet in so far as the design of aircraft is involved the position was rapidly improving in 1926.

Forced Landings.—The need for a forced landing arises primarily from failure of the power plant, generally due to a defect developing in some minor part and not to a breakage in the engine itself. Deprived of its power an aeroplane must eventually descend. In practice, from the height at which most civil flying takes place (about 3,000 ft.), about three minutes are available in which the pilot may choose a landing place. If the failure occurs before the aeroplane has reached its working height, the time, and the corresponding area of ground in which this landing place is to be found are reduced in proportion. These considerations unfortunately result in the pilot having to execute somewhat sharp turns in order to place the aeroplane correctly, and it is during these that the control ability of the machine is most severely tested. The ultimate danger lies in the fact that the speed of horizontal travel at the moment of landing cannot possibly be less than the stalling speed. In practice with a typical commercial aeroplane it will be between 65 and 75 m.p.h. The pilot, therefore, endeavours to make the most of what space is available. This consideration, combined with the psychological effect of the apparent increase in the aeroplane's speed as the ground is approached,[1] lead him to carry out the manoeuvres at a low speed, where the inherent characteristics of the aeroplane are least favourable and the controls least powerful (see above).

The dangers associated with a forced landing may be reduced in three ways:

(1) The probability of complete failure of the power plant may be reduced by subdivision. Machines with three engines (see above) are now coming into favour, capable of maintaining their height with any two engines and of greatly prolonging the time of descent with one engine only working. (2) The controls may be so arranged that they give the pilot complete command over the attitude of the aeroplane right down to the stalling speed (see above). (3) The stalling speed may be reduced (see above), so that the space required for landing, and the consequent need for sharp turns, etc., are also reduced.

Reference has been made to what is now possible in the arrangement of controls. But even with controls as normally arranged, there is little room for doubt but that a limitation of the stalling speed of civil aircraft to some 45 m.p.h. would greatly reduce the principal danger of flying. A reduction in stalling speed reduces the space required for landing and therefore increases the proportion of the accessible ground which is suitable. It reduces the danger in the event of over-running the selected landing ground, and it reduces the psychological effect on the pilot of the approach of the ground, in the opinion of some by no means the least valuable advantage. Such a limitation would probably involve for a time an increase in fares, since the aeroplanes would be more costly. This might temporarily retard the development of flying, but in the end the gain in safety could react only to its advantage.

STRUCTURAL DESIGN: THE GENERAL PROBLEM

The aeroplane shown in fig. 8 was designed about 1914, but in its general aerodynamic and structural design it is not fundamentally different from the majority of modern aeroplanes. Regarded as a problem in structural design, a normal aeroplane wing, such as that shown in fig. 8, is a double cantilever, *i.e.*, two similar cantilevers joined at their roots, carrying a load distributed approximately uniformly over its span. The intensity of the loading begins to diminish appreciably at about one chord from the tip, but is still $\frac{3}{4}$ of its value at the centre, at a distance of $\frac{1}{5}$ chord from the tip. The wing itself is essentially a lamina, the wing sections most commonly used (see fig. 2) having a greatest depth of from $\frac{1}{14}$ to $\frac{1}{8}$ chord. The resultant loading is nearly perpendicular to the chord, but its line of action (as seen in side elevation) intersects the chord at a point (the so-called "centre of pressure") whose distance from the leading edge of the wing varies from $\frac{1}{3}$ to $\frac{1}{2}$ chord in normal flight, but may travel much further to the rear, even beyond the trailing edge—in special conditions. As a whole, therefore, the wing structure must be capable of taking torsion.

From general principles it would appear that the lightest way of bracing such a lamina would be to stiffen it internally by longitudinal and transverse beams, spars and ribs, and to support these by external bracing. The arrangement of two planes, one above the other, connected by struts and wires to form a braced tubular girder, suggested itself to the earliest experimenters in flight. Such a solution is seen in fig. 8 and is typical of the majority of modern aeroplanes.

Alternatively, by tapering the wing in plan (fig. 7b) and thus both reducing the intensity of loading outwards from the centre, though not, it appears, in proportion to the reduction of the chord, and increasing the available depth at the root, the whole of the necessary structure could be contained inside the covering. This is the principle of the internally braced wing characteristic of many foreign designers. It has the advantage of avoiding the resistance of the exposed bracing which is characteristic of the first solution.

Comparison of Monoplane and Biplane.—Many variants of these two main schemes have been used, but in general there is a clear division between them. The first undoubtedly produces a

[1] To a passenger in an aeroplane 1,000 or 2,000 ft. up, there is generally no sensation of speed relative to the ground.

lighter structure and a more compact aeroplane. For, with the same total weight and wing area, the biplane has a smaller span and chord and requires a shorter body and smaller tail.

With the aid of the Prandtl theory it is possible to arrive at comparative overall dimensions for a normal biplane and a monoplane of otherwise similar characteristics. Such a comparison is shown in fig. 13. The span of the monoplane, (full lines) is about 10% larger than that of the biplane (broken lines), and its chord 65% larger. The length of the body and the tail area required are each increased about 28%. Each type has other advantages and disadvantages, but the mere existence of many examples of each indicates that technical opinion is divided on

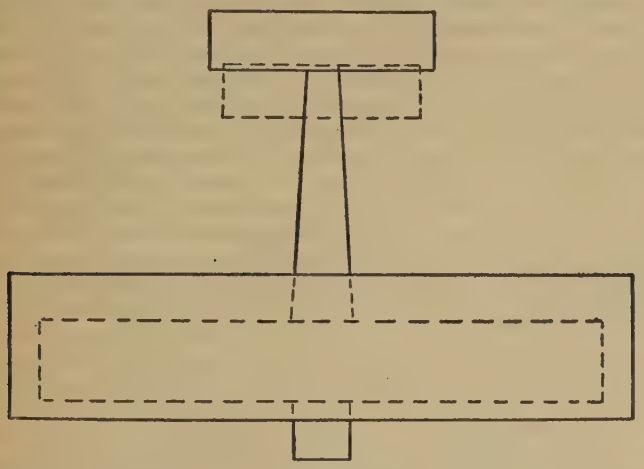


FIG. 13.—Comparison of plans of normal monoplane and biplane.

their merits, and to a great extent experience in the design and manufacture of one or the other is a dominating factor in the choice between them.

Refinement in Details.—The details of the structural design depend largely on the materials used (see below). But the main problems are not essentially different from those of the design of ordinary engineering structures, except in one particular. The importance of saving weight in every item of an aeroplane makes it economically possible to carry refinement in design to a point not usually attempted in any other structure. For the same reason elaborate calculations are made during the design, and the effect of every minor strengthening is carefully considered. All aeroplane structures are highly redundant and initial stresses are imposed on the members by tightening the bracing wires, in order to increase the stiffness of the structure. The design of modern aeroplane structures takes account of these features as far as it is possible to do so, in contrast to the general tendency of modern bridge design, for example, which tends to avoid them as sources of uncertainty (*see* BRIDGES). Where saving of weight is a prime consideration such a course is not possible.

Strength of Aeroplane Structures.—Since an aeroplane must be able to manoeuvre rapidly, many systems of air pressure, differing both in distribution and in intensity, must be taken into account. How rapidly it should manoeuvre depends on its class, *e.g.*, a small war machine must be able to execute safely any manoeuvre of which an aeroplane is capable, whereas less exacting conditions suffice for a large commercial machine. Spins, rolls, loops have all to be considered and experiments have been made in order to ascertain the distribution of the air pressure in such manoeuvres. The fundamental manoeuvre is, however, that of rapid recovery from a steep dive at a high speed, and here the combined effect of centrifugal force and gravity produces an equivalent gravity (*see* AERODYNAMICS) several times the normal. It can be shown that, given the necessary control power and indifference to his own safety, the pilot of an aeroplane could impose in this way forces up to 10 or 12 times those which the structure has to bear in the normal flight. As much as seven times normal gravity has been recorded in experiments under war conditions.

This number, the ratio between the effective and the normal value of gravity, is termed the load factor for the whole machine under the stated conditions. A normal commercial aeroplane need never experience a load factor of as much as 2 in flight. In practice it is designed to bear a factor of from 4 to 6, dependent on its size and class. (See R and M 673, the report of the Load Factors sub-committee of the Aeronautical Research Committee.) This is the basis of the specified strength of modern commercial aeroplanes. The ratio between the maximum load factor considered in the design, for any stated form of distribution of air pressure, and the factor in any actual condition of flight appropriate to that distribution, is the nearest approach to the factor of safety commonly used in engineering.

For a commercial aeroplane the factor of safety, as thus defined, seldom falls below 3. In normal level flight it is of the order of 5. For a war aeroplane it may fall to $1\frac{1}{2}$, so that the most highly stressed member is loaded to two-thirds of its breaking load, or even less, but only in extremely rapid manoeuvres.

A commercial aeroplane has a true factor of safety, a margin of strength not called upon under the worst conditions which it normally experiences. The load factors corresponding to irregularities in the air are very small. So long as it is in the air, an aeroplane is exposed to much smaller risk of the failure of its structure by stress of weather than is a ship at sea. Any commercial aeroplane which conforms to the official criterion of strength, and has thereby secured an air-worthiness certificate without which it may not carry passengers, is capable of performing many manoeuvres such as looping and spinning with complete safety.

MATERIALS USED IN CONSTRUCTION

Composite Structures.—The materials which have been most commonly used hitherto for the main structural members of aeroplanes are wood and steel, with a fabric covering for the wings. The wood used is chiefly spruce of the highest grade, and in many aeroplanes the whole of the main structure, with the exception of ties and joints, is of this material. Ties and the joints or fittings by which they are attached to the other members are generally of steel. Steel tubes are used in some parts, either, as in the undercarriage, on account of their robustness, or, as in the control mechanism, because of their efficiency in transmitting torsion.

The general arrangement of the members of a conventional aeroplane structure of this composite character will be seen in fig. 8. The cross section of the wing spars has the I section commonly used in general structural engineering, though the thickness of the web and flanges is much larger in proportion to the overall dimensions of the section than is usual in steel I girders.

The wings of the aeroplane shown in fig. 8 are in biplane form with external bracing. Composite construction has also been applied to wings with no external bracing, generally, but not invariably, monoplanes. The Dutch firm of Fokker is the chief European exponent of such methods. Their wing structures are built mainly of wood, the spars being box girders. The covering of the wings is of three-ply wood, which also enters largely into the ribs and spars.

In aeroplane construction the primary requirement is lightness, and a modern composite aeroplane structure is on the whole nearly as light as one of any other type of construction so far developed, for the same strength. At present it is also very much cheaper. Nevertheless, in so far as it embodies wood it suffers from the following disadvantages:—

(1) Wood of a suitable grade cannot be freely obtained. (2) When exposed to the atmosphere, particularly to large changes in temperature and humidity, wood deteriorates more rapidly than steel or other metals. (3) Wood is not a reliable material. Its external appearance is often misleading as an indication of its internal condition. (4) In aeroplane structures glue and woodscrews cannot be entirely avoided. Both are sources of weakness and uncertainty. (5) When a wooden structure is involved in an accident, many of its members break completely, and splinter and the structure disintegrates, whereas metal members often merely bend, and an all-metal structure generally preserves much of its original shape. The

passengers in a wooden aeroplane are thus exposed to greater danger in case of an accident. (6) Wood has no inherent resistance to fire and cannot be rendered fire resisting.

These disadvantages of wood have been the chief incentive to the development of all-metal construction for aeroplanes.

All-Metal Structures.—The development of all-metal structures by British designers has been mainly confined to replacing each of the wooden members of the composite structure described above by a metal member, using either steel or duralumin. In such a structure the load to be borne by each member is of a fairly simple character and can be estimated fairly closely. Hence a comparison of the merits of a composite and an all-metal structure on these lines can be reduced to a comparison of typical members.

On the other hand European and American designers have used all-metal construction chiefly for monoplanes with no external bracing. The most prominent example is the German firm of Junkers.[1] A wing of this kind cannot readily be considered in detail. In fact it is definitely regarded by its designer as a structural whole. Its structure is highly redundant in character and the corrugated metal covering combines the function of the ribs and fabric found in most other aeroplanes, and in addition contributes largely to the torsional stiffness of the whole wing, a function which in a biplane is performed mainly by the wire bracing. The relative advantages and disadvantages of these two distinct types of aeroplanes are concerned more with their general characteristics than with the materials of their structures.

Relative Cost of Wood and Metal.—The world's present demand for aeroplanes is uneconomical in character. The total volume of the demand is small and it is spread over a large number of types. This reacts to the disadvantage of all-metal aeroplanes in particular. Wood is an economical material when small quantities of many types of articles have to be manufactured. The same raw material is required, and it can readily be shaped to efficient sections by the same simple tools and equipment. With metal, the raw material must be prepared by special plant into the necessary forms (tubes, strip, wire, etc.) and these processes are economical only when large quantities of one form are required. But given the demand for a standard article, metal is cheaper than wood.

Many of the metal details of aeroplanes have been standardised since early in the War, and nearly all the raw materials are now the subject of specifications issued by the British Engineering Standards Association. But there is nothing as yet to correspond with the standard sizes of steel beams (I, angle, channel, etc.) which are essential to economy in general structural engineering, though design is now approaching the stage when such a step will be possible. Against the high first cost, however, must be offset the longer life and greater reliability of metal, and it cannot be doubted that wood as a material for the construction of aircraft is rapidly becoming obsolete.

[1] See H. Junkers, *Journal of Royal Aeronautical Society* (Sept. 1923).

Physical Properties of Materials.—The disadvantages of wood as a material for the structure of an aeroplane, outlined above, give an idea of what should be the characteristics of a satisfactory material. There is the usual difficulty, common to most problems of engineering design, of assessing the relative importance of each of these characteristics. In fact, their relative positions in the scale change with time and circumstances. But, owing to the low weight of the composite structures characteristic of modern aeroplanes, the technical problem is simplified into that of finding means of making, at the worst equally light, and preferably lighter structures from materials that do not share with wood the disadvantages mentioned. In Table I. are given the strength and specific gravity of various materials which have been, or are likely to be, used for the main structural members of aircraft. They fall into three classes: wood, steel and light non-ferrous metals. The comparatively short life of wood has been quoted as one of its main disadvantages. Both steel and aluminium alloys need protection against corrosion (probably the most promising metal from this point of view being stainless steel). Although it would be misleading to suggest that all the problems of protection of metal structures have been solved, the experience gained suggests that effective protection can be given against all the ordinary causes of corrosion.

It is customary to regard the single figure obtained by dividing the strength by the specific gravity as a figure of merit on which the material can be judged. Such figures are not given in Table I. as they are not, in fact, a reliable criterion for all types of structural members.

Struts and Beams of Thin Metal.—The types of members responsible for the larger part of the weight of the structure of an aeroplane are two, struts and beams, the latter very often having to serve also as struts. Such members have essentially a variation of stress over their cross section, so that when the most heavily stressed point reaches the limiting stress of the material (this may be taken to mark the failure of the member as a whole), the majority of the material is under a lower stress. Hence the density of the material divided by its limiting stress is not in general proportional to the weight of the member.

In general, for a given area of cross section and a given limiting stress, the more the material can be spread out, *e.g.*, in the

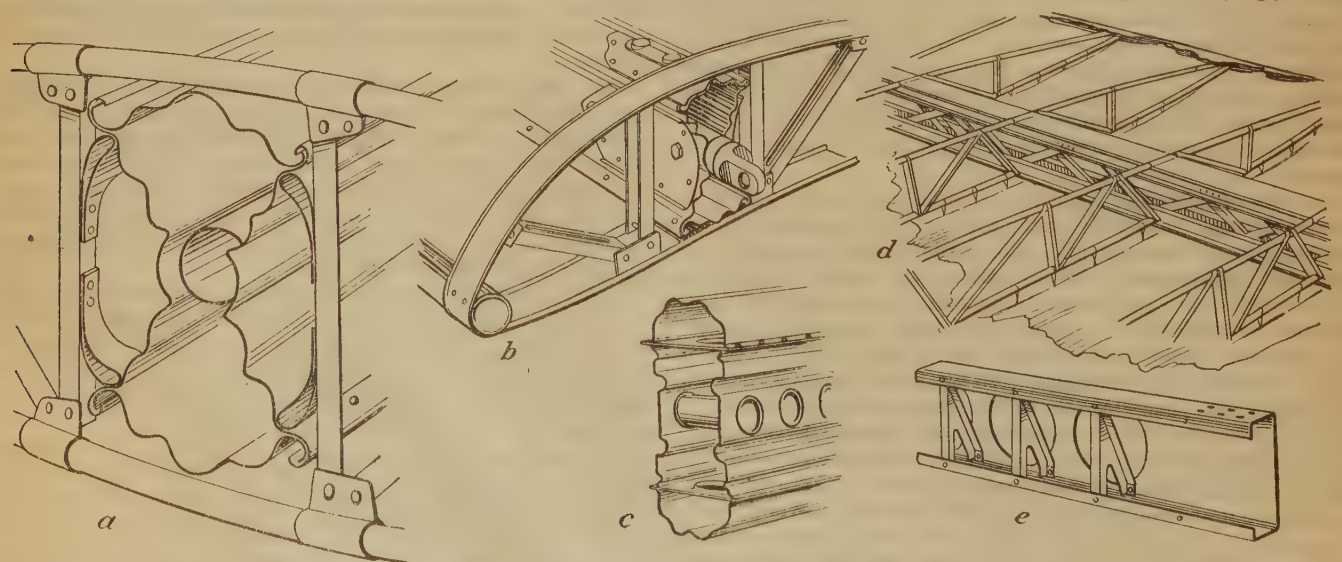


FIG. 14.—Examples of metal construction of spars and ribs for aeroplane wings. (a) Section of corrugated steel spar, showing method of attaching rib by means of spring steel clips rivetted to struts, pressing into corrugations in the spar. (b) Inner end of wing in steel, showing wide rib and attachment of wing to aeroplane. (c) Corrugated steel spar, using transverse tubes to stiffen webs, and duralumin strips to stiffen flanges. (d) Internal construction of wing in duralumin. Spar built up from sheet and angles. Ribs made from tube and channels. (e) Simplified wing spar in duralumin. (N.B. The greatest depth of each of the spars shown is about 5 inches.)

TABLE I.

Material	Specific Gravity	Ultimate Tensile Strength (tons/sq. in.)	Effective Strength in Compression (tons/sq. in.)
Wood			
Spruce	0·45	about 3	2
Steel			
Mild (soft)	7·8	26	15
Plain carbon steel bar for ties (cold-rolled)	7·8	70	..
Plain carbon steel strip (cold-rolled and blued)	7·8	60	50
3½% nickel steel strip (hardened and tempered)	7·8	90	60
Light Metals			
Aluminium (cold-rolled)	2·6	10	8
Duralumin	2·85	27	17

form of a circle, the greater will be the strength of the strut or beam, but the thinner will the material become. It appears, however, that a limit is reached for steel when the thickness is about 1/50 the radius beyond which an increase in the radius causes a decrease in strength. The member will then fail owing to local buckling of the material, at a load which corresponds to a maximum stress in the material, as calculated in the conventional way, which is below the limiting stress. The design of metal structures for aircraft hinges round the discovery of shapes of cross section which will enable the limiting stress of the material to be reached, and will be convenient for manufacture. The members must also be robust enough to ensure that ordinary handling does not damage them, a serious problem with thin sheets or tubes.

Limiting Stress.—The limiting stress in question is probably what is termed the yield point in compression, the stress at which plastic strain begins, for materials such as mild steel. For high tensile steel and light alloys, in practice the aluminium alloy known as duralumin is the only one used, there is no definite yield point and the limiting stress is accordingly somewhat uncertain. Shapes for members (see fig. 14) have been devised in which the greatest stress at failure is some 60 to 70% of the ultimate tensile strength of the materials (see Table I., column headed "Effective Strength in Compression") and there is reason to suppose that this is not far from the best that can be achieved. Some improvement may be anticipated from an extension of these results to still higher grades of steel, or from the development of a light alloy stronger than duralumin, but at the present time attention is concentrated mainly on the improvement of manufacturing methods.

The ruling principle in the shapes of cross section which have achieved these results with steel is corrugation of the thin sheet material used. The theory of the collapse of corrugated material awaits development, design being at present largely empirical. But the general nature of the strengthening effect of corrugation is well understood. A flat sheet of thin metal buckles readily under compressive stresses. Corrugation, in any direction which does not make too great an angle with the direction of the stress, stiffens it against such buckling. Moreover, it greatly reduces the influence of the inevitable local irregularities in actual materials, and gives robustness to what would otherwise be a very easily damaged member. It has been found essential in struts and beams of thin metal, to corrugate *longitudinally*. Transverse corrugations have proved ineffective.

Steel strip of thickness as low as 1/100 in. has been used in aeroplane spars. The material is either cold-rolled medium carbon steel, whose essential properties have been improved by a process known as blueing (heating to some 350° C.), but is otherwise not heat treated, or a nickel chromium alloy steel, hardened and tempered. Hitherto the strip has been formed into the final shape cold and without any subsequent treatment. This restricts the sections which can be produced and the materials which can be used owing to the need for ductility in order to avoid cracks. Progress has been made in the direction of forming the shapes while the material is in an annealed state and heat treating subsequently. This method will probably supersede "hard" drawing and rolling.

For spars of the size shown in fig. 14, it has been found that the low specific gravity of duralumin makes it possible to use material of such a thickness that corrugation is not always necessary. The resulting shapes (fig. 14) resemble those used in bridge construction, though the lattice girder seen in fig. 14d is found in practice to be heavier than the simpler shape in e. It is probable that, for the size of spar required in the largest present-day aeroplanes of the type under discussion, it is more economical of weight to use a spar composed of a few parts (such as a, c and e) than to build it up from many pieces. On the other hand for larger beams, such as are used in airships, a lattice construction is lighter. Probably the lightest all-metal construction for a wing structure using spars and ribs, etc., combines both steel and duralumin, the former for the main members (spars and struts) and the latter for the subsidiary ribs and edges. With the methods outlined above it is now possible to make an all-metal aeroplane certainly as light as, and sometimes lighter than, the corresponding composite machine.

(W. S. F.)

AEROTHERAPEUTICS.—(*see* 1.270).—In addition to the general use of open air and sunshine, there are several particular ways of using air for therapeutic purposes. Thus oxygen enriched air is used for those made ill through breathing irritant gases such as were used in warfare. These gases evoke oedema of the lungs and danger of suffocation through want of oxygen. So, too, in cases of pneumonia, shock and failing circulation, oxygen inhalation is useful. It is administered either by a mask or in a special chamber in which the patient is put. In the latter case great precaution must be taken against the danger of fire.

Oxygen containing 5% of carbon dioxide provokes deep breathing, and is useful in cases when the lungs require expanding, as after operations for empyema, when hypostatic congestion of the lungs threatens, and in cases of poisoning by carbon monoxide, as in ordinary coal-gas poisoning, etc. This mixture is particularly useful for breathing during induction of and after anaesthesia with ether, the deep respiration inducing on the one hand anaesthesia quickly, and washing the ether out of the body on the other hand at the end of the anaesthetic period (*see* ANAESTHETICS).

Compressed Air.—The breathing of compressed air in a special chamber has been used but this probably has no other action than that of increasing the concentration of oxygen in the air breathed. The breathing of nitrous oxide and oxygen in a compressed air chamber at half an atmosphere extra pressure gives deep and safe anaesthesia; an operating theatre constructed as such a chamber would be valuable.

Air Contamination.—The contamination of the air with certain dusts is important in those affected with hay fever and asthma, *e.g.*, the pollen of plants, spores of aspergillus mould, dandruff of horses, cats, dogs, feathers, to one or other of which dusts certain people have a sensitivity similar to that in anaphylaxis. It has been found possible to relieve such patients by sending them to the high Alps, to sea or by having them sleep in a special dust-proof chamber. Some may be relieved by vaccination with the specific exciting substance (*see* THERAPEUTICS).

Air may be cooled so as to resemble alpine air, but such a method is difficult and of little utility in the sick-room compared with the advantages of natural breathing of open air. Warming and drying air for respiration is of no advantage, but steaming the air is useful in cases of bronchitis.

In a mercurial or sulphur bath, the patient, enveloped in a sheet, sits on a chair beneath which a lamp is placed both to volatilise the drug and produce a steamy atmosphere. The vapour is absorbed by the skin. This treatment is used for syphilis and also for scabies and other affections of the skin.

Rarefied Air.—Rarefied air is used locally for cupping and thus producing local congestion, the blood being drawn into the part to which the cupping apparatus is applied at the expense of other organs. A similar result is got by local application of heat, poultices, etc. In operations where the chest cavity is opened air is blown into the lungs through a tube introduced through the larynx in order to keep the lungs distended.

Ozonised Air.—Ozonised air has been used in treatment of phthisis and wounds. Ozone is an irritant to the lungs and can be used safely only in very weak concentrations, *e.g.*, in a concentration just perceptible to the smell. It takes away the power to smell bad odours, but otherwise has no valuable properties which have been proven. Its chief use, then, is for deodorising offensive smells. (L. E. H.)

AESTHETICS (*see* 1.277).—The chief advances in aesthetics since Prof. Sully's survey—which remains the best statement in the English language—was published in the *Encyclopædia Britannica* (1911) have been applications of psychological discoveries. Though there is still "nothing answering to the German conception of a system of aesthetics in literature," Sully's central postulate (derived through Kant from Hume, who declared that " beauty is no quality in things themselves; it exists merely in the mind which contemplates them ") now finds few dissentients.

But the primary task of aesthetics is to describe and analyse the states of mind which give rise to ascriptions of aesthetic qualities, rather than to correlate these states with characters of the physical objects said to be beautiful, ugly, pretty, pleasant and so forth. The latter inquiry can rarely be carried to a useful conclusion, owing to the too great complexity of the factors involved. None the less, great efforts continue to be made to arrive at formulae and measurements which would explain the effect that different kinds of art have on us. But, as Edmund Gurney in *The Power of Sound* showed so conclusively for music, there is no likelihood that we shall ever discover a sufficiently wide formula for what is effective which does not also cover the ineffective. Such researches as those which claim that there are certain fundamental proportions in Greek architecture (J. Hambidge) may, like the printer's standard proportions for book margins, provide rules of thumb for the avoidance of certain crudely displeasing effects.

But the goal of aesthetics, regarded by Sully as the study of certain assignable characteristics by means of which an object " is fitted to affect us in a certain way," must now be recognised to lie rather in the evaluation of the different ways in which we are found to be affected. Very little can be done towards correlating aesthetic experiences with simple characters of their objects, in spite of the mass of material as to the improvised preferences of laboratory-subjects which have been accumulating since 1900, but a good deal can be said about the experiences themselves, and also about their value; *i.e.*, our considered preferences for one rather than another.

Opposing Theories.—Another fundamental assumption made by Sully is, however, being challenged, namely the existence of a distinctive aesthetic state, mood, or attitude, whether regarded as a unique effect of beauty, or as a necessary condition for its perception. Beautiful objects, it was held, either caused this state, or were only perceived to be beautiful when approached with an attitude opposed to that of the practical man, the scientist, or the moralist. This view has been attacked from two sides. In the first place, the so-called aesthetic state is really not one state but a number of superficially similar states, actually very different in origin and nature. Compare, for example, the " detachment " due to the fact that it is a picture we are looking at, and not a tree, with the " detachment " of the contemplation which is part of the final goal of tragedy. And, on the other hand, states similar to these often occur under conditions with which aesthetics would not seem to be concerned; for example, in the nitrous-oxide trance and in incipient stages of dissociation.

This re-orientation is largely due to a heightened sense of the verbal ambiguities involved. It has been customary to assume a common property in things called by the same name, and this tendency has been misleading here, for stricter psychological analysis has made it clear that different states are in question on different occasions.

Further experimental work bearing on this question makes such a result on the whole more probable, though the positive outcome is as yet slight. Some tempting minor theories have been disproved, such as the view that the pleasurableness of certain visual forms is derived from the relative ease of the eye movements by which we perceive them. It has been shown by Stratton and by Judd that the eye does not " follow lines "; it jumps about and its movements do not correspond to the course of the line. Perhaps the most interesting general result has been the demonstration of the great range of difference between individuals, both as to their preferences, for example among colours, and as to the motives which govern such choices.

The experiments of Bullough with colours[1] and of Myers and Valentine with tones[2] would seem to show that individuals fall into four distinct types with regard to their dominant attitude towards such objects: (1) the objective, by whom the colour is liked, *e.g.*, because it is " pure "; (2) the intra-subjective, by whom it is liked, *e.g.*, because it is " warming "; (3) the associative, by whom it is liked, *e.g.*, because it is the colour of wine; (4) the character type, who judge the colour to be " bold," " timid," etc. Further experiments are needed, however, before these types can be accepted as established, and they lend themselves, in any case, to a variety of interpretations.

Value of Experiences.—Another re-orientation concerns the value of the experiences studied by aesthetics. The most obvious point about them is their value, and any theory which leaves this unexplained must be defective. A theory of value in general is therefore necessary for aesthetics, and a thorough attempt to formulate and apply such a theory has been made by Richards,[3] with special reference to literature; an endeavour which represents a return to Socrates no less than to Tolstoi (*see* 1.285).

Aesthetics considers experiences with a view to their valuation; but aestheticians have tended to single out as the distinctive " aesthetic mood " that particular kind of experience in which they were most interested, and, since Kant, attention has been focused chiefly on the mood of detached and impersonal contemplation.

This state of contemplation has, however, often been misdescribed, probably through the influence of the now abandoned " faculty " psychology, as well as through the confusions noticed above. Every experience, no matter how detached or serene, arises only through the play of desires and activities. It is the peculiar direction of desire and will, not their absence, which marks off the contemplative state. They are directed, in fact, towards the maintenance and development *of the state itself*, in all its aspects, not towards the development of one special aspect (as in thinking), nor towards a change in the situation (as in practical activity). But there is nothing dreamlike or indifferent about this state.

Sully looked forward to a deeper inspection of the contemplative mood, and its further analysis has since yielded interesting results. Thus W. M. Urban (*Valuation*, p. 219), based in part on the theories of Meinong and Baldwin, sums up much useful analysis, by French aestheticians such as Paulhan and art historians such as Hirn, in " the concept of the widened ground of diffused stimulation, the *balance* of impulses." E. D. Puffer in 1907 (*Psychology of Beauty*, p. 50), developing one aspect of Schiller's view, had already described the calm or repose of contemplation as a tension, equilibrium or balance of forces; and according to Urban, who remarks that in primitive dances the object of desire, whether martial, erotic or religious, is " distanced," it is this equilibrium of impulses which " prevents the fundamental tendency from breaking forth into overt action."

One of the most interesting results of such an analysis has been

[1] *British Journal of Psychology*, 2 (1906–8), 3 (1908–10).
[2] *Ibid.*, 7 (1917).
[3] *Principles of Literary Criticism* (1925), especially chap. 5, pp. 35–38. See also C. K. Ogden and I. A. Richards, *The Meaning of Meaning* (1923), in which the verbal ambiguities involved in all discussions of art and beauty are dealt with in relation to the general psychology of language and symbolism.

to dispose of the theory of pure or aesthetic value which so easily springs from the assumption of the "aesthetic state." Another erroneous corollary has made the contemplative state a rare occurrence, unknown to savages, children and the uneducated. This has given rise to "aestheticism" with the implication that art is a monopoly of the leisured dilettante. A return to Tolstoi, who defined art as the communication of valuable experiences from one mind to another, has therefore been inevitable. It must be recognised, moreover, that very much which seems to be purely aesthetic criticism is in reality comment upon a lack of social opportunity (particularly the absence of an expensive education) and upon acquired mannerisms; the parallel case in which a man is judged by his dress is obvious.

An important influence leading in the same direction has been that of psycho-analysis (*see* PSYCHO-ANALYSIS) with its fresh light on the growth and development of preferences. Though at present easily misapplied in criticism, its consequences, especially for the study of creative imagination, are likely to be fundamental.[1] The work of the Gestalt school with its stress upon the unity of psychic processes, especially in the study of the perception of form, is also[2] promising, since this unity is certainly an essential consideration both in creation and in appreciation. A more specific problem which awaits development is that raised by the systematic analogical analysis of the emotional effects of sounds and colours.[3]

Philosophy of Aesthetics.—In addition to the endeavors of science to elucidate aesthetic experiences mention must be made of recent developments on the philosophical side. English writers, among whom Bosanquet, Wildon Carr, Carritt, and Collingwood may be cited, have been chiefly influenced by the work of the Italian idealist Benedetto Croce (*q.v.*). In discussing Croce's views it must always be remembered that his aesthetic doctrine forms an inseparable part of his general system of subjective idealism, which includes the denial of the reality of the physical world. It can only be accepted by those who are satisfied with that position, and the attempt to use his formulae by those who do not subscribe to the whole of which they form parts has led to much confusion. In brief, Croce identifies art with intuition, or imagination, the formulative activity of the mind which is prior to thinking in its narrower sense.

At the same time he sharply distinguishes it from the practical activity of the mind. Intuition he again identifies with expression, thereby bringing out the necessity for the formation activity to give form to what it is handling. The work of art, he holds, exists complete in the mind of the artist, the technical work of writing the poem or painting the picture being but a secondary practical activity of "extrinsication." Ugliness is thus regarded as incomplete, or partial beauty, the result of a failure to intuit or imagine with the necessary thoroughness. A psychologist who dissents from this philosophy will remark that the psychology of perception and imagination which Croce's formulae suggest to him seems to be mistaken. But to this the school of Croce have a ready answer, by which the objection is "surpassed." They reply that the methods and results of psychology are either illegitimate or have no bearing upon their position. So the matter must be left until the rival claims to authority of philosophy (in this sense) and of science (in the generally accepted sense) are adjudicated upon.

A new tendency of the past two decades has been the attention received by non-professional theorists. Recent violent revolutions in the arts left professional aestheticians temporarily at a loss, and, especially in England, the younger generation naturally turned to the critics and the artists themselves for guidance. Clive Bell's *Art* (1914) endeavoured to combine the theory of a specific aesthetic emotion with the then prevalent Cambridge Realism, but on closer examination the doctrine of "significant form" was seen to be baseless. The not dissimilar views of Roger Fry also enjoyed a wide vogue, and the more stimulating reflections of Kandinsky, Corbusier and Wyndham Lewis are still deservedly attracting attention. In the literary field, too, the critic has occasionally led the way, and such a work as T. S. Eliot's *The Sacred Wood* (1920) is a worthy successor to A. C. Bradley's *Oxford Lectures on Poetry* (1909). In different fields, also, the Futurist manifestoes of Marinetti, Vernon Lee's Studies in Empathy, the contemplative Hedonism of Santayana and the reported aphorisms of Cézanne have influenced contemporary aesthetic enquiry.

Conclusions.—We have first two views of objective beauty: (1) that there is a simple quality of beauty; (2) that beauty is a complex quality, namely the possession of aesthetic form. The improbability of the second of these has been commented on above; the progress of psychology has rendered the first obsolete. (3) That beauty consists in the imitation of nature. (4) That it is due to the successful technical exploitation of the artist's materials; this view has its relevance in connection with the applied arts. (5) That beauty is the product of "genius"; often an alternative formulation of other views. (6) That beauty is the revelation of (*a*) truth (in some sense), (*b*) the ideal, (*c*) the universal, (*d*) the typical. (7) That beauty consists in the creation of illusion; this has relevance in connection with hypnosis and suggestion theories of art, and in relation to the use of art as a drug (novel reading). (8) That beauty is to be judged in terms of desirable social effects. (9) That the beautiful is the expressive. The rise of the Expressionist school, particularly in Germany, has brought this theory back into prominence. The last seven views may be contrasted as a group with the remaining seven, which are all psychological in a narrower sense. (10) The beautiful is the pleasant. A subsidiary science, which might be termed hedonics, is required to deal with the special problems raised by "pleasure." (11) Beauty is what excites emotion; (12) promotes a specific emotion (*e.g.*, "aesthetic" emotion); (13) involves the processes of empathy; (14) heightens vitality; (15) brings us into touch with exceptional personalities; (16) conduces to an equilibrium of impulses.

BIBLIOGRAPHY.—There is still no comprehensive treatment of aesthetics in English. I. A. Richards' *Principles of Literary Criticism* (1925) provides the best orientation. E. Meumann in his *Ästhetik der Gegenwart* (1919) and his *System der Ästhetik* (1919) has compiled a useful introduction, and R. Müller-Freienfels' *Psychologie der Kunst* (1912) covers a good deal of ground from the psychological angle. A condensed survey, with illustrations, of the 16 main types of theory will be found in C. K. Ogden, I. A. Richards and J. Wood, *The Foundations of Aesthetics* (1922).

The writings of V. Basch, "Le maître-problème de l'esthétique," *Revue Philosophique* (July–Aug. 1921), of C. Lalo, *L'Art et la Vie Sociale* (1921), *L'Art et la Morale* (1922), *La Beauté et l'Instinct Sexuel* (1922), *Esthétique* (1925); and of Fr. Paulhan, *L'Esthétique du Paysage* (1913), will give a good idea of French points of view. B. Croce's *Aesthetic* (Eng. trans., 2nd ed., 1922), and his *Essence of Aesthetic* (*Breviario di Estetica*, 1924) are now available in English; the former contains an extensive historical survey. English followers of Croce are B. Bosanquet, *Three Lectures on Aesthetics* (1915), E. F. Carritt, *The Theory of Beauty* (1923), and R. G. Collingwood, *Speculum Mentis* (1924), *Outlines of a Philosophy of Art* (1925). Criticism of Croce's system will be found in Albert Cock, *Proc. Arist. Soc.* (1914), and H. R. Marshall, *The Beautiful* (1924), chap. 14, the latter being an informative treatment from the hedonistic standpoint, which is also well represented, with a difference, by G. Santayana's *The Sense of Beauty* (1918).

Since vol. iii. of J. Volkelt's *System der Ästhetik* (1924), Theodor Ziehen's *Vorlesungen über Ästhetik* (1925) is the most formidable continental attempt to construct a system. In addition to the experimental work already cited, C. W. Valentine, *An Introduction to the Experimental Psychology of Beauty* (1913) may be mentioned. Max Eastman, *The Enjoyment of Poetry* (1913) and *The Sense of Humor* (1921), J. C. Gregory, *The Nature of Laughter* (1924) and F. A. Beaumont, *The Hero: a Theory of Tragedy* (1925), deal with the literary aspects of Aesthetics. Lucien Bourguès, *La Musique et la Vie Intérieure* (1921), G. Révész, *Erwin Nyiregeházi* (Eng. trans., *The Psychology of a Musical Prodigy*, 1925) and H. J. Watt, *The Foundations of Music* (1920), serve to indicate the material accumu-

[1] See A. Adler's essay on Dostoevsky in chap. 23 of his *Individual Psychology* (1924); C. G. Jung's many contributions are often suggestive, though S. Freud's studies in this field (cf. *Der Wahn und die Träume;* Eng. trans., *Delusion and Dream*, 1917) have perhaps not the outstanding merits of his other work.

[2] The columns of *Psychologische Forschung* (see for example, the contributions of von Allesch in vol. vi., 1924–5) contain the best work of the Gestalt theorists. C. Koffka's remarks on melody in his *Growth of the Mind* (1924) also merit attention. *Cf.* C. Fox, *Educational Psychology* (1925), chap. 10.

[3] Cf. *Psyche*, vol. ii., Jan 1922, for an outline of the Tudor-Hart theory of the analogy.

lating in one province alone, since the earlier work of Helmholtz, Moos and Hanslik on music; while M. Dessoir's *Zeitschrift für Ästhetik und allgemeine Kunstwissenschaft* (vol. v., 1910, *et seq.*) covers the whole field of reference. (C. K. O.)

AFFORESTATION: *see* FORESTRY.

AFGHANISTAN (*see* 1.306), an independent state in Central Asia. The portion of the frontier between Afghanistan and India to the west of the Khyber was demarcated in 1919 and 1921. The full sovereign rights of Afghanistan were recognised by Great Britain in the Treaty of Peace between the two countries signed on Nov. 22 1921. Estimated area, 245,000 square miles. Population about 10,000,000.

The War Period.—Until the outbreak of the World War, Amir Habibulla had to face only one serious crisis—the Khost rebellion of 1912, which was caused by the rapacity and exactions of the local governor. After considerable trouble the rebellion was put down on terms unexpectedly favourable to the rebellious Ghilzais and Mangals. Amir Habibulla's clemency was prompted both by a desire to conciliate the Ghilzais, the hereditary enemies of the Durrani dynasty, and by the knowledge that his acceptance of Western ideas and encouragement of modern technical improvements had undermined his own popularity. Among the many mixed blessings of modern civilisation which he had introduced in a conservative and unappreciative country were motor-cars, telephones, newspapers, a hydro-electric scheme and a superior high school, the Habibia College in Kabul, staffed chiefly by teachers from India.

With the protraction of the World War, Amir Habibulla's position grew increasingly difficult. At its outset he had declared his intention to abide by his engagement with the British Govt. and keep his country out of the turmoil. But the entry of Turkey, the protagonist of Islam and the holder of the Caliphate, into the War on the side of the Central Powers gave strength to the anti-British party in Afghanistan and paved the way for the dispatch of a Turco-German mission to Kabul in 1915–6. An interesting account of the mission is given—unfortunately for the historian, with admirable discretion—by W. O. von Hentig, its German head, in a book published during the War. The mission had a paper success which did not deceive even von Hentig, who was chiefly responsible for it; and Amir Habibulla had the satisfaction of seeing the War close with his promise to Great Britain fulfilled. There was much speculation, not confined to India or Afghanistan, over the nature of the War reward he was likely to receive, and belief was general that it would take a political as well as a financial form.

Third Afghan War.—All expectations, however, were upset, first, by his assassination on Feb. 20 1919, and then by the Third Afghan War,[1] which was thrust upon India in the following May by his second son, Amanulla, who had ousted his uncle Nasrullah from the throne after a six-day Amirate. The concentration of the British forces was hardly completed when peace overtures, precipitated by the appearance of the first aeroplane over Kabul, were received from the young Amir. The negotiations that followed ended in a Treaty of Peace, signed at Rawal Pindi on Aug. 8 1919, which proclaimed the resumption of peaceful relations, the annulment of the annual subsidy which the Amir had been granted from 1879 onwards, and (more or less as a corollary and for this reason perhaps in a separate letter) Afghanistan's release from Great Britain's control of her foreign relations. This was followed by a Conference at Mussoorie in 1920 at which outstanding differences between the Indian and Afghan governments were freely discussed and the ground cleared for a treaty of neighbourly relations signed at Kabul on Nov. 22 1921 (British White Paper Cmd. 1,786 of 1922).

Independent Afghanistan.—Afghanistan lost no time in making good her foothold within the circle of fully independent nations. Treaties or agreements were made with several of the leading Powers; ministers were sent to Moscow, Berlin, Paris, Rome, Teheran, Angora, and later to London; and as many foreign legations were set up in Kabul. The establishment of a British legation in Kabul put the final seal on Afghanistan's emergence from her old hermit condition. In view of the fate of the British Residency in 1879 it was not entered upon lightly. It was perhaps the most notable feature in the Anglo-Afghan Treaty of Nov. 22 1921, which was only concluded after 10 months of patient negotiation between Sir Henry Dobbs, then Foreign Secretary to the Govt. of India, on the part of Great Britain, and Sardar-i-Ala Mahmud Tarzi, the Amir's father-in-law and Foreign Minister, on the part of Afghanistan. Chief among the difficulties responsible for drawing out the negotiations was a clause in the Russo-Afghan Treaty of Feb. 28 1921,[2] under which Russia had acquired the right to establish consulates at Ghazni and Kandahar—localities admittedly remote from all prospect of Russian trade, and useful to Russia only as jumping-off grounds for intrigue on the Indian frontier. Indeed, Great Britain from the outset declined to negotiate a treaty unless Afghanistan found a way out of a commitment so manifestly hostile in design. Afghanistan's success in doing so was noted in the European Press at the time as a sign that she was not entering the comity of civilised nations altogether unequipped with the weapons of modern diplomacy. And in the next three years there were at least two international crises that attracted attention in the world's Press, from which, after what were apparently false steps at the beginning, she extricated herself with a diplomatic skill and a robust common sense that commanded general respect. The first arose in 1923–4 out of the murder of two British officers by two Afghan subjects within a mile or so of the Afghan border, which was closely followed by the flight into Afghanistan of some ruffians who had murdered an English officer's wife and abducted her young daughter. The second and in some ways even more sensational crisis (for it all but ended in a rupture with Italy) arose out of the shooting of an Afghan policeman by an Italian named Piparno in Afghan Government employ. The procedure adopted in the trial was according to Western ideas highly prejudicial to the accused, and even ran counter to one school, at any rate, of Moslem jurisprudence, in that it ignored the prior settlement of the case with the cognisance of the state by blood-money paid to the relatives. After a protracted incarceration Piparno was summarily executed, and feeling in Italy at once grew tense. In both crises the young Amir took charge of affairs himself when the crisis was at its height, and proved that the Amirate had lost little if anything in strength with Afghanistan's political development, and that when his country's honour was at stake Amir Abdur Rahman's grandson had an ample share of that political sagacity which had been among his grandfather's most marked characteristics.

Modern Development.—In other spheres Amir Amanulla has broken away from his great ancestor's policy, notably in his determination to open up his country to Western civilisation. Here and there indeed he seems to have been dangerously in advance of his time, as in his schemes for the emancipation of women through female education—schemes which were apparently the cause or chief among the causes (under the agitation of the Mullas) of the dangerous rebellion that broke out in Khost in the spring of 1924 and was only suppressed in the following spring after the Afghan Govt. had organised considerable forces to cope with it.

But even clerical conservatism seems unlikely to be able to obstruct the more material of Amir Amanulla's schemes for the development of his country, such as much-needed improvements in communications. In addition to a wireless station at Kabul which is in regular communication with Peshawar and Tashkent, Kabul and the more important localities in its neighbourhood are linked up with the Indian telegraph system, and a project has been on foot ever since the Russo-Afghan Treaty of 1921 for linking up Kabul with the Russian system through Kandahar and Herat. Road communications have improved very greatly during the period 1910–25, for the introduction of motor-cars has necessitated the reconstruction of the principal roads, especially in the neighbourhood of the capital itself. The pros-

[1] For this campaign see *Papers regarding hostilities with Afghanistan*, 1919 (Cmd. 324 of 1919) and a despatch from Gen. Sir C. C. Monro printed in *The London Gazette*, March 12 1920.

[2] Translation of the text in *L'Europe Nouvelle*, May 28 1921.

pect of a really well-aligned motor-road from Kabul to the Khyber, and from Kabul to Kandahar and thence to Chaman, is not, perhaps, far distant, and when realised must have a profound effect on the economic and political development of the country. Trade between India and Afghanistan, especially by the Quetta route, has increased considerably of late years, and cannot fail to be greatly enhanced by the construction of roads fit for motor transport. The barrier of the Hindu Kush range, with its steep ascents and numerous passes, effectively blocks communication by mechanical transport between Kabul and the north for the present.

Against the Amir's extensive employment of Europeans on technical, educational and other work, there are some murmurings. And whether clerical conservatism or politicians of the Abdur Rahman school will continue to acquiesce in the Russification of some of the essential services and in particular of the tiny air force that Afghanistan is trying to build up, seems very doubtful.

Trade with India.—The foreign trade of Afghanistan is mainly with India. The construction of motor-roads and the completion in 1925 of the Khyber Railway from Janrud to the head of the pass are of great importance to the trans-frontier trade between Afghanistan and India. The only figures available for the trade of Afghanistan are those issued by the Govt. of India and by the governments of the provinces bordering the Afghan frontier. The following table gives the value in rupees of the trans-frontier trade for the average pre-War year and for 1921–2 and 1922–3:—

	Exports to India	Imports from India
Pre-War average	1.07.00.000	1.53.00.000
1921–2	81.00.000	1.35.00.000
1922–3	1.61.00.000	1.58.00.000

The chief exports to India are raw wool, manufactured woollen piece goods, shawls, fruit, nuts, vegetables, ghi, asafoetida and hides. The principal imports from India are cotton piece goods, twist and yarn, indigo, manufactured leather, wheat, sugar, tea and liquors. A trade convention signed at Kabul on June 5 1923 provided for three transit routes across British India for the forwarding of goods to and from Indian posts.

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AFRICA (*see* 1.320).—The period 1910–25 witnessed many important developments in Africa. Territorial changes were numerous and had a marked effect upon political, social and economic conditions. Many pages were added to the history of discovery, while the newly gained knowledge of the continent has greatly affected past conceptions of the development of the higher forms of vertebrate life, especially of the mammals of the Old World from Morocco to China, and even across the Atlantic to South America. South America and the West Indies, it is now clear, were once united with West Africa by a broad belt, across which vertebrates from the Old World in the Eocene, Oligocene and early Miocene formations poured westward and gradually peopled cis-Andine South America.

I. EXPLORATION

The largest unknown area of Africa in 1910 was in the Sahara, including the Libyan desert. Only the central part of the Sahara had been adequately explored, while the greatest gaps on the map were in the Libyan desert. This region may be considered first. Here in 1920 Hassanein Bey (Ahmad Muhammad Bey Hassanein), an Egyptian officer, made a somewhat remarkable journey from the confines of Cyrenaica to the Kufara oasis, the headquarters of the Senussi sect. He was accompanied on this journey by an English woman, Rosita Forbes, who has since made further adventurous journeys in the northern part of Morocco, Abyssinia and the lands east of the Nile. Hassanein Bey in 1923 accomplished a still more remarkable penetration of the unknown, making a journey through the Libyan desert, during which he examined two "lost" oases, into Darfur and Kordofan.

Work of the French.—Previous explorations by the French (1912–7) had greatly increased knowledge of the eastern limits of the Chad basin, and had definitely proved the distinction and disconnection of the Chad-Niger basin and the western basin of the Nile. In this region the name of Col. Jean Tilho remained predominant owing to the greatness of his discoveries, though the spelling assigned by his and other expeditions in the Tibesti and Ennedi mountains requires careful revision. Col. Tilho's expeditions had revealed altitudes in Tibesti of 11,200 ft. and the height of Mt. Tuside as 10,700 ft.; lesser altitudes of 9,800 ft. were determined at Jebal Marra, in Darfur, and of 4,000 to 5,000 ft. on the western borders of the Sudan, while there are other indications of high land on the northwestern edge of the great Nile basin. Further to the south in the Nilotic Sudan, to the east of the main Nile, altitudes of 10,000 ft. were discovered in 1911–2 by Col. H. D. Pearson. Maj. Cuthbert Christy made an interesting journey in 1916 along the southwestern limits of the Nile basin, which in places traversed the ironstone region wherein waters within sight of the explorer flowed either southwards into the Mbomu and its affluents (Congo basin), or northeast into the Nile basin.

French officers, among whom may be named Gen. Laperrine, Capt. Martin, Capt. Mougin and notably Capt. Augiéras, had begun as early as 1904 to continue, in an energetic and scientific manner, the survey of the western Sahara, from the southern confines of Morocco to the basin of the Senegal river and the northern and northwestern Niger. The great depression (the bed of a dried-up sea), known as the Juf, remained unexplored up to 1922; but since then its northeastern fringe has been made a little more known by the adventurous journeys of the Citroën cars across the desert from the latitudes of Insalah and Ahaggar in southern Algeria. A little has been added to the knowledge of the mysterious area, traversed by many great rivers, of Portuguese Guinea, and since 1921 the vast southern part of the Niger basin, and the Black and White branches of the mighty Volta river, which flows into the sea in the British Colony of the Gold Coast, have become better known in detail and in general features. At the same time, northern Togoland, Dahomey, Southern Nigeria and the basin of the great Benue river were mapped in detail.

East and Central Africa.—Much good work was done in East and Central Africa. Mr. I. N. Dracopoli in 1912–3 explored part of southern Jubaland; he reached the Lorian swamp, which receives the waters of the Uaso Nyiro, and solved the problem of its outflow, showing that its waters eventually reach the Juba river. In April 1912, Mr. (later Sir) G. F. Archer completed, after over two years' work, surveys connecting the triangulation of British East Africa with Maj. Gwynn's Abyssinian boundary survey. In East Central Africa a survey by Capt. E. M. Jack, in 1911, of the region northeast of Lake Kivu and west of Lake Victoria added to the knowledge of the Mufumbiro range of active volcanoes; Karisimbi was found to be 14,780 ft. high. In Dec. 1912, Sir A. Sharpe and Mr. M. Elphinstone witnessed the formation of a new volcano, named Katarusi, which, following an earthquake, rose out of an old grass-covered lava field, sending into the northeast corner of Lake Kivu a river of lava which filled up a large bay. Since that time the Mufumbiro region and western Uganda have been surveyed in considerable detail.

The first survey along its whole length of the Congo-Zambezi watershed was made in 1911–4 by Anglo-Belgian and Anglo-Portuguese boundary commissions. As in the Congo-Nile watershed, it was found that many rivers ran for considerable distances parallel to the divide, which is largely bush-covered. Maj. Reginald Walker, one of the British commissioners, discovered that the Luapula, the main eastern headstream of the Congo, did not, as was believed, issue from Lake Bangweulu, but was a continuation of the Chambezi, which passes through the great swamp south of Bangweulu.

Results of the War.—During the World War, exigencies of

campaigning led to many additions to the knowledge of the topography of tropical Africa, partly through the use of aircraft for survey purposes. Thus very useful maps, showing routes unsuspected from the ground, were made by airmen of the northern part of Portuguese East Africa. In 1920 Dr. P. Chalmers Mitchell, who passed over the Nile basin in an aeroplane, proved the value of air reconnaissance to geology by the discovery in the Bayuda desert, north of Khartoum, of the volcanic character of a range of hills. A little later the French began to use aeroplanes for survey purposes in the Sahara.

After South-West Africa was taken over under mandate by the Union of South Africa much attention was given to Ovamboland (Amboland), that very interesting northern part of the territory. The strenuous efforts, made for over 10 years, of E. H. L. Schwarz, professor of geology, Rhodes University College, Grahamstown, have led to a more persistent and scientific attempt, during which in 1925 air surveys were made, to explore the western part of the region lying between the Kunene river, Lake Ngami and the southern part of Bechuanaland. The urgent need of saving the country between the basin of the Orange river in the south and the western Kunene on the north from complete desiccation impelled Schwarz to recommend the diversion of the Kunene river from its present route to the sea to its former connection with the half-dry Lake Etosha (Etosha Pan). He hopes, by reuniting all these waters in the northwest of Bechuanaland, to reopen communication both with the Orange river in the south and with the Zambezi in the east.

II. COMMUNICATIONS

The first railway and steamer route across Africa was completed by the opening, in March 1915, of a railway from Kabalo on the Lualaba river (Upper Congo) to Albertville on the west shores of Lake Tanganyika. The year before (1914) the German railway from Dar-es-Salaam had reached Kigoma, on the east shores of Lake Tanganyika. A part of this trans-African route is by the Congo, the navigable stretches of the river being linked up by railway. An all-rail east-west route across South Africa had also been completed. In 1915 a line was built from Prieska to Kalkfontein, connecting the system of the Union of South Africa with that of South-West Africa, and in the same year a short line of 21 m. was constructed joining Walvis Bay with the South-West African system. By this means Walvis Bay and Delagoa Bay were linked by railway. A second east-west all-rail route across Africa will be provided by the railway from Lobito Bay, on the coast of Angola, to Katanga, where it will join the lines to Beira and other east coast ports, as well as to Cape Town. In 1925 some 500 m. of this line remained to be completed, but the whole route had been surveyed, and its construction, after many delays, had been resumed.

While the Cape-to-Cairo scheme still exercised men's imaginations, it was increasingly recognised that the true function of cross-Africa routes was to bring the produce of Central Africa direct to the nearest seaport. The railway from Cape Town via Bulawayo and the Victoria Falls, which had reached the Belgian Congo frontier in 1909, was, however, continued northwards across Katanga to Bukama on the Lualaba river; the line was completed in May 1918, an addition of 442 m. in 10 years, making a through service from the Cape, on the same gauge (3 ft. 6 in.), of 2,598 miles. In order to compete for the copper output of Katanga, the Belgians, in 1922, began the building of a railway from Bukama to Ilebo on the Kasai river, this being a modification of a scheme for a through railway from Bukama to the lower Congo.

East and West Africa.—In East Africa, an extension of the Uganda Railway was begun in Dec. 1921. A line was constructed from Nakuru to Eldoret, and in 1923 loans were raised to carry the line to Mbulamuti on the Busoga Railway, running from Jinja to Namasagali, which is on the first navigable stretch of the Nile. The new line opened up rich cotton growing regions. In Tanganyika Territory a branch line from Tabora, on the Dar-es-Salaam–Kigoma line, with its ultimate terminus at Mwanza on the southern shores of Lake Victoria, was under construction in 1925, the section to Kahama having been completed. In the same year the British Govt. announced its approval of a proposal to raise loans up to £10,000,000 for the further extension of railways and the improvement of harbours in British East Africa.

In West Africa the French drew up plans to connect the middle Niger with the Guinea Coast by railway. The principal line, from Thies, on the Dakar–St. Louis Railway, to Kayes on the Senegal river in the French Sudan—whence a railway already ran to Bamako and Kulikoro on the Niger river—was begun in 1907, but was not completed till 1923. It is 682 m. long. In British West Africa a railway from Accra in the Gold Coast Colony to Kumasi in Ashanti was completed in 1923. In Nigeria the bridging of the Niger river at Jebba, completed in 1914, gave the railway from Lagos to Kano, 704½ m. long, an uninterrupted service.

In 1913 a railway was begun from Port Harcourt, at the mouth of the Bonny river; it was completed to the Udi coal-fields, a distance of 151 m., by May 1916. From Zaria, on the Lagos-Kano Railway, a branch line, 143 m. long, built across the tin-field area to Bukuru, was completed in Dec. 1914. The extension of the Port Harcourt–Udi line northward, via Makurdi on the Benue river, to Kaduna, on the Lagos–Kano line, was begun in 1921 and was nearing completion at the end of 1925. This extension is some 450 m. in length.

During the 16 years 1910–26 the railway mileage in South Africa was greatly increased. The new railways were mainly of local interest, but a line from Beira to the Zambezi, completed in 1922, gave Nyasaland direct access to the ocean, save that the Zambezi remained to be bridged.

Trans-Saharan railway schemes had not, up to 1926, got beyond the stage of preliminary survey, unless the extension of the railway from Biskra to Tuggurt, opened in 1914, be taken as the first section of such a route. The surveys had shown, however, that there were no serious engineering difficulties to be overcome. Political interest in Morocco led the French Govt. to build lines traversing that country from Casablanca, on the Atlantic Ocean, via Fez and Taza to Ujda, where a junction is made with the Algerian railways. The rising against the French and Spanish governments in Northern Morocco had, however, up to 1926, paralysed any efforts to connect Tangier and Tetuan with the French railway system, though there was then hope that such work might soon be undertaken. In the Suez Canal zone a railway from El Qantara, on the Canal, to Gaza, in Palestine, was constructed in 1916–8 by the British for military purposes, thus giving railway connection with the systems of Palestine, Syria and Asia Minor.

Roads and Air Routes.—Road building, ancillary to, or in substitution for, railways, made great progress, notably in West Africa, the Belgian Congo and Uganda. Since 1910 powerful wireless telegraph stations have been established at many ports and inland centres, while motor-cars and aeroplanes have achieved a conquest of blank and unmapped Africa with a degree of rapidity which would have been deemed marvellous at the beginning of the 20th century. The first flight from Cairo to Cape Town was made in 1920; in 1925 the continent was first traversed from end to end (Algeria—Sahara—Belgian Congo—Uganda—Tanganyika—Cape Town) by motor-car.

III. ETHNOLOGICAL DISCOVERIES

One direction in which Africa has greatly increased its importance and interest in the eyes of reflective persons lies in the past history of the human and sub-human species within its domain. We are gradually coming to understand that, subsequent to the complete severance of West Africa from Brazil, which took place, we may guess, somewhere early in the Miocene epoch and, at a later date, of East Africa from Madagascar and the broken sub-continent of which Mauritius, Réunion, the Amirante Is. and the Seychelles are now the only remains, some further changes took place during the Miocene and Pliocene epochs in the western Sahara and in the Libyan desert between the Tibesti heights and the Nile.

AFRICA
English Miles
0 500 1000
Kilometres
0 500 1000
Main Railways
International Boundaries
Intercolonial ,,
District ,,
Former German Territory
Area
sq.m. sq.m.
France 4.200.000 Italy 680.000
Gt Britain 3.984.000 Egypt 350.000
Belgium 930.000 Abyssinia 350.000
Portugal 788.000 Spain 140.000
Liberia 40.000 sq.m.
NORTH ATLANTIC OCEAN
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
RED SEA
PERSIAN G.
EUROPE
ASIA
SAHARA DESERT
MOROCCO
ALGERIA
TUNIS
TRIPOLITANIA
LIBYA
Libyan Desert
EGYPT
CYRENAICA
FRENCH WEST AFRICA
FRENCH SUDAN
MAURITANIA
SENEGAL
GAMBIA
PORT GUINEA
FR. GUINEA
IVORY COAST
GOLD COAST
SIERRA LEONE
LIBERIA
NIGERIA
NIGER
UPPER VOLTA
DAHOMEY
TOGO
CAMEROONS
FRENCH EQUATORIAL AFRICA
CHAD
UBANGI-SHARI
GABON
MIDDLE CONGO
BELGIAN CONGO
ANGLO-EGYPTIAN SUDAN
ERITREA
ABYSSINIA
ITALIAN SOMALILAND
BR. SOMALILD
FR. SOMALILD
ADEN
UGANDA
KENYA
TANGANYIKA TERRY
ANGOLA
RHODESIA
NORTHN
SOUTHN
NYASALD
MOZAMBIQUE
SOUTH WEST AFRICA
BECHUANALD
UNION OF S. AFRICA
TRANSVAAL
NATAL
CAPE OF GOOD HOPE
MADAGASCAR
Equator
Tropic of Cancer
Tropic of Capricorn
Cape Town
C of Good Hope
Port Elizabeth
Durban
Pretoria
Johannesburg
Kimberley
Walvis Bay
Windhoek
Lourenço Marques
Beira
Salisbury
Leopoldville
Elisabethville
Nairobi
Addis Ababa
Khartoum
Cairo
Alexandria
Tripoli
Algiers
Tangier
Rabat
Fez
Madrid
Lisbon
Oporto
Bordeaux
Marseilles
Rome
Naples
Venice
Belgrade
Constantinople
Angora
Smyrna
Athens
Salonika
Batum
Baku
Tehran
Damascus
Baghdad
Jerusalem
Beirut
Aleppo
Alexandretta
Port Said
Suez
Mecca
Medina
Riyadh
Port Sudan
Suakin
Massawa
Asmara
Aden
Djibuti
Berbera
Mogadishu
Kismayu
Brava
Obbia
Hafa
Abu Hamed
Berber
Kassala
Gondar
Harar
Dire Dawa
Jijiga
Ogaden
Mokalla
Hadramaut
Socotra
Muscat
Bushire
Basra
Al Kuwait
Bahrein
Dhahran
Qatar
Abu Dhabi
Trucial Oman
Oman
Aden
Guardafui
Obock
Zeila
Berbera
Bulhar
Burao
Hargeisa
Erigavo
Las Anod
Bender Bela
Alula
Obbia
Itala
Lugh
Ferrandi
Mahaddei Uen
Dolo
Gorrahei
Wardair
Warandab
Gore
Jimma
Lake Tana
Blue Nile
Abbai R.
Ankober
Debra Tabor
Gondar
Adowa
Aksum
Asmara
Keren
Agordat
Barentu
Kassala
Gedaref
Sennar
Khartoum
Omdurman
Berber
Abu Hamed
Dongola
Karima
New Dongola
Wadi Halfa
Shellal
Aswan
Kena
Luxor
Qena
Kharga
Siwa
Matru
Sollum
Derna
Benghazi
Tobruk
Ghadames
Ghat
Murzuq
Sokna
Aujila
Jaghbub
Ghirza
Tripoli
Gabes
Sfax
Susa
Tunis
Bizerta
Constantine
Bougie
Bone
Oran
Algiers
Tangier
Gibraltar
Ceuta
Melilla
Tetuan
Rabat
Casablanca
Mogador
Agadir
Marrakesh
Fez
Meknes
Tafilet
Figuig
Colomb Bechar
Tuggurt
Wargla
Ghardaia
Insalah
Ahaggar
Tibesti
Kufara
Uweinat
Jebel Arkenu
Gilf Kebir
Kufra
Jof
Timbuktu
Agades
Ennedi
Zinder
Kano
Bauchi
Yola
Benue R.
Niger R.
Senegal R.
Kayes
Bakel
Dakar
St Louis
Podor
Matam
Bafoulabe
Kita
Bamako
Kulikoro
Segou
Mopti
Wagadugu
Bobo Dioulasso
Kankan
Konakri
Freetown
Bathurst
Sedhiou
Ziguinchor
Bissau
Bolama
Boke
Labe
Timbo
Dalaba
Pita
Mamou
Kindia
Conakry
Beyla
Nzerekore
Kissidougou
Macenta
Kerouane
Bissandugu
Odienne
Bouake
Kong
Bondoukou
Bobo Dioulasso
Wagadugu
Tenkodogo
Fada N'Gourma
Say
Niamey
Gaya
Dosso
Nikki
Parakou
Save
Porto Novo
Lagos
Abeokuta
Ibadan
Oshogbo
Ife
Ilorin
Jebba
Bussa
Zaria
Kaduna
Sokoto
Katsina
Maradi
Tahoua
Agadez
Zinder
Nguru
Maiduguri
Dikwa
Gashua
Bauchi
Jos
Makurdi
Enugu
Onitsha
Owerri
Aba
Calabar
Victoria
Buea
Duala
Kribi
Ebolowa
Yaounde
Batanga
Fernando Po
Principe I.
Sao Thome I.
Annobon I.
Libreville
Port Gentil
Lambarene
Mouila
Ndjole
Lastourville
Franceville
Mayumba
Sette Cama
Loango
Cabinda
Banana
Boma
Matadi
Thysville
Leopoldville
Coquilhatville
Bikoro
Lake Leopold II
Port Francqui
Ilebo
Kasai R.
Lusambo
Kongolo
Kabalo
Albertville
Stanleyville
Yakoma
Mbomu R.
Uele R.
Bambesa
Buta
Bunia
Irumu
Mahagi
Lake Albert
Lake Edward
Lake Kivu
Ruanda
Urundi
Usumbura
Kitega
Ngozi
Kigoma
Tabora
Mwanza
Shinyanga
Musoma
Kisumu
Nakuru
Eldoret
Kitale
Lodwar
Voi
Malindi
Mombasa
Pemba I.
Zanzibar
Dar es Salaam
Tanga
Morogoro
Kilwa
Lindi
Mikindani
Port Amelia
Cape Delgado
Comoro Is
Aldabra Is
Mozambique
Mazhunga
Analalava
Tamatave
Antananarivo
Majunga
Tulear
Fort Dauphin
Cape Ste Marie
Andevorante
Mananzhari
Quelimane
Chinde
Mauntirano
Beira
Umtali
Fort Victoria
Gwelo
Que Que
Bulawayo
Victoria
Lake Ngami
Francistown
Palapye
Messina
Lobatse
Mafeking
Vryburg
Kuruman
Kimberley
Port Nolloth
Lüderitz
Keetmanshoop
Gibeon
Mariental
Kalahari Desert
Walvis Bay
Swakopmund
Windhoek
Karibib
Otjimbingwe
Omaruru
Outjo
Grootfontein
Tsumeb
Namutoni
Ovamboland
Lobito
Benguella
Mossamedes
Pto Alexandre
Moçamedes
Novo Redondo
Ambriz
Loanda
Malanje
Duque de Bragança
Luanda
Ambaca
Elisabethville
Jadotville
Kambove
Ndola
Broken Hill
Lusaka
Kafue
Livingstone
Victoria Falls
Wankie
Lupane
Bulawayo
Gwelo
Que Que
Salisbury
Umtali
Beira
Chimoio
Tete
Zumbo
Blantyre
Port Herald
Fort Johnston
Nyasa
Lake Nyasa
Tanganyika
Lake Tanganyika
Albertville
Kigoma
Usumbura
Ruanda
Urundi
Kitega
Ngozi

The Congo basin, like Lake Chad, had become a great shallow inland sea, and before the advent of man these western portions of the continent contained vast areas covered with shallow water. In any case, from the evidence offered by the prehistoric and historic distribution of mammals and birds, a striking dissimilarity has been shown between the prehistoric mammalian fauna of the north of Africa, Egypt, Abyssinia, the Nilotic Sudan, and east, south-central, southwest and southernmost Africa on the one hand, and the western portions of the continent on the other. Over an increasingly narrow belt, which stretches westward from the Nilotic Sudan to the Cameroons, there still continues a certain affinity in beasts and birds; this affinity extends to the southern part of Senegambia, though even here, and in Nigeria and the Congo basin north of the main Congo, there still exists a strange dissimilarity in the distribution of the mammalian fauna. In the same way South Africa exhibits a wealth of mammalian life which, so far as present discoveries go, is absent from West Africa.

Evidences of Early Man.—The most remarkable development in African discovery has taken place since 1922. Before that date no discovery, of an unchallengeable character, showing the existence there of any human race earlier than the negro, the term negro including Bushman and Hottentot, had been made in Africa. There were faint evidences in the rocks and caves of southernmost Africa of the co-existence there at a relatively remote period—though there was little in the remains which assigned the date with tolerable precision—of some Bushman-like race with mammals now extinct, such as a lingering type of mastodon. But all the human remains of any antiquity in East, North or South Africa seemed to be of negro type, and therefore within the range of close kinship with *Homo sapiens*.

But in 1921 a fine specimen of a male skull, which has been subsequently named *Homo rhodesiensis*, was discovered in the Broken Hill mine, in the central part of Northern Rhodesia. There were also traces of accompanying bones of the limbs. This type bore suggestive resemblances to *Homo neanderthalensis*, whose former existence in North Africa had been suspected for some 30 years, though until then it had left unquestionable remains only at Gibraltar and in Palestine.

At the beginning of 1925 a further discovery was made at Taungs in Bechuanaland, in what is now an almost desert region. Here, embedded in the rocks of the surface, the bones of a young individual, perhaps 10 years old, were brought to sight, so clearly significant as to be unmistakable. Hitherto, though the negro sub-species offers, like the Australoid, indications of ape-like features lost by the white man and the Mongol, it was difficult to extrude either negro or Australoid from specific kinship with the rest of existing humanity. But the human remains found in south-central Africa near the Kafue river, and this truly remarkable man-ape from the heart of Bechuanaland, show that at some period of uncertain remoteness there lingered an ape-like human being with close affinities to the man of Neanderthal, and also, in an upward direction, to the Australoid sub-species of *Homo sapiens;* and further, that the chimpanzees had penetrated to South Africa, and there had left behind, perhaps 500,000 years ago, under altogether different climatic conditions, an ape-like form very near to the human family.

IV. POLITICAL HISTORY

The political map of Africa changed very considerably between 1910 and 1925. In 1910 the British self-governing colonies of the Cape, Natal, Transvaal and Orange Free State were formed into the Union of South Africa, with a single government and one Legislature. In 1911 a considerable area of French Equatorial Africa was transferred to German Cameroons and in return Germany acknowledged a French protectorate over the greater part of Morocco. In Nov. 1912 a Franco-Spanish treaty defined the Spanish zones in Morocco. In 1912, also, Italy annexed the Turkish vilayets of Tripoli and Benghazi (Cyrenaica) to which the common name of Libya was given. In Dec. 1914 a British protectorate over Egypt was proclaimed, but by a declaration of Feb. 1922 Great Britain acknowledged the independence of Egypt. The status of the Anglo-Egyptian Sudan remained unchanged.

In June 1919, by the Treaty of Versailles, Germany renounced possession of all her oversea protectorates in favour of the principal Allied and Associated Powers. These territories, which had all been conquered by the Allies during the World War, were placed under mandatories. The Union of South Africa became mandatory for German South-West Africa; Togoland was divided between France and Great Britain; and France became mandatory for Cameroons, except for a small portion which was placed under the administration of British Nigeria. Britain became mandatory for German East Africa, renamed the Tanganyika Territory, but by subsequent Anglo-Belgian agreements Belgium became mandatory for the provinces of Ruanda and Urundi. In 1920–5 Italy gained additions to Tripoli and Cyrenaica by arrangements with France and Egypt and to Italian Somaliland by arrangement with Great Britain.

As a result of these changes Africa was divided among the following Powers. The territories governed under mandate are reckoned in the possession of the Power named:—

	Sq. m.
France	4,200,000
Great Britain	3,984,000[1]
Belgium	930,000
Portugal	788,000
Italy	680,000
Egypt	350,000
Abyssinia	350,000
Spain	140,000[2]
Liberia	40,000

These figures give a total of 11,462,000 sq.m. as the area of Africa. In the absence of definite surveys of large areas of the continent this may be regarded as a close approximation to accuracy.

German Policy.—The extinction of Turkish rule in North Africa had long been foreseen and was no matter for regret. It ended a connection which had lasted five centuries and had been almost wholly evil in its effects. German sovereignty in Africa had only dated from 1884 and had been rapidly enlarged. Endeavours to extend it further had been a prominent factor in German policy for a decade before the World War. Germany desired a footing on the African coast of the Mediterranean and a port on the Atlantic coast of Morocco. These desires conflicted with Italian and French ambitions, and in 1911 the issue on both points was decided against Germany. As to Morocco, the Franco-German convention of Feb. 9 1909 had recognised the privileged position of France in Morocco, but not a French protectorate over that country, and the sending of the German gunboat, "Panther," to Agadir, in July 1911, was a protest against what Germany considered an unwarranted extension of French influence in Morocco, and an intimation that if German treaty rights in Morocco were to be renounced, France must make compensation. The intervention of Great Britain on the side of France put an end to a dangerous situation; Germany, by a convention concluded Nov. 4 1911, accepted compensation in Central Africa and withdrew opposition to the establishment of a French protectorate in Morocco.

While the Franco-German negotiations were in progress, Italy abruptly declared war on Turkey and invaded, and held, Cyrenaica and Tripoli. Thus Germany, who had designed to exploit those vilayets through the medium of an Austro-Hungarian chartered company, was deprived of her last opportunity—short of war—of gaining a foothold in the Mediterranean. She turned her attention to the development of a *Mittel Afrika* policy. This policy aimed at securing Germany's supremacy, primarily economic and ultimately political, in central equatorial Africa. The aim was to reserve the Belgian Congo, Angola and Mozambique, north of the Zambezi, as a German sphere, and thus to link up Cameroons with the South-West and East Africa protectorates. German industries had need of the raw material tropical Africa produces, and, moreover, southern Angola was a good field for European settlement.

[1] Including Anglo-Egyptian Sudan.
[2] Including the Spanish zones in Morocco.

British statesmen were not unfavourable to German expansion in equatorial Africa, so long as it was confined to the economic sphere. In 1898 an agreement, signed by Mr. A. J. Balfour and Count Hatzfeldt, had divided Angola and Mozambique into spheres in which Great Britain and Germany respectively were to give financial and economic help to the Portuguese. This was followed in 1899 by the Treaty of Windsor, the object being to reassure Portugal that the Balfour-Hatzfeldt agreement was not in derogation of her sovereign rights in Africa. Neither the agreement with Germany, nor the treaty with Portugal was published.

After the settlement of the Morocco crisis, Germany reopened negotiations with Great Britain in respect of Portugal's African colonies, and Prince Lichnowsky (the German Ambassador) and Sir Edward Grey reached a new agreement, which was ready for signature in 1913. Nearly all Angola was recognised as a German economic sphere, as well as the northern part of Mozambique. The rest of Mozambique, including Delagoa Bay and the Zambezi valley, was to be a British economic sphere. Sir Edward Grey made it a condition of signing that the 1898 and 1899 documents should be published. The German Foreign Office raised objections, Herr von Jagow (then Foreign Minister) stating that the German Press would regard the terms of the Treaty of Windsor and the Lichnowsky agreement as contradictory. By July 1914, however, German consent to publication had been given, but before the new agreement could be signed the World War had broken out.

The World War.—During the progress of the campaigns in Africa the whole of the continent, except Abyssinia and the Spanish protectorates, became involved in the struggle. The conquest of the German colonies was foreseen in the negotiation which preceded Italy's entry into the War, and Article 13 of the agreement signed in London on April 26 1915, between France, Russia, Great Britain and Italy, laid down that:—

> In the event of France and Britain increasing their colonial territories in Africa at the expense of Germany, those two Powers agree in principle that Italy may claim some equitable compensation, particularly as regards the settlement in her favour of the questions relative to the frontiers of the Italian colonies of Eritrea, Somaliland and Libya, and the neighbouring colonies belonging to France and Great Britain.

Italian Ambitions.—Italian ambitions had gone beyond the readjustment of frontiers; in particular Italy wished to acquire Jibuti, the port of French Somaliland and the starting place of a railway to Abyssinia. As Jibuti was the only French port on the Suez Canal route to the East and to Madagascar, as well as the only approach to Abyssinia that France possessed, she declined to entertain proposals for its surrender. Italy, however, obtained from France a welcome rectification of the Tripoli-Tunisia frontier, as well as valuable railway and commercial concessions in Tunisia.

In regard to the Cyrenaica-Egyptian frontier, the British Govt., in 1919, offered Italy a readjustment of territory in the Libyan desert. The negotiations had not been concluded when Egypt was granted independence and after that time they were conducted directly between Italy and Egypt. They turned largely on the possession of the oasis of Jaghbub, a place of some strategic importance, where is also the tomb-mosque of the founder of the Senussi sect. On Dec. 6 1925, an Italo-Egyptian agreement was signed, by which Jaghbub was included in Cyrenaica. The wells to the west of El Sollum were included in Egyptian territory, thus giving El Sollum a needed water supply. South of Siwa the frontier was drawn along longitude 25° E. to the boundary of the Anglo-Egyptian Sudan in latitude 22° North. In 1925 the Anglo-Egyptian Sudan was verging on the position of a clearly defined British protectorate; the tributary sultanate of Darfur had been conquered in 1915, and in 1922–3 the frontier separating it from French Equatorial Africa, which had been in question since 1899, had been delimited on the spot.

France and Spain.—In the same year (1912) that France obtained her protectorate in Morocco, she concluded an arrangement with Spain whereby a Spanish protectorate was set up in the northern part of the sultanate, the port of Tangier and a small area around it being made however an international zone. In the French protectorate Marshal Lyautey, the Resident-General, adopted a bold and conciliatory policy and won the confidence and respect of the Moors. In their zone the Spaniards met with determined opposition, largely owing to the uprise of a Moor, styled Abdel-Krim. In the territory known, somewhat vaguely, as Er-Rif, there seems to have been, as in the coastward portions of Algeria and Tunisia, a much more marked Iberian element in the population than there is in the south of Morocco, and this part of northern Morocco had shown a great hatred of European interference. The Spaniards suffered a severe reverse in 1921 and there was again heavy fighting in 1924 and 1925. In the last-named year the Rifs invaded the French zone, but were defeated and driven back, while the Spanish forces gained some successes in the northeastern area.

Recent Developments.—Abyssinia under Ras Tafari has been making strenuous efforts to attain the position of a civilised power and has joined the League of Nations, but evidence is still needed to show that she possesses in her yellow, brown and black people the elements of real and lasting progress without extraneous European support. In Southern Rhodesia the growth of a vigorous white community led to that country being made, in 1923, a self-governing colony of the British Empire, and with the assumption of direct Imperial control of Northern Rhodesia in 1924 chartered-company rule in British Africa came to an end. In East Africa another vigorous and local white community made its influence felt, namely the settlers in the British East Africa Protectorate, which protectorate was annexed to the British Crown in 1920 and renamed Kenya Colony.

A subject which raised large issues was the position of Indians in South and East Africa, but it was of less importance than the growth of race consciousness among the negroes. Increase of education and of Christianity, the employment of large numbers of Africans in industries and the lessons taught by the World War, were among the factors which intensified the feeling of racial unity and led to manifestations of a new anti-white movement. This movement was different to the simple objection to interference by Europeans, or Arabs, previously displayed, and had a consciousness of the need of self-development and progress. Not all the ferment among the negroes was anti-white, however, and an encouraging feature was the growing recognition, in South Africa as in the tropical regions of the continent, of the duty of the white man to help the negro in his efforts to attain a higher status. For further information, see the articles on the various countries of Africa, *e.g.*, ABYSSINIA; BELGIAN CONGO; CAMEROONS; EGYPT; KENYA; MOZAMBIQUE; SOUTH AFRICA. *See* also MANDATE; NILE.

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The officials of the British Museum Natural History Dept. have published some very interesting works on Africa since 1904. Prom-

inent among them is Dr. C. W. Andrews, *A Descriptive Catalogue of the Tertiary Vertebrata of the Fayum, Egypt* (1906). P. L. Sclater, Oldfield Thomas and others, *The Book of Antelopes*, in 4 vol. (1894–1900); Dr. Rudolf Marloth, *The Flora of South Africa* (1913–5).

Similarly a good deal of light is thrown on the palaeontology of Africa in the works and the pamphlets issued by Dr. Peringuey and Dr. Robert Broom in South Africa, and in the United States by Henry Fairfield Osborn. For current affairs consult *The Geographical Journal*, *The Journal of the African Society* and *L'Afrique Française* (Paris, monthly). See also the bibliographies under SOUTH AFRICA, EGYPT, etc. (H. H. J., F. R. C.)

AGA KHAN (1877–), Indian Moslem leader (*see* 1.363). During 1910–21 his influence both on Indian and international affairs was shown in various directions. He was president of the All-India Moslem League and initiated the fund for raising the Mahommedan college at Aligarh to university status, which was effected in 1920. During the World War he endeavoured to secure the support of the Moslems of the Empire for the British cause. In 1918 he published *India in Transition* which was not without considerable effect in the final shaping of reforms under the India Act of 1919. At the Peace Conference in 1919 and subsequently in 1921 before the Treaty of Sèvres, and in 1923 before the Treaty of Lausanne he advocated a less stringent attitude towards Turkey. His manifold services to the cause of international peace led the council of state in India to recommend, Feb. 5, 1924, that he be awarded the Nobel Peace Prize.

AGLIARDI, ANTONIO (1832–1915), Italian cardinal and diplomatist (*see* 1.377), died in Rome March 19 1915.

AGRAM: *see* ZAGREB.

AGRICULTURE (*see* 1.388a).—This article is divided into four main sections: I. a general sketch of the progress of agriculture from 1910; II. an account of the scientific developments; III. the economics of agriculture, discussed under the three headings of credit, insurance and prices; IV. the use of electric power for agricultural operations.

I. GENERAL SURVEY

The last quarter of the 19th century witnessed an unprecedented fall in the prices of all agricultural produce, especially of wheat and meat. This was due to the opening up of new areas, particularly in America; in the United States alone 300,000,000 acres of land were brought under cultivation between 1870 and 1900, an area greater than that which was being farmed in Europe during the same period.

It was Great Britain with its open markets, with its great emporium trade, with its increasing population already far out of proportion to the productive capacity of its land, that experienced the full brunt of the competition; other European countries protected their farmers by tariffs; one country alone—Denmark—seized the opportunity to expand her agriculture. To the Danish farmer, educated and adaptable, cheap corn and feeding stuffs afforded a means of producing butter, bacon and eggs for the ever-growing English market, and of making a profit on the conversion. The opportunity was equally open to the British farmer, but he did not display the same adaptability in taking advantage of it. With industries near at hand competing for men and capital, the English farmers and their men were not prepared to give the high level of ability and labour for the possible returns that contented the Danish small farmers; moreover, the latter had worked out a system of co-operative marketing which for the first time enabled the agricultural community to hold its own in international commerce. The growth of agricultural co-operation in the last quarter of the 19th century may be regarded as the other great discovery of that epoch, which will rank with fertilisers and machinery in recasting the agriculture of the future.

Prices.—Despite the inroads the farmers of America and of the other new countries were making upon the welfare of European agriculture, it cannot be said that this period of expansion was one of particular prosperity for them. They lived and multiplied exceedingly, but it has been stated that in the aggregate the only profit they made came from the rising values of their land as the community grew round them. On the whole wheat and the other staple crops were being sold at below the cost of production measured in terms of labour, which is the only ultimate standard.

The later period down to the outbreak of war in 1914 saw a gradual rise of prices and the restoration of mild prosperity to British farmers, though any general confidence in the future of agriculture was slow of growth. They had modified their methods to meet the conditions, they were paying more attention to education and scientific developments, they were adapting themselves to the special market at their doors and though all too large a proportion were contenting themselves with an unenlightened routine of cutting expenditure to the bone so as to take a profit out of what the land itself would give, the ever difficult situation was being met. Then followed the World War with a few years of exalted prices and undreamt of profits for all farmers with a well-ordered business. The reaction was equally sudden, and the pit into which agriculture fell was deeper than the peak to which it had temporarily ascended. The War had caused a great stimulus to wheat production, in particular in the Americas (22,000,000 ac. in the United States, 13,000,000 ac. in Canada, 2,000,000 ac. in South America). Markets began to be temporarily overstocked, and if the great break in prices in 1921 was mainly financial in origin, to the farmer it was accentuated by an existing surplus.

Moreover, the War had forced up wages to double or treble their former level, to one more nearly comparable to that prevailing in the industries, while the standard of work rendered had fallen. If to these causes we add a succession of bad seasons from 1921 to 1925, seasons that would have hit the arable farmer hard under the most normal of price conditions, it is small wonder that British agriculture is still staggering under the blow and doubtful which way to take for safety. American farmers have been little less severely hit. In the Agriculture Yearbook for 1923 it is reported that in 15 corn and wheat producing states in 1922 8·5% of owner farmers lost their farms with or without legal proceedings, and the percentage of tenants who lost their property ran materially higher. The bankruptcy cases among farmers rose to 14% of the total as compared with about 5%, which was the figure for pre-War years.

But American agriculture is chiefly suffering from the disparity of reward that it offers as compared with the industries; no single-handed farmer working even a well-established 160-ac. farm can hope for the cash returns that a bricklayer can earn, after all allowance has been made for board and lodging. Prices of agricultural produce are high as judged by old standards, but the farmers' outgoings have risen in a much greater proportion. Particularly where there is a surplus of production above home requirements, a surplus that has to be sold in European markets, the price at home is forced down by competition to a parity with this European level, one which is below the average cost of production.

In European countries, where as a rule peasant farming and protection tariffs prevail, the agricultural community is comparatively speaking prosperous; the farmers' expenditure on raw materials or equipment is small, he and his family supply the labour, so that he reaps almost the full advantage of the higher prices and the depreciated currencies.

Live Stock.—Two types of livestock production exist: grazing on ranges of natural pasture, and more intensive production under artificial feeding. As regards cattle the two systems intermingle; the cattle may be raised on the pastures and sold thence to other districts for finishing. For example, much of the beef produced in Great Britain begins as store cattle raised in the west or north or imported from Ireland or Canada, and then fattened on the rich pastures of the Midlands or the coast, or in the yards of the arable farmers. Similarly feeder cattle from the ranges in the United States travel to the middle west in order to be fattened.

The tendency throughout the world is for ranging to be exchanged for cultivation, consequently the number of range cattle tends to diminish, and this tendency is not compensated for by corresponding increase in cattle raised on the mixed farming that succeeds the ranging. Milch cattle always then begin to

grow at the expense of beef cattle. In Australasia an increase in cattle production is still possible, chiefly in Queensland, but there is no great unstocked area available as there was 50 years ago. South Africa is still an undeveloped country as far as the international meat trade goes; a few live cattle are being exported to Great Britain for slaughter, but ranging in South Africa is subject to much greater risks from disease than in America or Australasia. So far, no freezing works have been put up to develop a trade, and until this is done and communications are improved, the capabilities of South Africa and of the highlands of Central Africa to add to the beef supply of the world will remain obscure.

Beef.—Nor is it quite clear to what extent the demand for beef from European countries will persist, stimulated as it has been by the supplies poured in from America in 1918 and 1919. Prior to the War, European countries other than Great Britain were not great consumers of beef but rather of pork and dairy products, their agriculture being founded upon milk and pork production. When cheap grazing is not available the production of beef requires a larger consumption of food than that of pork; in consequence the agriculture of arable countries like Germany tends toward the more economical production of milk and veal, or of pork. The beef consumed is cow or ox beef rather than that of steers or heifers deliberately fattened for the purpose; in fact the purely beef breeds of cattle are little known in Europe. Thus beef is somewhat of a luxury article of consumption compared with pork. If the dietaries of Germany and the United States before the War are compared, with an equal supply of energy the American obtained 39·6% from animal foods, of which 5·3% was beef, whereas the German obtained only 32·4% from animal products, of which 3·2% was provided by beef. Thus the supply of beef in the world may be expected to decline with the diminution of range conditions, while the price must rise to meet the more expensive methods of production.

Sheep.—Specially marked, however, has been the reduction in the number of sheep that took place during the War and since. The following table shows a comparison for some of the chief sheep-producing countries between 1913 and the most recent year for which statistics are available.

Sheep

	1913	1924 (or latest available)	Percentage change
Germany	4,987,000	5,717,000	+15
Spain	16,441,000	18,460,000	+12
France	16,176,000	10,172,000	−37
Great Britain	24,279,000	22,239,000	− 8
United States of America	51,482,000	38,300,000	−26
Argentina	43,225,000	36,209,000	−16
Uruguay	26,286,000	14,514,000	−45
Union of South Africa	35,808,000	31,224,000	−13
Australia	85,057,000	80,110,000	− 6
New Zealand	24,182,000	23,776,000	− 2
	327,923,000	280,721,000	−14

The reduction has been in part due to encroachment on the pastures for cultivation when corn prices were so high, and in Australasia to the lack of a market when transport was no longer available. Great Britain lost 4,542,000 sheep between 1914 and 1920, a loss which has only been repaired since to the extent of 3,350,000. The decline in Britain took place in great measure in those districts where arable sheep farming prevailed, where the sheep are kept for the greater part of the year in folds on turnips and green crops. During the War the arable land was wanted for corn, and both then and since the heavy labour costs incurred both in growing the green crops and in working the folding have made this form of intensive sheep farming unprofitable. It is only in England that this form of sheep raising is general; in all other countries sheep are grazing animals generally reserved for the poorer and drier lands. For this reason sheep farming does not bulk large in the farming of any other European country, except in Spain where there are great tracts of poor and mountain pasture, not utilisable otherwise. Sheep indeed rarely play any considerable part in peasant farming on cultivated land, even under the most intensive system of folding upon green crops.

The finest wool is that provided by the Merino sheep, which originated in Spain but had become widely diffused toward the close of the 18th century. It was with these sheep that the new countries—South Africa, South America, Australia, New Zealand—were at first populated, because wool was the only product exportable, but since the introduction of refrigerated transport they have to some extent given place to Lincolns, Romney Marsh, Leicesters and some of the short-woolled breeds because of their better carcasses. For the really dry countries with rainfalls of 10 in. and less Merinos still hold their own, though a new race, the Corriedales, evolved from crosses between Merino and Lincoln, is coming into favour.

On land suitable for cultivation sheep will always give place to more intensive forms of farming, but nothing can well take their place in the hill country, especially where the rainfall is low. Their numbers are not, therefore, likely to grow in the more settled countries, and there does not as yet appear to be any area available for ranching unless it be some of the high land of Central Africa.

Pigs.—If sheep are associated with the pastoralist and the open spaces, pigs are presumably the live stock of the arable farmer, and are especially valuable to the dairy farmer turning his milk into butter or cheese. Pigs are the great converters of the maize of the Middle Western states into a more salable form of produce, and the bacon industry of Denmark has been built up on the by-products of the dairy and cheaply purchased cereals. Danish farmers have indeed given a lesson to the whole world in the skill with which they have standardised the production of a type of pig suited to the bacon trade. American pigs are in the main of the wrong conformation for bacon, and run too readily to fat, especially upon the predominating feeding with maize; English pigkeepers are perplexed by an unnecessary multiplication of breeds, often with conflicting ideals. The value of the Danish breeding has lain in the elimination of all other considerations than the requirements of the bacon factory. The great exporting countries of pig products are therefore the United States and to an increasing extent the Argentine, and, in Europe, Denmark, Holland and Sweden. The higher-priced Danish and Swedish bacon goes chiefly to Great Britain, which with Germany takes also large quantities of the considerable American produce.

Population and Food Supply

At the present time live stock production is the most profitable side of farming. There is still abundant grazing land to produce meat cheaply with a minimum of labour, and cereals are still relatively cheap for the dairy-farmer and pig-feeder, whose business consists of converting these materials into milk and meat. If food supplies begin to grow short the scarcity will first be felt with regard to meat, indeed many observers consider that a definite shortage of meat supplies is already within sight. With a diminishing herd of cattle and sheep flock the time is not far off when the United States will be a competitor for the meat output of Argentina and New Zealand instead of the largest exporter of meat and animal products.

Everything, therefore, points to rising prices for meat, so that increased attention to live stock production is likely to be the most profitable line of business for the British farmer. As civilisation proceeds and the populations grow, meat will become more and more a luxury, because the open grazings on which alone cheap meat production is possible will become settled. Moreover, a community that is outgrowing its food supplies must become more and more vegetarian. As scarcity approaches, the land must be given up increasingly to the production of direct human food. That day is of course remote, but the indications would point to a gradual tightening of meat supplies and therefore in a country like Britain, accustomed to a high standard of living, to increasing opportunities to the farmer who specialises in live stock production.

The growth of population during the 19th century, unprecedented in the world's history, was rendered possible by the opening up of new lands of America, North and South, of Australia, New Zealand and South Africa. If we exclude from consideration the East (India, China, Japan), where the available land was already utilised to the full and the density of population was already excessive, excluding also tropical countries, we find that the area of land cultivated for the white peoples expanded from about 440,000,000 ac. to over 880,000,000 acres. Now upon the present basis of agriculture something more than two acres of land has to be cultivated in order to maintain one unit of population, man, woman or child, the amount being lower for intensively cultivated countries like Holland, Denmark or Belgium, or Great Britain. Of course maintenance includes other necessary agricultural produce besides food. For example a portion of the cultivated area is given up to fibre crops; and wool and hides are by-products of the livestock industry. Other instances could easily be given.

Areas Still for Cultivation.—Working upon this basis alone that about two acres of cultivated land are necessary for the maintenance of one person, it is evident that in the temperate regions of the world there is no longer land available for the feeding of any large increase of the present population. In Europe there are still great areas of forest, swamp and heath that might be brought into cultivation, but the process would involve an expenditure both of initial capital and continuing labour out of proportion to the returns. Either the prices to be received for produce must rise greatly, or the cultivators must be content with a lower standard of remuneration, before there is much addition to the European area under cultivation. In fact the present tendency is in the other direction; only Italy with its great pressure of population increase is adding to its farming land and reclaiming wastes. All over the poorer land of Great Britain abandoned holdings and crofts may be traced, abandoned for economic reasons alone, because men would no longer live and work so near to the starvation level. Nothing but the direst need or a new scale of prices whereby agriculture becomes relatively the most paying industry will ever bring such land back into cultivation. Other European countries to a less degree show the same tendency at work.

In the United States there are still great areas of potential farming land; for example O. C. Baker (*Economic Geography*, 1925) estimates a possible increase of the wheat area in the United States of America from the present 80,000to 130,000 square miles. But little of this, however, is the natural easily farmed land the settler looks for; the efforts to make good the arid lands by dry farming and irrigation show that the good land has mostly been taken up. What remains is land on which capital outlay is required, land on which production will always be more costly than on the great fertile plains of the Middle West. As in Great Britain, the recent tendency in the United States has been to abandon the cultivation of some of the poorer lands and let them fall back to grazing. Canada still presents enormous potentialities for settlement, though the vast areas the map reveals are severely restricted by increasing aridity toward the West and by cold northwards; Baker considers an increase of the wheat area from 25,000 to 120,000 sq. m. as physically possible. But similarly on most of this land the wheat will have to be more dearly bought, by labour, fertilisers and skill, than on the land now being farmed. The potentialities of South America are less easy of estimate, but in this region there is still a great area of rich plain country unsettled, and it is not too much to expect that another 40,000,000 ac. of land are available for farming under present conditions.

The potentialities of non-tropical Africa and of Australia are small; in the latter country the arid zone lies so near to the coast that the additional area available for normal cultivation is negligible in considering the world's need of food. The great unknown factor in this survey is Western Siberia, a natural wheat area, and Manchuria. All that can be said is that the physical possibilities are great, perhaps as high as 300,000,000 ac., but no one can guess when that will be realisable, dependent as it is upon the establishment of a stable and ordered government. Moreover, on the flank of these regions hang the vast unsatisfied populations of China and Japan, ever ready to expand as the means of sustenance permit, and on this account the expectation of food from this area for the Western peoples can be but small. The data are too approximate for an exact estimate, but it is at least clear that the good land still available for settlement in the temperate regions of the world will never permit of an expansion of population such as took place in the 19th century and indeed is inadequate to meet the present rate of increase.

As potential sources of food there still remain the tropical countries, in particular Brazil and Central Africa, where abundant rainfalls and high temperatures render feasible a very high level of production from the soil. The last 50 years have witnessed remarkable examples of organised production of tropical crops under Western direction and management. The growth of sugar in Java, Cuba and Hawaii, of rubber in Ceylon and the Straits, of tea in Ceylon and Assam, afford examples of the possibilities of organised agriculture, employing the resources of science, the labour-saving power of machinery, the criticism of cost book-keeping, such as can rarely be paralleled in the farming proper of the temperate regions. The same organisation is being extended to the coconut, which, converted into margarine, is becoming one of the chief edible fats of the world. Without doubt the tropics present enormous potentialities of food production for the world, mainly in the direction of oil seeds and edible beans. It must, however, long remain uncertain to what extent the cheap native labour upon which these tropical exploitations are dependent will continue to be available. It does not appear to be possible to maintain a white population itself engaged in the cultivation of the soil in contact and competition with native labour, and Queensland is the only tropical country where agricultural development is being attempted with white labour only.

In this brief survey it is only possible to indicate the broad grounds for supposing that the food production of the world as at present organised is on the point of becoming inadequate for the demands of the growing population. The enormous growth of the 19th century was rendered possible in part by the discovery of fertilisers, but in the main by the opening up of the new lands, particularly in the United States and Canada. The United States is already beginning to call for imports, and will soon require all the food she produces and no longer have an exportable margin for over-populated Europe.

Under a system that calls for two cultivated acres to support a unit of population there is not sufficient land in sight capable of settlement to provide for much further growth of population. The continual rise of food prices since the beginning of the century—and it would appear that the trend is being resumed after the violent fluctuations caused by the War—is further evidence that the process is at work.

The process is being accentuated by the growing disinclination of the civilised peoples to engage in agriculture, because of its small and uncertain returns as compared with other occupations. It appears to be a general experience that wherever by the extension of communications industries or commerce come close to agriculture the latter declines and begins to lose its best brains, its capital and its men. The lure of the cities is proverbial, but the fundamental factor is economic; unorganised agriculture cannot pay the wages obtainable in the organised industries. The decline in the agricultural population of Great Britain and the United States is the most marked, but it is significant that in France, where of all countries the farmer is most protected and prices have been maintained, the peasants are leaving the land for the growing industries, their places being taken in the south at least by Italian immigrants.[1]

Intensive Production.—If the land area for cultivation cannot be expanded the production from the existing area can be intensified, and it is evident from the most cursory examination of the yields of wheat in different countries that a great intensification of yield is easily possible. The select areas of Holland, Belgium, Denmark and Scotland average 40 bu. to the ac.; England produces 32, the world's average is in the order of 12. Turning to potatoes the British average yield is 6¼ tons per ac., though good potato growers expect 10, the average in many of the large producing countries, *e.g.*, France and the United States, is less than 3 tons per acre. Intensification of production involves, however, increased cost of production per unit unless in some way the system of farming can be changed. The much disputed law of diminishing returns comes into play, which states that if any factor of production be considered separately, *e.g.*, cultivation, fertiliser or water supply, successive increments of the factor give rise to increases of crop that successively diminish. In other words it is the last bushel of corn that costs the most fertiliser to produce, the last hundred pounds of increase in a bullock that involves the largest consumption of food. This expression of the law of diminishing returns is perhaps not literally correct, but of its general truth in relation to agriculture there can be no doubt. The best illustration of its validity on a large scale may be derived from the course of English farming after

[1] France:—

1846	Total population 35,400,000	Rural population 26,700,000
1911	Total population 39,600,000	Rural population 22,100,000
1921	Total population 39,200,000	Rural population 18,200,000

the great break in prices that began about 1875. At that time the English level of production as indicated by the yield of wheat, 32 bu. to the ac., was the highest in the world, but the English farmer could not meet the falling prices by increasing his yield. Instead he lowered his standard of cultivation and cheapened his costs. The average yields obtained remained about the same, 32 bu. per ac., because the acreage under wheat was contracted by more than one-half by the withdrawal of the poorer lands from the plough. To take another illustration, the cheap wheat which was forcing the English farmer out of wheat growing was not the production of heavier crops than he could raise; it was North and South American wheat from lands giving an average yield of about 12 bu. per acre. As Lawes put it "high farming is no remedy for low prices."

If then intensification of production on the existing farming land of the world is necessary, it cannot be obtained by merely tuning up farming as it is carried on at present, by employing more fertiliser or more labour, unless there is a general rise in the price of produce to justify the expenditure. There may be adjustments in the system of farming, there may be scientific discoveries or an all-round increase of skill, whereby an increased production is obtainable without increased cost, in which case the law of diminishing returns does not come into play or is disguised. But the probability is that such changes will come slowly; farmers all the world over are naturally conservative and disinclined to alter their proved methods, and under present conditions it would appear that a sharp rise in prices is a necessary antecedent to a wholesale movement in the direction of intensified production.

The introduction of artificial fertilisers and imported feeding stuffs enabled the British farmer between 1840 and 1870 to raise the level of his production by something like one-half; what further advances may be expected from science in the direction of intensification?

Conservation of Fertility.—Doubts have been expressed as to conservation of the fertility of the soil, but that fear may be dismissed. The introduction of leguminous crops into the rotation suffices to maintain a stock of nitrogen sufficient for the present average level of production, and from this source alone the soil of the old settled countries has maintained its power of production over many centuries. The latest extension of this principle has been the growth of lupins over the sandy soils of the northern European plain to be ploughed in as a preparation for the rotation of grain and fodder crops, with, as a result, a definite increase in the fertility of German and Polish soils. An intensive agriculture requires more available nitrogen than can be thus obtained, but this is assured by the many processes that have now been worked out for the fixation of atmospheric nitrogen. Concentrated nitrogenous fertilisers are becoming cheaper and more abundant, and the supply can be made to keep pace with almost any demand conceivable. Phosphates cannot be manufactured, but great deposits have already been revealed, and more will doubtless be discovered.

Most soils under cultivation, however, still remain comparatively deficient in phosphates, and, as Hopkins of Illinois so strenuously preached, if this deficiency be made up and leguminous crops are grown, the production of the Middle West soils can be maintained indefinitely even above its present level. On most soils the needs for potash are less, but the deposits of Stassfurt and Alsace, with the potential supplies from the undeveloped fields of Spain and elsewhere, are so vast as to assure a supply for the most intensified agriculture for a long time to come. The only obstacle to an all-round increase of crops by a greater use of fertilisers is the question of cost; as yet the grain raised on the new lands, cropped extensively at a low level of production without fertilisers is cheaper than that obtained from yields with fertilisers; hence progress depends upon the power of the industrialist to cheapen fertilisers rather than upon the farmer. Nor can much change be anticipated in the allied region of feeding stuffs, since they also are the product of cultivation.

Economics in Conversion.—Great economies are possible in the conversion of feeding stuffs into meat; a calculation made in war time showed that the amount of meat, milk and other animal products realised in Great Britain during the five pre-War years was only about $\frac{1}{3}$ of what might possibly have been obtained from the fodders consumed. But improvement in this respect will be the outcome of exact individual management rather than of any sweeping change of method, and the whole field is influenced by the economic consideration that it is often more profitable to let animals grow carelessly and wastefully on wide pastures rather than to spend labour on husbanding their resources to the full. Still the progress that has been made in America, the Scandinavian countries and Great Britain in the exact rationing of milch cows in proportion to their yield indicates the economies that could be effected.

The aim of the agriculture of the future will be to economise man-power as the expensive item in cost of production, and the value of machinery lies in its power of reducing the labour fraction in the cost per unit of the article turned out.

Breeding.—Genetics, the science of systematised breeding, has a great part to play. Even amongst crops like wheat and barley, which have been worked at by so many generations of the old empiric breeders and which are therefore less susceptible to improvement, great advances have been made within the last half century, not so much perhaps in gross yield as in adaptability to climatic conditions and disease resistance. The breeding of Marquis wheat has enabled the wheat belt to be pushed miles to the northward and added millions of acres to the potential wheat area, solely in virtue of its power of ripening a week earlier without loss or quality.

The enhancement of the percentage of sugar in sugar beet from something in the order of 10 to 18–20% is another example of the breeder's art, and similar improvements may be expected in other fodder crops which are often only the outcome of chance discoveries and accidental crossings. Many of the tropical crops, like the coconut, have never been subjected to selection and are still as nature made them. The immediate task before the breeders is to reduce the old sound doctrine of "pedigree" to terms of useful performance only, to eliminate "fancy" points and to standardise our breeds for production only.

But there is nothing basic, nothing immediately revolutionary in these measures; the key to progress lies in the general adoption of more exact measures and in the education of the farmer to be ready to take advantage step by step of the small but cumulative discoveries of the investigators. Assuming that the progress of science is capable of bringing about great enhancement of production by methods that do not immediately bring into play the law of diminishing returns, we may next inquire whether the organisation of agriculture is adequate to the demands made upon it.

Small or Large Holdings.—By far the greatest part of the farming of the world is carried on by peasant holders, using that term to denote men who cultivate their farms mainly by their own labour and that of their families.

If we ignore the social and political considerations that commend peasant farming to the statesman, to what extent can it be expected to meet the growing demands of the world for food? It may be agreed that the division of a large farm into small holdings is generally attended by increased production, but that is because it involves a change from an extensive to an intensive system of farming, a change which was equally open to the large holder. The efficiency of the peasant is not as a producer but as a competitor who can undersell the large farmer because he is content to give a great output of labour, that of his wife and family as well as his own, in return for a somewhat bare living. But the large farm can be the more efficient if efficiency is measured in terms of production for the labour expended. On the large farm alone can machinery and other labour-saving devices have full scope, and with the staple crops like wheat or potatoes the economy of large-scale working is obvious. Even allowing for the detailed handling involved in stock feeding, milk production, truck and fruit farming, a higher level can be reached by the organisation and skilled supervision of a team than by single-handed working. Large-scale operations for the amelio-

ration of the land by drainage and kindred operations are as a rule only applicable to large estates, unless the state exercises a paternal and often uneconomic control over the land. It may be doubted, too, whether peasant communities are going to be as receptive of the advances of science and new developments as large farmers working for profit.

However, the physical advantages of the larger farmer are very generally offset by his inability to get out of his men a day's labour comparable either in quality or quantity to that given by the peasant. Science and the art of management have not so far advanced as to drive the peasant worker to the wall; indeed, by his labour alone he is still able to undercut the large farmer and make him lose confidence in the power of organisation and machinery. It is in agriculture as it was in the textile industry a century ago, the hand loom weavers can still live alongside the power-mill and even break it by their competition. It is indeed one of life's ironies that just at the time when the advances of science are putting new powers at the disposal of the entrepreneurs of land, labour should be acquiring a new class-consciousness which renders it reluctant to co-operate in any experiment in large-scale farming. Yet it is only by developments of this kind that agriculture would be enabled to pay industrial rates of wages. At present the vicious circle is complete; low prices and the wage threat hold off the capitalist from any adventure into agriculture, while the same low prices prevent the present-day farmer from paying any higher wages.

In despair a solution is being sought in a reversion to peasant farming whereby the land is put into the hands of men who have, hitherto at any rate, been willing to give an ample day's work for an uneconomic return as measured by modern standards. It is often maintained that a peasant community can be united into an efficient agency of large-scale production by means of co-operative organisations, which ensure not only a proper market but also that degree of control of the individual producer that is desirable for his commercial welfare.

Co-operation.—A firmly established co-operative society can buy for the farmer the best type of seed and can almost insist on his growing it; it can enforce upon the farmer standards of cleanliness and quality in the milk produced, it can set out the particular type of pig it is prepared to market and say in what way it should be fed. And the Co-operative Society can exercise this wholesome pressure without hurting the independence of the farmer. Co-operative organisation by binding the farmers into efficient commercial units and by exercising pressure and persuasion in the direction of better technique may outweigh the mechanical disadvantages of the small farm, because it preserves individual initiative and the willingness to work characteristic of the peasant.

Some organisation of marketing is essential to the farming of the future, otherwise even the large farmer is powerless against the growing combinations developed by international commerce, powerless also to meet the fluctuations of production that are inevitable in agriculture. Since the farmer cannot regulate his production because he has to make his preparations long before the market is declared, since he has to adopt a routine susceptible of change only at considerable intervals of time, combination in marketing alone can save him from the damaging effects of seasonal over-production. It may seem idle to take precautions against over-production when the whole world is calling for supplies and a possible scarcity of food has to be contemplated. But it is just these over-productions, temporary, seasonal and local as they may be, that destroy confidence in farming and hinder its orderly expansion. Combination there must be, whether of small farmers moved by the spirit of co-operation or of great agricultural enterprises actuated by business intelligence. Control too may be predicted, whether it is control exercised by farmers themselves from within or by some external authority, for the present haphazard system with its destructive competition between individuals and between nations only results in keeping agriculture at a low level while people want food.

See also CO-OPERATION; FARM ORGANISATION; FARMERS' ORGANISATIONS; FOOD SUPPLY; GRAIN; LAND TENURE, etc.

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II. SCIENTIFIC DEVELOPMENTS

The period 1910–26 saw unprecedented advances in agricultural science. Until 1910 the United States and Canada were the only countries possessing adequate organisation for agricultural research. Germany had a number of experiment stations staffed by enthusiastic workers making the most of their means, but Great Britain and France were both badly equipped. In 1909 the British Parliament set up the Development Fund at the instance of Mr. Lloyd George, then Chancellor of the Exchequer, and assigned a capital sum of £2,900,000 for rural development, including agricultural education and research. Under the advice first of Sir A. D. Hall and afterwards of Sir T. H. Middleton, the Development Commission made grants out of this fund to certain institutions each responsible for one or more sections of agriculture.

In France, the Conseil d'Administration of the Ministry of Agriculture, under the Presidency of M. Roux, is projecting a National Experiment Station. In the British Empire, Canada has admirable agricultural colleges and experimental farms; India has the great experiment station at Pusa, founded in 1903 with the aid of a generous gift by Mr. Phipps, an American; Australia, besides its older Universities and agricultural colleges, has the Waite Research Institute at Adelaide, founded in 1923; New Zealand has the Cawthron Research Institute at Nelson, founded in 1915; Trinidad has the Imperial College of Tropical Agriculture, founded in 1924; while throughout British Africa, notably in the Union of South Africa and the Sudan, there are important laboratories and research stations. The tropical research station founded by the Germans at Amani has now passed into British hands. In the United States, agricultural research, already strong, has been considerably strengthened by increased appropriations, the estimates for the Dept. of Agriculture in 1924 amounting to no less than $42,000,000.

Side by side with these scientific activities, there have been marked developments in implements, including tractors, cultivating and draining machinery, milking machines, harvesting implements which not only cut, but thresh the grain as they travel, throwing out the sacks of grain on the field; and many other appliances. These implements are not as efficient as good workmen in the performance of individual operations, but they achieve more work in a given time. The results appear rather in the reduction in the hours of labour necessary to secure a given crop, than in any increased production per acre. A few crops show increased yields, *e.g.*, in Great Britain potatoes and wheat, but most do not. The human labour has, however, been greatly reduced without sacrifice of crop. Further, the losses through adverse seasons are diminished; there are now no catastrophes like that of 1879. Insect and fungus pests are distributed all over the world by modern transport, but their activities are being controlled.

CROP PRODUCTION

The main advances in crop production are due to: (1) a better knowledge of the properties of soils; (2) greater supplies and greater knowledge of fertilisers and other methods of increasing plant growth; and (3) the introduction of varieties of crops better suited to the local conditions.

The Soil Factors.[1]—The soil provides water and nutrients, but it must also allow liberal access of air to the roots, and be free from any harmful substance or obstruction limiting full root development. The quantity of water needed by the plant is considerable, usually exceeding 300 times the weight of the dry

[1] For further information see Sir E. J. Russell, *Soil Conditions and Plant Growth* (1926).

matter, or 30 times the weight of green crops (grass, cabbages, mangolds, etc.), while the amount of nutrients is less than 1/100 part of their dry weight. Indeed over a great part of the cultivated land of the world deficient water supply is the principal factor limiting crop production. Air supply is equally important; successful root development depends on an easy interchange of gases between the atmosphere and the soil through the pore spaces which form 30 to 50% of its total volume. But these spaces also contain water, and in a wet soil air movement is much restricted; carbon dioxide then accumulates, and injures the crop when its quantity rises much above the normal (0·2 to 0·5% by volume of soil air). Freedom of root development necessitates an easy passage of the growing rootlets through the soil. This is secured in practice by bringing the soil into the friable, crumbly condition known as a good tilth. These three factors, favourable water and air relationships and a good tilth are closely linked; the connection has now been traced to the soil colloids.

Soil Colloids.—Soil consists mainly of mineral particles ranging from 1 mm. diameter to ·001 mm. or less; a fraction, usually about 10% or less, has colloidal properties. Part of this fraction is organic, part inorganic.

The organic part is *humus* derived from decaying plant residues, principally from the lignin by oxidation. Part of this is an acid, humic acid; much of the remainder is akin to an anhydride, for it is transformed into the acid by hot alkali; the acid appears to be tetrabasic and to contain carboxyl groups but no nitrogen (Odén). In the soil it is closely associated with a complex nitrogen compound, probably protein.

The inorganic colloid is the ultra clay or colloidal clay isolated by the Sharples or other super-centrifuge. No sharp line divides this from the clay and fine silt of the older mechanical analysis; usually 0·001 mm. (=1μ) is taken as the conventional upper limit. R. Bradfield (Missouri Experiment Station) shows that the clay is a salt of a complex alumino-silicic acid. In normal soils the base is calcium; the clay is then readily flocculated and conducive to a satisfactory tilth. But the calcium can be replaced by hydrogen forming an acid clay not conducive to good tilth, and having the undesirable property of combining with, and therefore taking from the plant, bases needed for plant nutrition. The calcium is replaced by sodium when sea water floods the land; or, in dry districts, where the irrigation water contains sodium salts (as it commonly does); or in ordinary practice where sodium nitrate is used too intensively on heavy soils.

These base exchanges had long been known but not understood; they were discovered by the English chemist, Way, in 1850, and studied in recent years by Gedroiz at Petrograd and Hissink at Groningen; but the reactive substances were not isolated from the soil. Whether the colloidal clay is the only reactive body is not known.

The colloidal clay has the properties of an electronegative colloid. It can be flocculated by acids or by salts, but is dispersed or deflocculated by the negatively charged hydroxyl anions (*e.g.*, alkalis). The phenomena are complex. The sodium clay is the most easily and the calcium the least easily dispersed of all the clays.

Calcium clay is the normal clay. In the course of their evolution plants have become adapted to it, and it is therefore the most fertile of all clays, conferring on soils the desirable water relationships. Sodium clays, on the other hand, are the least suited to plants. Their easy deflocculation causes resistance to plant roots and filling of the pore spaces of the soil with water. Worst of all, they readily hydrolise in the presence of carbonic acid and water to form sodium carbonate, a dreaded plant poison, the black alkali of irrigated soils. The remedy for these evils, adopted by the California experts, is to convert the sodium into a calcium clay by treatment with calcium sulphate (gypsum); the sodium carbonate and sodium sulphate simultaneously formed is then washed away. The treatment is ineffective, however, unless sodium salts are withheld from the soil.

The colloids, both organic and inorganic, are distributed throughout the soil as a jelly-like coating on the surface of larger particles, or coalescing into smaller particles; their great power of absorbing water is the main factor in determining the water-holding capacity of soils.

These discoveries have found practical application. Dryness in soil, a frequent source of infertility, is associated with lack of colloidal material and is remedied by adding more plant residues, either farmyard manure or green manure, the alternative of adding more clay being usually impracticable. In irrigation schemes care is taken to exclude sodium salts, not always an easy operation, because sodium chloride and sulphate occur widely in the dry regions of the world, no doubt as the residue of former seas. Irrigation is combined with drainage to wash out sodium salts and facilitate re-formation of the calcium clay should the sodium clay arise.

Acidity or "sourness" in soil is now traced to the humic and clay acids; its quantity is measured by a "lime requirement" method based on the power of the soil to absorb calcium from a solution of calcium oxide or bicarbonate; and its intensity by determinations of the hydrogen ion concentration in the soil. Comparison between the two methods is complicated by the fact that the colloidal or other substances in the soil have a considerable "buffer" effect, but an expert analyst can form a fair estimate of the quantity of lime or of calcium carbonate needed to bring about a given degree of improvement.

The organic matter of the soil is more than a source of colloids. Being the remains of previous generations of plants it contains all substances necessary to the life of the plant, and, in addition, material synthesised by the plant during its life and still containing energy fixed by chlorophyl from the sun's rays. In the soil this energy material supports a multitude of micro-organisms: bacteria, fungi, algae, also protozoa feeding on the bacteria, and numerous insects feeding on the organic matter or preying on each other. In obtaining food and energy these organisms decompose the complex organic matter and liberate the energy stored therein, the final products being CO_2, water, simple compounds of potassium, calcium, etc., phosphates and nitrates, all essential plant nutrients. Thus the remains of one generation of plants afford food for a later generation; the transforming agents are the soil organisms which live on the energy and nutrients still remaining in the residues.

The production of plant nutrients, while the usual result of the activities of the soil organisms, is not an essential consequence of their existence. In their search for food and energy they may leave nothing for the plant, or even take up some of the plant nutrients already in the soil. Protein contains more nitrogen than the organisms need even after multiplying as much as the energy content allows; ammonia is therefore left for the plant. Carbohydrates and cellulose on the other hand contain no nitrogen, and the organisms, in multiplying up to their energy content, absorb nitrates from the soil; the plant therefore suffers. This explains why addition of sugar to the soil lowers crop yields, and why straw, in spite of its fertilising constituents, does not increase, but may diminish crop yields. The realisation that the organisms do not always or necessarily produce ammonia has caused the abandonment of the old division of soil bacteria into ammonifiers and non-ammonifiers.

While most, if not all, of the soil organisms can effect alternative reactions for obtaining food and energy, certain reactions can be brought about only by a few specific organisms, among them the oxidation of ammonia to nitrate, which provides energy for the organisms, and the fixation of atmospheric nitrogen and its conversion into protein by Azotobacter and Clostridium, though these organisms, by preference, assimilate nitrate if they have the chance. Other nitrogen fixing organisms live in the nodules on the roots of leguminous plants; the association is mutually beneficial because the plant receives nitrogen compounds from the organism and the organism receives carbohydrates from the plant. The number of organisms in the soil varies continuously.

There are great seasonal changes, the numbers being high in spring and autumn, low in winter and summer, as happens also for plankton in the sea and in fresh-water lakes and for algae in a pond. There are also great daily fluctuations. D. W. Cutler and L. M. Crump have shown that these are determined by fluctuations in the numbers of amoebae, thus confirming Russell and Hutchinson's discovery of the importance of protozoa in the soil economy. The meaning of these changes is not clear.

Three applications of soil microbiology are made in agricultural practice. Simplification of the population by partial sterilisation results in a greater production of nitrate and consequently greater productiveness; the soil can simultaneously be rid of some insect or other pest. In glass-house practice soil may be heated by steam or treated with poisons such as cresol, carbon-disulphide, chlorpicrin, etc. These do not long remain in the

soil, but are attacked by certain soil organisms and oxidised, presumably for the sake of the energy liberated. None of these methods is applicable to field conditions, but examples of the action are found in hot countries.

A second application of soil microbiology is the inoculation of the seed of a leguminous crop with the organisms associated with it so as to ensure more vigorous or greater growth. This was attempted as far back as 1890, but without success. Subsequent laboratory investigations showed that the organism passes through several stages in the soil, only one of which is motile. For maximum effectiveness it is necessary to ensure motility; this is done by adding milk and phosphates to the cultures. Difficulties of storage and transport of the organisms, which caused many of the best cultures to die before they reached the farm, have been overcome by storing the organisms in sterilised soil and transporting them on agar. The technical details have been worked out by Bartel of Stockholm, Christensen of Copenhagen and Thornton of Rothamsted. Inoculation of lucerne is now a recognised practice in Scandinavia, and is spreading in Great Britain, the empire and the United States.

The third application of microbiology is in the rotting of plant residues to produce a humus manure. The heap is soaked with water and mixed with an ammonium salt and calcium carbonate; the organisms are invariably present, and need only the added nitrogen to set them working vigorously. A fertiliser resembling farmyard manure is thus produced from otherwise waste substances.

The Use of Fertilisers

Where water supply is not a limiting factor, crop yields can be considerably increased by the proper use of fertilisers. The problem of fertiliser supply, formerly urgent, has been profoundly altered by the World War, one of the chief agents with which it was fought—combined nitrogen—being also an important fertiliser. Prior to the War Chile was the main source of nitrate and coal of ammonia; synthetic nitrogen fertilisers were obtainable, the industry having been founded as the result of Sir William Crookes' impressive address at the British Association in 1898, but they played only an insignificant part in farm practice. During the War extensive factories for the preparation of ammonia from atmospheric nitrogen were erected in central Europe and, since the War, in other countries also. Three processes are used: the arc process, yielding calcium nitrate, almost limited to Norway where water power is abundant; the cyanamide process, used in Switzerland and other countries near a source of coal; and a catalytic process now becoming the most popular, usually a modification of Haber's, yielding ammonia which can be converted into the chloride by combining the process with the manufacture of soda, or into the sulphate by reaction with gypsum, or into nitric acid by oxidation.

The effect of post-War developments is seen in the following estimates of the world's production of nitrogen compounds:—

Compounds in Tons (2,240 lb.) of Pure Nitrogen

	1924–5	1912	1903
Chile Nitrate	363,000	401,000	221,000
Sulphate of Ammonia By-product	290,000	247,000	108,000
Fixation Industry:—			
Arc Process (Nitrate of Lime)	25,000	10,000	Nil
Cyanamide	115,000	19,000	Nil
Catalytic Sulphate of Ammonia	255,000	Nil	Nil
Other Nitrogen Compounds	60,000	Nil	Nil
	1,108,000	677,000	329,000

The productive capacity is considerably higher than this; hence all fears as to supplies of nitrogenous manures have been banished. Some of the nitrogen is used for industrial purposes and explosives, but agriculture took about 595,000 tons in 1913, of which 290,000 tons was supplied by Chile nitrate, while it took 983,100 in 1924–5. Germany uses more nitrogenous manure than any other country in the world, her consumption in 1924–5 being estimated at 335,000 tons of pure nitrogen, almost all of which was for agriculture; this is greatly in excess of her pre-War consumption (225,000 tons[1]) and is more than one-third of the whole world's consumption. New methods of manuring crops are being tried (see below, under *Sulphate of ammonia*), in order to secure the maximum agricultural output as a rapid means of increasing wealth.

Nitrate of Soda.—The fears once entertained of an early exhaustion of the Chile nitrate deposits (1921 had been mentioned as a final date) have been dispersed by improved methods of extraction; in 1925 the prospects were so good that Messrs. Guggenheim, of New York, purchased large nitrate grounds and began erecting a plant for the operation of a new process not yet published. Most companies still employ the old Shank's system; some use the more modern processes of Gibbs or Butler,[2] with what success, however, is not known. The price still remains above pre-War levels, while that of sulphate of ammonia has fallen; in consequence the consumption in Great Britain and Ireland, which before the War was 80,000 tons per annum, has now fallen to 40,000 tons.

Nitrate of Lime.—The Norwegian product is entirely satisfactory; its calcium is useful on many soils and its solubility quickens its action. It usually contains 13% of nitrogen, and is thus somewhat less concentrated than nitrate of soda, which contains 15·5%. In the pure state it is hygroscopic, but this difficulty is now overcome.

Ammonium Nitrate.—This has the advantage of concentration, containing as a rule 34·8% nitrogen. Its deliquescence was overcome by crystallising in a special way. But it suffers from the insuperable disadvantage of being highly explosive when detonated, so that it is not likely to become popular as a manure.

Sulphate of Ammonia.—This is now made neutral and is drier, more friable, less sticky and more easily drilled than the old, which contained 0·03 to 0·05% acid; it is also slightly more concentrated, containing 21·1% nitrogen or 25½% ammonia against 20·8% nitrogen or 25¼% ammonia. In the export trade it tends to cake, a disadvantage that can now apparently be overcome. New methods of using it on grass land are being studied at Hohenheim; large dressings are given to force an early growth of grass, which is first grazed, then cut for hay and finally grazed again. The system necessitates increased dressings of potassic and phosphatic fertilisers and also of lime. It is being tested at the Dairy Research Institute, Reading.

Great Britain is the chief exporting country and the United States comes second; Spain, Japan, Java and France are the chief importers, using it for oranges in Spain, rice in Japan and sugar in Java. Consumption in Great Britain has risen from 40,000 and 50,000 tons in 1913 and 1914 to 153,000 tons in 1924. The price is now nearly at pre-War level and may fall lower. Cyanamide is inconvenient and uncertain as a direct fertiliser; it is therefore usually converted into ammonia though attempts to overcome its disadvantages are still being made.

Urea is the richest fertiliser in nitrogen (46·7%), a great advantage for export. It is also neutral, and unlike sulphate of ammonia, leaves no acid residue in the soil. As a fertiliser it is slightly inferior to nitrate of soda but not to sulphate of ammonia; it is better applied with the seed than used as a top dressing.

Superphosphate of Lime.—One ton of sulphuric acid reacts with approximately one ton of mineral phosphate to give superphosphate. The enormous consumption of sulphuric acid during the War caused a great expansion in productive capacity, which it was hoped would bring down the cost of the acid and therefore of superphosphate after the War. This hope has not been fulfilled; acid prices are still 50 to 100% higher than the pre-War level. The process of manufacture has become greatly improved by the instalment of labour-saving devices and of fans to remove the fumes.

Basic slag has greatly altered since the War because of the displacement of the Bessemer converter by the open-hearth process which yields a slag containing little more than half the phosphate formerly present. Further, the fluorspar used in making much of the slag reacts with the phosphate—yielding a fluorapatite, thus lowering its solubility and fertilising value.

Mineral Phosphates.—Ground mineral phosphate was generally unsuccessful as manure before the War. The failure is now explained; the grinding was not sufficiently fine. Good results are now obtained both on arable and on grass land with phosphate passing through a sieve having 120 apertures to the linear inch, instead of the old one with 100 apertures only. Even so, however, the mineral phosphate appears to be inferior to superphosphate on arable land and to high soluble basic slag on grass land.

Potassic Fertilisers.—Prior to the War potassic fertilisers were obtained only from Stassfurt. Three salts were worked: the sulphate, the chloride or muriate and kainit, a mixed salt containing potassium and sodium chlorides and magnesium sulphate standardised to contain potassium equivalent to 12·5% of K_2O. During the War the cutting off of German supplies led to exploitation of alternative sources, some of which were good. Since the War Stassfurt no longer monopolises the world markets, the French

[1] On the pre-War territory with 35,000,000 hectares of arable land: the post-War territory contains only 30,000,000 hectares arable land.

[2] See J. B. Hobsbaum and J. L. Grigioni. *Jour. Chem. Ind.* (Jan. 1917).

having opened up the mines of Alsace. These deposits differ from those at Stassfurt in containing neither potassium sulphate nor magnesium salts; hence they supply only the muriate or chloride of potassium and "French kainit," a mixed salt of potassium and sodium chlorides; Stassfurt still therefore has the monopoly of the sulphate and of magnesium salts. The sulphate and the chloride of potassium are on the whole equally effective in promoting plant growth (though in certain circumstances one is more effective than the other), but the sulphate is rather better for improving quality of potatoes, one of the most important crops for which potassic fertilisers are used. The consumption of potassic fertilisers has greatly increased since the War.

Other Suggested Fertilisers.—Magnesium sulphate has on occasion increased the yield of crops, but the conditions are not sufficiently well known to justify recommending its use by farmers. Silicates have been tried as fertilisers, especially in Germany, where it was hoped that they might partially replace phosphates and so reduce the need of importation, Germany having no phosphate deposits; but these hopes have not yet materialised. Manganese and boron are both essential to the growth of certain plants, but neither can yet be used by farmers.

Quality in Crops.—While quality is easily recognised by experts, it cannot yet for any crop except sugar beet be expressed in chemical terms. Quality is mainly determined by varietal factors, some varieties possessing it in greater degrees than others, but it is considerably influenced by temperature, water supply and soil type. Increasing efforts are made by experts to improve quality. In sugar beet, the percentage of sugar has been steadily increased by using as seed producers only those roots found by analysis to possess unusually high sugar content. In 1871 the average percentage was 10; now it varies about 18 or 19. The roots can be sampled without impairing their value for seed production. In potatoes, cooking quality cannot yet be explained in chemical terms, but it is associated with variety and with soil conditions, the black fen soils giving high yields but not high quality, while the silts of the Eastern counties and of the Lothians give both high yields and high quality. In barley, malting value also is not expressible in chemical terms but is associated with variety, with seasonal factors and with soil conditions. Milling value of wheat seems to be mainly varietal; for long it was confined to the hard spring wheats of continental regions (*e.g.*, Red Fife in Canada), but it has now been bred into autumn wheat by Biffen in his "Yeoman."

The effect of fertilisers on the quality of crops is less than was at one time supposed; nevertheless, fertilisers influence the character of the growth, and this reacts on the quality. More important effects are acceleration or retardation of ripening, tendency to strengthen or weaken the straw, and certain changes in the composition of leaf or seed.

Plant Diseases and Pests

Striking advances have been made in our knowledge of plant diseases and pests, and of measures by which they may be controlled. Three general methods are adopted:—

Varieties of plants are sought which are immune or highly resistant to the disease; if, as usually happens, these varieties lack some necessary or desirable character, they are crossed on Mendelian lines with others possessing it. This method is being adopted in the campaign against rust in wheat, one of the worst pests of this crop. It is also used against wart disease in potatoes, a fungus pest (*Synchytrium Endobioticum*) which threatened terrible damage to the crop but has been rendered almost harmless by the introduction of immune varieties.

The second method is to modify the conditions of growth so as to give the plant more vigour to overcome the disease. This has been successful in glasshouse practice in dealing with diseases of the cucumber and the tomato.[1]

The third method is to attempt a cure. Fungi are commonly controlled by spraying with finely powdered sulphur, polysulphides or Bordeaux mixture (copper sulphate and lime), the sulphur or polysulphides being used for the various mildews, and the Bordeaux mixture for other fungi, *e.g.*, potato blight caused by *Phytophthera infestans*, and "leaf curls" on peach, almond and other trees caused by *Exoascus deformans*. Insects are controlled by various sprays, the composition of which is determined by the nature of the insects and the state of the tree, *i.e.*, whether carrying tender foliage or in its winter resistant state. Eggs and sucking insects, *e.g.*, aphids, are killed by "contact" insecticides: alkali washes and coal-tar fractions or synthetic products in winter, nicotine and the various tropical plants used by natives as fish poisons (*Derris*, *Tephrosia*, etc.) in summer. Biting insects, *e.g.*, caterpillars, are killed by spraying lead arsenate on to the leaves; this treatment should never be used after the fruit has begun to form, especially in dry conditions, as nothing more readily causes a scare than the discovery of arsenic on fruit exposed for sale.

Systematic studies of insecticides at Rothamsted and elsewhere are bringing out effective organic compounds producible on the large scale. Other methods of control are to find weak points in the life history of the pest, the destruction of alternative hosts, and the search for hyperparasites which will greatly weaken the pest; this last is attractive but not yet successful except to a limited extent in certain islands, *e.g.*, Hawaii.

Much trouble is threatened by mosaic and other diseases caused by unknown agents and therefore vaguely attributed to a virus. Mosaic is transmissible by injecting a very small quantity of the juice of a diseased plant into a healthy one, and possibly by aphids in their passage from plant to plant.

Weed Control.—The growing cost of labour has compelled farmers to omit some of the cultivations by which in past days weeds were kept down. Four methods of control are adopted:—

(1) Certain free-seeding objectionable weeds are proscribed by law; farmers can be prosecuted for having them on their land.

(2) Threshing and seed-cleaning machinery have been greatly improved, so that seeds are now obtainable of a high degree of purity and entirely free from specified weed seeds.

(3) Effective machinery has been devised on the model of the horse-hoe for uprooting weed seedlings.

(4) Where the crop is already up and the weeds cannot be hoed except with difficulty, the whole field can be sprayed, at the rate of 50 gal. per ac. ,with a solution of either copper sulphate (3 to 5%), iron sulphate (10 to 15%), more popular on the continent of Europe than in Britain, or ammonium sulphate (30%), not yet commonly used; 5% sulphuric acid has eradicated bracken. These sprays need water, which is not always easily obtainable on the farm; dry sprays are therefore being used, especially finely powdered kainit (4 to 8 cwt. per ac.).

For yellow rattle (*Rhinanthus crista-galli*) in grass land, 6 cwt. powdered salt is applied per acre, and for daisies on lawns a mixture of dry sulphate of ammonia and sand (1:1 or 1:2) is sprinkled over the plants.[2] Once the land is free from weeds it can be kept clean by growing dense crops such as mixtures of oats with vetches, etc., which smother any weed seedlings and can be cut for hay or made into silage.

Other Methods of Improving Crop Production.—A high tension electric charge has been found to add about 25% to the crop yields, but the process is not yet practicable on the large scale. Radioactive fertilisers on this land are ineffective.

Suitable Varieties of Crops.—Modern agriculture is becoming more and more a study in adaptation. Instead of attempting by costly and laborious artifices to alter the soil or mitigate the effects of climate, farmers now seek out new crops or new varieties of old ones better adapted to their conditions than the old ones. This search for new varieties occupies much of the time of the research stations.

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(E. J. R.)

Plant Breeding

This ancient art, which by the end of the 18th century embraced systematic cross-breeding, received a great impulse from the rediscovery of Mendel's laws in 1900. In the past 20 years

[1] *See* W. F. Bewley, *Diseases of Glasshouse Plants* (1923).

[2] For further particulars see W. E. Brenchley *Weeds of Farm Land* (1920).

few agricultural areas have remained entirely unaffected by its exponents. Three broad procedures are now recognised: introduction of crop varieties from other lands, which still bears fruit in newly developing areas; selection or the search for individual plants of especial merit in field crops, which has brought notable advances; and artificial hybridisation or cross-breeding, which stands first in importance. Higher yield, better quality and resistance to disease have been the foci of effort. Only time can establish the merits of new forms. Official figures of acreage rarely discriminate between varieties, so that it is impossible here to mention more than the few more important but well proved advances.

Wheat.—Wheat improvements take first rank, and among them the Marquis wheat of Canada is pre-eminent in point of acreage. In 1892, Dr. William Saunders crossed Hard Red Calcutta, a commercial grade rather than a variety, and Red Fife, then the standard wheat of western Canada. Subsequently his son, Dr. Charles E. Saunders, selected one type from the progeny. This became commercially established in Canada in 1911 under the name of Marquis. In 1917 it constituted 80% of the wheat of the prairie provinces. Imported into the United States in 1913 it had, by 1919, a spread of 11,900,000 acres. Only one wheat is now more wide-spread in America; this is Turkey, which, with twice the area of Marquis, is a striking example of introduction, for it was brought from Russia by Mennonite immigrants. Earlier maturity, the primary distinction between Marquis and the Red Fife and other wheats it has displaced, makes for immunity from rust, drought and frost.

India, with great environmental diversity and characteristic impurity of native varieties, has proved a fine field for the breeder. Under Dr. A. Howard, the Pusa Institute has established selected wheats which are ousting the older forms. Pusa 12 and Pusa 4 have an area of 500,000 acres in the United Provinces, while Punjab 11 is grown in the canalised parts of the Punjab on nearly twice this scale. Helped by the provision of good seed, these new products are estimated to represent an annual gain to the cultivators of £1,000,000.

Something of romance attaches to the introduction into Argentina of a wheat from the Sze-chuan province of China. It has proved highly resistant to *Puccinia triticina*, the rust which more than anything else threatened to suppress the great promise of wheat-growing in South America. The introducer, Mr. W. O. Backhouse, has now raised hybrids which, both rust resistant and generally superior, are fast becoming the standard forms.

From the Swedish station, Svalöf, have come a number of new wheats, barleys, oats and peas; Swedish Iron wheat has added to its laurels by gaining a hold in England. English millers, however, dislike the thick skin and quality of its grain. New wheats continue to be produced in England, despite the many years of improvement already passed. The Little Joss and Yeoman wheats bred by Prof. Sir R. H. Biffen and introduced in 1912 and 1917, are shown by an official return to occupy one-tenth and one-fifth respectively of the whole wheat area of the 14 principal producing counties. Little Joss, a hybrid from Ghirka (Russian), and Square Head's Master, is the only form grown in England with a definite resistance to yellow rust (*Puccinia glumarum*). It has marked standing capacity and a curiously wide soil adaptation. Yeoman is also a product of premeditated synthetic breeding. The parents were Browick (English) and Red Fife—the world's best bread-making wheat. Heavy yield and great standing power are merits it shares with the best of the older forms, but its quality or bread-making capacity has set a standard formerly believed impossible in English wheats. None of the older wheats can be used for bread save in admixture with stronger overseas kinds. Inland millers pay heavy freights in bringing strong imported wheats from the docks to their mills. The all-English loaf is now being made commercially from Yeoman flour, and by partial displacement of imported wheats from the inland millers' blend is effecting a valuable economy.

Barley.—Barley is of peculiar interest because the quality of beer-making kinds is nearly as important as the yield. At the end of the 19th century Chevalier and Standwell were the prevailing forms in Ireland. Archer barley was introduced from England in 1900, and Irish Archer, a selection made by Dr. H. Hunter, soon displaced the older varieties. An even more marked success attended his hybrid Spratt-Archer. Spratt is an old form specially adapted to peaty soils: distinguished by high yield, exceptional standing power and superior quality, it now occupies almost 90% of the barley area of Ireland. It is estimated that £40,000 spent on breeding and testing in Ireland during the period 1905–25 has brought an increase equivalent to £250,000 per annum. Contemporaneously the selections, Archer and Plumage, introduced by Dr. E. S. Beaven of Warminster, have contributed to the prosperity of English growers. The former includes the specially valuable character of short-necked straw by which the loss of ears in tempestuous weather, once very serious, has been much reduced. More recently, Dr. Beaven's hybrid Plumage-Archer has come into cultivation. Its improved quality and increased yield have given it an unquestioned pre-eminence on the heavier barley soils of England and Scotland.

Roots.—Roots, such as potatoes which flower uncertainly and mangolds whose varieties freely intercross in the field, are difficult subjects. But mangolds and swedes have yielded to that systematic patience which has done so much in Danish agriculture. Helweg, in Denmark, first made clear that the only sound basis of estimation for mangolds was yield of solid matter per ac. and not mere wet bulk. Next he demonstrated that different forms or strains within any one variety might be widely divergent in gross yield and percentage of solid matter. Indeed, two strains of the same variety might correspond to a difference of £6–£8 in value of feeding material from one acre. The best strains were picked out, and by persistent teaching all bad strains were forced out of cultivation; good seed was ensured, and roots came to have a greater feeding value per ac. than corn. In England the area under roots is diminishing. In Denmark it has steadily grown, and when the World War stopped the importation of feeding-stuffs it was roots that saved Denmark. There was a time when wart disease (*Synchytrium endobioticum*) appeared to threaten wholesale destruction of English potato crops. But steady production of immune varieties, reinforced by appropriate legislation, may now be said to have brought security to the one great crop in which that country is still self-supporting.

Other Staple Crops.—Rice in Malaya and South India, the millets in India, the Fulghum oat of Texas and Kansas, the hybrid round-tipped tobacco of Connecticut, Svalöf's Victory oat, which has proved the best oat for England since Abundance was introduced, and Dr. C. A. Barber's new sugar-canes in India are among many other valuable new products of the last decade. Some of these forms may soon be displaced by better. Some may, in effect, suffer deterioration—a practical man's belief which the scientist no longer entirely scorns. Improvement is in certain instances largely attributable to general betterment of husbandry and the provision of good seed. But that all these new forms have advantaged the cultivator is beyond doubt.

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(F. L. EN.)

ANIMAL BREEDING

It must be frankly admitted that the expectations raised by the rediscovery of Mendel's laws have not been fulfilled. Nevertheless the conception that a stock animal should be judged by its progeny rather than by its ancestry or by its individual characters, a conception which owes its origin to experimental breeders or statisticians who have worked on Mendelian lines, has given at least three results of first-class economic importance: cows of improved milking capacity, hens which lay more eggs and pigs which reach factory size in less time. It must be added, however, that improved methods of management in feeding, milk recording, trap nesting and egg recording have contributed largely to these achievements.[1]

Vitamines.—The discovery of vitamines has not fulfilled expectations for animal husbandry. It is true that vitamine enthusiasts have brought to light many cases in which methods of feeding commonly used by owners of livestock result in producing symptoms of malnutrition, and more cases in which they do not yield results as good as the feeder ought to secure. Impartial examination, however, shows (*a*) that farm animals are

[1] R. C. Punnett, *Heredity in Poultry* (1923); F. H. A. Marshall and J. Hammond, *Physiology of Animal Breeding*, Ministry of Agriculture (1925).

much less affected by vitamine deficiency than are the rats, guinea pigs and pigeons, which were the subjects of the classical vitamine investigations, and (*b*) that farm feeding stuffs are seldom or never really deficient in vitamines. In short, vitamines are not a burning question in the nutrition of farm animals.

Mineral Requirements.—The many instances of rations in common use failing to produce the expected result or even causing symptoms of malnutrition, and the failure of the vitamine hypothesis to explain the facts, have focused attention on the much neglected subject of mineral requirements. Close examination of this question, more especially by Orr and his colleagues at the Rowett Institute, Aberdeen, has shown that most cases can be explained as being caused by a deficient or ill-balanced supply of ash constituents. There is no doubt that the modern deep-milking cow, the 150- or 200-egg hen and the quick-growing pig which reaches 200 lb. in six months, are excessively sensitive to ash deficiencies. There seems to be no doubt that the good results obtained by the use of fish meal for young pigs and laying hens are due in large measure to its high content of ash. In defining a balanced ration to-day, it is necessary to state not only the proteins, fats and carbohydrates, but also the ash constituents, and it must not be forgotten that even such elements as iodine and iron play their parts.[1]

Nutritive Value.—About 1885 Kellner showed that the real nutritive value of a feeding stuff was not the sum of the digestible nutrients which it contained. Experimenting with about a dozen typical foods, he was able to measure their net nutritive value, which he expressed as the number of lb. of starch equivalent to 100 lb. of the food. Assuming that the difference between the gross and net nutritive value was due to the work done by the digestive organs in disentangling the nutrients from the fibre, he devised a formula, based on digestible nutrients discounted for fibre content, for calculating starch equivalents of feeding stuffs. His starch equivalents thus calculated have received fairly general acceptance, and in fact are still the accepted basis for modern rationing.

Armsby and his colleagues, using quite a different method, have more recently measured net nutritive values, expressing their results in what they call calories of net energy. On theoretical grounds it has been shown that one lb. of Kellner's starch equivalent is equal to 1,070 calories of Armsby's net energy. When converted by this factor into the same terms, Kellner's starch equivalents and Armsby's net energy for the same feeding stuffs agree in most cases. This is very reassuring, since it confirms the accuracy of both figures. Cases in which there is significant disagreement are practically confined to coarse fodders such as hay and straw, and there is no doubt that Kellner's figures are too low for such materials. Armsby has shown that the difference between gross and net nutritive value is mainly due to the large outflow of heat following a meal—Rubner's specific dynamic action—which results from the stimulus given to the animal's metabolism by the absorption of the products by digestion. This being so, Kellner discounted the gross nutritive value too heavily for the presence of fibre, and his starch equivalents of fibrous foods are in consequence too low. It seems to be necessary to raise the starch equivalent of good hay from Kellner's figure of 30 to at least 40, which is Armsby's figure, and probably to raise other fibrous foods in like proportion.

Growth.—Comparative slaughter and balance experiments recently carried out have made it possible to calculate the composition of the increase in live weight of sheep, cattle and pigs at various shapes of growth and fatness.[2] It is quite easy to convert composition into calories, and since one lb. of starch equivalent can produce 1,070 calories in the body, it is possible to set out a table giving the weight of starch equivalent required to produce one lb. of live weight increase in any animal at any stage of growth or fatness. Such a table forms a logical basis for computing rations, provided of course the maintenance ration of the animal can be ascertained. The idea is the same as that underlying the modern method of milk rationing by computing the ration on the basis of maintenance plus so much per gallon of milk yielded. This method, the scientific basis of which was a paper by Kellner in 1911, is now widely used by progressive milk producers, and is perhaps the most valuable and practical outcome of modern nutritive studies.[3]

There is only one reason why rationing on the basis of maintenance plus so much per lb. of increase should not come into equally general use, and that is the lack of accurate knowledge of the maintenance requirement of young animals. Existing tables of maintenance requirements have been calculated by Rubner's surface law from the results of experiments on adult animals. That they may be as much as 50 or even 100% too low in some cases is indicated by du Bois' publications on the maintenance requirements of the human child and Deighton's measurements of the basal metabolism of the growing pig. From Deighton's curve for basal metabolism it is possible to estimate the maintenance requirement of the young pig from weaning to factory size. This information and the caloric value of the increase provide a logical basis for rationing.[4] No similar measurements of basal metabolism or maintenance requirements are available for growing calves, lambs or foals. (T. B. W.)

III. AGRICULTURAL ECONOMICS

This important part of the article on agriculture is divided into three sections, dealing respectively with credit, insurance and prices.

Agricultural Credit

Systems of agricultural credit may be broadly distinguished according to whether they are based upon a co-operative principle or not. Co-operative credit has been successfully applied in Europe (with the marked exception of Great Britain) and in India. In most of the newer countries the co-operative system has been relatively unsuccessful, and other means of financing agriculture have had to be found. The history of co-operative credit in the last 15 years records, almost without exception, an expansion of this system in countries where it had previously been firmly established; the number of rural societies has increased, and improvement and consolidation of central credit institutions have been effected.

Germany.—Even in Germany (the pioneer country in co-operative credit) which has suffered severely from the monetary disturbance due to the War, considerable expansion has taken place. Out of the 38,000 agricultural co-operative societies registered in 1924, 19,529 were rural banks, as compared with approximately 17,000 in 1912. The difficulties of the post-War period were, however, very considerable. Up to 1922, while prices were rising relatively slowly, the deposit of savings with the rural banks continued. But with the rapid collapse of the paper mark after that date the whole system became disorganised; confidence was destroyed and depositors ceased to make the necessary investments. The shortage of capital thus brought about caused acute difficulty in the joint purchase of agricultural requisites, and many co-operative societies were compelled to abandon it. Plans were attempted to obtain working capital; membership was increased, and endeavours were made to attract capital with high rates of interest.

None of these efforts, however, kept pace with the fall in values. Ultimately, attempts were made to stabilise the system by abandoning the basis of the paper mark and placing the business of the co-operative societies on a rye, wheat or gold mark foundation. Stability was ultimately introduced by the establishment of the Renten-mark, but the result was to disclose a shortage of credit in German agriculture, which led to serious difficulties in the sale of agricultural produce and the purchase of agricultural requirements. Since then efforts have been concentrated upon the restoration of the confidence of the rural investor, upon whom the system ultimately depends. Shortage of money and high rates of interest have continued to be one of the chief difficulties of German agriculture, as also is the case with other countries of central and southeastern Europe.

France.—The conspicuous feature of agricultural credit in France is the state subsidy which it carries with it. Under the

[1] See Dr. J. B. Orr, *The Mineral Elements in Animal Nutrition*, Presidential Address Section M. British Assn. Report 1925.

[2] H. P. Armsby and C. R. Moulton, *The Animal as a Converter of Matter and Energy* (1925).

[3] *Report of Departmental Committee on Rationing of Dairy Cows*, Ministry of Agriculture (1925).

[4] T. B. Wood, *Animal Nutrition* (1924).

Méline Act of 1894 all or part of the members of one agricultural "syndicat" or more (*see* CO-OPERATION, AGRICULTURAL) could constitute a credit society, whose capital was obtained by subscription of members. The credit society became a "filiale" of the syndicat. A considerable growth of these societies took place with the assistance of a voluntary organisation which prepared model rules. In 1897 it was made a condition of the renewal of the charter of the Bank of France that it would place at the disposal of the state without interest 40,000,000 francs together with an annual share in the profits of the bank, for the assistance of agricultural credit. In 1899 regional banks were created, the members of which were the local credit societies, and the above subsidy enabled the regional banks to reduce their rate of interest to the credit societies and consequently to provide cheap credit to farmers. The number of regional banks in 1921 was 69, with nearly 5,000 credit societies affiliated to them. The extension of the system to the provision of long-term credit was made under Acts of 1910 and 1920, which now permit a maximum loan of 40,000 francs to individuals to facilitate the acquisition and management of rural properties. These loans are for a maximum period of 25 years with interest at 2% (or 1% in the case of military pensioners or civil victims of the War).

Great Britain.—Great Britain has no standard machinery of agricultural credit, the ordinary joint stock banks and tradespeople providing the bulk of credit to farmers. In 1923 the Agricultural Credits Act was passed with the objects (1) of enabling persons who had bought their holdings during the currency of the Corn Production Acts—April 5 1917 to June 27 1921, when prices were exceptionally high—to obtain mortgage loans from the state, repayable within a maximum period of 60 years, and (2) of establishing co-operative credit societies empowered to borrow from the state. The latter are based on limited liability, each member being entitled to hold an unlimited number of £1 shares upon which 5s. is paid up. The societies are empowered to borrow from the state £1 for each share so held. The Act has not, however, been a success.

As regards long-term credit for the acquisition or improvement of agricultural land, the principle widely adopted in European countries is one under which credit institutions lend money upon first mortgages on farm lands and buildings, and raise money for the purpose by the issue of bonds to the public secured on these mortgages. Institutions of this character are to be found in Germany (Landschaften and mortgage credit banks), Austria, Hungary, Czechoslovakia, Italy, Denmark, etc. In many cases these are of early origin, but since the War, particularly in the countries of central Europe, they have suffered severely from shortage of money, and the high rates of interest have been a serious handicap to agriculture. In a few cases efforts have been made to sell land bonds in foreign countries.

United States.—Agricultural credit in the United States has undergone extensive reform as a result of important legislation passed during the period 1910–25. Under the Federal Reserve Act, Federal Reserve Banks (of which there are 12) are empowered to discount "eligible paper" as defined by the Act for "member" banks in their district. Farmers or other individuals must apply to their local banks which, if they are members of the Federal Reserve System, may rediscount with the Federal Reserve banks the notes, drafts and bills of exchange acquired from their customers. Under the Federal Reserve Act, the term of discount for paper drawn for agricultural purposes was six months as against a three months limit on commercial paper. The former was extended by amendment of the Act to a period of nine months. The Agricultural Credits Act of 1923 also extended the definition of agricultural paper, particularly as regards co-operative marketing associations.

The Act of 1923 extended the facilities for "intermediate" credit by establishing 12 intermediate credit banks, the primary function of which is to discount for or purchase from banks, trust companies, livestock companies and other bodies, notes, drafts and bills of exchange, the proceeds of which are to be used for agricultural purposes. They may also make loans direct to co-operative associations. These intermediate loans have maturities between six months and three years. In order to increase their loanable funds, these banks are empowered to issue collateral trust debentures which are exempt from taxation, up to 10 times their capital and surplus. Lastly, as regards long-term credit, the Federal Farm Loan Act (*see* FEDERAL FARM LOAN SYSTEM) passed in 1916, established a system bearing some resemblance to the German Landschaften.

Twelve Federal Land Banks, each operating in a separate district, are empowered to make long-period loans based on farm mortgages, and to issue bonds to the public, which are tax exempt, up to 20 times their capital and surplus. The borrower must join a Farm Loan Assn. through which he obtains the loan. The Farm Loan Assn. is essentially co-operative in form—each association guaranteeing its own mortgages. Each Federal Land Bank also guarantees the bonds of the others. In addition to these, legislation has provided for the formation of "Joint Stock Land Banks" which are empowered to make loans direct to individuals based on specific farm mortgages and to raise money for the purpose by the issue of tax exempt bonds in the same manner as the Federal Land Banks. A certain amount of credit is also furnished through co-operative channels, 19 states having passed legislation providing for the organisation of credit unions. These unions have some resemblance to the co-operative credit societies in Europe, and raise money for making small loans by the sale of shares and by receiving deposits. The organisation of credit unions as separate agricultural institutions has, however, made only a limited progress up to the present.

Canada.—In Canada credit unions have been more successful, and over 150 with a membership of more than 66,000 have been organised since 1906, mainly in Quebec and neighbouring provinces. By a number of Acts the provinces of Canada have also sought to extend the facilities for short-term credit to farmers. These include the Livestock Encouragement Act, 1917, of Alberta, under which persons may form an association and jointly apply to the Livestock Commissioners for a loan; the Livestock Purchase and Sale Act, 1913, of Saskatchewan; the Rural Credits Act, 1917, of Manitoba, and a similar Act in Alberta, both designed to promote co-operative credit. Mention should also be made of the Ontario Farm Loan Act, the Agricultural Development Act and the Agricultural Development Finance Act, all passed by the Ontario Legislature in 1921—designed both to assist land settlement and to provide short-term loans. As regards long-term credit, legislation has been enacted by the separate provinces. Manitoba passed the Manitoba Farm Loan Act, which became effective in 1917, and was subsequently amended in 1919 and 1921. The Act established the Manitoba Farm Loans Assn., which serves as the lending agency between the provincial government and the farmers, and is governed by a board of five members including a Commissioner of Farm Loans. Loans are secured upon first mortgages on farm lands and are repayable by annual instalment in 30 years. Saskatchewan has passed legislation on similar lines (the Saskatchewan Farm Loan Act, 1917), and Alberta has followed the general lines of the Farm Loan Act in the United States.

Australasia.—The development of agricultural credit has received, and is still receiving, a considerable amount of attention in Australia and New Zealand. Mention should be made of the Agricultural Banks Act, 1923 (Queensland), the object of which was to make provision for state advances to co-operative companies and associations and to farmers and others; the Co-operative, Community Settlement and Credit Act, 1923 (New South Wales), which amended the law in regard to co-operation and made provision for the formation and management of co-operative societies, including rural credit societies, and the Rural Credit Associations Act, 1922 (New Zealand). More comprehensive legislation is contemplated.

India.—The development of agricultural credit in India has mainly followed the European model, and has made consistently steady progress. The first Act legalising co-operative credit societies was passed in 1904. This Act was replaced by an Act in 1912 which closely followed the English Friendly Societies Act and permitted other forms of co-operation. The number of rural credit societies under this Act exceeds 40,000 and these are mainly modelled on the Raiffeisen plan.

AGRICULTURAL INSURANCE

The risks against which farmers are mainly concerned to provide are those incurred in growing, harvesting and storing crops, animal diseases, condemnation of carcasses in slaughter-houses and those risks commonly covered by ordinary life, accident and property insurance. The nature of the risks to which farming is exposed vary between one country and another according to its situation and climate. Thus losses from windstorms are more common in North America than in many countries of Europe (it has been stated that between 1916 and 1923, 752 tornadoes occurred in the United States—an average of 94 annually); in Great Britain animal diseases, and in Scandinavia forest fires, are more important risks, while in Canada damage by hail causes heavy losses to farmers.

Insurance against these risks may be carried out either through ordinary joint-stock insurance companies, or through farmers'

mutual insurance societies. Both methods are used, but the latter is held to have certain advantages. Many agricultural risks are, however, of a kind which differ from the risks of fire and accidents, in that the loss of a relatively large amount of property may occur at the same time. This is the case with windstorms which may affect a large area, with hail and with animal diseases which often take the form of epidemics, causing the loss of a large number of livestock within a short period. For this reason local mutual insurance societies operating in a small area frequently cover the risk by re-insurance.

Crop Insurance.—The insurance of crops after harvest is a relatively simple matter, and the risk—mainly a fire risk—is often covered by ordinary joint-stock insurance companies. The insurance of growing crops is a more specialised business. Under this head the most successful development is that in respect of hail insurance. In the United States 43 joint-stock fire insurance companies, 41 mutual companies and four state insurance departments carried hail risks estimated in 1919 at $560,000,000. In Canada the Hail Insurance District of Alberta was formed under the Municipal Hail Insurance Act of 1918, having in 1919 67 municipal districts. Hail taxes are paid by ratepayers to the municipal districts which in turn pay to the municipal board. The total risk borne by the Hail Insurance Board for the four years 1919–22 amounted to $72,000,000. In Saskatchewan the Municipal Hail Insurance Assn. carried an insurance of about $25,000,000 in 1921 and 1922.

Hail insurance in Europe has been developed to a less degree, but organisations to cover this risk are to be found in Germany, Austria, Denmark, Switzerland, France, Spain, Italy and elsewhere. In France 29 mutual societies existed for this purpose in 1921, and Italy had 51 societies in 1922. A certain amount of hail insurance was effected in England in the counties of Bedfordshire and Huntingdonshire after severe storms in 1906, but since then the matter has been allowed to decline. While hail insurance is the outstanding example of successful crop insurance, some progress has been made, particularly in the United States, in the provision of frost insurance. But more hope is attached to the development of comprehensive crop insurance policies, covering all the principal hazards. Several attempts have been made by joint-stock fire insurance companies and others in the United States to develop a system of comprehensive crop insurance, but it is still in an experimental stage. There appears at present to be little development in this direction in Europe.

Livestock Insurance.—Farmers in aggregate have large sums invested in livestock which is liable to suffer loss by disease and other causes. Insurance against these risks through mutual insurance societies or otherwise has made greater progress in certain European countries than elsewhere, although the United States has some 30 mutual livestock insurance companies. France provides perhaps the leading example of European livestock insurance; its development has depended partly on state subsidies. Out of the 14,896 subsidised co-operative insurance and re-insurance societies in France in 1921, over 10,000 were societies for the livestock insurance, and 78 for reinsurance. The annual premiums are fixed by rules of the societies at not less than 1% of the value of the animals in the case of societies which insure cattle only, 1·5% for societies insuring horses, mules, etc., 1·25% for societies insuring cattle and horses, 3·5% for societies insuring pigs. The amount of compensation varies between 50% and 80% of the net loss—*i.e.*, the value of the animals affected after deducting the value of the carcasses. In certain circumstances other methods of calculating the compensation are allowed.

The re-insurance societies cover certain defined areas, and may either contribute to the settlement of all losses falling upon the affiliated societies, or limit their contribution to such local societies as have had to pay compensation up to a sum in excess of a given rate. The affiliated societies contribute a certain proportion of the premiums to the re-insurance societies. Local societies may obtain from the Ministry of Agriculture grants of two kinds (1) establishment grants, made to societies in the course of formation, and (2) grants for losses incurred, made to societies in full working order which have suffered unusual losses. Similar grants may be made to re-insurance societies.

Co-operative insurance in Germany has not made progress comparable with that of other forms of agricultural co-operation. Only a small fraction of the livestock in the country is covered by insurance. In certain states, notably Baden and Bavaria, cattle insurance has received state assistance, and insurance of carcasses against condemnation by the sanitary authorities has also been adopted on a small scale.

In Great Britain certain joint-stock companies specialise in livestock insurance in addition to covering ordinary accidents and fire risks, while there are also a number of mutual societies for the insurance of livestock. There appears, however, little inclination on the part of British farmers to take advantage of these facilities except in the case of pedigree cattle or other valuable stock, the number of mutual societies registered and the membership having declined since 1913. There are, however, a considerably larger number of unregistered societies, such as pig clubs and cow clubs for the insurance of their members' livestock. It should be mentioned that under the Diseases of Animals Act, 1894, compensation is payable by the state to the owner of cattle slaughtered under the Act, in cases of foot-and-mouth disease, swine fever and other diseases.

Fire Insurance.—This is almost universally undertaken by the ordinary joint-stock companies but in some countries, notably the United States, it has also been largely developed on a co-operative basis. Indeed mutual fire insurance is one of the most successful as well as one of the oldest co-operative services which has grown up in that country. In 1924 there were about 2,000 farmers' mutual fire insurance companies carrying risks amounting to over $8,000,000,000. These societies operate largely on an unlimited liability basis, a relatively small number only limit the liability of members to a fixed sum per annum. The first mutual fire insurance companies in the United States were formed more than a century ago.

An interesting branch of agricultural insurance is that connected with forest fires in Scandinavia. Organisations for covering this risk have been formed in Sweden, Norway, Denmark and Finland. The Norwegian Society for Mutual Insurance against Forest Fires formed in 1911, covered risks in 1923 amounting to 335,000,000 crowns, while a similar society in Finland issued policies up to 653,000,000 crowns.

Agricultural Prices

The outstanding event in regard to prices of agricultural commodities during the years under review is the upheaval due to the War. In practically every agricultural country, the prices of farm produce rose rapidly from 1914, during the War, and up to 1920, and fell—even more rapidly—between the spring of 1920 and the end of 1922. Although other factors entered into it, the primary cause of this movement is widely recognised to have been monetary, that is to say, it was due to the almost universal monetary inflation which took place between 1914 and 1920, and to the monetary deflation which followed it. This is illustrated by the fact that the prices of agricultural produce, as measured by index numbers, have moved over the whole period in close harmony with prices of general commodities.

The following table shows for the years 1914–22 inclusive, the percentage rise and fall of British agricultural prices (Ministry of Agriculture and Fisheries index number) and the percentage rise and fall of general wholesale commodities (the *Statist's* index number) in each case based on the average of 1911–3 as zero:—

Year	Agricultural Produce	Wholesale Commodities	Year	Agricultural Produce	Wholesale Commodities
1914	1	2	1919	158	147
1915	27	30	1920	192	201
1916	60	63	1921	119	86
1917	101	110	1922	69	57
1918	132	130	..	..	..

After 1922 prices have remained relatively steady.

The general form of the price movement illustrated in this table is to be found in the case of most other civilised countries. The exceptions are Germany, Russia, Poland and some of the minor European countries, where the general price level continued to rise after 1920 in consequence of the continuance of monetary inflation. In Russia there was a great disparity between the two price levels owing to special considerations, the level of wholesale prices rising out of all proportion to the prices of agricultural produce. But elsewhere the gradual rise of prices, including those of agricultural commodities, from 1914, reaching a peak during 1920, followed by a rapid decline ending in most cases in 1922, was the common experience of each of the following countries: the United Kingdom, France, Sweden, Norway, Denmark, Switzerland, Holland, Spain, Italy, the United States, Canada, India, Egypt, Japan, South Africa, Australia and New Zealand. Although this was the form of the price movement, its extent and also the rapidity with which prices rose and fell differed between one country and another; the agricultural consequences of the price movement have therefore also differed.

The upward price movement was accompanied by general agricultural prosperity; in the United States of America it was a prosperity without parallel in its history. The downward movement was accompanied by serious and in some cases disastrous depression. In Canada, the United States and certain other countries, however, agricultural prices fell during 1920 and

1921 more rapidly than the prices of general commodities; in Great Britain they fell less rapidly. This meant that in addition to suffering the disabilities inseparable from a falling price level, agriculture in the former countries experienced a further difficulty by reason of the decline in the purchasing power of agricultural produce—the amount of other commodities which could be exchanged for a given amount of agricultural commodities. For example, in 1919 prices of farm produce in America stood at 131% above the level of 1913, while prices of all commodities were 106% above 1913. In 1922 the former figure had fallen to 33 and the latter to 49. The fall in the purchasing power of the "farmer's dollar," was therefore a potent factor in the agricultural crisis which developed in America after the spring of 1920.[1]

The curve in the general price movement of 1914–22 was partly due to the fact that the rise and fall of the prices of goods and services which the farmer had to buy—land (rent), labour, transport, seeds, fertilisers, feeding stuffs, etc.— lagged behind those of farm products, and secondly, that in agriculture the period of turnover is long. Thus in the case of Great Britain, in 1919 the prices of agricultural produce were 158% above the pre-War (1911–3) level. In the same year agricultural wages were 96%, fertilisers approximately 100%, feeding stuffs 157% above pre-War level, while the cost of rent and of rail transport had hardly begun to advance. In 1922 when agricultural prices were 69% above pre-War, wages were 74%, fertilisers approximately 52%, feeding stuffs 49%, railway transport about 75% above pre-War, while rents had advanced roughly by about 15%. In addition to this many of these costs of production were incurred many months before the produce was sold, and the effect of this was to increase the margin of profit in the upward movement and to decrease it in the downward. In actual fact these conditions led to a very large volume of agricultural produce being produced during 1920–2 at a loss, not only in Great Britain but in many countries overseas.

This was the primary cause of the almost world-wide depression of agriculture which began in the spring of 1920. But other factors contributed. The stimulus of high prices and increased profits during and immediately after the War, reinforced by the failure of Russia and Danubian countries, led to a rapid extension of the area under arable crops in certain countries. Taking the principal wheat exporting countries—the United States, Canada, the Argentine, Australia and India—the total area under wheat in 1918–9 had increased by nearly 33,000,000 ac. above the average figures for 1909–13; in 1923 they were about 28,000,000 ac. above this average. During the general decline of prices, there was both a falling off in consumption and recovery in European production. In addition to this the world's harvest of 1923–4, particularly in Canada, was an exceptionally good one. The result was that supply exceeded demand, and the general depression of prices consequent upon monetary deflation in 1920–2 was succeeded by a further depression of wheat prices due to increased production. The same applied in a greater or less degree to the other corn crops. As a consequence, a very acute situation developed amongst farmers of arable towards the end of 1923; in the wheat belt of the United States the crisis reached alarming proportions, and many of the banks concerned with financing farmers in this area, being unable to stand the strain, failed to meet their liabilities.

The general level of agricultural prices in Great Britain remained fairly steady in 1924, the chief event being the upward movement of grain prices towards the end of the year. The world's wheat area in 1924 showed a slight decline over that of the previous year, but the world's crop was substantially smaller, the average yield being only 88% of the 1923 crop. The result was to correct the abnormally low level of grain prices in 1923 and to bring the price of wheat approximately to the level of other agricultural commodities. This improvement in prices brought considerable relief to the great wheat-growing countries, particularly the United States, notwithstanding the fact that the purchasing power of farm produce as a whole still remained below its pre-War value.

In regard to the countries which continued monetary inflation after the War, the course of prices was entirely different, and the crisis of 1920–3 was not experienced. But a situation of a different kind developed later in consequence of the degree to which the value of the monetary units ultimately fell. Germany may be quoted as an example. The rise in prices continued comparatively steadily up to 1922, but after that the movement gained enormous momentum. The paper mark sank to a mere fraction of its pre-War value and with it invested savings often disappeared. This is what happened in the case of the rural credit banks, and when stability was ultimately restored by the introduction of the Renten-mark, agriculture was found to be seriously short of working capital. Farmers, in order to raise money for future operations, began to throw large quantities of produce on the market, with the result that prices fell. This in turn brought about a wide discrepancy between the prices of things the farmer had to sell and the prices of those he had to buy. In Jan. 1924, the prices of potatoes were 96%, rye 89%, fattened stock 73% of pre-War value, while superphosphates were 183%, machinery 164%, potash 105% and ammonia 96% of pre-War prices.

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IV. ELECTRIC POWER IN AGRICULTURE

The domestic and industrial uses of electric light and power have developed greatly in towns. There has been less progress in the country, owing chiefly to the high relative cost of distribution where the demand is small and scattered over a wide area.

Use of Electric Power.—Electric light and power have been found very useful on farm premises where current is available. Good light is as beneficial in a farmhouse as in an urban dwelling, in a cowstall as in a factory. The electric motor is simple, robust and easy to start; it gives a steady pull, and, with the usual charge ranging from 1½d. to 3d. an electric unit for power, it is cheap to work.

Barn Machinery.—Farmers rely on an oil-engine which is used (roughly in proportion to the acreage of the farm) to drive what is called barn machinery, *i.e.*, chaff-cutters, root-pulpers, cake and oat crushers, etc. These machines absorb from 1 to 5 H.P. according to size. On a grass farm, the engine, perhaps 1½ to 3 H.P., may work only for two or three hours a week in winter and be hardly used in summer when all the stock is out on the pastures. The annual consumption may be something like 1 H.P. hour per acre of land or, say, 600 H.P. hours per square mile of country, equivalent to 450 electric units of kilowatt hours. On an arable farm, where there is much preparation of food, including perhaps the grinding of barley-meal, an engine of 5 to 8 H.P. may work several hours a day, and the annual consumption amount to about 12 H.P. hours per ac., that is, about 7,000 H.P. hours or 5,000 electric units per square mile.

Cultivation.—The greatest consumption of power in agriculture is in field cultivators such as ploughing. On most farms, this work is still done by horses. The only places where they have been replaced successfully by mechanical power are in flat areas with large arable fields. There ploughing can be done more

[1] The subject is discussed in *The Agricultural Situation* by Warren & Pearson, Ch. 8, Wiley & Sons, New York, and in *Report of the Joint Commission of Agricultural Enquiry*, Part I.

economically by tractors on light land and by steam tackle on the heavier clay. On a farm where three quarters of the area is arable land, the annual consumption of energy in ploughing may amount to 15,000 to 20,000 H.P. hours per sq. m., and half as much again may be used for other cultivations, a total of 22,000 to 30,000 H.P. hours per square mile. Thus, on arable farms the energy needed for field work is considerably greater than that required to drive barn machinery.

Electric Ploughing.—Electric ploughing is being tried in France, Germany, Italy and elsewhere, and is generally carried out by contractors. The most usual method is to haul the plough backwards and forwards by means of a wire rope pulled by a motor mounted on a wagon at each side of the field, just as in steam ploughing. In a modification of this method, a single motor only is used, the wire rope passing round four anchored pulleys, two of which are moved as the plough proceeds. Experiments have also been made in which the motor is placed on a carriage attached to the plough, and current supplied to it through an insulated, flexible cable, which is unwound as the carriage and plough move one way across the field and wound up again as they move back in the other direction.

Costs.—It is difficult to get comparable figures of costs. A committee of the Institution of Electrical Engineers (Aug. 1925) quotes the prices of French contractors as 66 to 127 fr. per ac. for ploughing to depths of 6 to 14 inches. This, at a time when the external value of the franc was about 80 to the pound sterling, seems to be equivalent to 16s. to 32s. per ac., but internal and external values of a currency are different in times of rapidly varying exchanges. The quotations of East Anglian contractors for steam ploughing range from 17s. to 25s. per ac. according to depth (say 8 to 14 in.) and soil. The cost to a farmer of ploughing with horses is generally reckoned at about 15s. for light and 28s. for heavy land per ac. but, if this too were done by contractors, something must be added for profit.

Both steam and oil engines have the great advantage of being self-mobile; they can move about the roads and on to the field under their own power. With electric ploughing, the need of taking wires to each field, the great weight of the motors and carriage, and the cost of hauling them about with horses or tractors, together with the rapid depreciation of some of the machinery, militate against its success. It seems likely that, unless some new method or improvement is applied, electric ploughing will make no headway, and that the use of electric power in agriculture will be restricted to the driving of stationary machinery.

Special Machinery.—Besides the ordinary barn machines, less common implements must be brought under review. For threshing corn, smaller farms mostly rely on travelling threshing machines worked by steam traction engines. Some larger arable farms, however, have their own threshing plants. Where current is available, the machine can well be driven electrically with a motor of from 12 to 15 H.P. according to size. It is stated that, owing to the steadier pull of the electric motor, better threshing is done than with a steam-engine. On certain farms, power is used in other special ways. For instance, where a tower silo is installed, power is wanted to cut up the fodder and to lift it into the silo. Ensilage is sweet or sour chiefly according as it is made above or below a temperature of 47° C., and German experiments show that it may possibly be worth while to heat the fodder artificially by passing an electric current through the silo.

Artificial Drying.—Experiments have been made with some success, chiefly at Oxford, on the artificial drying of crops by blowing hot air through them. The process is not yet fully under control, but if it becomes common, it will consume power. This can perhaps be supplied more conveniently by oil-engines, but in special cases electric motors may be used to drive the fans which blow the heated air through the stacks of corn or hay.

Special Advantage.—One advantage of electric current is that power need only be used to the amount actually required. Motors of quite small size are made which will drive light dairy machinery, horse-clippers, fans for incubators, and other implements which absorb too little power to make it worth while to start an oil-engine to run them. The number of such implements is sure to increase as electric supply becomes more common. As regards dairies, milking-machines and also separators, clarifiers and butter churns are very suitable for electric drive. Dairymen, and perhaps fruit-growers, may find it profitable as time goes on to install refrigerating machinery. This may give another demand for power on certain specialised farms.

Poultry.—To turn on electric light in poultry houses on winter evenings and give the birds an extra feed is found to increase the number of eggs then laid. The rise in the total number laid throughout the year is insignificant, but, since eggs are worth more in winter, the redistribution more than pays for the cost of light, food and extra labour. Incubators can more conveniently be heated electrically than in other ways; by passing heated air through the apparatus by means of an electrically driven fan, uniform temperature and efficient ventilation can be secured.

Plant Growth.—Experiments indicate that plant growth is stimulated by a high voltage current of some milliampère per ac. passing as a discharge to the crop from a network of overhead wires, which are kept at 20,000 to 60,000 volts above the earth. Application for six hours a day for one month early in the growth of the crop seems quite as effective as a longer treatment. With certain cereals, an increase in yield of 20% has been obtained, but the results are not always assured, and the matter is still in an early experimental stage. Other experiments, carried out in America and elsewhere, show that electric light, both arc and incandescent, in greenhouses, has an effect in accelerating the germination of seeds and hastening the growth of certain vegetables, the effect depending somewhat on the colour of the light.

Electric Supply.—In the neighbourhood of towns, and in industrial and mining areas, farms can be and often are supplied with current from central power stations. Most of these stations now produce three-phase alternating current, and the corresponding squirrel-cage type of motor is very suitable for farm use. Further developments of this kind may be expected, but the purely agricultural demand is not enough to carry a network of mains over the countryside. Experience shows that the demand for light and power combined varies from 1,000 to 6,000 electric units per sq. m. in good agreement with the estimate for power alone from oil-engines, as given above. In towns, the consumption may be a thousand times more. Again, for long distances, in order to economise copper, high voltages must be used; these are dangerous, and must be transformed to lower pressures for domestic or industrial purposes. Transformers are expensive, and no ordinary sized farm consumes enough power to carry the cost of a high voltage transformer. Hence arises the apparent absurdity that a farm with high voltage mains running through it may be unable to get power. But, where a chain of villages creates a considerable demand along a definite line, or where pumping or irrigation needs a steady supply of power, the distribution of central station current in rural areas may become possible, especially if produced by cheap water power.

Village Supplies.—Where current from a large power station is not available, a village supply may be feasible; a considerable number have been successfully installed in England, some worked by small waterfalls, others by oil-engines. If water be plentiful, turbines and dynamos may run day and night, and a very cheap supply be obtained; but in other cases the energy must be stored in batteries of accumulator cells, which are costly and short lived. Whenever cells are to be charged, alternating current is, of course, inapplicable, and direct or continuous current must be used.

Private Installations.—When no public supply can be obtained, there remains the question of a private installation. If occasional power to drive barn machines alone is wanted, it is obviously better to drive directly from a small oil-engine. But, if good light be wanted, and use can be found for motors of fractional horse power in dairy or house, a private electric plant may be worth consideration. The dynamo is generally driven by a water turbine or oil-engine, but the use of windmills seems now becoming possible. (*See* also FARM MACHINERY AND TRACTORS.)

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AGRICULTURE, CENSUS OF.—The need for an international agricultural census has been recognised by everyone who has occasion to try to estimate world production, consumption or stocks of any agricultural, livestock or forest product that

enters into international trade. Many countries have never taken a census, others have taken censuses only at long and irregular intervals, and there is great diversity and lack of comparability in dates, in methods, in data and in form of publication in different countries. In a total of 201 countries, 140 have never taken a complete agricultural census. The date of the last census in Great Britain was 1908; in Germany 1913; in Austria 1910; in Italy 1918; in Argentine 1914; in Rumania 1905; in Cuba 1899; and in France 1892. Lack of uniformity exists in methods of collecting data, in data collected in censuses of different countries, and sometimes even in different censuses taken in the same country.

The International Institute of Statistics, at its meeting at Brussels in Sept. 1923, approved an exhaustive report by a group of experts nominated by the League of Nations with Professor Umberto Ricci as chairman, advocating the taking of periodical censuses and the improvement of annual statistics in all countries. The Pan-American Union, representing all American governments, which met at Santiago, Chili, in the spring of 1923, and the International Congress of Social Economy, that met in Buenos Aires in 1924, adopted similar resolutions. Each of these international bodies recognised the International Institute of Agriculture as the organisation best situated to promote improvement in national statistical services and the taking of periodical agricultural censuses in all countries.

In response to this expressed need the General Assembly of the International Institute of Agriculture, in May 1924, adopted a resolution confirming the great utility that would result from a general agricultural census in all the states in 1930–1 under a uniform plan. It also called the attention of the Permanent Committee of the Institute to the importance of inducing the adhering governments to agree to take such a census, and of preparing a draft basis programme to be submitted in 1926 to a meeting of specialists to be designated by the respective governments, the agreed programme to be transmitted to the various governments. The General Assembly authorised a small allotment of Institute funds for the expenses of the preliminary work, which was supplemented by funds supplied by the International Education Board and by the United States Department of Agriculture.

Work of the Institute.—The Institute then communicated the resolution to the adhering governments and favourable replies were received from the majority. In May 1925 a director of the preliminary work was appointed, a small office organised and a programme of procedure prepared. This programme contemplates:—

1. The preparation of standard forms of census schedules.
2. The preparation of a glossary of well-defined terms used in the census.
3. The compilation of data on the taking of agricultural censuses, on production and international trade in agricultural, live stock and forest products in all countries.
4. Revision of the preliminary draft of questionnaire forms by statisticians of adhering governments.
5. Discussion and final revision of the census forms by a committee of agricultural statisticians in connection with the General Assembly meeting at Rome in April 1926.
6. Explanation and promotion of the census project in all countries through correspondence, publicity and personal visits of the Director and his assistants.

International statistics of agriculture are important in promoting and facilitating international commerce, and constitute a potent factor in the determination of prices of agricultural, forest and live stock products, and of food, clothing and raw materials in every country, because of the universal operation of the law of supply and demand, and of modern facilities for rapid communication and transportation. But to be of real value international statistics must be comparable, and the only way to secure comparability is through international agreement to take censuses the same year and according to a uniform plan.

Other important results of the universal agricultural census will be its influence in bringing about improvement in the annual statistics of agriculture in many countries, and the probability that the census of 1930–1 will serve as a precedent for future world-wide censuses at regular decennial periods. (L. M. E.)

AICARD, JEAN FRANÇOIS VICTOR (1848–1921), French poet and dramatist (*see* 1.434), died in Paris May 13 1921.

AIRCRAFT CARRIER.—Although, previous to the outbreak of the World War, various trials had been carried out with launching devices for flying seaplanes from off the decks of a battleship, the progress made was slow and it was not until just prior to the outbreak of war in 1914 that a vessel was taken in hand for conversion to an aircraft carrier. The British Govt. then took over a tramp steamer which was subsequently named the "Ark Royal" and fitted her with a flying-off deck forward and two cranes for lifting the seaplane inboard after returning from a flight. This vessel was completed at the end of 1914 and proceeded to the eastern Mediterranean where she proved useful as an aircraft depôt ship.

"*Campania.*"—Further seaplane carriers being needed, several cross-channel steamers and passenger vessels were taken over and converted into seaplane carriers. The largest of these, the "Campania," was taken up in 1915 and a large flying-off deck fitted forward for the purpose of flying seaplanes off wheel trollies. These alterations were completed early in 1916 and the vessel proved of such service that a demand arose for further similar vessels to accompany the British fleet at sea.

"*Conte Rosso.*"—The next vessel taken over was the Italian passenger and cargo ship "Conte Rosso," renamed "Argus" which was building in 1916 at the works of Messrs. Beardmore & Company. A complete flying deck was fitted fore and aft with a hangar for stowing the machines under this deck. The funnels were carried up to the level of the hangar roof and then turned back to run horizontally beneath the flying deck to the stern so as to discharge all funnel gases abaft the stern of the vessel, fans being fitted to cause a good draught through these funnel ducts. For transporting purposes lifts were fitted from the hangar to the flying deck and cranes to lift the machines from the water. To enable machines to be carried on the deck in addition, wind-breaking palisades were fitted which could be raised simultaneously to a height of 14 ft. above the level of the flying deck.

"*Furious.*"—Whilst the first trials of this vessel were proceeding early in 1917 it was decided to appropriate the "Furious," then completing at Messrs. Armstrong's naval yard for aircraft-carrying purposes. This ship was originally designed as a large light cruiser to carry two 18-in. guns in single turrets, one forward and one aft. The first stage of conversion was to remove the forward turret and fit a flying-off deck and hangar, and from this deck seaplanes and aeroplanes could be flown off successfully. Attempts were later made to land machines on this forward deck, but these were not successful and so later the stern 18 in. gun was removed and a big flying-on deck fitted, the two flying decks forward and aft being joined by a walking way around the mast and funnel.

Owing to disturbances set up by funnel gases and eddies around the funnel structure, this flying-on deck was not a great success and the ship was further re-constructed, being finally completed in 1925. This vessel was fitted like the "Argus" with a clear fore and aft flying deck, the funnel gases being led out over the stern.

"*Hermes.*"—About the same time as the appropriation of the "Furious" for conversion, designs were prepared for a carrier named the "Hermes" and this was the first vessel primarily designed as an aircraft carrier. Some six months after, the Chilian battleship "Almirante Cochrane," building at Messrs. Armstrong's works, was taken over for conversion and renamed the "Eagle."

In both these vessels a departure was made in the construction of the flying deck since a completely clear fore and aft deck was not fitted, as in the "Argus" and "Furious." The funnels and navigating positions were incorporated in an "island" arranged on the starboard side, thus giving a clear deck of a width slightly less in way of the island than just forward or aft of it. Neither of these vessels was completed until 1924, and in the meantime vessels of this type received consideration at the Washington Conference, being defined as follows:—

An aircraft carrier is a vessel of war with a displacement in excess of 10,000 tons (10,160 metric tons) standard displacement, designed for the specific and exclusive purpose of carrying aircraft. It must be so constructed that aircraft can be launched therefrom and landed thereon, and not designed and constructed for carrying a more powerful armament than that allowed to it under Article 9 or Article 10 as the case may be.

Articles 9 and 10 are as follows:—

Article 9. No aircraft carrier exceeding 27,000 tons (27,432 metric tons) standard displacement shall be acquired by, or constructed by, for or within the jurisdiction of, any of the contracting Powers.

Aircraft Carriers (1925)

Country and Vessel	Date of Launch	Date of Completion	Length between Perps.	Breadth	Draught	Displacement	Speed	Horse-power	Armament
BRITISH EMPIRE			ft. in.	ft. in.	ft. in.	tons	knots		
Argus	1917	1918	535—0	68—8	21— 0	14,450	20½	20,000	2–4 in., 4–4 in. A.A. 20 aeroplanes
Hermes	1919	1924	548—0	70—3	18— 7	10,950	25	40,000	7–5·5 in., 4–4 in. A.A.
Eagle	1918	1924	625—0	105—2	21—11	22,790	24	50,000	9–6 in., 5–4 in. A.A.
Furious	1916	1925	735—0	88—0	21— 6	19,100	31	90,000	10–5·5 in., 6–4 in. A.A.
Courageous	1916	Being reconstructed	735—0	81—0	22— 3	18,600	31	90,000	.....
Glorious	1916	Being reconstructed	735—0	81—0	22— 3	18,600	31	90,000	.....
UNITED STATES									
Langley (converted)	1912	1922	520—0	65—0	19— 0	12,700	14½	7,160	4–5 in. 30 aeroplanes
Lexington	1919	Bldg.	874—0 Extreme	104—0	30— 0	33,000	34	180,000	8–8 in., 12–5 in. A.A. 72 aeroplanes
Saratoga	1925	Bldg.	874—0 Extreme	104—0	30— 0	33,000	34	180,000	carries a catapult
JAPAN									
Hosho	1921	1922	510—0	62–0	20— 3	9,500	25	30,000	4–5·5 in., 2–12 in. A.A. 26 aeroplanes.
Akagi	1925	Bldg.	820—0 Extreme	103—0	30— 0	33,000	33	170,000	Reported stowage for 50–70 aeroplanes.
Kaga	1921	Bldg.	700—0	100—0	28— 9	27,000	27	60,000	
FRANCE									
Bèarn	1920	Bldg.	560—0	89—0	29— 0	24,800	21	35,000	

However, any of the contracting Powers may, provided that its total tonnage allowance of aircraft carriers is not thereby exceeded, build not more than two aircraft carriers, each of a tonnage of not more than 33,000 tons (33,528 metric tons) standard displacement, and in order to effect economy any of the contracting Powers may use for this purpose any two of their ships, whether constructed or in course of construction which would otherwise be scrapped under the provisions of Article 2. The armament of any aircraft carriers exceeding 27,000 tons (27,432 metric tons) standard displacement shall be in accordance with the requirements of Article 10, except that the total number of guns to be carried in case any of such guns be of a calibre exceeding 6 in., except anti-aircraft guns and guns not exceeding 5 in., shall not exceed eight.

Article 10. No aircraft carrier of any of the contracting Powers shall carry a gun in excess of 8 inches. Without prejudice to the provisions of Article 9, if the armament carried includes guns exceeding 6 in. in calibre the total number of guns carried, except anti-aircraft guns and guns not exceeding 5 in., shall not exceed 10. If alternatively the armament contains no guns exceeding 6 in. in calibre, the number of guns is not limited. In either case the number of anti-aircraft guns and of guns not exceeding 5 in. is not limited.

The aircraft carrier was thus recognised as a definite and essential unit in a modern fleet by the Washington Conference at the end of 1921, although the first practical vessels of the type had not been commenced until 1916, those previous to this being experimental and at the best only floating aerodromes with repair facilities. The other naval Powers followed the British lead in the building of this type of war vessel, and the aircraft carriers in service and building in 1925 for all Powers are shown in the table above. This table is restricted to aircraft carriers proper, the earlier smaller vessels, which are really aircraft tenders or depôt ships, being excluded. (E. T. D'E.)

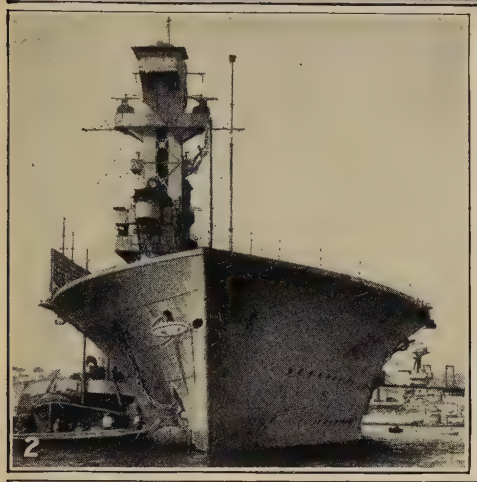
AIR FORCES.—The World War provided a powerful stimulus to all branches of war flying, and great advances were made in technical equipment and experience. This intensive development led to constant changes not only in the practice but in the application of flying, so that when peace came it was expected that progress would be as rapid as in wartime. This led to a hesitancy on the part of most nations to commit themselves definitely to a rigid line of policy in aviation matters. The tendency was to wait and see what the future disclosed rather than to base programmes of development entirely upon past experience.

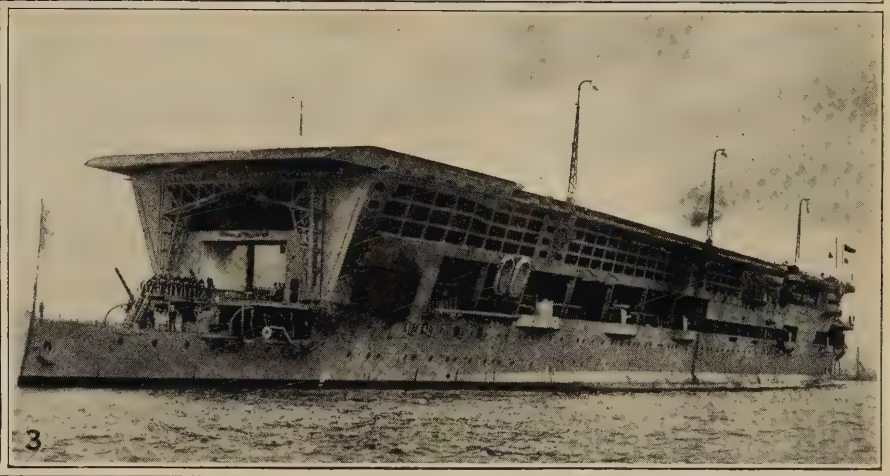
The nations therefore shaped their aeronautical policies with an open mind regarding the future, and in most cases refrained from radical adjustments and expedients which progress to date might have suggested as desirable. What may in externals appear stagnation is not necessarily so in fact. Every forward step is preceded by much research and experiment before it is presented to the world as a concrete achievement. Even by the beginning of 1926 many war experiences had not been fully digested, nor their lessons properly formulated.

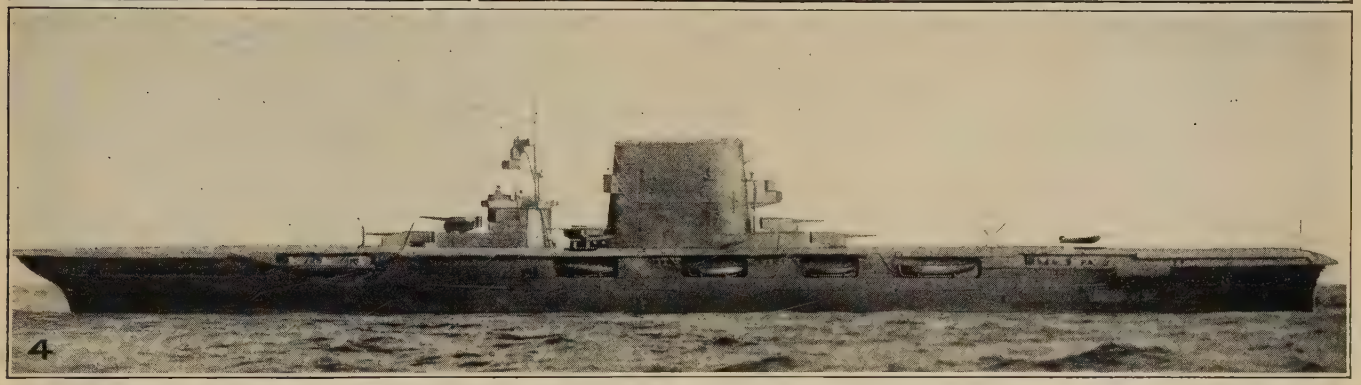
Analysis of available data, research and experiment, although less apparent, equals in importance the more tangible evidence of aeronautical progress. Unlike armies and navies, air forces cannot be judged solely by what is visible to the eye. A policy readily adjustable to whatever changes the future may bring; an elastic organisation that lends itself readily to expansion; adequate provision for research and experiment; training facilities; a husbanding of the resources, industries and trades that subserve the needs of aviation, and the national attitude towards flying give a truer perspective of potential air power than mere numbers of machines. Nor is novelty of type much to go by, since a machine that is ahead one day may be surpassed by others in a little while. Policy and organisation are the most important criteria.

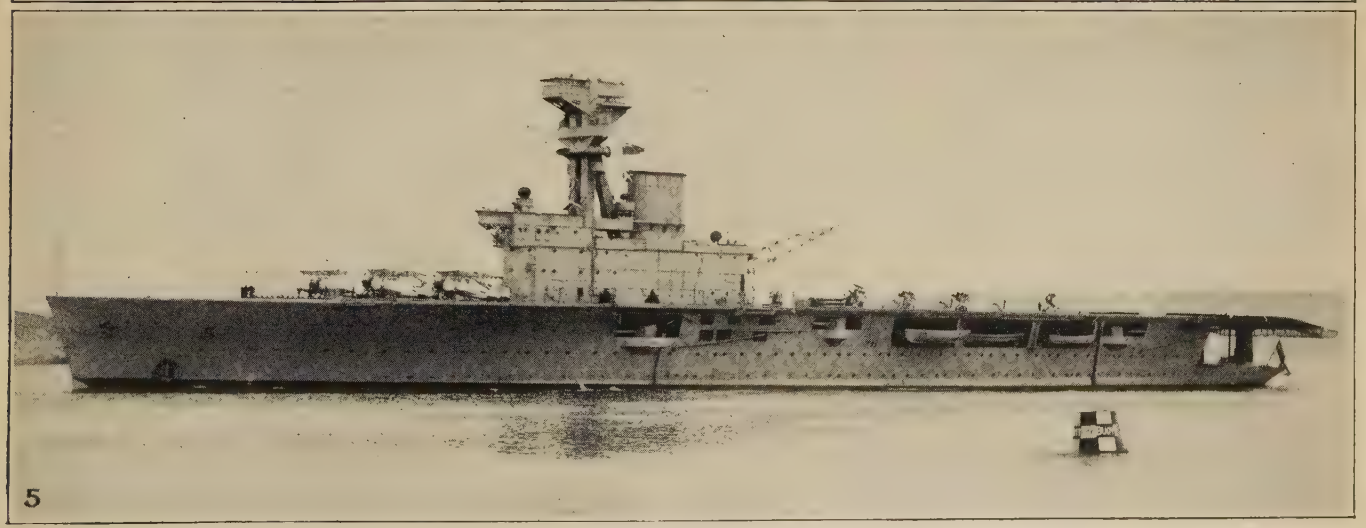
Two Theories of Control.—Two different schools of thought exist in regard to the general principle that should govern the organisation, administration and development of air forces. One school regards flying as a science that can best be applied to war uses by entrusting armies and navies with its adaptation to their own respective needs. Aviation is, accordingly, constituted a component of these services, and its application in war is governed by naval and military considerations. Although this system has certain advantages, in that it grafts a novel instrument of war upon an existing stem and so avoids the disadvantage of setting up an entirely new organisation, there is no doubt that it exerts a limiting influence. The soldier and the sailor naturally approach aviation from the angle of their own profession, and view its possibilities in their bearing upon naval or military warfare.

Such advances as are made are likely to follow divergent courses. An apparently inevitable spirit of competition between armies and navies also leads to duplication and tends to deprive effort of its full measure of results. The other school considers that the air merits a profession of its own, and that untrammelled









TYPES OF AIRCRAFT CARRIERS

FIG. 1. H.M.S. "Eagle," port quarter view, showing flight deck. Fig. 2. H.M.S. "Hermes," bow view. FIG. 3. H.M.S. "Furious," latest British aircraft carrier. FIG. 4. Model of U.S. aircraft carrier, of the "Saratoga" type. FIG. 5. H.M.S. "Hermes," showing aeroplanes parked on flight deck.

(Figs. 1, 2, 3 and 5. Photos by Abrahams, Devonport. Fig. 4. Courtesy of U.S. Navy Dept.)

devotion to the science and art of flying is necessary to do full justice to possibilities, not only in relation to war but as a factor in modern life. It accordingly seeks to concentrate all aeronautical effort into one main channel, with branches to the various departments which flying can serve. Duplication can thus be avoided and the fruits of experience can be adequately considered and properly collated.

I. GREAT BRITAIN

Great Britain was the first to gather together the threads of aeronautical activity and place them in the hands of a central authority; and at the beginning of 1918 the air branches of the Admiralty and War Office departments were amalgamated into the Air Ministry (*q.v.*). In April 1918, the flying branches of the navy and army were merged into the Royal Air Force. The idea was not a new one, and, although the impulse of war made obstacles easier to overcome, it was not in war that the conception had its origin. The sub-committee of the Committee of Imperial Defence, charged in 1911 with the study of aviation in its relation to defence, mentioned in its report that such a step might be desirable when flying was more advanced. The germ of the idea is also to be found in the constitution of the Royal Flying Corps, formed in 1912, with its naval and military wings. In this instance, however, the measure was too far in advance of the time to survive inter-service jealousies, and shortly before the outbreak of the World War the Royal Naval Air Service was formed, the Royal Flying Corps becoming part of the army.

As air warfare grew in volume and importance, the defects of the dual system under war conditions became more and more apparent. Full use of the nation's resources was prejudiced, and civilian ministers were not only denied unanimous advice on air matters, but were sometimes forced to choose between discordant views and to settle vital differences of opinion. The drawbacks of this competitive system were particularly glaring in the matter of technical supply. Improvement was sought in the principle of joint naval and military Air Boards to co-ordinate supply for the two air services. These boards had, however, no executive control over policy, and achieved but little. Finally the Air Ministry was brought into being as the only apparent alternative to the existing evils.

Although a war measure, the Air Ministry survived the peace, and administers not only the Air Force but controls civil aviation as well. It has, however, not been allowed to continue its existence as a Department of State without considerable hostility and adverse criticism. Its chief opponents were the navy and army. With their establishments reduced to a minimum, and their budget grants diminishing every year, the older fighting services viewed with misgiving the allotment of funds to the newcomer. They argued that the main use of aircraft in war is to assist directly or indirectly the army and the navy, and that accordingly these services should have entire control of their respective air arms. The reply to this objection is that the conquest of the air has disclosed possibilities which transcend the scope of land and sea warfare; that to narrow the view-point to naval or military problems is to bring their possibilities into a false perspective; and although that aerial assistance to the forces that fight upon the sea and on land is necessary, this need by no means marks the limit that should be set to aerial operations. Moreover, to regard the air merely as an auxiliary to the sea and the land is a dangerous doctrine, since circumstances may render naval and military operations secondary to those carried out by air forces. Another criticism was that a separate air force is extravagant, since it involves additional overhead expenditure. The reply is that this is offset by the economy achieved in having a single authority dealing with air matters.

One result of recognising aviation as a profession in its own right has been a breakaway from traditional practice in policing the British mandates in the East. Security in these territories is the responsibility of the Royal Air Force; aeroplanes are recognised as the chief instruments for the support of law and order, and military forces are used as auxiliaries. The measure has been justified by the great economy achieved. The development of this conception and its successful application would not have been possible without an Air Staff. Another result is a reversal of principle governing the air *vis-à-vis* the land and sea forces in the defence of Great Britain against air attack. Instead of dividing the air into two portions, one above the land and the other above the sea, and making the army and navy responsible for their respective spheres, the air is regarded for purposes of national defence as a single field of activity. The Air Force is accordingly responsible for guarding against air attack, and such ancillary ground forces as may be necessary conform to air defence measures and it carries out its work under the orders of the air commander.

Aviation in Peace and War.—Since it is sometimes claimed that a true appreciation of a nation's air strength cannot be reached without taking into consideration the civil aspect of flying, it is desirable to note the relationship existing between the peace and war sides of aviation. Air strength is represented by air forces maintained in peace, ready to function the moment war breaks out. Heavy losses in life and equipment are, however, to be expected in air warfare, especially if the belligerents are at all equally matched. Air power will, therefore, depend ultimately upon the means available for rapidly making good these losses—that is to say, upon a reserve of flying personnel and on a healthy aircraft industry. It is in respect of these two important factors that civil aviation must make its contribution to a nation's air strength. Hence the practice of granting government subsidies to commercial air transport enterprises. It may, however, be a long time before civil aviation will occupy, in relation to air strength, a position analogous to that occupied by the mercantile marine in relation to British naval strength.

The requirements of civil and war flying differ considerably. For commerce, economy in running and maintenance and paying load are the factors that count most. For war, speed, climbing power, the carriage and use of armament, and fighting qualities in general are the chief factors that control design. Consequently apart from the fact that they connote an aircraft industry and the existence of a potential reserve of pilots, aeroplanes used for civil purposes do not contribute directly to a nation's strength in the air.

The Royal Air Force

The officers of the general duties or military branch of the Royal Air Force are divided into two categories. About 50% of the total are those for whom the Air Force provides a permanent career. Practically all officers in this category must pass through the R.A.F. Cadet College at Cranwell. The remainder consists of officers serving temporarily in the Royal Air Force; either those from civil life who engage for a period of five years on the active list followed by four in the reserve, or those seconded for a period of four years from the army or navy. The other ranks are filled either by boys who go through an apprenticeship in a trade at one of the boys' training establishments, passing into the ranks on reaching the age of 18, or by men enlisted direct from civil life. The normal period of service is seven years with the Colours and five with the reserve. In addition to the general duties branch of the Royal Air Force, there are the stores, accounting, medical, dental and chaplain's branches.

Units are divided into the following types:—

TABLE I.

Type of unit	Equipment
Fighter squadrons	12 single-seater fighting aeroplanes.
Bombing squadrons	12 single-engine bombers, or 10 multiple-engine bombers.
Army co-operation squadrons	12 Army co-operation aeroplanes.
Navy co-operation flights	6 aeroplanes, seaplanes or flying boats.
Fleet air arm	6 aeroplane flights in aircraft carrying ships.

Directly under the Air Ministry are a number of commands embracing air force activities both at home and overseas. The following table indicates the various areas in question, and the composition of the different commands:—

TABLE II.

Inland Area	
	2 Fighter squadrons (directly under area headquarters).
Group 1 .	2 Bombing squadrons; Army co-operation squadron; armament and gunnery school; men's schools of technical training.
Group 3 .	6 bombing squadrons; 2 flying training schools; experimental establishments.
Group 6 .	8 fighter squadrons.
Group 7 .	1 fighter squadron; 2 bombing squadrons; flying training school; central flying school; electrical and wireless school; 3 army co-operation squadrons; school of army co-operation.
Coastal Area	
Headquarters .	4 fleet fighter flights; 2 reconnaissance flights; marine aircraft experimental establishment; flying boat development flight; R. A. F. units in H.M.S. "Argus" (aircraft carrier), and H.M.S. "Pegasus" (seaplane carrier).
Group 10 .	Coastal reconnaissance flight; 3 fleet spotter flights; 2 fleet torpedo flights; air pilotage school; seaplane training flight; school of naval co-operation.
Overseas Commands	
Middle East	2 bombing squadrons; army co-operation squadron; aircraft depôt; engine repair depôt; flying training school; Aden flight.
'Iraq . . .	Fighter squadron; 6 bombing squadrons; army co-operation squadron; 3 armoured car companies; 4 infantry battalions.
India .	4 army co-operation squadrons; 2 bombing squadrons.
Mediterranean. .	1 coastal reconnaissance flight; 2 fleet fighter flights; fleet spotter flight; 2 fleet reconnaissance flights; fleet torpedo flight; R. A. F. units in H.M.S. "Hermes" and "Eagle," aircraft carriers.
Palestine .	1 Army co-operation squadron; 1 armoured car company.

In addition to the above the organisation includes a cadet college at Cranwell, Lincolnshire; a school of technical training for boys at Halton, Buckinghamshire; the staff college at Andover, Hampshire; and the Royal Aircraft Establishment at South Farnborough, Hampshire.

The following table gives figures relating to the three chief air forces in Europe:—

TABLE III.

Country	Personnel		Available for independent air action		For army co-operation	For naval co-operation	Total machines
	Officers	Other ranks	Fighters	Bombers	Machines	Machines	
Great Britain .	3,000	33,000	144	266	132	118	660
France .	960	19,778	180	256	Obs. 536 Fighters 160 Total 696	60	1,192
Italy[1] .	2,640	29,226	702		513	315	1,530

[1] According to 1926 development programme.

Although all general duty officers are on a single list and are, with the exception of those in the fleet air arm, available for any form of work, the varied functions performed by the air force result in the division of its units into types, such as the fighter squadrons, fleet air arm, bombing squadrons, etc., according to the duties they perform and the aeroplanes with which they are equipped. Officers, accordingly, become identified with the type of unit in which they have had the most experience, although rigid specialisation is discouraged as a general principle.

(A. W. H. E. W.)

II. UNITED STATES

When the United States entered the World War, the aviation personnel consisted of 65 officers and 1,120 men of the army and 35 officers and 163 men of the navy. When the Armistice was signed, the Army Air Service had reached a total of 20,000 officers, 600 cadets, and 164,000 men, while naval aviation had a strength of 6,716 officers and 30,692 men. At the declaration of war, the United States possessed about 300 training planes, of which many were of inferior types. At the time of the Armistice, about 8,500 training planes had been delivered. The Army Air Service had, in addition to these, about 3,300 service type aeroplanes, De Havilland 4's and Handley-Page bombers, while the navy had about 1,600 anti-submarine flying boats. Up to the Armistice, 15,700 training engines and 13,396 Liberty engines had been produced. The Liberty engine development, in point of rapidity, cost and quality, was one of the most strikingly successful projects of the War.

Post-War Problems.—At the commencement of the War, army aviation was under the Signal Corps, but during the War the U.S. Army air service was organised to concentrate the administration of aviation personnel and equipment. In March 1918, the control of naval aviation was centralised in the Office of Operations under the Director of Naval Aviation, where it remained until the organisation of the Bureau of Aeronautics in 1922. The close of the World War found the United States with a large number of aircraft on hand. These were primarily military and naval aircraft unsuited for commercial purposes. Furthermore, in accordance with the war policy laid down, the types of aircraft built by the United States were limited to army observation planes, navy coastal patrol planes and training planes for both the army and the navy. The close of the War found the country therefore with a vast problem of developing and building military aircraft of many other types to meet the special needs of the army and the navy and also the growing demands of commercial aviation.

In the meantime it was necessary, not only from the standpoint of economy but also from that of training, to utilise to best advantage the aircraft on hand. Since the personnel of war-time aviation was recruited largely from civil life and demobilisation deprived the army and navy of the services of this personnel, it likewise became necessary to recruit and train replacement personnel. The Government had the choice of operating the types remaining at the close of the War and building more of the same types, or of operating war types to a limited degree and spending most of the available funds in the development of new types. Since no war was threatened the latter procedure was followed. Development work progressed to the point where in 1926, in so far as quality was concerned, the United States was not exceeded by other countries, and where superior types might be built in quantities in relatively short periods of time.

General Principles.—Military and naval aviation have two primary aspects, which may be characterised as Air Service and Air Force. By air service is meant that portion of the aviation activity which is auxiliary to the military and the naval establishments, such as reconnaissance and the control of gunfire. By air force is meant that branch which contemplates offensive air measures, co-ordinated, of course, with the military and naval establishments. The U.S. national policy requires that naval aviation be maintained in the same degree of readiness as the fleet and in the same proportion of strength, and this is the theory

on which the Government has been working. It is a fundamental principle that the best defence is a strong offence, and this implies that naval aviation must be prepared to take the offensive with the fleet. The country is open to invasion from the northwest, the northeast and from the southeast by overseas countries.

In so far as aircraft are concerned, bases would be required for such an offensive. With the fleet at sea fully equipped with its surface vessels, submarines and aircraft, no enemy could establish such bases. Again, with the fleet at sea with its own aircraft, the air force could establish its own bases and carry out its own offensive; but this offensive, in so far as aircraft are concerned, must be based primarily on the decks of the carriers of the fleet. In other words, aviation is an integral and important component part of both the military and naval establishments, and its best effort must be directed in conjunction with the army and the navy, and not independently. Strategic considerations based on the present capability of aircraft require that the United States air force should be the naval air force, not a separate air force based on shore or on ships. On the basis of these fundamental conceptions, development has gone ahead with rapidity.

The air forces of other countries (*e.g.*, *see* FRANCE; ITALY) are discussed in the articles thereon under the sub-heading "Defence." For commercial aviation *see* FLYING.

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AIR MINISTRY.—The British Army and Navy at the beginning of the World War in Aug. 1914 had separate administrative organisations for their air services which were the Royal Flying Corps and the Royal Naval Air Service respectively. These were amalgamated early in 1918 and the Air Ministry was formed. It is a state department and the Secretary of State for Air is the responsible Cabinet Minister. He is also president of the Air Council, whose functions are analogous to those of the Board of Admiralty and the War Council.

The Air Council.—In addition to the president, the Air Council is composed of the Under Secretary of State for Air, who must be a member of either House of Parliament, four service members (the Chief of the Air Staff, the Air Member for Personnel, the Air Member for Supply and Research and the Deputy Chief of the Air Staff) and the secretary, a civil servant. The Air Ministry provides the administrative machinery for giving effect to the Air Council's decisions and it consists of various main departments. The directorate of civil aviation deals with all matters connected with the regulation of civil flying. It comprises an accident branch, which investigates the causes of accidents, whether to service or to civil aircraft; an air transport branch, and a licensing branch. The department of the secretary is charged with the internal administration of the Ministry and is responsible for the general routine. Included in the department are the directorates of accounts, contracts and lands and the meteorological office.

The department of the chief of the air staff includes the directorate of operations and intelligence and the directorate of staff duties and organisation, which, in addition to the functions implied by its designation, controls the signalling branch. This branch deals with questions of wireless communication for both the Royal Air Force and civil aviation. The directorate of works and buildings is also under the chief of the air staff. The department of the air member for personnel deals with the recruitment, discipline, general welfare and training of officers and other ranks of the Royal Air Force. The directorate of medical services forms part of this department.

The department of the air member for supply and research includes the following directorates: (1) the directorate of scientific research and technical development, divided into branches which deal respectively with design, armament, instruments and scientific research; (2) the directorate of airship development; (3) the directorate of aeronautical inspection, which is responsible for the inspection of all materials used in the construction of aircraft and engines; (4) the directorate of equipment, which is responsible for the supply, storage and issue of all equipment for the Royal Air Force. (A. W. H. E. W.)

THE UNITED STATES

In the United States there is no department of the Government corresponding to an Air Ministry as it exists in Great Britain. Instead of endeavouring to administer all aeronautic activities through one central organisation, the Government has divided the administration into three main departments. Military aviation is handled by the War Department through the United States Army Air Service. Naval aviation is administered by the Navy Department through the Bureau of Aeronautics. The only extensive commercial aviation activity is the United States Air Mail, administered by the Post Office Department. This department announced a policy of transferring the operation of some of the air mail lines to private contract. Proposed legislation in Congress in 1926 contemplated the establishment within the Department of Commerce, of a bureau whose purpose it would be to foster commercial aviation.

The geographic position of the United States largely dictated this general policy. As the country is not within close striking distance by air of any major overseas force, it has been the policy to develop air service and air force within the army and the navy rather than a separate air force with subsidiary branches in the army and the navy. Since the types of aircraft required by the army and the navy must be specially designed to meet the requirements of each of these services, and since commercial aircraft have entirely different characteristics, this policy would appear sound. The aeronautic activities of the different departments have been co-ordinated through joint boards and through the National Advisory Committee for Aeronautics.

There are, then, two policies in the matter of administering aeronautics: the one, the British in which military, naval and commercial aeronautics and the separate air force are all controlled by an Air Ministry; the other, the American, in which military, naval and commercial activities have the initiative in development, each along its own special line, co-ordinating their efforts through co-operation, rather than as dictated by a single organisation. These two different policies are in accord with the methods of government of the two countries and are largely dictated by geography and by policy. (W. A. M.)

AIR POWER.—The uses to which ability to fly have been put are threefold: tactical military employment, strategical military employment and social use. All of these may be expected to increase.

Prior to the World War, flying was almost entirely self-educational; its military uses were largely experimental and its commercial value non-existent. Nevertheless, the reconnaissance work carried out by the Royal Flying Corps of Great Britain in 1914 enabled Sir John French, in his own words, "to make speedy dispositions to avert danger and disaster." But visual reconnaissance was only the first of the new tactical utilities; subsequent developments included aerial photography, artillery observation assisted by wireless telegraphy, attack on ground targets by bomb and, later, by machine-gun from low-flying armoured machines. Air attack upon and protection of these services brought about air battles involving up to 100 specialised craft. Special British night-flying fighting squadrons were organised, which, controlling from the air a conjunctive force of guns and searchlights, sustained an effective defence against enemy bombing formations. In the naval sphere both aeroplane and airship were successfully employed in submarine spotting and destruction and in the convoying of mercantile surface vessels. Torpedo attack on ships was developed; and reconnaissance for the contesting fleets had a marked influence in the conduct of the naval campaign in European waters.

Yet the million hours flying on the Western Front did not give the fullest opportunity for tactical air employment. This is exemplified by the operations in Palestine in 1918 when air superiority protected and concealed a British independent cavalry

turning movement, and an air attack on retreating columns caused the abandonment of all enemy transport and a complete dislocation of the Turkish plans of retirement. In short, tactical air units developed from an assistance to a vital adjunct to land and sea forces. Even so their possibilities are only partially explored and will undoubtedly increase in the future, prominent amongst the inevitable extensions being the use of troop-carrying aircraft to increase the mobility of armies.

Air Strategy.—In strategy, however, the air war demonstrated in greatest degree the possibility of revolution in military science. Long-range bombing attacks on the industrial centres aimed at the morale of the enemy were first carried out by the Germans; and, though counter-measures put a stop to these raids, their possibility necessitated the retention of considerable defensive forces in Great Britain until a late period of the War. And the effects of subsequent British strategic air power, though it was not systematically organised until the last year of the War, and though the Armistice put a stop to its development, showed both military and political authorities alike that direct attack on the morale of enemy civilian population must be an inevitable accompaniment of any future war and that nations must prepare accordingly for this eventuality.

Air strength can be easily, cheaply and secretly prepared; its radius of action at the close of 1925 was approaching 1,000 m. at 150 m. per hour, and these figures will increase. It opens a new phase and sphere in warlike operations and entails a radical rearrangement of the fighting services and the alteration of the composition of armies by forcing them to take mechanical forms. In addition to being a vital adjunct to the senior arms it is likely to play an increasingly important strategic rôle. An air offensive which is encountered in the air will compel the removal of seats of government and of defence bases beyond its radius of action. With an increased range of aircraft this zone of ineffectivity will extend. Power in the air will dislocate all forms of communication and, if it does not actually cut off the supply of food and raw material, it will render their transit precarious.

Air navigation may go far to assist the avoidance of conflicts, but in time of war, in combination with chemistry, its possibilities will only be countered by superiority in the air. The defence of the British Empire in particular is growing more complicated. Great Britain no longer depends for its security on the sea. On the contrary, its geographical position and extent open it to military attack, and air power is essential to its security (*see* BRITISH EMPIRE: DEFENCE).

Two Principles.—For the full future development of military air power two principles assert themselves; the radical revolution it occasions in the training for and practice of war and the necessity of advancing air power by forwarding the power of flight. Success in military air forces does not depend on numerical superiority alone. Air efficiency, like naval efficiency, depends on the national aptitude and ordinary use in peace. The best airmen are those who are accustomed as a normal routine to flying in all weathers, and decisive success in air battles can only come from long training in the air. Air-going services, both military and mercantile, are the source of air strength, and power of expansion must rest on a widespread civil aerial activity.

Progress and Limitations.—A constantly increasing number of long-distance demonstration flights since 1918, including a flight round the world in 1924, have shown the technical possibilities of aircraft as a means of commercial communication. More practical demonstration is provided by the 30,000 m. of air routes in regular operation in Europe in 1925, extending from London to Nijni Novgorod and from Helsingfors to Malaga, and thence to Dakar, and by the 1,000,000 m. flown by British commercial air services for every fatal accident.

The limitations to the use of this social power at the end of 1925 appeared to be three in number. First, though the risk of accident was small, safety comparable with that of other means of transport had not been obtained. The remedy is further technical progress, particularly in securing by mechanical means much for which the human factor is still responsible. Second, strict regularity of service, an essential in successful transport endeavour, was absent. Conditions of bad visibility still dislocated air services. Allied to this defect was the inability to fly by night, with a consequent loss over long distances of a large proportion of the time saved by travel by day. These limitations are not applicable where fog is of rare occurrence, or where the competition of a highly developed ground transport does not operate. But, with few exceptions, such areas offer no traffic for which speed is essential and its cost economic. The remedy for these disabilities is again technical development which will allow for safe flight in conditions of bad visibility.

The final limitation is economic. The cost of air transport in 1925 may be taken as some 5s. per ton mile and 5d. a passenger mile. On very few routes is there a regular commercial traffic for which such a rate is economic. The remedy is to attract increased traffic by a more efficient service and to reduce costs of operation. Technical progress is the source of both.

Of transport by airship nothing could be said with certainty at the close of 1925. For uninterrupted flights of 2,000 m. or more the airship suggests a means of high-speed economic operation. Such experience as exists shows a series of mishaps, in each of which an attributable and avoidable cause was present; and an unremitting caution in every detail of experimental operation is essential to progress. The military values of air power are demonstrated, but not yet fully developed. Its social value has yet to be proved; but it must be remembered that civilisation has been spread by the extension and development of means of communication, and there is no authentic record of improvement in speed of communication being found and abandoned. (F. H. S.)

See W. Mitchell, *Winged Defence.* 1926.

AIR RAIDS.—Directly Great Britain came into the World War, the German High Command began to encourage their public with prophecies of the havoc the Zeppelins were about to work in England, but it soon became evident that for airships to fly in daylight over enemy territory was to invite disaster. Hence, although reconnaissances over the North Sea towards England were begun by airships, the first actual attacks were made by aeroplanes.

Raids in 1914–5.—In Dec. 1914 a couple of bombs were dropped in the sea off Dover, and three days later, on Dec. 24, the first German projectile hit English soil. A few half-hearted attacks by aeroplanes and seaplanes, made during 1915, were ineffective, and it was left to the lighter-than-air machines to cause the first serious damage. In the evening of Jan. 19 1915 two naval airships approached the coast between Yarmouth and Cromer. They separated and dropped bombs on both towns. Four people were killed.

On April 14, Mathy, boldest of all German air commanders, commanding L9, made a considerable tour over the northern counties. On this occasion he was not particularly successful, most of the bombs falling harmlessly in open country, but the following night L9 caused some damage in Suffolk. The next four raids were similar. Capt. Linnarz, very active about this time in command of one of the military airships, succeeded in bringing his ship over the metropolis on the night of May 31 1915. There was on this night only one raider, armed with an inefficient type of bomb, but there were 41 fires while five people were killed and 14 injured.

Further raids in Yorkshire and Kent on June 4 had little result, but two nights later Mathy again attacked the north. He found Hull, and killed 24 people, besides wrecking some 40 houses. Another airship, LZ37, that attempted to raid on the same night, was destroyed by Lt. R. A. J. Warneford, R.N., while returning home near Ghent. The first serious military damage in England was done by a single ship that raided the north on June 15.

A series of nine raids took place in the latter part of 1915. It opened inauspiciously for the Germans, a Zeppelin engaged in bombing Dover being hit by a 3-in. gun that had just been mounted there. She struggled across the Channel, and was finished off by bombing aeroplanes.

London was reached on four nights during this period. On Sept. 8 Mathy bombed the city deliberately; the damage done amounted to more than £500,000. Mathy also took part in the raid of Oct. 13, when his ship bombed Woolwich. On this occasion the casualties were 33 killed and 77 wounded. Two buildings were destroyed, 20 seriously damaged, and there were 13 fires, the total damage being estimated at £50,250.

Raids of 1916.—The defences could do no better in the early raids of 1916. Nine Zeppelins manoeuvred over the midland counties on the last night of Jan., one getting nearly to Shrewsbury, and 59 people were killed. Out of 16 British aeroplanes that went up in pursuit, 8 crashed on landing. A month later two airships were able to sit over Hull and bomb it from a low height, without any interference from the defence. From this time, however, the defences improved. L15, one of the five ships that attacked on March 31 1916, was hit by the gun at Purfleet; it was then attacked in the air by Lt. A. de B. Brandon, of the Royal Flying Corps, eventually falling into the sea off the coast of Essex. Fifteen airship flights were made over England and Scotland during this April. The British losses were 84 killed during the series.

Further raids at the end of April were organised in conjunction with the naval bombardment of Lowestoft and Yarmouth. A large number of airships took part, but the result was small. London was saved from bombing by its defences on April 25. One Zeppelin was eventually destroyed on the coast of Norway.

An abortive raid on Harwich was followed on Aug. 24 by an attack on London by Mathy. A determined attempt on London was carried out by 14 ships on Sept. 2. The metropolis was undoubtedly saved by Lt. W. L. Robinson of the R.F.C., who attacked the military airship SL11. She fell, a burning mass, near Cuffley, Middlesex. On Sept. 23 1916 11 airships left Germany and the main attack was directed on London by three of the newest super-Zeppelins.

Having crossed the Essex coast shortly before 11 P.M., L33 was over east London ten minutes after midnight. Here she dropped 20 bombs. London, however, was no longer the helpless mass of former days. The searchlights continually lit up the hull of the airship; she was badly holed by the guns, one of her engines was damaged and she began to lose gas and fly clumsily. To add to her miseries, Brandon now brought his machine close up to her. For 20 minutes he stuck to her, pumping bullets into the fabric. As she laboured back towards the North Sea, the crew threw out everything on which they could lay their hands. Her commander crossed the coast at Mersea I., going out due east. But the certainty that his ship would fall into the sea was too much for him; he turned her about and came to earth three miles inland near Colchester.

Mathy meanwhile brought his ship L31, in company with L32, up the English Channel and, turning in over the Kent coast, passed straight over the centre of London. South London and the extreme north of the metropolis suffered severely; but, for some reason, Mathy threw no bombs in the central districts. The handling of the companion ship, L32, was not of nearly so bold a character. Her commander spent an hour circling about Romney Marshes. As he crossed the Thames near Dartford he was picked up by lights and attacked by guns. Lt. Frederick Sowrey succeeded in setting the ship on fire in several places; she fell at Billericay. The British casualties on this night were 40 killed.

On the night of Sept. 25, seven ships raided the north. Mathy, on this occasion, took his ship on an entirely new line; he flew up the Channel as far as the Isle of Wight, where he turned north and went over Portsmouth. He dropped no bombs on the fortress or dockyard.

Yet another serious attempt to bomb London was made on the night of Oct. 1. Eleven ships started from Germany. Mathy, in L31, came in over Lowestoft about 8 P.M. and as usual steered an excellent course on London. Soon after passing Chelmsford, however, he found that the outer defences on that side of the capital were ready for him. He therefore turned and steered northeast. Turning again he flew southwest, in order to get into position for his favourite dash down wind over the city. After drifting a few moments towards Ware, he set his engines going and started for north London at full speed. Suddenly a heavy gunfire was opened on him and he decided to abandon his attempt. Sec.-Lt. W. J. Tempest came up to the ship at 12,700 ft. and brought her down in flames at Potter's Bar. During the whole of this great raid the only British loss was one man killed. The defence of London had now definitely got the better of the lighter-than-air attack; after this period no German airship ever flew intentionally over the metropolis.

Deterred by the victory of the London defences, the Germans turned their attention to the north for the final effort of 1916. They met with no better success. Of the 10 ships that left Germany in the course of Nov. 27, 8 came over land. One was destroyed on the coast near Hartlepool before midnight by Capt. J. V. Pyott of the R.F.C. Another raider, L21, after a remarkable journey right across England to Cheshire, was caught in the early morning, when she was leaving the coast at Yarmouth. She fell into the sea from 8,000 ft. and sank at once. During 1916, 18 raids were made on England by aeroplanes and seaplanes.

The first aeroplane attack on London itself was made on Nov. 28 1916 by a single machine; the only intimation was the fall of six small bombs between Brompton Road and Victoria station.

Raids of 1917.—Before the end of 1916 it had become evident to the German command that, if effective bombing was to be kept up on targets that were worth attacking, it would be necessary to try new methods. Early in 1917, therefore, they began equipping a squadron with special machines suitable for bombing England systematically.

The first attempt came on May 25 1917. The 3rd Bombing Squadron, 16 machines strong, left Belgium early in the afternoon and made the coast about 5 P.M. There were thick banks of cloud over Essex. The task of navigating to London was found too difficult and the leader had to give up the attempt. He therefore turned south. Bombs were dropped on the Canadian camp at Shorncliffe, where there were 100 casualties. The worst effect was produced in Folkestone itself. One bomb fell in a crowded street and killed 33 people, mostly women. The second unsuccessful attempt was made on June 5; 18 machines bombed Sheerness with some effect. The guns at Sheerness succeeded in hitting one of the raiders, which fell into the river off Barton's Point.

London Seriously Damaged.—The third attempt on London was more successful. The whole of the 3rd Squadron started in the morning of June 13; London was reached a little before noon. A few bombs were dropped in the East End and near the Royal Albert Docks; then, at a signal from the leader, the formation loosed 72 bombs over a small area having Liverpool Street station as its centre. The station itself was hit by three bombs. The casualties were severe, 104 killed and 423 injured.

The next raid on London on July 7 was also successful. Twenty-four machines started. The main body of 22 machines came to London. The city received 76 bombs, one of them starting a fire in the General Post Office; 46 persons were killed and 123 injured, 22 buildings were destroyed, and 87 seriously damaged, the total damage being estimated at over £200,000. The anti-aircraft guns fired a large number of rounds, but produced no effect.

The failure of the defensive arrangements caused considerable agitation, and the British Govt. ordered a complete reorganisation. The London Air Defences were formed as a separate command to include all the means of defence, both from the ground and in the air. Gen. E. B. Ashmore was brought from France to take charge of the new arrangements.

The new arrangements were soon tested; on Aug. 12 a party of nine Gothas made the land near Harwich. After following the coast to the Blackwater, they turned inland for London. The communication system of the defence control worked well, and the squadrons immediately defending London were at the required height in time to meet the enemy formation. The German commander turned his formation about before reaching the outer line of guns. A number of bombs were unloaded on

Southend as the enemy made off, and 32 people were killed. An attempt on Aug. 18 was frustrated by bad weather.

An abortive attack on the Midlands by 8 airships on the night of Aug. 21 was followed by the last day attack on England on Aug. 22, when Capt. Kleine, commander of the 3rd Squadron, started out with 13 Gothas to bomb Sheerness and Dover. A number of naval machines turned the Sheerness bombers from their objective, and the German formation, harassed by the British pilots, wheeled south by Ramsgate. Here the anti-aircraft guns, working with great accuracy, shot down two of the raiders. A third was shot down off Dover.

Night Attacks Begin.—The first group of night attacks came in the beginning of Sept. 1917 and one of these reached London itself. On the night Sept. 3–4, about 10:30, hostile aeroplanes were reported near the North Foreland, and warnings were sent out by the central control a few minutes later when it was clear that they were coming up the Thames. Unfortunately there was serious telephone delay in getting the warning out at Chatham, and before cover could be taken a bomb had fallen on a drill hall in which a large number of naval ratings were asleep. No fewer than 107 were killed and 86 wounded.

Although on this night the defence was ineffective, certain points gave hope for the future. Three pilots went up in fast scout machines, and found that it was by no means impossible to handle them at night. The idea also was evolved of barrage fire, a curtain of bursting shell put up in the path of the raiders.

The last raid of this moon period, on Sept. 4, reached London. The barrage fire, organised since the previous night, turned back some of the pilots, but 10 raiders reached the metropolitan area. Considering the magnitude of the raid, the damage caused was small, and the total casualties for the night included only 14 killed and 48 injured.

Favourable weather produced a sustained series of raids, opening on the night of Sept. 24 with an attack on London by aeroplanes, in conjunction with an airship raid on Hull and the north. Nine at least of the pilots attempted to attack London itself, but considerable improvement had by this time been effected in putting up barrage fire, which was successful in turning back all but three of the attackers. Although 27 English machines went up they failed to find any of the enemy; the gun-fire brought down one of the Gothas, which fell in the river near Sheerness.

The attack on the north was carried out by 10 airships under Capt. Peter Strasser. Although Hull was found, the raid had very little success. On the following night, Sept. 25, 10 aeroplanes attacked, and 9 people were killed. The attacks were continued on the 28th, when some 20 machines came over; the night was cloudy and a few only approached London; they were all kept off by the barrage fire.

The barrage was again effective on the following night, Sept. 29. Out of the 18 or 19 machines that came over only 4 penetrated far enough to bomb London. The Dover guns did well, bringing one of the enemy down in flames. On the next night, Sept. 30, five German pilots got over London and bombed places as far apart as Highgate, Edmonton and Woolwich: 14 people were injured and two killed. The last raid of the series, on Oct. 1, was made by about 18 machines.

During these raids a large proportion of the attackers had been turned before reaching their target, but the defences were still far from complete. The barrage fire was expensive in ammunition and there was a doubt if the supply could be kept up. The defending squadrons had not reached the necessary efficiency in machines or pilots.

The "Aprons," a new defence devised after the raid of Sept. 5, were only beginning to be installed. The central control as organised in Sept. 1917 could give no information to pilots when once they had been sent on their patrols, but schemes to rectify this had already been initiated.

The airship raid of the night Oct. 19–20 1917, which became known in London as the "silent raid," has points of special interest. Eleven airships met on the evening of the 19th off the Yorkshire coast for an attack on the industrial centres of the Midlands. While over England, the ships flew well over 16,000 feet. At this altitude the efficiency of the crews was much impaired by height sickness and the intense cold. Another and fatal condition was produced by the weather. Near the ground the air was misty and there was very little wind, but at the height of the airships a strong gale was blowing from the north, and in this the Zeppelins drifted blindly south. One airship passed over London without recognising it and dropped a few explosive bombs; one of 50 kgm. fell in Piccadilly near the Circus and caused some casualties.

Realising that, on account of the ground mists, searchlights would have no chance of lighting up a high Zeppelin, the defence ordered them to remain covered unless an airship could be heard. London was saved from a combined attack and the raid ended in disaster to the attackers. One airship only returned to Germany in the usual way; six got back after flying over Holland or across the Allied lines. The remaining four were destroyed during the following day on French territory.

Aeroplane raiding was resumed during the moon period at the end of October. An attempt on the 31st was carried out by 24 machines. Considering that a good many of them got over London, the effect of the bombs was small, 8 persons being killed and 21 injured.

The weather in Dec. 1917 was unfavourable and only three attempts were made on London. The defences showed steady improvement. Two Gothas were brought down by anti-aircraft gunfire during a raid in the early morning of Dec. 6. On the night of the 18th one Gotha was so damaged that it fell into the sea off Folkestone and was destroyed. On this night the new Giant aeroplane dropped one 300-kgm. bomb near Eaton Square, making a large crater but doing little serious damage. The whole raid, however, cost London more than £225,000, 42 buildings being seriously damaged and 9 destroyed, while there were 13 fires. On Dec. 22 the last raid of the year was frustrated by unfavourable weather; one Gotha was forced by engine trouble to descend near Margate, where it was destroyed by the crew.

Raids of 1918.—In the five aeroplane raids of the first quarter of 1918 there was a tendency to replace the smaller Gotha machines by the new Giants. A Gotha was destroyed by a defending aeroplane on Jan. 28. During this raid a bomb dropped by a Giant fell on a building in Long Acre that was being used as an air-raid shelter, and 41 people were killed. Three Giants attacked on Feb. 16; the only one that penetrated to London demolished a house in Chelsea Hospital with a 300-kgm. bomb. The raid of March 7 1918 was remarkable as being the only occasion on which aeroplanes attacked London in the absence of any moonlight. Warrington Crescent was terribly wrecked.

To turn to the airships, raiding was not resumed until the nights of March 12 and 13 1918. Both these raids were made at an immense height, and the damage did not amount to much. Five airships of the newest and largest type attacked the Midlands on the night of April 12. The end of the airship raiding came on Aug. 5–6 1918. Five ships came up to the coast of Norfolk, no bombs were dropped on land, but L70, the latest word in airship construction, was destroyed.

In the great aeroplane raid of May 19 1918, the Germans made their maximum effort in this form of attack; between 30 and 40 Gothas of the 3rd Bombing Squadron took part, with at least two Giant machines. Thirteen of the raiders managed to get over London. The casualties included 34 killed and 98 injured, and £130,000 worth of damage was done in the London area alone. But the defence had by now made very real progress. The Germans lost 7 machines, 3 shot down in air combat, 3 destroyed by gunfire, and one from engine failure. This success of the defence was final, and the London area was saved from further bombing.

In addition to casualties (1,413 killed, 3,407 injured) and damage, the German raids on England produced actual results by no means negligible. A night raid stopped munition work over a large area. In order to establish a defence, men and material were kept back from France. Two hundred aeroplanes of the

AIR RAID DEFENCE

One of the Balloon Aprons covering the approaches to London in 1917–18. The effect of these Aprons was to limit the German bombers to certain heights, and to make it easier for the defending patrols to obtain contact.

best performance and 200 highly trained pilots were available about London at a time when they would have been of the utmost value on the Western Front. (E. B. A.)

European Air Raids.—Apart from raids that formed part of the ordinary operations on the various battle fronts, there were raids on towns of France, Germany and elsewhere, similar in intention to those on Great Britain. On Sept. 27 1914 the first bombs were dropped on Paris by a German aeroplane. On March 18 1915 bombs were dropped on Calais, killing 7 French refugees and injuring twelve. On Sept. 22 1915 French aeroplanes dropped bombs on Stuttgart as a reprisal for the bombardment of open towns by the Germans. In Dec. there were air raids on Calais, and Salonika was bombed by the Germans.

In 1916 on Jan. 29 a Zeppelin flew over Paris, dropping bombs which killed and wounded over 50 persons. In Feb. and March 1917 the Germans raided Salonika, and in April 1917 a large squadron of British and French aeroplanes bombarded Freiburg as a reprisal for attacks on British hospital ships. During the autumn of 1917 the British and French repeatedly carried out raids on the towns of western Germany, and in particular on Saarbrücken and Kaiserslautern. On Dec. 24 1917 a British squadron dropped a ton of bombs on Mannheim-on-the-Rhine.

Early in 1918 the British and French Flying Corps carried out raids against the towns of western Germany. One of the most successful of these was on Jan. 14 by the British upon Karlsruhe, when the main railway station was heavily bombarded and many buildings set on fire. On March 11 1918 hostile aeroplanes raided Paris. On March 29 1918 Good Friday, a shell from "Big Bertha" hit the church of St. Gervais, killing and injuring many of the worshippers. In May of the same year British airmen dropped 33 bombs on Cologne in daylight and also bombed the port of Durazzo in Albania and sank an Austrian torpedo boat. On July 19 1918 British seaplanes bombed the Zeppelin sheds at Tondern (Schleswig) and did much damage.

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AIRSCREW.—The purpose of the airscrew (popularly known as the propeller) in an aeroplane is to transform the power of the engine into a thrust giving a velocity to the aircraft. It consists, usually of two, but sometimes of three or four, blades which have a length about five or six times their width and cross sections of aerofoil shape. One end of each blade is fitted to, or is integral with, a central boss, which fits on and revolves with a shaft of the engine. The blades are equally spaced round the boss.

The motion of any point in the blade is made up of two motions, the first (represented by a b, fig. 1) in a circle around the

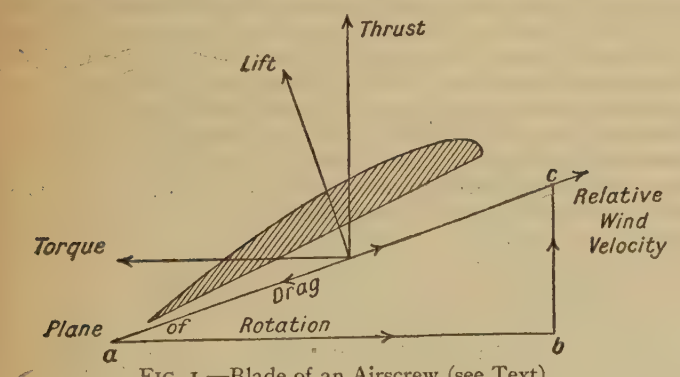

FIG. 1.—Blade of an Airscrew (see Text).

axis of the engine shaft, and the second the forward speed (b c) of the aircraft which the screw is propelling. This second motion is at right angles to the first. The resultant direction of motion is thus a c at an angle to the plane in which the screw rotates. Since the forward motion b c is the same for all points in the blade whilst the circular motion varies from zero at the centre to a maximum at the tip of the blade, this angle varies with the radius.

Each portion of the blade is set at a small angle to its resultant direction of motion. Hence the blade is a portion of an approximately helical surface, the pitch of which is known as the geometrical pitch of the screw.

Each portion of the blade is exactly similar to a portion of an aeroplane wing. Like the latter it experiences a "lift" tending to push the blade at right angles to the resultant direction of motion and a "drag" against that direction. The difference between the components of these forces in the direction of travel of the aircraft is the thrust, and the sum of the components in the plane of rotation of the screw is the torque against which the engine drives. In general the thrust is greatest when there is no forward motion of the aircraft. As the speed of the aircraft increases, the thrust falls until at a certain speed it becomes zero. Further increase of speed would result in a resistance instead of a thrust. The distance travelled forward during one complete revolution of the screw when the thrust is zero is known as the *experimental mean pitch.*

If T is the thrust, Q the torque, n the rate of rotation in revolutions per unit time, D the diameter, ρ the density of the air in units of mass, then it can be shown that for geometrically similar airscrews

$$T = \rho\, k_t\, D^4 n^2$$
$$Q = \rho\, k_q\, D^5 n^2$$

k_t and k_q are numerical coefficients whose values depend on the ratio of the speed of translation and the peripheral speed of the tips of the airscrew. These coefficients can be experimentally determined on models of airscrews running in wind tunnels or they may be estimated.

The methods by which such estimates are made and the theories on which they are based form the subject matter of much mathematical and experimental research, of which the following is necessarily a very brief outline. The bibliographical addenda gives references to the more important contributions.

The Momentum.—Airscrew theory has developed along two independent lines. The first is the momentum theory and is associated with the names of Froude and Rankine. According to this theory the airscrew is assumed to be a disc moving at velocity V and imparting a steady change of pressure to the column of air through which it moves. The thrust or change of pressure is necessarily associated with a backward velocity of the column of air which at some distance behind the disc will have acquired a velocity v which velocity is termed the "outflow." A part of this velocity λ v is acquired in front of the disc and this part is termed the "inflow" and the factor λ is called the inflow factor.

The velocity of air passing through the disc is thus $V+\lambda v$ and the mass of air is $A\rho(V+\lambda v)$ where A is the area of the disc and ρ the density of the air in mass units. The thrust is estimated from the rate of change of momentum thus generated and is equal, therefore, to $A\rho v(V+\lambda v)$.

In the further development of the theory it is shown that the inflow is one-half the outflow velocity, *i.e.*, $\lambda = 0{\cdot}5$, and thus $T = A\rho v(V+\frac{1}{2}v)$, and also that the efficiency is $V/(V+v/2)$. The velocity v is assumed as a purely axial outflow. In the actual airscrew the creation of a thrust is accomplished by the blade exerting a torque, which sets up a rotation in the outflow, and in a complete solution it is therefore necessary to consider a rotational inflow and outflow.

Blade Element Theory.—The second line of development was proposed by Froude and developed by Drzewiecki and Lanchester. In this—the Blade Element Theory—the blade elements are regarded as aerofoils. The velocity of the air relative to the blade element is determined. From this the angle of incidence and the lift and drag forces follow. From these the thrust and torque of the elements are deduced and integration over the length of the blade gives the total thrust and torque. In the simple theory as developed by Drzewiecki no account was taken of the inflow and in its application by designers the lift and drag forces of the elementary aerofoils were taken from wind tunnel tests of rectangular aerofoils having a ratio of length to width of about 6. It was further assumed that the elementary lengths behaved as if independent of neighbouring aerofoils, an assumption shown by recent work to correspond closely with fact.

Both these two theories are incomplete. The momentum theory takes no account of the turbulent and rotational effects implicit in the blade element theory, which in most airscrews account for a very large proportion of the wasted energy. The second takes no account of the inflow shown by the momentum theory.

Modified Theories.—Efforts are therefore made, notably by Fage, Bothezat, Riach and Bairstow, to combine the two theories. Bothezat and Riach develop closely similar lines of argument. Both take account of axial and rotational inflow and show theoretically that both are one-half of the additional velocity in the ultimate slipstream. It is not clear what aerofoil characteristics are to be used. If characteristics taken from wind tunnel experiments are used, the theories appear inapplicable for practical design, since the angles of incidence quoted in such experiments are not the angles to the relative air at the aerofoil but to the air unaffected by its action.

Fage avoids this ambiguity by using an inflow factor which is frankly empirical and is chosen to obtain agreement between the observed and calculated characteristics of the airscrew. A good exposition of the application of the inflow and blade element theories to design is given by Bairstow who uses an inflow factor of 0·35.

Glauert's Theory.—Probably the most complete and successful airscrew theory has recently been proposed by H. Glauert in *An Aerodynamic Theory of the Airscrew.* Glauert has reviewed the whole basis of airscrew theory in the light of the circulation and vortex theory of aerofoils developed by Prandtl and other writers. The theory is based in part on the conception of the slipstream as a cylinder of vorticity, and the relationship between the interference flow at the airscrew and the slipstream velocity is established in a manner more rigorous than that used by other authors.

It is shown that it is not strictly correct to equate the thrust to the rate of change of momentum but that the difference is of no practical importance. When this point is neglected the solution given is identical in form with that given by Bairstow and in current use by designers. The essential feature of this theory in which it differs from or amplifies earlier theories is that the aerofoil characteristics used should be those of an aerofoil having infinite length compared with its width.

These characteristics can be deduced from those measured on aerofoils having a finite length to width ratio. The form of the correction follows from Prandtl's work and is given in a simple and suitable form by Glauert. With such aerofoil characteristics the theoretical inflow factor of one half is used.

This relatively new point of view avoids the empiricism of Fage and Bairstow and the uncertainties expressed as regards Bothezat and Riach and brings theory and experiment into close agreement. The theory does not attempt to take into account the effect of the periodicity of flow inherent in an airscrew which usually has two, and rarely more than four, blades. The author justifies his omission on the grounds of the good agreement shown between observed results and those calculated from his theory but it is this omission which leaves his solution still incomplete and which may therefore give rise to further developments.

Airscrew Windmills.—The term airscrew has so far been used as applying to the only type of propeller used on aircraft. The term applies also to what is popularly known as a windmill. The function and working conditions of the airscrew windmill are in general the reverse of those of the airscrew propeller. The latter receives its power as a rotating torque and transforms it into a moving thrust. The former receives power by means of a thrust due to a forced translational velocity through the air and transforms it into a rotating torque. The propeller accelerates and the windmill retards the air passing through the disc of rotation.

The various airscrew theories are as valid for windmills as for propellers, the windmill being regarded as an airscrew propeller with a negative velocity of advance.

Between the two states, however, there is a range of working, including that referred to by Bothezat as the vortex ring state, for which the usual equations are inapplicable.

There is room, therefore, for development in airscrew theory to cover this gap and to give a complete solution for the thrust and torque of an airscrew under all possible conditions. Work in this direction is proceeding in Great Britain.

Variable Pitch Airscrews.—When the normal aircraft engine is fitted with an airscrew of fixed pitch designed to allow it to run at normal rate of rotation at maximum flying speed, then at any less speed, the rate of rotation will fall until when stationary on the ground the rate of rotation is, according to circumstances, from 80–90% of the normal. Thus it is not possible when taking off or climbing to utilise the full power of the engine.

The speed of the engine also falls with increasing altitude, but only due to the decreasing speed of the aircraft, carburation, and frictional losses in the engine. Apart from the effect of the last two points, it is correct to say that at any given aircraft speed the rate of rotation is independent of the altitude of flight, since both the resistance of the airscrew to rotation and the power available to rotate it vary with the density of the air.

If the engine is supercharged partially or fully to maintain its power independent of altitude, then this balance is destroyed and such an engine fitted with an airscrew of fixed pitch designed, say, to run at normal rate of rotation at a high altitude, would run much slower at lower altitudes thus preventing the utilisation of the full power of the engine under all conditions.

In order to control the rate of rotation under all conditions of speed and altitude and to utilise the maximum power in the most efficient manner, it would be necessary to vary both the pitch and the diameter of the airscrew. The design of such a screw presents almost insurmountable difficulties and has not been seriously considered.

Although it does not give the most efficient screw for all conditions, an airscrew of which the pitch only can be varied is considered a practical compromise. Even this presents difficulties and at the time of writing a completely satisfactory solution of the problem has not appeared. In most countries promising designs are under experiment and the problem may be said to be well on its way to solution. A variable pitch propeller is essential to the full success of the supercharged engine, but its advantages for the ordinary engine are very limited.

The Helicopter.—The helicopter is a particular use of an airscrew. It has frequently been proposed and many attempts have been made to build an aircraft in which the direct lift is supplied by the thrust of an airscrew mounted in a more or less horizontal plane, this airscrew replacing the conventional wings and airscrew. The advantages claimed are a vertical ascent and descent. It is generally believed that the difficulties to be overcome are considerably greater than those presented in the conventional aeroplane and that the resulting performance would be distinctly inferior. The theoretical considerations have been dealt with by Von Kármán and Riach.

The Autogiro.—Whilst a successful solution of the helicopter is still wanting, a type of aeroplane bearing some resemblance to a helicopter has been developed in Spain by Señor Juan de la Cierva and deserves mention as being the first and only successful fundamental departure from the conventional type of aeroplane, and also as giving rise to new aspects of airscrew theory. This aircraft to which has been given the name "Autogiro" is an ordinary aeroplane with its wings replaced by four wings or blades rotating about a vertical shaft fixed at the centre of gravity of the machine. These four wings constitute in effect an airscrew of large diameter. Instead of this airscrew being driven by a power unit as in the helicopter, it is free to rotate and does so under the natural air reactions experienced by the blades when the airscrew moves through the air. It is in fact a windmill driven by a wind at small angles to the plane of rotation. The individual blades are hinged at their inner ends, so that they set themselves in a position in which the resultant of the lift and the centrifugal force passes through the axis of the hinge. The blades therefore rise and fall as they pass up wind and down wind respectively in one revolution. The effective angle of incidence to the relative wind varies therefore throughout a revolution. The net result is that the lift is concentrated at the centre of gravity of the machine without causing the rolling movement involved with a rigid airscrew. This particular and interesting application of the airscrew-windmill gives rise to new problems which are being closely investigated in Great Britain.

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Apart from the text-books which are included for convenience, only authors and papers are mentioned which are considered to contain fundamentally new developments; papers of purely expository value are omitted. For detailed references see "Propellers" in the *Smithsonian Bibliography of Aeronautics*, vol. 1 (to 1908), vol. 2 (1909–16), vol. 3 (1917–9), vol. 4 (1920–1), vol. 5 (1922).

(H. C. W.)

AIRSHIP (*see* 1.260).—Three generally accepted types of airship—non-rigid, semi-rigid and rigid—have been evolved. Each in its own particular way aims at providing a container or envelope which will meet all the conditions described below, and hitherto each type has had its structural limitation which has prevented the choice of an absolutely ideal shape. In the non-rigid and semi-rigid types, the variation of gas volume is dealt with by providing internal ballonets which are inflated with air, from a blower or scoop or valve in the nose of the ship. They swell up or deflate within the gas space, thus maintaining in the main envelope which contains the gas a constant but very small excess of pressure above that of the atmosphere. This small excess pressure with the aid of the tensile strength of the fabric serves to preserve the form of the flexible envelope against the distorting forces due to various conditions of static and dynamic loading.

Non-Rigid Type.—The non-rigid type has an envelope of rubber-proofed fabric from which one or more cars are slung by wire rigging while the stabilising and controlling planes are supported on skids directly attached to the envelope. The chief classes of non-rigid airships are:—

(1) Those with a plain envelope of circular cross section, from which the cars, etc., are suspended from special patches on the envelope. This class is exemplified in the British S.S. and small American ships.

(2) The German Parsival type, in which an envelope of circular cross section is reinforced against bending under the rigging tension by special trajectory bands disposed along lines of greatest tension in the surface of the envelope and terminating in a girdle to which the car is rigged.

(3) The French Astra Torres type, trilobe in section, with riggings led inside the envelope and divided into fans secured to points along the two top ridges. This type was developed in England during the War, and is represented in the N.S. class.

The non-rigid type was developed most successfully in Germany and France before the War, in England during the War, and latterly in the United States. It has the merit of great simplicity, and has been most successful in small sizes, say from 1,000 to 10,000 cu. metres capacity, or from 1 to 10 tons gross lift. The application of these small airships is for such purposes as coastal patrol, where ability to fly for long periods at moderate speeds is required, or for patrol or inspection at low altitudes over tracts of country unsuitable for aeroplane landing grounds. They have been successfully operated from temporary bases constituted merely by a clearing in a wood with a narrow avenue leading to open ground, this shelter proving sufficient in winds of 60 m. per hour.

Semi-Rigid Type.—The semi-rigid type has been developed chiefly in Italy. A fabric envelope divided into compartments is employed, stiffened longitudinally by a framework, usually of steel tubular construction, running along the bottom and rigidly connected to the stabilising fins at the after end. It is claimed that a given weight of metal can be more economically disposed in the form of a frame of fewer members carrying greater loads than in the form of an exceedingly slender frame completely outlining the hull such as is involved in a small rigid airship. On the other hand, particularly when mast mooring is contemplated, there is a tendency in the larger ships to extend the structure at nose and tail, and to widen the keel structure, so that the distinction between the types becomes less marked.

The range of size for which the semi-rigid type is appropriate, and particularly its upper limit, can, as yet, only be a matter of personal opinion. A ship of about 50 tons gross lift is at present being built in Italy, and will be the largest yet built of the type. The best existing semi-rigid airship is probably the Italian "N1," particulars of the performance of which are given in the table. In these two ships the arrangement of accommodation, power cars, fuel storage, etc., is similar to that of modern rigid airships. The "N1" and the Zeppelin rigid "Bodensee" are of similar size and similar in performance. These two ships are good representatives of their respective types for this particular size.

Rigid Type.—It is, however, in the large, rigid type that the unique possibilities of the airship are fully realised. Development of the rigid airship is largely the outcome of persistent effort, aided by the state, by the Zeppelin and Schütte-Lanz companies in Germany. Their results have been carefully studied by other nations, active interest being taken principally by Great Britain and the United States. Great Britain built one rigid airship in 1909, and in this and others built during the early part of the World War achieved a measure of success independent of Germany and with little knowledge of her methods. In the latter part of the War details of German design became available, and full advantage of this was taken in British ships built subsequently.

There are two assets of the airship which distinguish it essentially from heavier-than-air craft, and may be expected to ensure its continued development. For the first, fundamental principles indicate that as size is progressively increased, range and/or speed will also steadily increase, while they do not indicate any well-defined limit to such increase in size with known materials. Consequently, larger airships than have yet been built will undoubtedly give greater ranges and speeds than those hitherto realised, quite apart from improvement to be expected in design and metallurgical science. The second is the ability to remain aloft independent of motive power.

Developments.—Although the development of the airship commenced many years before that of the aeroplane, it has never been pursued with anything approaching the intensity applied to the latter. Consistent development over extended periods has taken place in only two countries, Germany and Italy. More recently Great Britain, and, to a smaller extent, the United States have contributed substantially to the sum total of progress. France took a leading part at first, but has done little in the last decade.

The small share of aeronautical effort devoted to the airship as compared with the aeroplane, is no doubt largely attributable to the relative size of individual craft of the two classes, which greatly affects the relative cost of each step in development although having no direct bearing on the cost of operation of serviceable craft. The aeroplane, promising so much, has provided since its advent an almost sufficient scope for available talent. In consequence, the airship has not hitherto realised expectations based upon current engineering knowledge to the same degree as craft heavier than air.

Lifting Power.—An airship derives its static lifting power from the fact that its gross weight is less than the weight of the effective volume of air which it displaces. A large envelope or container, to have a gross weight less than that of this volume of air, must be filled with some very light gas, or its internal space must be vacuous. The latter alternative has not been found possible, since the weight of the walls of the container would have to be very heavy to resist the large difference of pressure which would exist between the outside and the inside. The only suitable gases which exist for the inflation of an airship, in order to give it a reasonable amount of lift, are hydrogen and helium.

The gross lifting force of an airship is equal to the product of the volume occupied by the gas, and the difference between the densities of the surrounding air and of the gas. The density of pure hydrogen is 7% of that of air at the same temperature and pressure. Similarly the density of helium is 14% of that of air. Consequently, some 7% of the gross lift obtainable with hydrogen is lost by exchanging hydrogen for helium. In recent airships filled with hydrogen, about 40% of the gross lift has been available for paying load and fuel together, and as the loss of lift on substituting helium must be borne by these two items, it can be represented as a reduction of each by $\left(7\times\frac{100}{40}\right)\%$, that is, by $17\frac{1}{2}\%$.

Neither gas can be obtained or maintained quite free from air in practice, and there is a loss of available lift on this account.

The large size and necessarily light weight of the structure not only put the idea of a vacuous container out of court, but actually require that the pressure of the contained gas shall be practically equal to that of the surrounding atmosphere at all times. The temperature of the gas may, however, differ appreciably from that of the surrounding air under conditions referred to below.

Regulation of Volume.—Since the volume of a given mass of gas when the pressure and temperature vary is proportional to the ratio of its absolute temperature to its pressure, provision must be made for change in volume of the gas within the envelope when these factors vary, notably with change of altitude.

The gas does not fill the whole volume within the envelope and the required adjustment is invariably effected by admitting air to occupy the varying difference between the volume required by the gas, and the total volume of the external envelope. Mixture of this air with the gas is prevented by flexible separating surfaces whose arrangement varies with individual design. A sufficient increase of altitude must clearly result in expansion of the gas beyond the bulk of the external envelope. Gas is then irrecoverably discharged through safety valves, leaving the envelope just full of gas when the ascent ceases. During any variations of height below this limit the mass of contained gas remains constant. Its pressure is always equal to that of the surrounding air, and its temperature approximately so. Consequently, under these conditions the mass of displaced air and the lifting force also remain approximately constant, the only variation being due to difference between the temperatures of the gas and surrounding atmosphere, and a small correction for humidity. The height at which the gas would just fill the envelope is known as the "pressure height." An airship may alter its altitude below this limit substantially without change of lift; but must lose gas, and consequently lifting force, if it exceeds that height, and in this event will have, of course, a new "pressure height." These considerations are essential for an appreciation of the conditions governing the flight of an airship, yet have been seriously misstated in more than one comparatively recent work, purporting to deal authoritatively with airships.

Temperature Variations.—A difference in temperature between the gas and surrounding air often results from solar radiation, which heats up the gas just as the air in a greenhouse becomes heated. Such a difference is known as superheating. The same or the reverse effect may also be produced, at least temporarily, when flying through atmosphere of varying temperature. Again, when altitude is changed rapidly, so that the gas expands or contracts nearly adiabatically, its temperature may vary more rapidly than the usual atmospheric temperature gradient. The maximum lift obtainable at ground level by filling the ship full of gas, thus rendering the "pressure height" zero, is governed by the density of the air at ground level, and therefore varies with barometric pressure and air temperature prevailing there.

An airship commences a long flight full, or nearly full, of gas, thus realising its maximum lift. The pressure height is small in consequence. As the flight proceeds, fuel is consumed and the ship acquires excess buoyancy. To maintain static equilibrium gas is deliberately discharged. It is not, however, necessary to preserve correct static equilibrium at every moment throughout flight, since a certain departure from static equilibrium is already countered aerodynamically, as explained below.

The envelope will be subjected to the lifting forces due to the displacement of air by gas and the gravity forces due to the weight of structure, gas-bags, gondolas, machinery, fuel, etc. The aim in design is to balance these forces at every point along the ship, as nearly as possible. It will be obvious that this idea cannot be realised for every condition of loading, hence the envelope will be subjected to bending and shearing forces in a vertical plane due to what may be described as static causes.

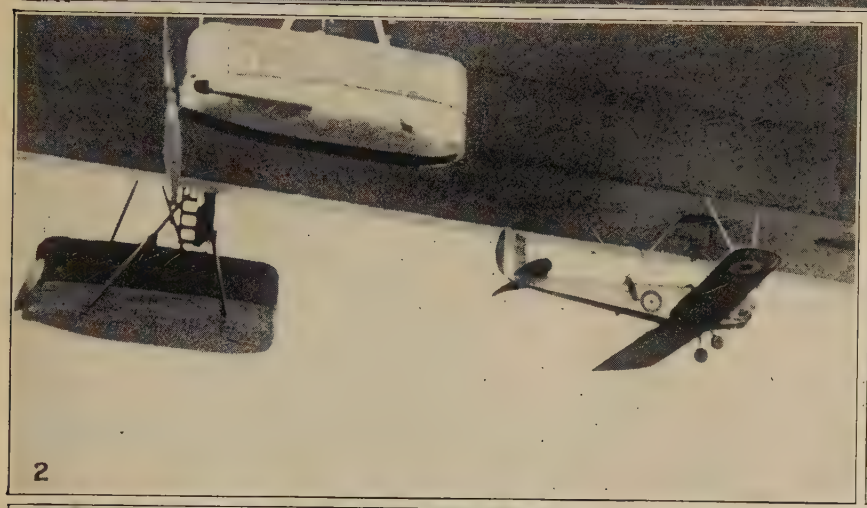
The Envelope.—The envelope must be provided with stabilising surfaces or fins which, in all modern airships, are attached to the stern. To these fins are attached hinged flaps. Those on the horizontal fins serve to incline the axis of the ship to the horizontal plane. When thus inclined the envelope acts somewhat in the same manner as the wing of an aeroplane, and in its passage through the air experiences an aerodynamic force urging it up or down, according to the direction of inclination. This is the normal method employed for alteration of altitude during flight. Moreover, if there is any lack of static balance which it may be undesirable to correct by discharge of gas or ballast, then the ship may be flown with its axis inclined, and kept on a horizontal path by means of the aerodynamic up-thrust, or down thrust. (This force may be quite large. In the case of R33, which has a gross lift of about 60 tons, the maximum possible dynamic lift is about 5 tons, *i.e.*, 8%.) This inclination, of course, reduces the forward speed.

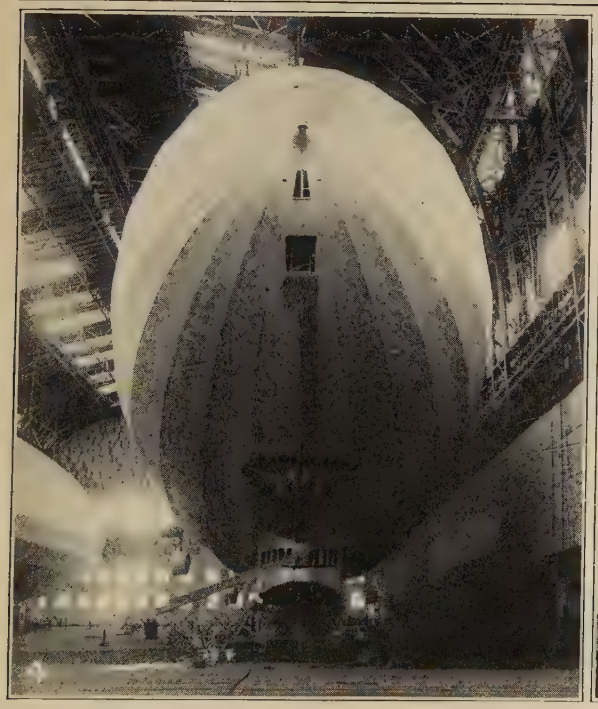
When the nose of the ship is inclined upwards, the general character of the distribution of the aerodynamic up-thrust is that of an upward force on the nose and tail of the ship, and a lesser downward force near the centre. It thus subjects the envelope to additional shearing and bending forces in the vertical plane. In a similar manner the flaps or rudders attached to the vertical fins serve for steering the airship, *i.e.*, turning her in a horizontal plane. In such a manoeuvre, the centrifugal force on the airship, acting outwards from the centre of the turning circle is balanced by a large aerodynamic force acting inwards on the forward portion, a similar one acting inwards on the tail and fins, and a small one acting outwards about the centre. The envelope is thus subjected to bending and shearing forces in the horizontal plane also.

The shape of the envelope should be such as to give the least possible resistance for its volume. The ideal appears to be a bluff nose with a curvature which decreases progressively toward the tail. The shape of the hull in early rigid airships was cylindrical, with more or less pointed ends and a ratio of length to diameter of 10 to 1, or even greater. Research on models in the wind tunnel has shown that a very much reduced resistance to motion for a given volume is offered by a fair shape conforming to certain general principles and from about four to six diameters in length. This has been borne out in practice. The cylindrical portion was progressively reduced and died hard on account of its cheaper construction, but it has disappeared completely in recent designs. The specific resistance does not vary much over the range of "fineness ratio" mentioned, and choice may be determined by considerations other than those of head resistance. At a value of seven, however, the resistance may be expected to show an appreciable increase.

Insufficient appreciation of the forces exerted by the air on the hull during various manoeuvres was reflected in the historic disaster to R38, a British-built airship which broke into two parts in the air in 1921. This accident emphasized the need for more exact determination of the loads imposed on the structure under all conditions of flight, as also of the internal stresses resulting from these loads, and led to the carrying out in England of research to fill the more important gaps in the fund of data necessary for precise design.

The present airship programme of the British Govt. includes extensive research into the distribution of aerodynamic forces and methods of determining internal stress distribution in structures such as that of rigid airship hulls.





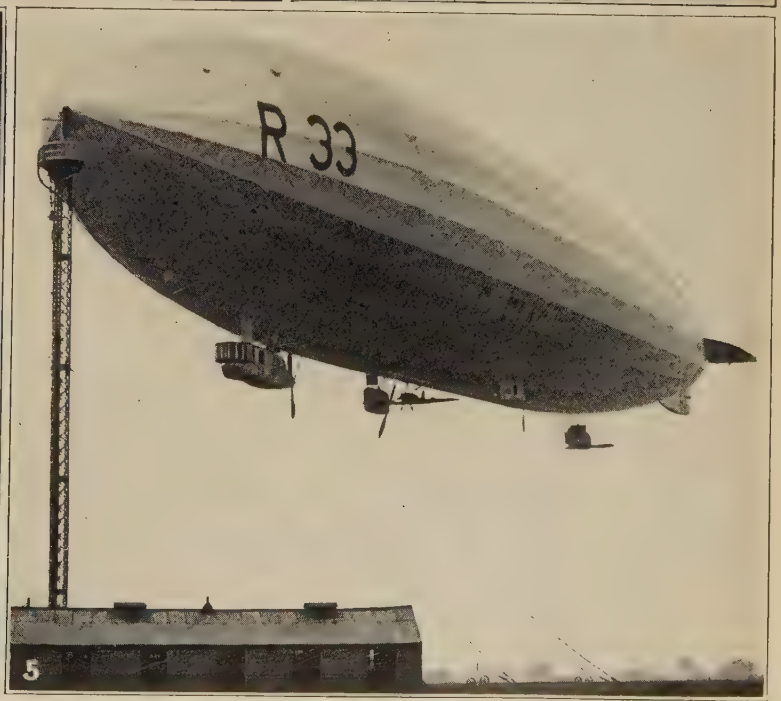


FIG. 1. British naval airship N.S.11. FIG. 2. British airship R.33 with D.H.53 light monoplane attached. FIG. 3. View of monoplane showing attaching mechanism. FIG. 4. U.S. airship "Los Angeles" in her shed at Lakehurst, N.J. FIG. 5. R.33 at mooring mast.

(Figs. 2 and 5. "Central News." Fig. 3. "Topical Press.")

The Hull.—The hull of a modern rigid airship is a stiff framework completely covered with fabric to provide a smooth exterior and it contains a number of fabric gas-bags, each free to expand or contract within the limits of its allotted space, within a wire network closing the panels in the structure, and transverse bulkheads, also of wire, which prevent axial movement when the ship is inclined. The atmosphere has free access to the interior of the hull through suitable openings in the outer cover to accommodate change of volume of the gas in the bags. Some four, five or six propulsive units are attached below the hull, each consisting of a car containing an engine driving an airscrew, to which it is coupled either directly or through reduction gearing. The several cars are so disposed that the slipstream from the propeller of each does not interfere with that of any other.

There is normally a mechanic on watch in each car, and minor repairs are possible during flight. Fuel tanks are disposed within the lower portion of the hull, where accommodation for personnel is also provided. The ship is navigated from a car which normally has the form of an excrescence on the under side of the hull. Access to the exterior of the hull at the top and at the stern is usually provided.

Zeppelin Hull.—The Zeppelin hull comprises a shell framework of duralumin lattice girders and steel wire bracing. The girders are built up of rolled sections and stamped lattice pieces, riveted together. Main longitudinal girders run from bow to stern, with polygonal transverse frames at equal intervals. The latter are normally of two types, main and intermediate, placed alternately. Of these, only the main frames are braced in their own plane by wires traversing the hull and constituting the bulkheads which locate the gas-bags axially. Other builders have followed Zeppelin practice latterly, but a departure is to be anticipated in future designs since types of girder more economical in weight are now known, and because increased sizes and loads will favour alternative arrangements of hull members.

The Gas-Bags.—The gas-bags are of light cotton fabric, lined with gold-beater's skin, for which a synthetic substitute sufficiently gas tight and of similar weight has not yet been found, although it is an object of research, and there is little doubt that one or more will be found.

The Engines.—Petrol-burning engines are used; yet conditions of service differ sufficiently from those for which aeroplane engines have been developed to render the latter in general unsuited for airship use. In a large airship, the total engine power installed is comparatively small in relation to the gross weight; whilst the initial weight of fuel per horsepower installed, or, in other words, the number of hours flown at a stretch, is relatively great. An engine is therefore required which gives high fuel economy at a power output which it can develop for many hours continuously and consistently.

A relatively heavier engine is justified to achieve this. The German Maybach is the only notable example of an engine developed for airship use. Reduction of hull resistance by improved design involves either reduced number or dimensions of propellers for equal results, or increased propeller efficiency for the same dimensions, irrespective of the power applied. These processes are mutually reactive, because the resistance and weight of the power units and propellers is such a large proportion of the whole. As a result, very great improvement in aerodynamic efficiency has been achieved with progress in design. Incidentally the power installed has increased vastly, and direct coupling of engines to airscrews, which was at first out of the question, is now practicable with the advantage of simplicity.

Performance.—Of the two chief assets of the airship cited earlier, the small airship can claim only the second. But this gives a sufficient advantage over other types of aircraft for some purposes, and although the performance is relatively low, one factor may be made good at the expense of another. That is to say, if speed is not required, the craft may remain in the air for a long time, and cover a reasonable distance when employed for purposes such as those already mentioned with reference to non-rigid airships.

The large airship has demonstrated its capacity for fast long-distance travel. ZR3 flew without stop 5,000 m. at an effective speed of 60 knots with no paying load and little margin of fuel. This implies that a distance of the order of 2,000 m. would be economically well suited to this ship, allowing for roughly equal division of available lifting capacity between fuel and paying load (to give maximum ton-mileage) after providing a reserve of fuel for emergency. It may be remarked that the same argument as to relation between extreme range possible and a commercially advantageous range applies equally to any power-driven aircraft.

ZR3 is of 2,500,000 cu. ft. capacity, or about 75 tons gross lift. The construction of airships of twice this size has now been embarked upon, and correspondingly enhanced performance is anticipated. The table gives some data for several types and sizes of ships.

Airship	Length, feet	Diameter, feet	Gas capacity, million cub. ft.	Gross lift, tons	Total disposable lift, tons	Useful lift, tons	Engines			Max. speed, knots	Extreme range in still air with *no* paying load at speeds specified	
							No.	H.P.	Total H.P.		Nautical miles	Knots
Non-Rigid S.S.Z. British, 1916	143	30·7	0·07	2·15	0·7	0·43	1	80	80	43	750 1,000	at 43 " 35
N.S. ditto	262	54	0·37	11·4	4·3	3·2	2	275	550	50	1,200 1,800	" 50 " 35
Semi-Rigid N.I.Italian, 1924	348	60	0·67	20·3	8	5·5	3	245	735	59	1,850 3,600	" 59 " 40
Mr. ditto	105	24	0·035	1·07	0·5	..	1	40	40	39	1,000	" 30
Rigid "Bodensee," German (modified), 1919	430	61·5	0·8	24·3	10	7	4	240	960	65	1,900 4,500	" 65 " 40
R33, British, 1918	640	79	1·96	60	24	15	5	250	1,250	52½	3,000 4,200	" 52 " 40
ZR3, German, 1924	656	90·5	2·48	75	42	30	5	400	2,000	68	4,300 11,000	" 68 " 40

If useful lift be divided equally between paying load and fuel, and one-third of the fuel be set aside for head winds and reserve for contingencies, ranges are reduced to one-third of the figures in the table.

The performance of an airship is adaptable to requirements. Useful lift is defined (in England) as the total available for fuel and paying (or military) load together. It may be divided between the two in any desired proportion. For reconnaissance of patrol, the whole of the useful lift is available for fuel. For commercial work, an equal division between fuel and paying load gives maximum ton-miles, and represents an ideal to be kept in view in choosing routes and intermediate stopping places. Strength and rigidity of the structure in a particular design limit the horse-power which can be safely installed. If relatively low speeds only are required, useful lift may be increased by reducing the weight of machinery.

Altitude, at the commencement of a flight, is obtainable only by sacrificing useful lift, since the maximum lift will be determined by the gas which can be contained at the desired pressure height, and is correspondingly less than that of the ship full of gas at ground level. High altitude may be a military requirement. At 20,000 ft. the gross lift has roughly half the value available at sea-level. The actual power necessary to obtain a given speed, and the aerodynamic loads which may be applied to the structure at that speed, are similarly reduced. If, therefore, full speed is only required at great height it is permissible to reduce the strength and weight of the hull, and advantageous to use a super-compressed, or better, a super-charged engine which will give the required power at the working altitude with reduced machinery weight. For commercial purposes, however, great heights are not sought. It is desirable to fly above the disturbed and "bumpy" air overland in daytime. More advantageous winds may sometimes be found by changing altitude. A reasonable height under good conditions is 2,000 feet. At the latter height the maximum lift is, in an average atmosphere, about 6% less than that available at ground level with a ship quite full of gas.

As a first approximation, the range corresponding to a given quantity of fuel is inversely proportional to the square of the speed. That is to say, the range at half speed should be four times that at full speed. This relationship is modified by the following factors, in order of importance:—

(1) Winds have relatively less effect as speed is increased.
(2) Temporary departure from static equilibrium, compensated by inclined flight, causes relatively less increase in resistance at high speeds.
(3) The overall efficiency of the propulsive machinery and airscrews falls off somewhat with decrease in speed. This effect depends considerably on design.

Economical Speed.—Were none of these factors operative, fabulous ranges would be obtained at very low speeds. All these factors, however, tend to increase the economical speed, or speed at which the range is a maximum for a given quantity of fuel, and either 1 or 2 may provide a definite lower limit to the speed. In passenger carrying it is essential to make such an average speed over the whole journey as will offer sufficient advantage over alternative means of transport, and unless the economic speed is of the same order it cannot be considered.

Generally speaking, the economical speed for a large modern airship under average conditions will lie between 25 and 40 knots, relative to the air, while a speed of the order of 60 knots is probably required for passenger service in competition with other conveyance. For reconnaissance and patrol, however, 25 to 40 knots may be very suitable, and, owing to the enormous corresponding ranges, may make the airship a very useful craft for these duties.

In estimating the fuel required for a certain journey with a particular airship it is clearly necessary to take into account:—

(1) The average wind to be expected.
(2) The speed at which it is intended to fly.
(3) The degree of uncertainty as to the average wind, and the existence or otherwise of emergency bases as determining the reserve of fuel necessary as a margin beyond estimated requirements.

These considerations show that statements of range, carrying capacity and speed of airships, as of other aircraft, can be very misleading unless relevant conditions are specified and appreciated.

Piloting and Navigation.—The distance flown in one stage by a large modern airship is such that widely differing alternative routes can be taken without material increase of mileage. This permits prevailing winds to be avoided or taken advantage of to a valuable extent and similarly enables temporary adverse winds such as those accompanying cyclonic depressions to be wholly or partially avoided, when the affected area is advised by a meteorological service or appreciated from observations on board. The careful selection of routes both before and during flight is of great importance in reducing the reserve of fuel necessary, and thereby increasing the useful load, as well as enhancing the regularity with which a time schedule may be worked to. Good meteorological information is essential to successful commercial airship operation. It is now available, and its scope is increasing apace. Flight by night presents no difficulties, but rather the reverse, owing to the absence of superheating. A striking demonstration of this, and of the safety of airship travel, is the fact that it is not unusual to make the first trial flight of a new airship by night.

Safety in flight depends upon the ability and judgment of the captain and the ability of the navigator rather than on manipulative skill. In determination of geographical position, all the usual methods are available, including astronomical observation and radio direction-finding. The restrictions as to space, position of instruments and general convenience of the navigator, which necessarily obtain in present heavier-than-air craft, do not apply to the airship.

Changes in Buoyancy.—As has already been explained, changes in buoyancy occur during flight from various causes. That due to consumption of fuel is met by discharging gas. Temporary changes of temperature either of the atmosphere or of the gas are constantly occurring during the daytime. Fortunately, the vertical aerodynamic force available by flying in a slightly inclined attitude is sufficient to deal with these temporary variations of buoyancy. The amount of inclination required, and with it the relative increase in drag due to this inclination, vary inversely as the speed. This always tends to increase the economical speed of flight.

Air Currents and Storms.—Moderate vertical air currents are experienced, usually in conjunction with changes of air temperature and particularly at moderate altitudes in hot countries. These are met in flight by inclining the ship and present no difficulty except when landing at noon or afternoon in places where such currents are prevalent. It is remarkable that such districts commonly provide particularly easy landing conditions at other times. Vertical currents of a more serious kind occur in thunderstorms and "line squalls." These can usually be avoided by the aid of visual or communicated warning. Their vertical velocity may be greater than that which an airship could counter by inclination to maintain her altitude. Also such currents may have sharply defined boundaries so that a ship would be involved and carried up or down before she could incline by means of the elevators. Again the first action of the current or gust tends to incline the ship in a sense the reverse of that desired. It is therefore important that an airship should be able to sustain without damage a rapidly impressed change of height, and hence of atmospheric pressure, which may in extreme circumstances be unavoidable. That implies chiefly—adequate openings for air entering or leaving the hull, and adequate gas safety valves in case the ship should be driven above her pressure height. The provision of these is practicable. The conditions also provide one of the most severe cases of aerodynamic loading to be taken into account in designing the hull structure.

Fire Risks.—Careful metallic bonding of every part of an airship is adopted, and has been proved to be necessary and effective in eliminating the danger of ignition of hydrogen by electric spark. This bonding prevents difference of static electric potential arising between various parts. Cases of airships having been struck by lightning without harm are on record, a necessary precaution in these circumstances being to avoid discharge of gas.

Handling on Ground and Mooring.—A large airship cannot be

taken into or out of a shed in more than a moderate wind if the wind direction be across the entrance. Since there are comparatively few favoured regions where light winds are the rule throughout the year, such a limitation on airship operation could not be accepted. A revolving shed has been built in Germany, which could always be swung round into line with the wind, but this could not be considered a satisfactory solution owing to its high cost.

The Mooring Mast.—These facts have led to the development of the mooring mast, to which the bow of a ship may be directly connected by a universally jointed coupling. Having been the subject of isolated and inconclusive experiments at various times, including trials with the first British rigid airship in 1909, the mooring mast was proved as thoroughly practicable for large rigid airships by extensive trials made in England in 1920 with R33. It was then shown that an airship can remain at a mast in strong winds, and can moor in a wind of over 30 m. per hour. These figures do not represent limits, but the maxima that were attempted. The same airship, brought again into use in 1925 after several years of inactivity, broke away from the mast in a gale. Loads are imposed on the forward portion of the hull by mast mooring, different from those which may occur in flight. R33 had not been designed for mast mooring, being an old ship impressed for the experiments of 1920, and had been equipped for these tests with a special bow cap. In the light of more recent knowledge it appears that the factor of safety conferred on the forward portion of the hull by this modification, was inadequate to deal with the lateral loads imposed on a moored airship by rapid change of velocity and direction of the wind such as may occur in stormy weather. The subsequent flight for 30 hours and eventual safe landing with an extensively damaged bow are famous, and provide evidence of the ability of an airship to proceed under control at reduced speed when seriously damaged.

The mooring mast achieves much more than the ability to land and leave in other than fair weather. It enables this to be done with about 10 men in place of a landing party of several hundred. It removes the necessity of going into the shed except as a sea-going ship goes into dry dock, since fuel and gas are piped up the mast and running repairs can be effected there. All this was demonstrated during the trials referred to, when R33 was continuously operated from the mast for several months without entering her shed. Consequently, intermediate bases on a long route need a mast alone, the cost of sheds being saved.

Landing.—An airship landing to a mast drops a length of cable from her bow which is then coupled to a cable led out through the mast-head, enabling the ship to be hauled in by a power-driven winch. The chief technical difficulty which had to be overcome in developing the method was that of rendering the final stage of hauling-in, steady. The system devised for the 1920 trials with R33 has been adopted in America and used extensively for the airship "Shenandoah." This airship was also successfully operated from a mooring mast erected on the steamship "Patoka."

Small, non-rigid airships have also been adapted for mast mooring. One of the more successful experiments in this direction took the form of a mast having a rotatable horseshoe head, to which the ship was attached at a point on each side of the envelope a little aft of the bow. The need for mast mooring is, however, not so well established in the case of small, non-rigid airships, for which other methods, such as the natural shelter, referred to earlier, are available.

Aeroplane Carrying.—The idea of an aeroplane being carried by an airship, flying from and returning to the latter at will, has long been in view as a means of combining the extreme mobility of the one craft with the long range of the other. Launching an aeroplane from an airship in flight has been achieved successfully on a number of occasions in the course of experiments conducted in several countries. In some tests in America an aeroplane made "contact" with an airship in such a way as to show that re-attachment was probably feasible although it was not actually performed. Recently in England the complete process has been carried out, a light aeroplane leaving the airship R33 in flight, being subsequently re-attached by its pilot, and properly made fast again to the airship. In this experiment the aeroplane returning to the ship attached itself to a trapeze suspended some distance below the airship. This was subsequently hauled up and the pilot of the aeroplane was able to leave his machine and enter the hull of the airship.

Future Development.—The design and construction of two airships of 5,000,000 cu. ft. capacity, or about 150 tons gross lift, has been sanctioned by the British Government. These ships are to be tried in operation between England and India via Egypt, in an endeavour to carry the development of the large airship rapidly to a stage at which it can be shouldered by commercial enterprise. In connection with the scheme, a suitable shed is being erected in England and another in India with a mooring mast in proximity to each, and an intermediate mooring mast in Egypt, which will divide the journey into two stages and enable the ship to take supplies of fuel and gas.

The risk of fire in airships, apart from military incendiary action, has always been on account of petrol rather than hydrogen, and the precaution now taken in bonding of all parts for electrical conductivity has practically eliminated the hydrogen risk, with the reservation as to military action, while the petrol danger has remained. For the two airships now being laid down, petrol has been abandoned as a fuel in favour of crude oil and kerosene, which are to be tried in the two craft respectively, the design of special engines being involved.

It is further intended to test two methods of effecting economy over the normal system of discharging gas during flight equivalent in lift to the weight of fuel consumed. One of these is the recovery of water condensed from the exhaust gases of the engines equal or nearly equal in weight to the fuel consumed. This would render the discharge of gas unnecessary. The other is the use of hydrogen as a subsidiary fuel in such proportion to kerosene as to maintain the ship in equilibrium as regards buoyancy. By thus reducing the consumption of the primary fuel, an increased paying load may be carried. Both methods have already been demonstrated to be possible. Water recovery was regularly performed on the United States airship, "Shenandoah," although with corresponding disadvantages in weight and head-resistance of apparatus, which further improvement should remove. The use of hydrogen as an auxiliary fuel has been proved on ground tests, and has been tried in the air in small airships, but not to conclusion. (*See* AERONAUTICS; FLYING.)

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AIR, THE WAR IN THE.—Airships and aeroplanes, as distinct from captive balloons, were first used in warfare by the Italian Army during the campaign against the Turkish forces in Tripoli in 1911 and 1912. With the exception of aerial combat, there being no enemy aircraft to encounter, most of the features of modern air warfare were introduced by the Italian airmen. Both aeroplanes and airships were used extensively for reconnaissance work; the Turkish positions were frequently bombed by both types of aircraft, which in some cases received damage from rifle fire and from guns trained vertically by the simple expedient of placing them on the slopes of hillsides; and enemy troops were subjected to fire from aeroplanes armed with rifles and revolvers. Extensive photographic reconnaissance flights were made by airships and the photographs obtained formed into a mosaic from which a revised general staff map of the Tripolitan area was prepared.

The World War.—In the World War the first squadrons of the British Royal Flying Corps flew from Dover to France on Aug. 13 1914. Squadrons 2 and 4 were homogeneously equipped with

B.E.2 type aeroplanes, but Squadron 3 had both Bleriot monoplanes and Henri Farman biplanes, while 5 used Farman and Avro biplanes. Though the Lewis gun had been tested in an aeroplane in 1913, the adoption of machine-guns had not been general, and indeed no provision was made for the arming of these early machines, bomb sights and bomb racks being also lacking. This was partly because their primary duty was held to be visual reconnaissance, and partly because of the narrow margin of lift available, which prohibited any addition to the load beyond the weight of the pilot and of petrol. The same consideration prevented the carrying of cameras, but valuable work was done by the early reconnaissance flights, the first of which was made on Aug. 19. On Aug. 23 the reports of the massing of German troops led directly to Gen. French's order for the retirement which saved the British Army, and timely warning was given on Sept. 4 of the commencement of Von Kluck's attempted enveloping movement against the French left, which led to the battle of the Marne.

The first approach to a fight in the air occurred on Aug. 22 1914, when a German Albatross machine appeared over the aerodrome at Maubeuge and was chased by several British machines. Two days later the first German machine to be brought down was forced to land by machines of Squadron 2. It was considered at that time that the most suitable type for aerial combats was the slow two-seater Henri Farman with propeller in the rear giving a free field of fire for the observer armed with a rifle. Before the end of 1914 it was, however, beginning to be recognised that the greater speed and manoeuvrability of the single-seater gave it advantages over the slower type. The French tried to get over the difficulty of firing forward in the tractor type, with propeller in front, by fitting metal plates on the airscrew blades to deflect the bullets, but this was found to have an adverse effect on the efficiency of the aeroplane. When the Lewis gun was adopted, the British fitted it on the top plane to fire either over, or at the side of, the tips of the airscrew blades, the trigger being operated by Bowden wire from the pilot's seat. The selection of the single-seater machine for fighting purposes necessitated the adoption of the principle, already familiar in the submarine service, of training the whole machine at the enemy aircraft with a fixed gun, in place of the free rifle of earlier days, or the swivelling gun of the two-seater.

The cessation of movement and settling down into trenches and a war of positions led to the development of aerial photography, in order that changes in the positions or sizes of enemy railheads, ammunition dumps and camps might be recorded. Early attempts at co-operation with the artillery also began, generally with the aid of coloured signal lights fired by the aeroplane to indicate the fall of shell; but as early as Sept. 15 1914 an experiment in the use of wireless telegraphy on active service was made, and on Sept. 27 the R.F.C. headquarters wireless section was formed.

Air Fighting Develops.—Air fighting and organised bombing raids developed in 1915. Early in Jan. the Germans made several raids on Dunkirk with a number of machines flying together, in place of the isolated attacks by individual machines which had hitherto been the practice. On Jan. 22, for instance, 13 machines appeared and dropped bombs on the docks. During the battle of Neuve Chapelle in March 1915, in addition to the routine work of reconnaissance and artillery co-operation, the Royal Flying Corps interfered with the enemy's movements by attacking such important points on his lines of communication as Menin, Courtrai and Douai. During the battle of Loos on Sept. 25, co-operation with the artillery was considerably improved and a system of "zone" calls introduced, by which the guns could be rapidly put on to "fleeting" targets.

The co-ordination of aeroplane bombing attacks with army operations was also further developed during this battle and attacks were made on railway lines, trains and important junctions. Early in March the R.F.C. had received the first batch of a newly designed aerial camera, from which greatly improved photographs resulted. In May the Germans produced the Fokker monoplane equipped with an interrupter gear which enabled the machine-gun to be fired through the revolving tractor screw blades, a device which took by surprise the Allied air services, which for some time to come were to continue to rely mainly upon "pusher" machines for fighting. At the beginning of 1916 the uses to which British aeroplanes were being put were reconnaissance, artillery observation and bombing with B.E.2 machines; and aerial fighting with Vickers and F.E. two-seaters, and with D.H.2 single-seater "pusher" machines and the new Bristol Scout single-seater tractor biplane with a machine-gun firing over the airscrew. The universal adoption of the tractor type for fighting was still awaiting the synchronised gear operated by the engine for firing through the airscrew, which appeared on the curiously named Sopwith "Pup," a high performance scout, in the summer of 1916. Squadrons for the definite purpose of fighting in the air were organised and a regular patrol was kept up by each squadron over its own sector of the trenches to engage and drive back the enemy's long-range reconnaissance and bombing machines.

Verdun and the Somme.—During the battle of Verdun, which opened on Feb. 21 1916, the French introduced a new and successful form of air fighting in sending their own machines into German territory to seek out the enemy machines before they reached the lines. This to a large extent enabled their own reconnaissance and artillery machines to do their work undisturbed. The Germans replied to this by developing the "circus" system, never copied by the Allies, of giving a recognised star pilot, or "ace" as the French called him, command of a special fighting squadron for which he chose his own pilots. The originator of this system was the German pilot Boelcke; another famous leader being Von Richthofen, whose "circus" would move to different parts of the line, where the needs of the moment called for it, in an effort to obtain local air supremacy. The opening of the battle of the Somme on July 1 1916 was signalised by intensive British reconnaissance and bombing flights, as well as by attacks with small 20-lb. bombs and machine-guns on the front line troops, in the trenches and billets and on transport immediately behind the lines. The same battle was also the occasion of the introduction of "contact patrol" work in an organised manner and on a large scale. This consisted in locating units of Allied forces, and keeping headquarters informed of the progress from hour to hour; reporting on the positions of the enemy, and in particular on movements of his reserves; transmitting messages signalled by the infantry from the ground to headquarters; and dropping ammunition and supplies to isolated bodies of troops.

The year 1917, and indeed the remainder of the war period, was chiefly occupied in developing and bringing to perfection the different operations in which aeroplanes had already been engaged. Fighting in formation was developed until it became a highly scientific operation in which whole squadrons and even larger formations were frequently engaged. Bombing raids were also carried out in formation on a large scale, both by "day bombers" operating from behind the lines upon reserve ammunition dumps, railheads, concentration camps and similar objectives and by twin-engined "night bombers" working from bases on the coast and far in the rear of the front line upon munition works and industrial centres in the heart of the enemy country itself. Raids of this nature had been carried out by the Germans from 1915 onwards, but it was not until 1917 that the appearance of the large Handley Page machine made retaliation possible; a development which led to the formation of the Independent Air Force on June 6 1918, for the definite purpose of bombing German munition centres. (*See* AIR RAIDS.)

In dealing with the use of aircraft with the military forces during the World War, attention has been confined to operations on the Western Front, because the work in other scenes of war was mainly on the same lines, except for such spectacular performances as the wiping out of the whole of the Turkish VII. Army on Sept. 16 1918, when it was caught in a ravine and bombed to extinction by relays of British aeroplanes. Nothing has, however, been said of the growth of the kite balloon service, which developed from two naval sections that arrived in France in

May 1915, until at the end of the War there was a row of them along the whole line of trenches co-operating with the artillery, for which work they possessed the advantage of rendering possible direct communication by telephone between the observer and the battery.

Operations by Naval Airmen.—The first naval flying operation of the World War was a patrol by Parseval Airship IV. during the night Aug. 5–6 of the approaches to the mouth of the Thames. Airships and aeroplanes patrolled the English Channel during the crossing of the Expeditionary Force to France. For the remainder of 1914 the Naval Air Service was chiefly engaged upon bombing operations with land machines from aerodromes on the coast of France upon the Zeppelin sheds at Cologne, Düsseldorf, Friedrichshafen and other points. The navy introduced the kite balloon to the British services and in March 1915 the first kite balloon section left for the Dardanelles in the "Manica," from which ship the balloon was used to good effect in spotting for the "Queen Elizabeth" and other battleships engaging the Turkish batteries and ships.

About the same time a programme of "S.S." (submarine scout) airships, for use in patrolling the Channel and approaches to the Irish Sea, was laid down. By the end of 1914 three seaplane carriers were in commission in home waters, and shortly after the New Year the "Ark Royal," soon followed by the "Ben-My-Chree," left for the Dardanelles. From the "Ben-My-Chree" were launched the seaplanes which made history in attacking and sinking surface vessels by torpedoes dropped from the air. All these vessels carried the seaplanes in their holds and hoisted them out over the side by derricks to start from the water. In July 1915, seaplanes were used on the east coast of Africa in spotting for the monitors engaged upon destroying the German light cruiser "Königsberg." On Nov. 3 1915 a Bristol scout aeroplane rose from the foredeck of the "Vindex" and thus became the forerunner of the ship aeroplanes which were subsequently developed.

The autumn of 1915 saw the production of the first "Coastal" two-engined type airship, for anti-submarine operations from stations on the east coast. During 1916 aeroplanes of the Naval Air Service were still employed in bombing aerodromes, coastal batteries, docks and also points of military importance, while in the Mediterranean regular anti-submarine and reconnaissance patrols by seaplanes and airships were instituted. In 1917 the navy introduced the Handley Page bombing machine which made it possible to extend the range of bombing attacks. In home waters a more powerful airship, in the "North Sea" class, was produced and still further increased the length of anti-submarine patrols, while airships and, to a less extent, seaplanes began to accompany for prolonged periods the convoys of merchantmen which were organised by the Admiralty. Progress was made in the development of large flying boats operating from Yarmouth and Felixstowe, which patrolled the southern part of the North Sea for submarines and Zeppelins. The principle of carrying aeroplanes in ordinary ships of the navy and flying them from platforms revolving with the gun turrets was introduced, while the torpedo-carrying seaplane was also very considerably developed during this period.

Aircraft versus Submarine.—In 1918 the German submarine campaign reached its height and anti-submarine operations were intensified. Airships accompanied the Scandinavian convoy on the greater part of its journey, while a practically constant supervision was exercised by seaplanes, aeroplanes and airships over the "east coast lane," a narrow belt of water close to the shore to which merchant ships were required to keep for their own protection in their passage up the coast. All the American convoys, both of transports and merchant ships, were regularly met at a distance of some 150 m. from the coast and escorted to port. Aircraft were, perhaps, the most potent factor in combating the submarine menace in convoy work as in reconnaissance, in co-operation with surface vessels and direct attack. Kite balloons were also installed on monitors, patrol boats and even battleships as an aid to the location of submarines.

Towards the end of the War the "Furious" appeared in its converted form as a seaplane carrier with a long flying deck on which aeroplanes could land as well as take off. An instance of the production of a special device for a specific purpose may be mentioned in the mounting of a Sopwith "camel" aeroplane on a lighter, towed behind a destroyer, for the purpose of making a surprise attack on a patrolling Zeppelin airship. At the date of the Armistice the British airship service was on the point of producing rigid airships capable of accompanying the Grand Fleet to sea as advance scouts, but the German Navy employed Zeppelins for this purpose on many occasions and throughout the War maintained a patrol of the North Sea which enabled them to receive early warning of the movements of the British Fleet. (*See* CONVOY.)

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AIR WARFARE.—This article, after an historical introduction, deals with the strategy and tactics of air warfare.

I. HISTORICAL SKETCH

Reconnaissance was, probably, the only clearly defined duty of the British Flying Corps, during the retreat from Mons, and on Sept. 13 when artillery observation by wireless telegraphy and photography from the air were carried out on the Aisne. At the battle of Festubert in May 1915 there took place the first definite attempt at contact patrol with the infantry; machines were allotted for artillery observation; bombing attacks were made on enemy railways and headquarters; and patrols were organised to prevent enemy air reconnaissance. At the battle of Loos, Sept. 25 1915, the co-operation with artillery was extended to counter battery work, and long distance reconnaissance was done as well as tactical reconnaissance.

The next development was due to the appearance of the German *Fokker*. This was a type of aeroplane specially designed for fighting, which seriously interfered with British artillery observation machines; and the practice began of allotting a fighter to an artillery machine for its protection. Later a definite offensive policy was adopted, and specialised fighting squadrons were organised.

Aircraft on the Somme.—The next milestone was the battle of the Somme in July 1916. Aerial activity on this occasion included attacks on hostile balloons, railways and infantry in trenches; artillery observation and contact patrols with the infantry were carried out. In subsequent battles, as at Arras, Messines and the third battle of Ypres, offensive patrols worked far over the German lines and even waited over their aerodromes, their object being to ensure for the attacking infantry freedom from observation and for the artillery observation machines freedom from aerial attack. There was considerable bombing of railheads, trains, dumps and living quarters, both by day and night, and the use of photography was greatly extended.

The battle that began on March 21 1918 marked an important change in air strategy. The normal search for information and the normal fighting for the maintenance of air superiority were completely abandoned in favour of intervention in the ground fighting. Throughout the Allied advance in the second half of 1918 the fighting in the upper air and the attacking of enemy aerodromes with bomb and machine-gun were resumed, as were also reconnaissance and artillery co-operation. Further, there was a great increase in the attacks on troops on the ground, on bridges and on railway stations.

Co-operation with the Navy.—The development of naval co-operation can most conveniently be considered under the headings of work with the battle fleet, commerce protection and the support of military expeditions overseas, respectively.

On the outbreak of the War several cross-Channel steamers were bought and fitted up as seaplane carriers, to work with the Harwich Force; and a Cunard liner was similarly used in the Grand Fleet. The next step in the evolution of the aircraft-carrier was the provision of ships with a flying deck forward whence aeroplanes could fly off, though they were forced to alight in the sea on their return. It was also found practicable to fly an aeroplane off a ship's turret. Finally, as the possibility of an aeroplane alighting on a deck became evident, aircraft-carriers were provided with a deck both for alighting and flying off.

At the time of the Armistice there were two large aeroplane-carriers, "Furious" and "Argus," the former carrying reconnaissance machines and the latter torpedo machines. In most light cruisers a single-seater fighter was carried, whose primary function was to attack Zeppelins. Each capital ship carried two aeroplanes either single-seater fighters or two-seaters, the former to obtain local air superiority, the latter to spot for gunfire. During the last two years of the War long reconnaissance flights, of about 400 m., were made by flying boats from Killingholme, Yarmouth and Felixstowe, over the southern part of the North Sea. The Germans made no attempt to develop aeroplanes or seaplanes for fleet work, but relied on their long range airships, which accompanied the German Fleet on nearly all its important operations, and also maintained throughout the War a very effective patrol of the Heligoland Bight.

In commerce protection aircraft played an important part. A bombing force was used to attack the submarine bases in Belgium, and a limited amount of bombing of the submarine base at Cattaro was done in the spring of 1917, but the most effective rôle of aircraft in anti-submarine warfare was convoy work. Air stations were built up first of all in the English Channel and on the east coast, and later they were extended to the Irish Sea, Mediterranean, French Coast, Newfoundland and the Gulf of St. Lawrence. Airships, flying boats, seaplanes, aeroplanes and kite balloons were all used.

In connection with the navy's function of supporting military expeditions overseas, the Dunkirk aircraft kept a very close watch on the enemy's Belgian ports, to prevent his making, by surprise, a raid in force on the cross-Channel communications of the British Army. At the Dardanelles aircraft co-operated with the ships, working both from carriers and shore bases. It was here that the first successful attacks by torpedo planes were made in Aug. 1915. Air co-operation was also provided for by the navy in East Africa in 1915, in the Red Sea in 1916, in North Russia and on the Caspian in 1919. Since the Armistice considerable progress has been made in fleet co-operation, spotting for gunfire, reconnaissance and torpedo plane work, while the development of flying boats has proceeded so that they are now capable of making cruises lasting several days.

II. STRATEGY AND TACTICS

The principles governing the strategy and tactics of air warfare can now be reviewed, and when possible, suggestions can be made how such warfare may in future develop.

Armies of the Air Force.—If small wars are fought by the air force alone, the objective is to make the enemy's life so burdensome—by material loss, by the interruption to normal life, by the moral effect—that he will sue for peace. This method of war is advantageous in that it can be used very quickly, and that provided the air base is secure, there is no line of communication to guard. Moreover, the force can be kept centralised, which is both safe and economical. However, it is often necessary to employ troops also and in this case, the first duties of the air forces may consist of direct action before the troops are in contact; then, normal co-operation with ground columns as they advance. In addition, there will be the work of watching the long line of communication, and of supplementing it by using aircraft for carrying men and supplies, and for intercommunication. Before ever force is resorted to, aeroplanes may, by demonstration or dropping propaganda over disaffected areas, prevent the spread of trouble and render further action unnecessary. So successful and economical have these methods proved, that it is likely they will be considerably used in future for the control of semi-civilised areas.

In a war to be won primarily by air action, the objective will be the same as in the small war, viz., to interrupt an enemy's national life to such an extent that he prefers to make peace. An air force differs from a fleet or an army in that it cannot adopt temporarily the defensive, and then assume the offensive at its selected time, the reason being that it is impracticable to provide an air force with an impregnable base wherein to shelter during its defensive. Therefore an air force must always be on the offensive, even if it is co-operating with a navy or an army which is temporarily on the defensive. Air fighting is subject to the same principle. On the defensive it is difficult to avoid surprise, because attack may come from any direction or angle in three dimensions. The effect of the offensive on morale is probably even more marked in air fighting than in sea or land fighting. One of the most important parts of any home defence organisation will be its offensive bombing squadrons.

Tactics of Air Fighting.—In a fighting machine the offensive is generally pursued by means of surprise. In the case of one single-seater attacking another, surprise is obtained by attacking from above and behind, since the attacked pilot does not see in this direction. But where a two-seater is attacked, other methods must be used. For instance, attack may be made from behind clouds or from such a direction that the pilot and observer attacked cannot avoid looking towards the sun; or the enemy may be induced to attack a decoy aeroplane, whereupon he himself becomes attacked from above. Fighting machines at first worked singly, later, the formations of fighters were adopted, the most usual being a V echeloned in height.

In the latter stages of the World War it became the practice for a fighter squadron to fly in three V's, the leading V being the lowest, and the rearmost V the highest. Thus the rear of a lower formation was guarded by the formation above it; in the same way that the rear of a single-seater fighter in a formation is guarded by the machine above and behind it. The attacks by fighters led to bombers in the World War flying in formation for mutual protection. A V formation was generally used. Owing to the difficulty of attacking a well handled formation of bombers, the practice of sending fighters as a close escort to bombers is to be deprecated as wasteful. Moreover, fighters which are tied to a bombing formation necessarily lose much of their greatest asset, mobility.

Naval War.—If a naval battle is fought outside the radius of action of shore-based aircraft the first air objective should be to obtain local air superiority, either by incapacitating the enemy's carriers before their aircraft have taken off, or by air fighting. If a fleet were to pass within the range of a powerful, shore-based enemy air force it would lose all power to effect surprise. Another problem is the ability of an air force to drive an enemy fleet to sea in order that it may there be defeated. If the enemy's fleet is based outside the range of shore-based aircraft, the limited effect of air raids by the machines from carriers would not suffice to do this, but if it is based within such range a reasonable measure of air superiority can be obtained, then by continuous air bombardment the fleet's base could be made untenable. Similarly, a smaller air force, though unable to maintain an offensive strong enough to drive out the fleet, could watch the base so closely that if the fleet did come out, the fact would be quickly reported.

For the defence of trade outside the radius of shore-based aircraft, each ship would have to carry an aeroplane, if the trade were dispersed. A catapult or flying-off deck would be necessary and some device to enable the aeroplane to alight on the ship. If the trade were in convoy, it might be desirable to have an aircraft-carrier with the convoy. Within the radius of shore-based aircraft, trade could be assisted and protected by patrols from coastal stations, as in the World War, but to a greater degree in view of the increasing efficiency of aircraft. In attacking trade, aircraft could be most effective if directed against enemy ports, where trade would be concentrated, and the loading

and unloading of ships would suffer interruption. At sea aircraft, outside the radius of shore-based aircraft, could be carried in and used as auxiliaries by surface raiders or submarines. Within the radius of shore-based aircraft, merchant shipping could be attacked easily and effectively.

As all arms now use aircraft for tactical co-operation, it is to be expected that simpler methods of inter-communication will be evolved. Again, as aircraft grow more powerful, the blows that are dealt from the air to the ground by bombing and shooting will become heavier. Bombing will become more accurate, and the increased range of aircraft will naturally give them greater scope. Finally, the appreciation of the offensive power of air forces will probably lead to a greater use of air power at critical times, as, for instance, to fight a rearguard action or, conversely, to turn an enemy's retreat into a rout.

Defence Against Overseas Invasion.—In these operations air power appears to be of the greatest importance. Surprise for a sea-borne land attack would be almost impossible to obtain in the face of aerial coast patrols. The patrols would give warning and the defenders would concentrate their sea, land and air forces at the point on which the attack was seen to be directed. One is led to expect an extension of this method of defence, which is obviously more economical than fixed defences distributed along a coast line. An adequate air patrol is essential. The great power of the defender's aircraft to delay or stop an attack by damaging transports, by attacking troops going ashore or by preventing supplies being sent ashore after the troops are also to be considered. Air power seems likely to favour the defender much more than the attacker.

Imperial Defence.—As regards the future use of air forces for Empire defence it should be assumed that an air striking force is normally stationed in some central position, whence air routes radiate to different parts of the Empire, and that every outlying part of the Empire that is liable to attack has a small garrison capable of holding out until the air striking force arrives. The arrival of the striking force would mean that the attacker would be unable to get that measure of air superiority which is essential nowadays for the success of any war by sea, land or air. One advantage of this strategy would be that the air striking force would arrive in a few days, whereas in the past, relief forces have taken weeks or months to reach their destination. Another advantage would be its comparative cheapness, for the striking force would be centralised, which always makes for economy, and the air routes would be maintained by commercial aviation. The underlying strategic principle is that full use is made of the mobility of air forces to bring about a rapid concentration at the decisive point. (*See* BRITISH EMPIRE: DEFENCE.)

(C. H. K. E.)

AKHENATEN.—Akhenaten, the son of his predecessor Amenophis III. and his wife Ty, came to the throne of Egypt about 1375 B.C. Not later than his sixth year the new king transferred his capital from Thebes to Tell el-Amarnah, where he built a new city called Akhetaten "Horizon of the Disk." Thither he retired with his court and gave himself up to the worship of the Aten or Disk of the Sun. This deity had already attained to the dignity of a temple in Thebes under Amenophis III., but Akhenaten raised him to still greater prominence by suppressing the worship of the old state god Amenrē'-Horus-of-the-Horizon and probably, though less vigorously that of the other Egyptian deities. The result was a monotheism, though probably not a strict one, showing an undoubted tendency to compromise with the old sun-cult of Heliopolis. Fragments of hymns to the Disk, perhaps composed by the king himself, have been found; these do not differ in any essential respect from hymns to other Egyptian gods, more particularly Amenrē', though as literary productions they stand possibly a little higher. The religion of the Disk as we see it was a contemplative worship with little or no trace of ethical content, and hardly justifies the encomiums passed upon it by some modern historians.

Akhenaten reigned at least 17 years. His wife was a woman called Nefertete, of whose origin nothing is known, but who apparently fell into disgrace toward the end of the reign. The couple had at least seven daughters, of whom the eldest died young, while two others married respectively Sakerē' and Tutankhaten (later Tutankhamun), who in turn succeeded their father-in-law on the throne. Akhenaten's new religion barely survived his death, but his neglect of home and foreign affairs had cost Egypt her empire in Syria-Palestine and reduced her internally to a state bordering on chaos.

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(T. E. P.)

AKRON, Ohio, U.S.A. (*see* 1.458), had a phenomenal growth in the decade beginning 1910, due chiefly to the demand for tires and other rubber products incidental to the expansion of the automobile industry. Its area was doubled, and the population tripled, reaching 208,435 in 1920, of whom 5,580 were negroes and 38,021 foreign born. The aggregate value of manufactured products rose from $73,158,000 in 1909 to $558,962,000 in 1919; the average number of wage-earners in the factories, from 15,831 to 65,054. This development was arrested by the general depression of 1920–1, but by 1925 it was estimated that the population had again reached the figures of 1920. The output of the factories in 1923 was valued at $406,836,922; their employees numbered 44,903.

Expenditures for health and sanitation increased from $53,231 in 1910 to $402,459 in 1923; for education, from $277,454 to $2,640,833. A new water system, begun in 1915, represented by 1924 an investment of $11,000,000. Elimination of grade crossings was begun in 1924. A new charter, which came into operation Jan. 1 1920, set up the office of city manager, but four years later his duties were transferred to a mayor elected at large. The City Planning Commission, created by the charter of 1920, secured the adoption of a zoning ordinance in 1922. The municipal University of Akron was created in 1913 by the action of the City Council in accepting the plant and endowment of Buchtel College as a nucleus, the original institution retaining its identity as Buchtel College of Liberal Arts in the university. In 1924–5 the total net enrolment reached 2,151.

ALABAMA (*see* 1.459).—In 1920 the population was 2,348,174, as against 2,138,093 in 1910, an increase of 210,081, or 9·8%. Although the proportion of urban population was greater than in 1910, yet, in spite of the marked development of mining and manufacturing interests, more than three-fourths of the inhabitants were still rural and chiefly agricultural. The urban population (inhabitants of cities of 2,500 or more) was 509,317, the rural 1,838,857. The distribution of population by race was as follows: whites, 1,447,032; negroes, 900,652.

During the decade 1910–20 the white population increased 17·8%, while the negro population decreased 0·8% due to male negro migration to northern industrial centres. The U.S. Census Bureau estimated the population of Birmingham, the leading city of the state on July 1 1925, at 205,670—an increase for the five-year period of 27,400. Other bureau estimates of the same date are: Mobile 65,955, Montgomery 46,481, Bessemer 21,975, Anniston 20,531, Gadsden 17,104 and Selma 16,987. There were 256,099 farms in 1920, against 262,901 in 1910, a decrease due to the negro migration noted above; but there was a marked increase in total production.

Industries and Transport.—Three new lines of material progress are notable: (1) the use of hydroelectric power; (2) the utilisation of the canalised rivers Warrior and Tombigby from the heart of the inland mineral district to the important port of Mobile; and (3) the building of docks, owned and controlled by the state, at Mobile. A private corporation completed two great dams across the Coosa river, and in 1925 a third was in progress. The company supplies electricity for lighting and power to the chief centres of population and industry throughout the state; and in 1925 it had undertaken the construction of a system of dams on the Tallapoosa river at Cherokee Bluffs.

The U.S. Govt. has completed the Wilson dam on the Tennessee river at Mussel Shoals.

During the closing months of 1920 the first vessel of a fleet of government-owned and operated, self-propelling barges made its way down the Mississippi river to New Orleans and into the Gulf, then to Mobile and up the rivers to Birmingham and Cordova in the heart of the Warrior coal-fields. A balanced tonnage, up and down stream, is steadily being developed by the transhipment at Mobile of manganese ore from Brazil, for use in making high-grade steel in the Birmingham district, and by the establishment of an all-water freight rate from New York and other eastern points, via Mobile, to the various river ports.

An amendment to the state constitution having authorised the use of the credit of the state for the construction of a great system of docks at Mobile, an Act of the Legislature at its session of 1923–4 authorised the issue of $10,000,000 of bonds for that purpose and a commission was put in charge of the work. The commission thereupon acquired for the state approximately 400 ac. of land, with a water frontage of two miles on the northern outskirts of the city.

The greater part of the pig-iron produced in Alabama and not used in the manufacture of steel is made into cast-iron pipe, mostly in the Birmingham district. Since 1910 there has been a remarkable development of the cement industry, due to the presence of practically inexhaustible deposits of limestone in the heart of rich coal-fields, side by side with extensive areas of shale and clay, in a territory served by adequate hydroelectric power. Alabama furnished 60% of the domestic graphite used in the World War.

Education.—The Legislature passed an Act, approved Feb. 6 1919, creating a commission of five members, appointed by the governor, to make a study of the educational system of the state with the object of determining its efficiency. The commission in turn invited the U.S. Bureau of Education to accept the task. The result was a series of Acts passed by the Legislature in 1919, constituting the school code of Alabama. Among the most important of these Acts was one providing for a state council of education to co-ordinate the efforts of the University of Alabama at Tuscaloosa, the Alabama Polytechnic Institute at Auburn and the Alabama Technical Institute and College for Women at Montevallo, by assigning to each special fields for higher education.

Taxation and Finance.—Alabama has neither state income nor state inheritance taxes, while its constitution of 1901 limits the state property tax to 0·65% upon assessed values. Under the revenue laws in force at the end of 1925 both real and personal property valuation for taxing purposes was placed at 60% of a reasonable cash value. Under an amendment to the constitution, the Legislature provided for a $25,000,000 bond issue, to be matched by a like amount from the Federal Govt. to be used in constructing highways connecting the several county seats.

History.—During the period 1916–25 the government of Alabama remained in the control of the Democratic party, with only nominal opposition by the Republican party, the educational, property and other qualifications for voters under the state constitution of 1901 having eliminated the bulk of the negro Republican voters. Only in the presidential election of 1920 were there indications of the development of a white Republican party in the state. In that election that party polled 31·9% of the vote cast, thus securing the privilege of a primary for the nomination of candidates in the next election at the expense of the state government.

Before this time factional differences in the Democratic party were fought out in the primary elections under state supervision and the general elections were merely formal ratifications of the choices made in the primaries. It was not easy to distinguish clearly between the two leading factions that developed in the dominant party, but perhaps the terms conservative and progressive sufficiently indicate the line of cleavage. The former insisted on the fullest protection to vested financial interests, and before the adoption of the Eighteenth (prohibition) Amendment to the Constitution of the United States, on a liberal policy of local option in the manufacture and sale of alcoholic beverages. The latter stood generally for strict control, by the state, of corporate capital, especially in the matter of railway rate regulation and for prohibition of the liquor traffic.

Several amendments to the state constitution of 1901 were adopted during this period, most of them dealing with matters of local interest to counties and cities. Two, however, were general in their scope: one providing for local option by counties and school districts as to increased taxation in the interest of public schools; the other authorising the issue of state bonds to the amount of $25,000,000 for the construction of a complete system of highways, thus enabling the state to secure the national appropriations in aid of that policy. At its regular session in 1919 the state Legislature refused to ratify the Nineteenth Amendment to the Constitution of the United States providing for woman suffrage; but as soon as the requisite number of states had made it a part of the Constitution, a special session of the Legislature was called (1920) which promptly passed an Act providing for the registration of women voters and for otherwise carrying into effect the provisions of the amendment.

Governors after 1910 were Braxton B. Comer (Dem.), 1907–11; Emmet O'Neal (Dem.), 1911–5; Charles Henderson (Dem.), 1915–9; Thomas E. Kilby (Dem.), 1919–22; and William W. Brandon (Dem.), 1922– (T. C. McC.)

ALAND ISLANDS: *see* AALAND ISLANDS.

ALASKA (*see* 1.472).—A territory of the United States in the northwest of North America. Area 586,400 square miles. The most important events in the history of Alaska subsequent to 1910 were: (1) the extension of surveys and investigations of resources over more than half of the total area; (2) the change in the public land policy, which no longer prohibited the utilisation of Alaska's coal, petroleum and water powers; (3) the granting of a measure of home rule to the people of Alaska; (4) the improvement of transport by the construction of a government railway from an open port on the Pacific to the navigable waters of the Tanana river, by the construction of many wagon roads, and by the installation of many lights and other aids to navigation; and (5) the great advance of the copper and salmon fishing industries and of gold mining previous to 1916. Alaska's normal development, interrupted by the World War, suffered from a period of post-War stagnation. In 1925 the country was just emerging from this depression.

Public Land Policy.—The political history of Alaska has largely centred in a struggle for more liberal land laws. In early days it had been considered best to transfer the lands to private ownership as quickly as possible, without too close a scrutiny of the means employed. This policy was completely reversed as a result of the conservation movement inaugurated under President Roosevelt. The original aim of the movement was to prevent waste of natural resources, but as this proved unpopular it gradually veered to a protest against corporate control of lands and resources. An important result of the conservation movement was the increase of reservations in Alaska, some 40,000 sq. m. being set aside for various purposes, exclusive of mineral or forest withdrawals. For many years, however, the conservation issue remained unsettled and industries languished. With an abundant supply of fuel close at hand, Alaska was forced to import coal and petroleum at great cost; her pulp wood was rotting in the forest, her water powers were undeveloped. Only gold and copper mining and salmon fishing increased. Finally, during the Wilson administration, a leasing policy for coal and oil lands and water powers was established by law. At about the same time the shortage of paper had a liberalising influence on the regulations relating to the sale of timber from the national forest.

Government.—The struggle of Alaska to attain representation in Washington, lasting nearly 40 years, resulted in 1906 in the authorisation of an elected delegate to Congress. At each biennial election which followed, home rule was the only important issue, until in 1912 an Act was passed granting a territorial government; the post of Governor remained a Presidential

appointment, and provision was made for a two-chambered Legislature. The upper chamber, or Senate, consisted of two senators from each of the four judicial districts, serving four years. Sixteen representatives formed the lower chamber, or House of Representatives, four elected for two years from each judicial district. This equal representation gave the less-populated areas of the interior an unjust preponderance in the Legislature, and in many instances worked against the best interests of the Territory as a whole.

Under the Constitutional Act, Congress expressly retained the right of repealing all laws enacted by the Alaska Legislature. Furthermore, the Territory was denied the right to enact laws relating to the excise, to game, fish, fur-bearing animals or to the existing Federal licence tax. It was provided that the capital should be at Juneau.

The first session of the Territorial Legislature was convened on March 3 1913, and the first law passed gave the franchise to women. Since that date the most important legislation has related to mining, hours of labour, workmen's compensation, banking and education. Heavy taxes were also imposed on the salmon fishing industry, and from these the Territory derived a large part of its income. In 1916 the Legislature authorised a plebiscite on the prohibition of the sale, transport and manufacture of all alcoholic beverages. The vote was in the affirmative by 7,958 to 4,431; as the Legislature had no power to change the excise law, a petition was submitted to Congress, which passed a dry law for Alaska in 1917.

Education.—The white schools are under territorial management. The Agricultural College and School of Mines at Fairbanks was opened in 1922. In 1924 there were 77 schools for whites. The education of Alaskan Indians and Eskimos was in the hands of Federal agencies, and in 1924 there were 76 Indian schools, too few, however, to accommodate the children of the natives. In addition to the government schools, there were about 36 sectarian missions for the natives.

Population.—In 1920 the population was 55,036, a decrease of 14·5% from 64,356 in 1910. The whites numbered 29,000, the Indians and Eskimos 25,000; the balance represented Mongolian and other races. Juneau, the capital and an important mining centre, was the largest town, with a population of 3,058 in 1920. The white population of Alaska steadily increased until 1915, when it exceeded 40,000. Subsequent losses were due to: (1) enrolment in military service of about 3,500 men, few of whom returned; (2) high wages in the United States; and (3) the decrease in the gold mining industry. The upward curve in population was not restored until 1924. In that year the number of people arriving in the Territory exceeded the number departing by 577. In addition to the permanent residents of Alaska, between 25,000 and 30,000 men annually visit the Territory to find employment in fishing and mining.

Mountaineering.—The mountain ranges include a number of the highest peaks on the continent. Mt. St. Elias (18,024 ft.) was ascended by the Duke of the Abruzzi in 1897. Several attempts were made to climb Mt. McKinley, the highest peak in North America, before William Taylor and Peter Anderson, prospectors, reached the summit of the north peak (20,000 ft.) in 1910, and Hudson Stuck and Harry P. Karstens the summit of the south peak (20,300 ft.) in 1912. Katmai Volcano on the Alaskan Peninsula, on the margin of the Valley of Ten Thousand Smokes, though dormant for more than a century previous, in 1912 gave forth one of the greatest eruptions in historic times.

Railways.—At the close of 1910 there were 371 m. of railway in Alaska. This mileage included 20 m. of the White Pass Railroad (narrow gauge) which ran inland from Skagway across the international boundary to White Horse in the Canadian Yukon (110 miles). While primarily serving Canadian territory, this line gave access during the open season of navigation to the settlements on the lower Yukon. The Copper River & Northwestern Railroad (standard gauge), extending from Cordova on the coast to the Chitina copper belt (196 m.), was completed in 1910. In 1912 Congress authorised a special commission to report upon the Alaska railway situation. The commission recommended the construction of two lines: one from Cordova to Fairbanks, the other from Seward to the navigable waters of the Kuskokwim. The estimated cost, $35,000,000, was appropriated by Congress in 1914, but in the following year the administration announced the selection of a railway route from Seward to Fairbanks, a far more expensive undertaking. Construction on the Alaska Railroad was begun in 1916 and finished in June 1923, at a total cost of $56,000,000.

Commerce.—In 1924 minerals, furs, fish, etc., were exported to the value of $61,015,062, and the value of imports was $32,580,057. During that year 2,802 vessels entered Alaskan ports and 2,675 vessels were cleared. Coastal Alaska was served by three regular passenger and freight steamship lines which during 1924 operated 12 steamers. A boat service was furnished on the Tanana and Yukon rivers by the Alaska Railroad.

Mining.—From its small beginning at Juneau in 1880 up to the close of 1924, Alaska mining yielded a total value of $535,000,000. Of this 98% represented gold and copper, but the mines also produced silver, platinum, palladium, tin, lead, antimony, tungsten, chromite, coal, petroleum, marble, gypsum, graphite, barite and sulphur; development work was done on deposits containing nickel, iron and molybdenite. Gold production up to the end of 1924 was worth $347,800,000, of which $234,000,000 worth was yielded by placers. After 1916 gold mining steadily declined until 1923 as a result of economic conditions attendant upon the World War. Following the completion of the Alaskan Railroad and the introduction of improved mining methods, the year 1924 showed a slight increase in production. The United States Geological Survey estimated the value of the placer gold reserves to be at least $360,000,000, in addition to the vein deposits whose value could not be estimated. Auriferous lodes have been found in many localities, but the only large lode mines are in southeastern Alaska. Copper mining began in 1901, and up to the close of 1924 had produced 456,000 tons of metallic copper valued at $167,500,000; this was largely the output of the Kennecott mines in the Chitina district. Copper ores are widely distributed, but most of the deposits are as yet inaccessible. Coal, both bituminous and anthracite, occurs in the Bering river and Matanuska fields, the latter within reach of the government railway; the territory contains an abundant supply of sub-bituminous and lignitic coals, which are very widely distributed. All Alaskan coal lands were withdrawn from entry in 1906; no development of the industry was possible, therefore, until a coal leasing law was enacted in 1913. The production up to 1925 was about 670,000 tons.

Important oil seepages have been found at five places on the Pacific seaboard, and at two places in the Naval Petroleum Reserve No. 4 on the North Arctic coast. The withdrawal of all oil lands from entry in 1911 stopped development until 1919, when an oil leasing law was passed and operations began in several localities; up to 1925 the production of petroleum had been confined to the Katalla field. About 12,700,000 oz. of silver and 7,000 tons of lead have been produced. Almost all the tin output of North America comes from Alaska, chiefly from the York district in the Seward peninsula; over 1,000 tons had been mined between 1900, when operations began, and 1925. The mining of platinum and related minerals began in 1916, and about 1,600 oz. had been produced by 1925. Quicksilver mining has been carried on in a small way for many years. In southeastern Alaska extensive deposits of high-grade marble have been quarried on a large scale.

Fisheries.—The product of this industry is greater than the sum-total of all other Alaskan products. The total value of fish marketed between 1867 and 1924 was nearly $600,000,000. In 1924 the fisheries brought in over $39,000,000, of which about $35,000,000 was for salmon. During the World War the salmon catch assumed such proportions that there was grave danger to the industry, but in 1924 Congress authorised the Secretary of Commerce to impose suitable restrictions. The halibut fisheries were also being rapidly depleted, but in 1924 Congress ratified a treaty with Canada and Great Britain for the preservation of the halibut fishery of the Northern Pacific: the value of the Alaskan

catch in 1924 was $1,619,443. The number of cod on the Alaska cod banks is enormous, but as yet they have been but little exploited. Herring are found in great abundance as far north as Bering Strait. Whale fishing, once a very important industry, has decayed.

Forest Products.—The commercial timber of Alaska is contained in the two great national forests, the Tongass in south-eastern Alaska and the Chugach on Prince William Sound. These have a total area of 21,000,000 ac., and are estimated to contain 79,000,000,000 ft. (B.M.) of timber. Extensive use is now made in local industry of this supply. Sitka spruce, which is very tough, has been exported for use in aeroplane construction. In 1925 a pulp-wood industry was being developed under the encouragement of the Forest Service.

Agriculture.—In 1924 the best developed farming area was in the neighbourhood of Fairbanks, where hardy varieties of wheat were matured and a small flour-mill operated. There is an abundance of good grazing land in the interior, but the period of winter feeding is about eight months. The Matanuska Valley has proved particularly adapted for breeding dairy cattle. The domesticated reindeer herds in 1924 numbered 350,000, valued at $8,750,000. This was the natural increase from the original 1,200 imported by the Government between 1892 and 1902. About 70% of the herd was owned by the Eskimos, for whose support the animals were first imported. After the opening of the Alaskan Railroad the export of reindeer meat became of importance.

Fur Industry.—Between 1867 and 1924 Alaska produced furs to the value of $104,000,000, of which $57,000,000 represented seal skins taken on the Pribilof Islands. Up to 1910 the Government leased the seal-catching privileges on these islands to private corporations, which killed 2,320,028 seals and paid the Government $9,474,000 in royalties. The land killing of seal was restricted, but pelagic sealing, which was becoming very destructive, could not be controlled by the American Government; a treaty was therefore signed in 1911 between the United States, Great Britain, Russia and Japan, abolishing it and providing that the United States was to pay to both Great Britain and Japan 15% of the value of the catch made on the islands. Since 1910 killing has been prohibited on the Pribilof Islands, except by Federal agents. Thanks to these provisions the seal herd increased from 215,000 in 1912 to 697,158 in 1924. The annual production of fur, other than seal, was valued at approximately $2,000,000 in 1924. Most of this was due to the rapid increase of fox-farming, more than 200 fur farms being in operation. Two companies were engaged in sheep-grazing in the Aleutian Islands.

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ALBANIA or SHQIPËRI (*see* 1.481), an independent republic on the Adriatic coast of the Balkan Peninsula, and a member of the League of Nations. Its area is 10,757 sq. m. and its population was 816,900 in 1923.

I. POLITICAL HISTORY

The Albanians, distributed in the region between the Vardar and the Adriatic Sea and between Thessaly and Montenegro, with the former Turkish vilayets of Scutari and Yannina as their ethnographic centre, formed part of the Ottoman Empire from the 15th century onwards. That domination, however, was never anything but nominal, the Albanians having had their own administration and never having paid taxes. In 1911 the Maltsori, or tribes of part of Northern Albania, revolted against Turkey, and obtained recognition of their administrative autonomy. But, in the course of the Balkan Wars, the Serbs having invaded Northern Albania and the Greeks Southern Albania, the Albanians claimed their independence at Valona on Nov. 28 1912, and the Conference of Ambassadors, meeting in London, recognised on Dec. 20 1912 the independence of Albania, the crown being offered to the Prince of Wied in Feb. 1914. On Sept. 3 1914 the Prince, besieged in his capital, Durazzo, by the insurgents, had to leave Albania.

Albania during the World War.—At the very beginning of the World War, the Greeks occupied Southern Albania and the

Italians the port of Valona. In 1915 the retreating Serbian Army passed through Albania towards the Adriatic coast, and in the spring of 1916 the Austrian Army penetrated Northern Albania as far as Berat, while the Italian troops, after Italy's entry into the War, pushed back the Greeks and took possession of Southern Albania, effecting their junction with the French Army coming from Salonika. Albania had become a battlefield.

The Country after the War.—After the Armistice, Albania was practically occupied by the Italian Army, but in Jan. 1920 a national Albanian Congress assembled at Lushna in Central Albania and nominated a provisional government, which aroused the country against the Italian occupation. Under the Treaty of Tirana, Aug. 3 1920, Italy recognised the Albanian Govt. and evacuated Albania, with the exception of the waterless island of Saseno (originally a part of the Ionian Is. ceded to Greece in 1864, and by Veniselos to Albania) commanding the roadstead of Valona. Albania was admitted a member of the League of Nations on Dec. 17 1920.

The frontiers of the new state were still in doubt. The Treaty of London (May 17 1913) between Turkey and the Balkan States had left delimitation to the Great Powers, but the Northern Epirotes refused to become Southern Albanians and proclaimed an "autonomous" government in 1914. The Corfu Conference (*see* CORFU) decided that question, but only the Albano-Greek frontier had been determined when the World War broke out. There was incessant trouble in 1920 on the Yugoslav frontier, and Yugoslav troops remained in occupation of part of the territory claimed by Albania. Both Greeks and Yugoslavs contended that the decisions of 1913 were irrelevant to post-War conditions. The proclamation of an independent "Mirdite" republic in Northern Albania in 1921 was declared by the Albanians to be the fruit of intrigues conducted from Belgrade. Albania brought up the frontier question to the Assembly of the League of Nations, which decided (Oct. 2 1921) on sending a mission of inquiry. Incursions by Yugoslav troops led to a situation so dangerous that the British Govt. took prompt action (Nov. 7 1921) asking for an immediate meeting of the Council of the League.

Before the meeting took place (Nov. 16) the Yugoslav troops were, however, withdrawn, and in the short interval the Council of Ambassadors had adopted a decision fixing the main outlines of the Albanian boundaries, and leaving the detail to a delimitation commission working on the spot. In its special session (Nov. 18) the Council of the League confirmed this proposal, with the acquiescence of Yugoslavia. The work of the commission was difficult and prolonged, and led indirectly to a serious international incident when the Italian Gen. Tellini, engaged in delimiting the Greco-Albanian frontier, was murdered on Greek territory (Aug. 27 1923). But friendly relations were established with Belgrade and eventually with Athens and Angora. In 1923, however, the Council of the League of Nations had again to intervene between Greece and Albania over a dispute arising on the protection of Albanians during the Turco-Greek exchange of populations. No less than 20,000 Albanian Moslems were said to be affected.

Internal Politics.—The first Albanian Parliament met on March 8 1921. The internal situation of Albania was excessively disturbed throughout 1921 and 1922. Governments succeeded each other in rapid succession, and on March 8 1922 Elez Yusuf, at the head of a band of rebels, established himself in Tirana, and civil war was only prevented by the friendly mediation of Sir Harry Eyres, the British minister. A period of comparative tranquillity followed, in which Ahmed Zogu maintained power almost uninterruptedly. But he was shot at and wounded in the corridors of the Parliament House on Feb. 23 1924 and a new Govt. was formed. In June, Southern Albania revolted, and Ahmed Zogu and his friends fled to Belgrade and Corfu.

The leader of the Democratic and Liberal party, Bishop Fan Noli, said to be a Greek from near Adrianople, declared that the revolution was directed against the corruptness of the late administration and the retention of feudal privileges. The Chamber was dissolved, but no new elections were held. But before the year was out an insurrection, instigated by Ahmed Zogu, broke out in Northeastern Albania. Ahmed Zogu once more entered Albania, reaching Tirana on Dec. 24. Fan Noli and his supporters fled to Italy. He declared that the Yugoslav Govt. had supported Ahmed Zogu, an accusation emphatically denied from Belgrade. Ahmed Zogu declared for a republic (Albania had been nominally under a Council of Regency) and sought the "moral assistance" of the Italian Govt. in establishing a political stability. The Constituent Assembly elected him president of the new republic for a period of seven years in Feb. 1925. The new Govt. was not at first acknowledged by Italy, but nevertheless a group of Italian financiers provided the capital for the new National Bank of Albania. On Oct. 14 the Albanian Congress ratified the delimitation of the boundary with Yugoslavia.

II. SOCIAL AND ECONOMIC CONDITIONS

According to whether they live north or south of the river Shkumbi, the Albanians are called Gegs and Tosks, the latter having attained a more advanced state of civilisation. The social organisation of Albania, with its clans and tribes, recalls that of feudal Europe. The cohesion of the Albanian family is very remarkable.

Albania is divided into nine prefectures, called after the principal centres of population:—Argyrokastron, Berat, Dibra, Durazzo, Elbasan, Koritsa (Korça), Kosovo, Scutari (Shkodra), Valona. In 1923, 562,010 of the population were Moslems; 169,000 Orthodox Greek; and 85,600 Catholic. The Moslems, who represent 69% of the population, are in the majority in all prefectures, except in that of Argyrokastron, where the majority is Orthodox, and in that of Scutari, where Catholicism is predominant. Orthodox Christians are numerous in the regions of Koritsa, Berat and Valona, while the prefectures of Dibra, Durazzo, Elbasan and Kosovo are almost entirely Moslem.

The principal towns, in order of importance, are: Koritsa, 25,598 inhabitants; Scutari, 21,580; Argyrokastron, 12,400; Tirana, the capital, 10,845; Elbasan, 10,400; Berat, 8,000; Kavaja, 6,307; Valona, 5,942; and Durazzo, 4,785.

Religion.—The Albanians are extremely tolerant in religious matters. In 1923, the Moslem Congress at Tirana broke with the Caliphate, and proclaimed the religious autonomy of Albanian Moslems. After the Congress of Berat in 1922, the Albanian Orthodox Church constituted itself an independent church, with the consent of the Patriarch of Constantinople. This church has four metropolitans, at Durazzo, Berat, Argyrokastron and Koritsa. At Scutari the Catholics have an apostolic delegate and an archbishop. The country is divided into five Catholic bishoprics.

Education.—Under the Turkish domination, which prohibited teaching in the Albanian language, the Albanians remained in ignorance. The new state has succeeded in creating public instruction of all degrees. There are now in Albania 440 primary schools; 14 continuation schools; a teachers' training college at Elbasan; a school of agriculture at Lushna; a technical school at Tirana; an Albanian college at Scutari; and a French college at Koritsa.

Finance.—Albania is economically a backward country, and the state revenues, about 20,000,000 gold francs a year, are hardly sufficient to meet the cost of administration and the still rudimentary organisation of public services. Its economic development will only be possible with the aid of foreign capital. Albania has practically no external debt.

Production.—Albania is a primitive country. Almost the whole population is engaged in agriculture and cattle-raising. Each household attempts to produce all the necessaries of life for its own purposes, including flax, wool and leather, for clothing.

Albania is a mountainous country, a great part of its area being over 3,000 ft. above sea-level, the north and south offering vast districts unfit for cultivation. But the central region, the littoral, the shores of the great lakes, together with many wide valleys and high plateaus in the mountain districts, can be cultivated. The coast region is indeed very fertile, but it is for the greater part uncultivated, and indeed uninhabited, on account of the marsh-fever arising from the undrained marshes. In Northern and Central Albania, only about one-tenth of the arable land is under crops. In the northern mountains, land is held in common by families, the pastures being the collective property of the tribes. In the centre are found the large estates of the Albanian beys. The state moreover possesses a vast stretch of land in this region. South Albania is the best cultivated region.

Albania possesses vast forests of oak, walnut, chestnut, elm and plane trees, and in the high regions forests of beech, pine and fir. These forests are almost exclusively owned by the communes and by the state. The Germans began a timber industry in the forest of Mamuras, north of Durazzo.

Mines.—The mineral wealth of Albania, thought to be considerable, is not yet exactly known, no geological survey having yet been made. The results of the investigations made by the Austrians during the War have not been published. Almost the whole strip of coastline, about 40 m. wide, shows indications of the presence of hydro-carbons. Asphalt and bitumen are worked at Selenitsa, near Valona, by a French company. During the War, the Italians used a petroleum well in the same region. Petroleum concessions were granted to the Anglo-Persian Oil Co. and to the Italian railway lines connected with the Standard Oil Company. Coal seams exist in the regions of Tepeleni, Koritsa and Tirana; and there is iron in the basin of the Fani, near Scutari, and in the Tepeleni district.

Communications.—The ports of San Giovanni di Medua, Durazzo and Valona are good natural harbours, but they have not been developed. With the exception of the Bojana, which is the outlet of the lake of Scutari to the Adriatic, there are no navigable rivers. Since the recovery of her independence Albania has begun to construct

much needed roads. In 1925 there were about 720 m. available for motor traffic. There are no railways of normal gauge, though during the War the Austrians constructed "Decauville" lines from Scutari to Durazzo, Lushna and Berat, with branches to Tirana, Elbasan and Fieri. These lines still exist for the most part, but need repair. The line from Durazzo to Tirana is used for the carriage of materials needed for the repair of that route. Early in 1925 a German-owned aeroplane service was started between Scutari, Tirana, Koritsa and Valona.

Trade.—In 1924, Albania imported textiles, cereals, sugar and coffee to the value of 20,489,000 gold francs, three-fourths of which came from Italy. Exports amounted to the value of 12,379,000 gold francs, consisting principally of olives, olive oil, skins, cheese, eggs and bitumen. The greater part of this export trade went to Italy (4,900,000 gold francs). The maritime communications consist of two Italian steamship lines.

Currency.—Albania has neither metallic nor paper money of her own. The unit is the gold franc, but payments are made in napoleons (20-franc gold pieces and 8-florin Austrian gold pieces) and in crowns (silver Austrian money). In Sept. 1925 there was formed the National Bank of Albania, with a capital of 12,500,000 gold francs, of which 51% was subscribed by an Italian group. This bank has the right to issue bank notes. (*See* LEAGUE OF NATIONS.)

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ALBANY, N.Y., U.S.A. (*see* 1.489), had a population of 113,344 in 1920, of whom 17,695 were foreign-born. Of the native-born an exceptionally high proportion (91·8%) were natives of the state. The population in 1925 was 117,820, according to the state census. The varied output of Albany's factories rose in value from $22,826,000 in 1909 to $45,455,000 in 1919, and, after a slight recession in 1921, to $53,026,337 in 1923. The deepening of the Hudson river authorised in 1925 will give a 27 ft. channel from Albany to New York City and Albany will become virtually a seaport. The railway yards under construction (1925) by the New York Central Railroad in the "capital district" at an expenditure of about $20,000,000 will be the largest in the world. The Quentin Roosevelt Memorial Aviation Field, maintained by the Chamber of Commerce on Westerlo I., is accessible to hydroplanes as well as to aeroplanes. A tract west of the state Capitol was added to the parks of the city in 1921 and was opened in 1924. A zoning ordinance was adopted in 1924. In June 1924 Albany celebrated its tercentenary in a three-day festival.

ALBERT I., King of the Belgians (1875–), was born at Brussels, April 8 1875, the younger son of Philip, Count of Flanders (1837–1905), who was a brother of Leopold II., and Princess Marie of Hohenzollern. The other children of this marriage were Baldwin (b. 1869), Henriette, afterwards Duchess of Vendôme (b. 1870), a daughter who died in infancy, and Josephine, afterwards Princess Charles of Hohenzollern (b. 1872).

The premature death of Prince Leopold, only son of Leopold II., on June 22 1869, made Prince Baldwin heir presumptive to the Belgian crown, but on his death on Jan. 23 1891, Prince Albert became next in the line of succession. He was carefully educated, and showed a marked taste for engineering and mechanics, studying both naval and aerial construction. He received his training in military matters at the École Militaire under Gen. Jungblut, and also became a thorough sportsman, taking much interest in mountaineering and later in aviation. He served as an officer in the Grenadier regiment. On Oct. 2 1900 he was married at Munich to Elisabeth (b. July 25 1876), second daughter of Duke Charles Theodore of Bavaria. Three children were born of this marriage, Leopold, duke of Brabant (b. Nov. 3 1901), Charles, count of Flanders (b. Oct. 10 1903) and Marie José (b. Aug. 4 1906).

Prince Albert also travelled widely, paying a visit to America in 1898, and in 1908 visiting England in order to study naval construction. In April 1909 he went to the Belgian Congo. This visit was of great educational value. Starting from the Cape, he visited the Cape province and the Transvaal, going from there to Elisabethville. Thence he traversed the Katanga mineral region and followed the course of the Congo to its mouth. He returned to Belgium in Aug. and three months later King Leopold died.

Albert as King.—On Dec. 1 1909 Prince Albert took the oath of fidelity to the Belgian constitution and became king under the name of Albert I. Before his accession he had evinced a genuine interest in the welfare of his people and on his own initiative had founded a training institute for fishermen and pilots. By this means he sought to develop that class of seamen indispensable to the merchant fleet which he desired his country to possess. In his speech from the throne the King emphasised his care for the people's welfare in the words: "Our prosperity depends upon the prosperity of the masses." He occupied himself more especially with the organisation of the army and in May 1913 gave his assent to the law which was designed to secure for Belgium an army of 350,000 men. He also interested himself in various social and legal reforms, while his scientific tastes did not prevent him from becoming a friend of art and literature. The economist Waxweiler, the poet Verhaeren and the painter Laermans, were on friendly terms with the royal family, the latter receiving personal attention from the Queen when he was threatened with the loss of his sight.

Albert was anxious to preserve friendly relations with neighbouring states and after 1910 paid official visits both to Berlin and Paris. On Nov. 5 and 6 1913 the King, who had been appointed honorary colonel of the regiment of Hanover Dragoons, visited Germany for the second time. At a reception in Potsdam, the Emperor William II. and Gen. von Moltke informed him that they considered war with France imminent. The King gave warning of this to the French ambassador in Berlin through his own Minister Plenipotentiary, Baron Beyens. On July 31 1914, when the European crisis came to a head, the King wrote a personal letter to the German Emperor, reminding him of the respect due to Belgian neutrality. Germany replied by the ultimatum of Aug. 2, which in turn was answered by a *fin de non recevoir* and hostilities began.

The King in the Field.—The King took command of the troops and established his headquarters first at Louvain and afterwards at Antwerp. He directed in person the first advance from Antwerp towards Louvain which was intended to relieve the French and British armies engaged with the forces of Kluck and Bulow. After the fall of Antwerp, the King and Queen sent their children to England, while they themselves accompanied the retreating army; when it came to a halt on the Yser they took up their residence at Furnes. From Oct. 17 to 24 the Belgian Army, under the King's command, withstood the German invasion without any Allied assistance. During the whole of the War he remained with the troops, having his headquarters at La Panne, where he was exposed to the risk of enemy bombardments. He made continual visits to the front-line trenches, and even surveyed the enemy's lines from an aeroplane. The Queen remained with him, acting as a nurse in the Hôpital de l'Océan at La Panne. She also interested herself deeply in the welfare of the soldiers in the trenches, and superintended the establishment of canteens and aid posts. Prince Leopold, King Albert's elder son, lived, by his father's wish, the life of a simple soldier in the 12th Regiment. The sovereigns never left Belgian territory except to visit the French troops entrenched in Champagne and the British troops before Ypres. It was only after the War had ended that the King, accompanied by the Queen, crossed the Channel in an aeroplane to visit the King and Queen of England.

When the general offensive of Oct. 1918 was undertaken, Albert was appointed commander of the northern army groups, consisting of both Belgians and French, which captured the forest of Houthulst, "the Flandernstellung," Thourout, Ostend and Bruges, and forced the passage of the Lys. On Nov. 11 1918 the King and Queen made their entry into Ghent, and on Nov. 22 into Brussels, being received with enormous enthusiasm. Even before the signing of the Armistice the King had summoned at Lophem a number of politicians, and arranged a new government containing representatives of the three more important Belgian political parties. After a triumphant reception by

Parliament, the King made a speech from the throne, in which he appealed that all parties should work together for national reconstruction, while, addressing himself to the Allies, he asked for the abolition of Belgian neutrality and of the treaties of 1839 which had left Belgium open to invasion. After the Armistice King Albert declined the augmentation of his civil list. He occupied himself actively with the improvement of conditions in his country, visiting the devastated areas, and contributing considerable sums to "King Albert's Fund," which was devoted to providing temporary shelter for sufferers from the War. He also undertook journeys to Brazil, Spain, France, the United States and England, with the object of studying trade conditions and finding new outlets for Belgian commerce. The popularity of the King and Queen, great even before the War, steadily increased, even the Socialist party taking many opportunities of expressing feelings of respect towards the royal family. In 1923 the Queen visited Morocco and in the following year Egypt. In 1925 the sovereigns took a long voyage to India. During this trip occurred the celebration of their silver wedding and on their return to Brussels large crowds assembled to give them a most enthusiastic reception.

In the matter of his children's education, the King sought to preserve the links of friendship between Belgium and her former allies. Princess Marie José was sent to Florence for the completion of her education, Prince Charles became a midshipman in the British Navy, while a French tutor was appointed to Prince Leopold, the heir to the throne. Particular care was bestowed upon Prince Leopold's education. He studied French and Flemish literature, history, law, economics and philosophy under professors chosen by the King, while Cardinal Mercier directed his studies in metaphysics and moral science. Like his father, the Prince entered the Military Academy and after two years of study was promoted sub-lieutenant of Grenadiers. He then took a year's course at the faculty of philosophy in the University of Ghent, where his studies in history came under the supervision of Prof. Pirenne. At the same time he made a regular study of foreign policy with M. Jaspar, Minister for Foreign Affairs. In 1925 the King arranged for him to make an educational tour to the Congo.

The King did not cease to interest himself in Belgian expansion and colonisation. He expressed a desire to preside in person at the Colonial Congresses of 1920 and 1926 and made important speeches on those occasions. He was actively interested in the development of the Belgian mercantile marine. As before the War, he continued to support the intellectual development of his country. After the War he made official visits to the state universities of Ghent and Liége. In Jan. 1926 King Albert, who had been given honorary degrees by many universities, was elected a member of the *Institut de France*. His solicitude for the welfare of his people was unfailing and, during the floods which ravaged Belgium in Dec. 1925, he and his Queen lost no time in succouring the distressed inhabitants of the inundated districts. (*See* BELGIUM.)

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(H. P.)

ALBERTA (*see* 1.499).—The population of the Canadian province of Alberta in 1921 was 588,454, an increase of 57·22% over 1911. The rural population amounted to 365,550 and the urban to 222,904. The principal groups were English, 180,478; Scotch, 96,062; Irish, 68,246; Scandinavian, 44,038; German, 35,333; French, 30,913; Ukrainian, 15,251; Russian, 21,212; Austrian, 19,430; Indians, 14,557. The Legislative Assembly consists of 60 members, with an executive council chosen from the Legislature. The province is represented at Ottawa by 16 Members of the House of Commons and six Senators.

Agriculture.—Agriculture is the predominant industry in the province. Southern Alberta is of true prairie character. Northern Alberta is to a large extent wooded and enjoys a greater rainfall. Land in the foothill country continues to be devoted to ranching. The wheat yield in Alberta for 1923 was 144,834,000 bu.; oats, 114,977,000; barley, 14,774,000 and rye, 7,640,000 bu. Figures for farm live stock for the same year were horses, 829,143; cattle, 1,520,924; sheep, 239,174; swine, 706,681; poultry, 6,630,163. The production of creamery butter amounted to 17,868,853 lb. The farmers of Alberta are strongly organised and have developed powerful co-operative organisations and pools to market their products.

Mining.—The coalfields of Alberta are the most extensive and valuable in Canada. Anthracite and semi-anthracite appear in relatively small deposits, but every other grade, from the best bituminous to ordinary brown coal or lignite, is found. In 1923, 6,854, 397 tons were mined. Natural gas is found at many points and is extensively used for power, fuel and light. A widespread search has been conducted for oil and the outlook is considered excellent. The tar sands of northern Alberta are a striking feature in the geological resources of the province. There are also large deposits of salt in the north.

The principal manufacturing industries are flour-milling and those associated with slaughtering and meat production and lumbering. Fur trading is still an important industry in the northern part of the province. The province is well served with railways. In recent years large shipments of grain have been made to Europe via Pacific ports and the Panama Canal. Alberta was the first province in Canada to own and operate a telephone system of its own. (*See* CANADA.) (D. A. McG.)

ALBERTINI, LUIGI (1871–), Italian journalist and politician, was born at Ancona, Oct. 19 1871, and after graduating in law took to journalism. In 1896 he joined the staff of the Milan newspaper, *Il Corriere della Sera*, and, in 1909, became editor and chief proprietor. Under his guidance *Il Corriere* became the foremost journal in Italy. In 1914 Albertini was nominated Senator and showed himself a convinced interventionist. After the War *Il Corriere* was steadily anti-Socialist, and Albertini at first sympathised with Fascismo but when the movement began to aspire to seize power by violence he opposed it. When the Black Shirt *squadre* occupied Milan they forced *Il Corriere* to suspend publication, but Mussolini afterwards revoked the suspension. In Parliament Albertini made several important speeches against the Govt. and, after the Matteotti affair, against Mussolini in particular. His paper was frequently confiscated under a decree restricting the liberty of the Press. In Nov. 1920, owing to the difficult position of *Il Corriere*, the company was dissolved, Albertini bought out and a new director appointed.

ALCOHOL (*see* 1.525).—The manufacture of alcohol for industrial purposes and as a source of power has developed greatly on both sides of the Atlantic since 1910.

I. INDUSTRIAL ALCOHOL

Large quantities of duty-free alcohol are used in Great Britain in trade under conditions laid down by statute and administered by the Commissioners of Customs and Excise. The policy of that department enables alcohol to be used in industry with the minimum of restriction, while the revenue is safeguarded against loss from the use of alcohol for drinking or making perfumes by the addition of denaturants such as crude wood naphtha, whose main constituent, methyl alcohol, is difficult to remove from ethyl alcohol even by distillation, and can be detected by several very delicate tests. In more recent times other nauseating ingredients, such as pyridine, have been added for the same purpose.

Apart from its consumption as a beverage, the largest usage in Great Britain is for domestic and industrial purposes, for which, as the circumstances warrant, the alcohol is denatured according to certain general and special formulae, or it may be pure. At present 6,000,000 bulk gallons are used for these purposes. These natures of alcohol are free from duty, but must not be employed in the preparation of an article capable of use as a beverage or internally as a medicine. In many countries it is the

custom to publish a large number of formulae for denaturing alcohol to be used for various purposes. In Great Britain, however, the published formulae are few in number, but to meet the requirements of specific industries the Board of Customs and Excise can prescribe denaturants other than the usual ones, many of these being ingredients or intermediate products connected with the process in question.

Grades Used.—The following are the specified grades of alcohol used for industrial purposes:—

Mineralised methylated spirits (1) (2) (4) (9) (11) consist of a mixture of 90 parts by volume of ethyl alcohol, 9½ parts of wood naphtha, and one half part of crude pyridine, together with ⅝ths of 1 gallon of mineral naphtha or petroleum oil and 1/40th of an ounce of methyl violet dye in each 100 gallons of the mixture.

Power methylated spirits (8) (9) (10) prepared in accordance with the following formula: 92 parts of alcohol, 5 parts of benzol, one half part of crude pyridine, and 2½ parts of wood naphtha, together with 1/40th of an ounce of Spirit Red III. dye, in each 100 gallons of the mixture, are sold free of duty and restriction when mixed with 25% of petrol, benzol, denatured ether or some other substance approved by the Commissioners of Customs and Excise.

Industrial methylated spirits (1) (2) (4) (9) (11) consisting of 95 parts by volume of alcohol and 5 parts of wood naphtha, can be obtained for the arts and manufactures under the authority of the Board of Customs and Excise, under bond and certain not very onerous restrictions.

Industrial methylated spirits (Pyridinised) (11) have the same composition as industrial methylated spirits, together with one half of one part of crude pyridine.

To none of these varieties of spirits may essential oils or flavouring matters be added without the express sanction of the Commissioners.

Industrial Uses of Alcohol

Mineralised Methylated Spirits.—Mineralised methylated spirits, which are largely used for burning in lamps and for cleaning purposes, are sold under licence but otherwise unrestricted and duty-free. The quantity used in a year is about 1,500,000 bulk gallons.

Power Methylated Spirits.—This is intended for use in admixture with petrol benzol or denatured ether and is issued for use by the public only when so mixed. Up to the present time a comparatively small quantity of this grade of alcohol has been used for motor traction.

Industrial Methylated Spirits.—The uses to which industrial methylated spirits are put are very varied; over 60, many of them under general headings, being quoted in the Report of the Commissioners (14). Out of a total of nearly 4,000,000 bulk gallons in 1925 (an increase of 25% over that of 1913), 2,500,000 went for varnishes, "finish," stains and paints. By Regulations which came into force on Feb. 1 1926, "finish," having between three and sixteen ounces of gum resin in actual solution in each gallon, when offered for sale, must be made with industrial methylated spirits (Pyridinised).

Of industrial methylated spirits 250,000 bulk gallons were used in the linoleum industry, nearly 200,000 gallons for the manufacture of ether, over 130,000 for the manufacture of celluloid and collodion, 140,000 in the manufacture of soap and 120,000 for liniments and hair washes.

Smaller quantities are employed in the following manufactures: fine chemicals (81,000); dyes (68,000); medicinal extracts (53,000); photographic plates and papers (41,000); inks and printing (32,000); disinfectants and insecticides (17,000); surgical dressings (15,000); rubber (12,000); and for the following purposes: for use in hospitals (82,000); in dyeing and cleaning and in dye-works (35,000); in chemical laboratories (13,000); in arsenals and dockyards (9,000); in colleges and schools (7,000); and for preserving museum specimens (5,000).

By the regulation of Feb. 1 1926 (11) a pharmaceutical chemist may be authorised to obtain industrial methylated spirits for sale as such or as a constituent of a lotion for external use, not capable of being used as a beverage, for medical and surgical uses other than internal, and for veterinary purposes, under certain defined conditions, involving prescriptions from qualified persons, labelling bottles for external use and limitation as to quantity. Application to use industrial methylated spirits must be made through the local surveyor to the Commissioners of Customs and Excise, who consider each case on its merits. Pure, that is, undenatured alcohol, may also be permitted duty-free by the Commissioners under the Finance Act of 1902 (3) for use in the arts and manufactures, when methylated spirits are unsuitable or detrimental.

Pure alcohol is allowed to colleges and public institutions for teaching and research purposes without any onerous conditions beyond the keeping of a stock account.

Methyl Alcohol.—Methyl alcohol when pure is liable to duty, but is permitted by the Board of Customs and Excise to be used duty-free in arts and manufactures under regulations similar to those for industrial methylated spirits, and is largely used in the manufacture of formaldehyde, of methyl derivatives among dyestuffs and fine chemicals, and for the purpose of crystallisation.

Specially denatured alcohol, also free from duty, is allowed to manufacturers under restrictions compatible with the safety of the revenue, a very wide choice of denaturants being permitted. When, as frequently happens, a suitable denaturant is found in some intermediate product, or acid used or produced during the manufacturing operations, or when the alcohol is a constituent of some mixed solvent, permission is the more readily granted for its use. Thus, the Board of Customs and Excise allow the use of pure ethyl alcohol, denatured with 2% of pure methyl alcohol, in the production of insulin, without onerous excise restrictions.

Under the Finance Act of 1921 (8) an allowance of 5d. per proof gallon, equivalent to about 8d. per bulk gallon, is made on spirits used for preparing industrial methylated spirits and power

Spirits for Non-potable Uses (bulk gallons)
United Kingdom

	1913–4	1921–2	1922–3[1]	1923–4[1]	1924–5[1]
Mineralised methylated spirits	1,754,514	1,167,344	1,273,572	1,345,144	1,402,582
Industrial methylated spirits	3,253,061	2,620,779	3,120,634	3,426,344	3,865,994
Power methylated spirits	..	14,596	87,244	171,219	108,738
Other non-dutiable:—					
For arts and manufactures	434,045	236,703	352,628	401,992	411,643
For arts and manufactures (methyl alcohol)	37,869	39,214	146,353	209,111	268,738
For scientific purposes	4,538	6,407	7,420	7,260	7,424
For scientific purposes (methyl alcohol)	190	194	436	400	381
Total	5,484,217	4,085,147	4,988,287	5,561,470	6,065,500

[1] Great Britain and Northern Ireland only.

France

	1922	1923	1924
Alcohol submitted to denaturation	12,067,946	14,843,290	17,150,012

Germany

	1919–20	1920–1	1921–2	1922–3
Delivered for industrial and other purposes	18,105,450	14,837,548	28,042,454	16,910,564

methylated spirits, or on spirits received for use in the arts and manufactures.

A rebate under the Finance Act of 1920 (5) (6) (7) (12) (13) amounting to 80% of the present duty is made in the case of duty-paid spirits used for medical purposes, such as the preparation of tinctures, etc., and for scientific purposes in chemical laboratories.

REFERENCES.—Laws. Spirits Act 1880, 43 & 44 Vict. Ch. 24, S.S. 116 to 132; Customs & Inland Revenue Act 1890, 53 & 54 Vict. Ch. 8, S. 32–34; Finance Act 1902, 2 Edw., VII., Ch. 7, S. 8; Revenue Act 1906, 6 Edw. VII., Ch. 20, S. 1 & 2; Finance Act 1915, 5 & 6 Geo. V., Ch. 62, S. 2; Finance Act 1918, 8 & 9 Geo. V., Ch. 15, S. 4; Finance Act 1920, 10 & 11 Geo. V., Ch. 18, S. 4; Finance Act 1921, 11 & 12 Geo. V., Ch. 32, S. 15–16; Finance Act 1924, 14 & 15 Geo. V., Ch. 21, S. 13; *Regulations*—The Power Methylated Spirits Regulations, 1921; Spirits (Medical Purposes) Regulations, 1924; Spirits (Scientific Purposes) Regulations, 1924; The Methylated Spirits (other than Power Methylated Spirits) Regulations, 1925; Annual Reports of Commissioners of Customs & Excise. (R. R.*)

INDUSTRIAL ALCOHOL IN THE UNITED STATES

An alcohol, from a chemical standpoint, belongs to a class of substances containing, in their molecular structure, one or more replaceable hydroxyl (OH) groups; thus, methanol (wood alcohol), butanol (butyl alcohol), glycerine, phenol (carbolic acid), etc., are all alcohols. Commercially, the term "alcohol" refers to the well-known ethyl (grain) alcohol, produced by the fermentation of the sugar or starch content of vegetable substances such as molasses, grain, cane, potatoes, fruit juices, etc.

Ethyl alcohol, next to water, is the most important and generally used solvent in industry, and is a basic material for the manufacture of a wide variety of products essential to daily life, such as artificial silk and leather, flavouring extracts, varnishes, photographic films and over 300 other products in 4,759 factories in America.

Legislation.—The principle of taxing and regulating alcoholic beverages is fundamental in all civilised countries, and this principle is applied to alcohol itself until industrial needs achieve special legislation, granting tax-free alcohol for industrial purposes. The laws and regulations of the U.S. Govt. providing for tax-free alcohol for industrial purposes were first effective in 1907. The policy of protecting these industries was further confirmed with the advent of national prohibition in the law of 1919, entitled "An Act to prohibit intoxicating beverages, and to regulate the manufacture, production, use and sale of high-proof spirits (alcohol) for other than beverage purposes, and to ensure an ample supply of alcohol and promote its use in scientific research and in the development of fuel, dye and other lawful industries."

Special Exemptions.—The United States laws exempt from tax pure alcohol used by the Federal, State and municipal governments, by educational institutions, hospitals and in scientific research. Alcohol for public distribution and for industrial uses is also tax-free when legally denatured, *i.e.*, when mixed, under Government supervision, with specified materials which shall render the alcohol, or any compound in which it is authorised to be used, unfit for use as an intoxicating beverage.

Denaturation.—Completely denatured alcohol, intended for unrestricted sale and distribution, is effected by the addition of a small quantity of such a material as wood alcohol or kerosene. Six different formulae for completely denatured alcohol are now in public use. Specially denatured alcohol, on the other hand, is designed for distribution to approved manufacturers, under regulations, protected by a bond to guarantee the faithful performance of the conditions stipulated by the Government. In such alcohol only those denaturants are used which will not materially interfere with the special manufacturing use to which the alcohol is to be put. Seventy-four formulae for specially denatured alcohol have been authorised by the Government for over 300 different uses.

The development of the great group of chemical industries based upon an abundant and cheap supply of industrial alcohol may be directly measured by the growth of the production of industrial alcohol. Since tax-free denatured alcohol for industrial uses was first made available in the United States in 1907, the steady growth of this industry, and by comparison those industries using industrial alcohol, may be illustrated by the table in first column from official sources.

Fiscal Years	Denaturing Plants	Completely Denatured	Specially Denatured
		Wine Gallons	Wine Gallons
1910	12	3,076,924·55	3,002,102·55
1915	23	5,386,646·96	8,599,821·81
1920	52	13,528,402·99	15,307,947·18
1921	67	12,392,595·02	9,996,229·90
1922	77	16,193,523·60	17,152,224·31
1923	76	27,128,229·54	30,436,913·14
1924	83	34,602,003·72	33,085,292·04
1925	91	46,983,969·88	34,824,303·28

The saccharine and starch materials used for the manufacture of industrial alcohol in the United States, and the relative proportions of each for the year ended June 30 1925, are as follows: rice, 682,690 lb.; starch, sugar and syrup, 8,107,258 lb.; miscellaneous materials, 145,071 bu.; molasses, 203,270,135 gal.; corn (maize), 7,200,818 bu.; rye, 96,793 bu.; raisins, 96,170,629 lb.

The greater portion of the molasses used in America as the raw material for industrial alcohol is imported in tank steamers from the West Indies. (M. C. W.*)

II. FUEL ALCOHOL

Whilst alcohol is applied in motor-engines in a similar manner to petrol, its vapour mixed with a proper proportion of air being drawn into the cylinder where it is compressed and ignited, it cannot be used with maximum efficiency by itself in engines such as are fitted to modern motors because it requires a higher degree of compression than petrol engines are usually designed to stand, and also because, unless special arrangements are made, a motor-engine will not start readily from the cold with alcohol alone. For these reasons alcohol has not been used to any extent in petrol motors. Mixing with benzol or petrol, or with ether in varying proportions, enables it, however, to be employed successfully in them, until such time as engines specially designed for its use are available. In the event of its production being a commercial possibility it should, therefore, form a valuable addition to the liquid-fuel resources of the world.

Miscibility.—Alcohol of the strength usually employed as a liquid fuel, viz.: 95% by volume, will mix with ether in all proportions and motor fuels consisting of alcohol and ether are in use, *e.g.*, Natalite. Alcohol will not, however, form a stable mixture with benzol or petrol under all conditions of temperature. Increased miscibility at low temperature can be obtained by the addition of a third substance, and higher alcohols, of which butyl and amyl alcohol are the best, and many other liquids, have been patented for the purpose and of these extended trials have been made.

Absolute Alcohol.—If, however, anhydrous or absolute alcohol is employed, then miscibility with petrol is obtained under all practical conditions of use. The production of absolute alcohol has been considerably developed since 1921, and several processes, for the most part using either solid or liquid dehydrating substances, have been invented and some of them have been applied on a technical scale. As a solvent it is more valuable than the ordinary industrial alcohol of 95% strength, and it is especially suitable for the manufacture of nitro-cellulose varnishes. In the years that followed the World War this was coming into use on a considerable scale.

Production Processes.—Alcohol is produced by fermentation from vegetable substances containing starch or sugar, from fermentable sugars produced by the hydrolysis of cellulosic bodies, and synthetically from calcium carbide and from the ethylene contained in coal and coke-oven gases. The vegetable substances may be divided into foodstuffs and non-foodstuffs. If foodstuffs are to be employed it must be possible to grow them in excess of food requirements, and at a cost low enough to ensure that the price of the alcohol shall be about the same as that of other liquid fuels.

Alcohol is produced from molasses in British Guiana, Canada, India, Natal, Queensland, Guatemala, the Hawaiian Is., from potatoes in Germany and Czechoslovakia, from the Mahua flower (*Bassia latifolia*) in India, from maize in Natal, and in New Zealand from waste potatoes, grain, fruit and various shrubs and roots. In Queensland cassava, sweet potatoes, arrowroot and other starch-bearing plants are used.

Research Work.—In a memorandum issued in 1925 by the Fuel Research Board of the Dept. of Scientific and Industrial Research, a British official body, the possibilities of using potatoes, mangolds and Jerusalem artichokes as raw materials for the production of alcohol for power purposes in Great Britain were discussed. Of the three materials, the Jerusalem artichoke was considered to be the most likely, since by treatment of the stalks, a pure, resistant cellulose could be obtained suitable for certain purposes.

Research work is in progress to discover a process that can be worked on a commercial basis in those regions where non-foodstuffs, or cellulosic materials, such as grasses, reeds, straws, peat, waste wood, sawdust, etc., exist in sufficient abundance.

Recent experiments on the hydrolysis of the cellulosic materials have indicated that a soaking of the material in dilute acid can be substituted for an acid hydrolysis under pressure, thus obviating the necessity of using acid-resisting autoclaves and therefore removing some of the difficulties attending the commercial application of the process. The fermentable sugars (pentosans) produced in this way, when fermented, give an alcohol-acetone liquid in the proportion of about 90% alcohol to 10% acetone, a more efficient motor fuel than alcohol alone. The yield of this liquid varies from 15 gal. to 20 gal. per ton, according to the raw material. The production of power alcohol from waste materials, which can be collected and treated at low cost, offers probably the best chance of the solution of the problem of the supply of an alternative liquid fuel for internal combustion engines.

Its manufacture from carbide is only possible where very cheap power is available, and its conversion from the quantities of ethylene removable from coal and coke-oven gas, even should a cheap process be worked out, is not likely to add very materially to the world's liquid-fuel supplies.

Foreign Countries.—Argentina has a *Carburante Nacional* composed of 50% of 98·4% alcohol, and 50% petrol by volumes. Czechoslovakia produces a composite fuel known as *Dynalcol*, a mixture of approximately 3 parts of alcohol to 4 parts of benzol, the latter obtained from the coke and gas industries. In 1923 the production of alcohol in Denmark was 4,980,000 litres; in 1924 it was 6,420,000 litres. In Feb. 1923 a law was passed in France prescribing a "Carburant National." It requires all importers of petrol, benzol, benzene, toluene and coal distillation products, either alone or mixed, in order to obtain importation licences, to purchase from the state a quantity of absolute alcohol corresponding to a minimum of 10% on the quantity of petrol, etc., imported during the preceding month. The alcohol is to be used exclusively in motor fuels. By a decree of May 31 1923, the composition of alcohol-petrol mixtures for sale must consist of not less than 95 and not more than 105 parts by volume of absolute alcohol to 100 parts by volume of hydrocarbons. The law has, however, become inoperative because users of the *Carburant National* are not satisfied with it, and it entails a considerable loss to the state.

Recovery in the alcohol industry in Germany awaits a restoration of the potato production to something like pre-War standards, when about 75% of the alcohol made was distilled from potatoes, of which 2,500,000 tons, unsuitable for other purposes, were utilised, producing an average of 77,000,000 gal. annually. The price which alcohol manufacturers may offer for potatoes is limited by the Government in the interest of conserving the potato crop for human and animal consumption. Meanwhile, the available potatoes are being supplemented by the importation of Indian corn. The national liquid fuel in Germany *Reichskraftstoff* is composed of 25% alcohol, 50% motor benzol and 25% tetralin (Tetrahydronaphthalene). In Greece industrial alcohol is made in large quantities from currants. It is used for domestic illuminating, heating and cooking, for street lighting, etc. In the Hawaiian Islands the surplus of molasses is used to some extent for the production of alcohol for domestic purposes and for use in internal-combustion engines.

In Japan there are one or two motor fuels of which alcohol is an ingredient to about 50%. There are three plants in the Philippines for the manufacture of alcohol, and two liquid fuels are produced from it. One is a mixture of alcohol and ether, the other a mixture of alcohol and petrol. The introduction of absolute alcohol will facilitate its use with petrol as in the case of the "Carburant National" in France. In Sweden a mixture of 25 parts of alcohol, obtained from sulphite lyes, and 70 parts of benzol is being sold under the name of "Bentyl" for use in motors. (F. L. N.)

ALDANOV, MARK ALEXANDROVICH (1889–), Russian novelist and publicist, also known as Landau-Aldanov, was born in Kiev Oct 26 1889. He joined the Socialists and, after the Bolsheviks, in 1917, overthrew the Kerensky Govt., left Russia for Paris, where by his writings both in French and Russian, he soon won a reputation. His most considerable work is a trilogy, *The Thinker*, of which in 1926 less than half had appeared, and in which the French Revolution is treated with learning, understanding and philosophy. He also discusses in *Armageddon* (1915) the World War, but here shows himself more elegant than precise. Studies of Tolstoi and Lenin are more thoroughly executed. Although Aldanov lacks the grand epical imagination of a Tolstoi and the wide sympathy of a Dostoievsky, he is not unworthy to be ranked as their successor. He avoids the sheer morbidity of the later Russians; he has something to say and says it well. Moreover, he brings to his treatment of the French Revolution the personal experience of a disappointed "Girondin."

ALDRICH, NELSON WILMARTH (1841–1915), American politician (*see* 1.536), died in New York April 16 1915.

ALEPPO (*see* 1.541) has an estimated population of 140,000. There is a European colony there, and the native industries, except that of carpet-making, have given place to European manufactures. The silk trade is important and the exports are mainly raw products. Railways were opened shortly before the World War to Aleppo, which is now connected with Nisibin toward Mosul and with Adana and Mersina in the west, besides the older line connecting with the one between Beirut and Damascus. Aleppo is in Syria (*q.v.*) under the French mandate (*q.v.*).

ALEXANDER (1893–1920), King of the Hellenes, second son of King Constantine and Queen Sophia, was born Aug. 1 1893 and ascended the throne of Greece on the dethronement of his father, June 14 1917. The Govt. itself was for the time in the hands of Venizelos, who had the confidence of the Allies. But the defeat of Germany, and Venizelos's diplomatic triumphs at the Peace Conference, seemed to breathe a new spirit into the young King. From the day of his triumphal entry into Adrianople, he took an active personal interest in the prospect of being the ruler of Greater Greece until his sudden death on Oct. 25 1920, by blood poisoning from the bite of a pet monkey, put a sudden end to all such expectations. In Nov. 1919 King Alexander made a morganatic marriage with an Athenian lady, Aspasia Manos; and after his death a daughter was born to her in Paris on March 25 1921. On Oct. 12 1922 the marriage was declared valid by royal decree, so that Alexander's daughter became her father's legal heir, though she did not thereby acquire any rights in respect of the throne.

ALEXANDER I., King of the Serbs, Croats and Slovenes (1888–), was born at Cetinje on Dec. 4 1888, the second son of Prince Peter Karagjorgjević, later King of Serbia, and of Zorka, third daughter of Prince Nicholas of Montenegro. His mother died in 1890, and during his early years he shared the exile of his father at Geneva. In 1899 he was sent to Leningrad (St. Petersburg), to be educated, and in 1904 entered the *corps des pages* at the Tsar's court. It was not till 1909, nearly six years after his father's election to the Serbian throne, that the young prince came to reside permanently in Serbia. Soon after his return his elder brother, Prince George, was obliged to renounce the succession (March 1909), owing to his unbalanced temperament, and various incidents that occurred during the Bosnian crisis; and Alexander was thereupon formally recognised as crown prince. On the outbreak of the Balkan War (1912) he assumed nominal command of the I. Army and won his spurs at the battle of Kumanovo, subsequently serving with distinction in the campaigns against Turkey and Bulgaria.

On June 24 1914 King Peter, whose health had completely broken down, appointed him prince regent, and he thus held the position of commander-in-chief when the World War broke out. He remained permanently at army headquarters, and shared with his soldiers all the privations of the retreat through Albania. On reaching the coast he fell ill and underwent a serious operation, but when already convalescent resolutely declined the proffered assistance of an Italian destroyer which had been sent to convey him across the Adriatic; he remained till all the refugees had been transported into safety, and eventually found his way on foot to Durazzo. After the exiled Serbian Govt. had established itself at Corfu, Prince Alexander and M. Pašić paid visits to Paris and London, where the prince was received with warm ovations. On April 5 1916, on receiving an important deputation of British sympathisers (led by the Archbishop of Canterbury, the Lord Mayor, Lord Milner and Sir Edward Carson), he publicly identified the dynasty with the cause of unity, expressing his conviction that in the final victory "our Yugoslav people, united in a single state, will have their part."

During the rest of the War he remained at Serbian headquarters and shared his army's victorious advance in Oct. 1918. On Dec. 1 delegates of the Yugoslav National Council in Zagreb formally recognised him as regent in all the Yugoslav provinces of the former dual monarchy, and he assumed the title of "Prince-Regent of the Serbs, Croats and Slovenes." The attempt made upon his life on June 29 1921, after he had taken the oath the previous day to the new Yugoslav constitution, was the outcome, not of any personal unpopularity, but of the subversive aims of the Communists and other revolutionary groups,

who hoped to create confusion in the new state, owing to the lack of a direct heir to the throne. On Aug. 16 1921 Prince Alexander succeeded his father as King of Yugoslavia. On June 8 1922 he married Marie, second daughter of King Ferdinand of Rumania, and on Sept. 6 1923 an heir was born, who received the name of Peter.

King Alexander inherited from his father a respect for constitutional and parliamentary traditions, which was conspicuously lacking in his predecessors of the Obrenović dynasty; and his influence has been repeatedly exercised behind the scenes to smoothe down the acerbities of party strife. It was very largely due to his insistence that a reconciliation was achieved between the Serbian Radicals under M. Pašić and the Croat Peasant party under M. Radić in the summer of 1925—an event which contributed greatly towards the political consolidation of Yugoslavia. (R. W. S.-W.)

ALEXANDER, SIR GEORGE (1858–1918), British actor (*see* 1.564), died at Chorley Wood, Herts, March 16 1918. He was knighted in 1911.

ALEXANDER, JOHN WHITE (1856–1915), American painter (*see* 1.564), died in New York June 1 1915. He had been president of the National Academy of Design since 1909.

ALEXANDER, WILLIAM (1824–1911), Irish prelate (*see* 1.565), died at Torquay, Eng., Sept. 12 1911.

ALEXANDRA (1844–1925), Queen Consort of Edward VII., King of Great Britain and Ireland, eldest daughter of Prince Christian of Glücksburg, afterward King Christian IX. of Denmark, and Louise, daughter of the Landgrave William of Hesse, was born at Copenhagen Dec. 1 1844, her full name being Alexandra Caroline Maria Charlotte Louisa Julia. One of her sisters married the Czar of Russia and became the mother of the Czar Nicholas II. As a child Alexandra was brought up with simplicity and early evinced a love of music and of fairy tales, being encouraged in both by her parents' friendship with Hans Andersen. She was married to Albert Edward, Prince of Wales, afterward Edward VII., March 10 1863, and was crowned with him in Westminster Abbey, Aug. 9 1902.

Her singular beauty and charm, first celebrated in Tennyson's *A Welcome to Alexandra* (1863) when she came to England as a bride, and preserved even into old age, won her immense popularity, and her progress through the streets of London on Alexandra Day, or Rose Day, a yearly event inaugurated by her in 1912 for raising funds for the London hospitals by the selling of roses in the streets, attracted annual crowds. She had earlier shown her great interest in the care of the sick by giving her name to the Queen Alexandra's Imperial Nursing Service, organised in 1902 to supply nurses for naval and military hospitals, as well as by the gift to the London Hospital in 1899 of the first Finsen lamp for light treatment of skin diseases. Her love of country life, and especially of horses and dogs, endeared her to a nation, like herself, lovers of animals. Though she took her full share in all public ceremonials, she was happiest in her country home at Sandringham. There in Dec. 1924 she kept her 80th birthday, surrounded by her children and grandchildren, and there she died Nov. 20 1925. She is buried with King Edward in St. George's Chapel, Windsor.

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ALEXANDRIA, Egypt (*see* 1.568).—The population at the 1917 census was 444,617; in 1925 it was estimated at about 480,000, including some 100,000 foreigners, of whom Greeks, Italians, Syrians and Jews were the most numerous. Between 1910 and 1925 the amenities of the city were considerably increased, largely through the activity of the municipality. A town-planning scheme was put into operation and in 1925 Lake Hadra was drained preparatory to the creation of a garden suburb. The public gardens at Nuzha, on the Mahmudieh Canal were enlarged. Harbour accommodation was increased and a breakwater to protect the quays of the eastern harbour completed in 1916. Schemes for the further increase of harbour facilities were under consideration in 1925. Some 90% of the total external trade of Egypt passes through Alexandria, including the whole of the cotton exports. A considerable share of the former passenger traffic of the port has been taken by Port Said. The main roads have been greatly improved and a service of public motor-omnibuses established in the district.

ALEXEYEV, MIKHAIL (1857–1918). Russian soldier, was born Nov. 3 1857. Entering the army in 1876, he became a general in 1904. At the outbreak of the World War he was appointed chief of the staff on the southwestern front, and in that capacity was largely responsible for the Russian victory in Galicia in 1914. In March 1915 he took over command of the armies on the northwestern front and by his energy and ability saved them from complete destruction. Appointed chief of the general staff in Aug. 1915, he had to give up this office in Nov. 1916 on account of ill-health. From March to May 1917 he commanded the army; recalled in September by Kerenski, he attempted to mediate between Kerenski and Kornilov. Failing in this, he went to south Russia and there organised the "Volunteer" army. On the death of Kornilov in March 1918, the military command of the army was taken over by Denikin and Alexeyev became leader of the Government. On Sept. 25 1918 he died of heart disease at Ekaterinodar.

ALFONSO XIII. (1886–), King of Spain (*see* 1.736), was born in Madrid May 17 1886, the posthumous son of Alfonso XII. Belonging to the House of Bourbon-Habsburg, he was baptised as Leon Fernando Maria Isidro Pascual Antonio. Born a king he was proclaimed at birth sovereign under the regency of his mother. Great care was taken to remedy the delicacy of his physique, with the result that in his sixteenth year he was hale and vigorous. His education was not neglected. He mastered thoroughly English, French, and German and acquired a fair knowledge of history and the elements of agriculture.

On coming of age in 1902 Alfonso XIII. endeavoured to get into touch with his subjects in various provinces of his realm, entered into personal relations with the representatives of science, art, and labour and sought everywhere to awaken enterprise and encourage effort. In 1905 he visited Austria, Germany, England and France. One day while driving in Paris, with the President of the French Republic, he narrowly escaped death from the bomb of an unknown criminal.

On May 31 1906 Alfonso married Ena Victoria, daughter of Princess Henry of Battenberg. On the same day a bomb was thrown at their carriage by Mateo Morral, but happily neither of the sovereigns was injured. After the birth of his eldest son Alfonso (May 10 1907), who was proclaimed Prince of the Asturias, the King renewed his travels in Spain, France and England, and at the close of the undecided African campaign of 1909 visited Melilla, where he familiarised himself with the scenes of the fighting. At the funeral of his murdered Premier, Canalejas, Alfonso XIII. fearlessly followed the coffin on foot amid a great concourse of people. In April 1913, when returning from the ceremony of the oath to the national flag in Madrid, the King was fired at three times and again he escaped unhurt. His coolness and dignified behaviour on this occasion won for him enthusiastic ovations, and the generosity that prompted him to commute the death sentence on his would-be assassin intensified his popularity without diminishing the dangers that encompassed him.

In the early days Alfonso had been singled out as the innocent symbol of an odious régime, but later he was charged with being the fomentor of a shameful system of favouritism. The Melilla campaign brought home the evils of bad government alike to the listless masses, who furnished the blood and money to carry it on, and to the officers' corps, who complained that rewards and promotion were lavished on drones while those who bore the brunt of the struggle were systematically ignored; and the monarch's popularity began to decline. By way of lessening the causes of dissatisfaction the King, after a visit to President Poincaré, announced Spain's adherence to the Franco-Anglo-Russian Entente respecting Morocco (1913) and in the same

year he strove to settle the Catalonian difficulty by adopting decentralisation and bestowing a large measure of autonomy on various provinces for administrative purposes. But the Morocco problem is perennial and the concession of home rule failed to satisfy the extremists in Catalonia, who forthwith clamoured for a degree of political independence incompatible with Spanish unity and destructive of their own economic prosperity.

Then it was that Antonio Maura (*q.v.*), having outgrown parties and factions, emerged as one of the few genuine statesmen produced by Spain in modern times. His measures of reform were root-reaching; but he was thwarted by the machinations of his adversaries, the perfidy of his partisans, and his own lack of peremptory energy and was therefore unable to enforce the restraints prescribed by the constitution. With the failure of Maura's experiment the last flicker of hope for Spain seemed extinguished. The position of the King became increasingly difficult, despite his efforts to better it. At the outbreak of the Portuguese revolution his official attitude, despite his dream of an Iberian union and the temptation to realise it, was irreproachable, and during the World War, when Spain's position was superlatively difficult, the King scrupulously discharged his manifold duties as a neutral and rendered immense services to the cause of humanity. At home he was less fortunate. The War, by depriving the Rif tribes of arms and ammunitions, had placed them at the mercy of Spain, but the parliamentarians allowed the opportunity to slip and the Moors to bleed the nation white (*see* MOROCCO, CAMPAIGN IN). He was held partly responsible for this disaster and also for the serious abuses prevalent throughout the Army and the Government.

Education was almost non-existent, the army was inefficient, the navy a fiction, justice itself was a sham and a snare, and the nation was but a shuttlecock in the hands of two parties tossed between hopeless ineptitude and insatiable greed. Discerning no hope of redress, the officers' corps, which was the only organ of remedial action in the Peninsula, drafted a reform programme and through the intermediary of the Infantry Union summoned the Govt. in June 1917 to accept it without restriction or delay. The arrest of the spokesmen only served to reveal the solidarity of the Army and the impotence of the Cabinet, and the triumph of the officers dealt a blow to parliamentary government from which it only began to recover in 1925. But before its final collapse the rulers allowed a tidal wave of syndicalist terrorism to invade Catalonia and render normal existence impossible there.

At this conjuncture Gen. Primo de Rivera (*q.v.*), aided by a group of resolute comrades and trusting in the King's official acquiescence in an accomplished fact, seized the reins of power, dismissed the Cabinet, proclaimed the Directorate, suspended the constitution, introduced censorship, and suppressed for the time syndicalism, separatism, and wholesale assassination. After two years' tenure of office he lost the support of some of his partisans and aroused the active hostility of many passive adversaries, while conspiracies were hatched in Paris, Barcelona, and Madrid, some for the purpose of assassinating the King, in June 1925, others with the object of overturning the Directorate in Nov. 1925. The King's family consists of four sons and two daughters. (E. J. Di.)

ALGERIA (*see* 1.642).—French colony in Northern Africa. Its area is 230,000 sq. m. and the population is 5,802,464.

I. POLITICAL HISTORY

Algeria during the War.—One of the first incidents of the World War was the bombardment of Bône and Philippeville by the "Goeben" and the "Breslau" (Aug. 4 1914). The Berbers of Kabylie were perhaps thought to be ready for insurrection as in 1871, and the attack was probably intended more to impress the natives than to hamper the transportation of troops from Algeria to France. German influence had been growing before the War. About 70% of the annual tourists were of German origin, and many of the large hotels were in their hands, as well as an important portion of the coal trade in Algiers. When the Turks entered the War, the propaganda against France and the Allies took more precise shape, especially in the southeast in the neighbourhood of the Senussi and also in the southwest along the Moroccan frontier, owing to the complicity of the unsubdued Atlas tribes. Tracts were distributed and anti-French songs circulated, in which the name of "El Hadj Guilioun" often recurred, but the country as a whole remained remarkably loyal.

The only notable incidents were a promptly suppressed agitation amongst a segregated tribe, the Beni-Chougran in the region of Mascara (Oct. 14), isolated outbursts of banditism on the Tunisian border and an attack by the Touareg Azdjer on the distant post of Djanet, in the neighbourhood of Rhat (April 16). The least trustworthy elements in the population were certain families of Turkish origin in the townships of Eastern Algeria (Constantine, Bougie, Djidjelli, Tebessa); and, at the other political extreme, the "Young Algerians," newly fledged modernists educated in the modernised *medresas* (religious schools) and in the lycées and universities, the North African replicas of the "Young Turks," "Young Egyptians" and their older cousins, the Indian Babus.

The mass of the natives proved to be more loyal; 30,000 of them were already enrolled in the Tirailleurs and the Spahis at the beginning of the War. Before the end 155,000 more had joined the colours, 75,000 by free enlistment and 80,000 by conscription. The total number killed was 19,000. In addition, 110,000 Algerians, largely recruited from the Kabyles, served as non-combatants in France in factories or on the land. In all, about 300,000 Algerian natives, about 6% of the population, assisted in the War. The French population in Algeria (of French stock and naturalised), which stood at 570,000 souls in 1914, provided 155,000 soldiers, of whom 18,500 paid the great price.

The colony did not give men only; it supplied food, especially wheat, sheep and wine. With the exception of 1917 the years of the War were, luckily for France, years of good crops. The season of 1918–9 even proved exceptional; it gave 13,500,000 cwt. of wheat, 13,000,000 cwt. of barley, 3,500,000 cwt. of oats, or 30,000,000 cwt. of cereals all told. From 800,000 to 900,000 sheep were bought every year for the army, which also took Algerian wool. Although certain industries, notably the iron industry and the export of early vegetables and fruit, suffered from the lack of labour and transport, the prosperity of the natives was on the whole increased. Salaries rose, produce fetched high prices, and the allowances paid to the families of enlisted natives were on the same scale as those paid to French families. Moreover, the moral ties between France and her subjects were strengthened.[1]

Political and Administrative Situation.—The only relatively important change in the administrative machinery of Algeria since 1911 has been a re-adjustment of the southern military territories which now are four in number; Ain-Sefra, Ouargla (Saharian Oases), Ghardaia (chief centre, Laghouat) and Touggourt (chief centre, Biskra). Each has at its head a military commander who has under his orders, under the authority of the Governor General, both the civil and military services. Their budget is distinct from that of Algeria proper.

No steps have been taken to create in Paris a Consultative Council, similar to the India Council in London. The tendency is, on the contrary, towards greater decentralisation; though the question of a "Ministry of Northern Africa" (Tunisia, Algeria, Morocco) is still sometimes agitated in political circles in France.

Political Rights of Natives.—The native population of Algeria was in 1921 4,971,424, of a total of 5,802,464 inhabitants, as against 4,740,000 in 1911. The Berber-speaking population is over 1,000,000, though the Berber language, of Hamitic origin, is losing ground before Arabic. But the fundamental ethnologic stock is certainly Berber. The descendants of the Arab invaders have the prestige of a literary language and of the Mahommedan religion; and the Arab "maraboutic" families, who wield great religious influence, have a Berber following. The enrichment of the Berbers, especially of the Kabyles, hard working peasants

[1] See, for instance, in the *Revue du Monde Musulman*, vol. 29, Dec. 1914, the addresses, etc., of the leading Algerian Moslems.

with traditions and customs of their own and a deep sense of equality, may have in time its political reaction. A race which includes a Terentius Afer, or, by his mother at least, a St. Augustine, and certain great caliphs in Spain, deserves its opportunity.

In the meantime a fundamental law passed by the French Parliament on Feb. 4 1919 regulates the political rights of the natives. French citizenship may be acquired by the native who makes application for it under certain conditions. The applicant must be 25 years of age, a monogamist or a bachelor; he must not have been convicted in court, must have resided for two consecutive years in the same township, and must, in addition, have one or other of a list of special qualifications, which are: having served in the French Army or Navy; reading and writing French; being landowner or farmer or proprietor of an urban building or paying the tax on traders (*patentes*); being invested with a public function or a Government pension; possessor of a French decoration or a public testimonial; being the son, of at least 21 years of age, of a naturalised native. The wife can also claim French citizenship. The fees for naturalisation are not very heavy, but the papers are complicated, and in five years the total demands were only 419, of which three-fourths were accepted by the authorities.

The reason for the small number of applications is that the Algerian native, even before the law of 1919, enjoyed, as a French subject without citizenship, a civil and political status with which, he had every reason to be satisfied. Moslem law applies fully or for the greater part according as he lives in the civil or military territories or in Kabylie. The native has representation, by different modes of votation, regulated by decrees, on all public bodies: Financial Delegations, where they make up a special Delegation, who vote the annual general budget; the Superior Government Council; *Conseils généraux*, one for each of the three *Départements;* municipal councils; municipal commissions; *djemaas*, native assemblies; the *douars*, geographical or tribal and administrative units, whether connected with the full townships (*communes de plein exercice*), or the "mixed" townships (*communes mixtes*), but independent in the Southern territories. The native members of those different public bodies have the same rights as the French members. They vote for the presidents, mayors or aldermen (*adjoints*). The special "Arab taxes" have been suppressed. The European colonists no longer enjoy any privilege, and the fiscal law is the same for all.

French Colonisation.—But the great question for France in Algeria, as in Tunis and Morocco, remains the question of French colonisation in Northern Africa. Naturalisation of the natives has played little part in this, as it is still, as we have seen, almost negligible. Twenty-five years ago there were 364,000 Frenchmen, of authentic French origin, in Algeria and the birth rate among French Algerians was high until recently. The 1921 census showed a total white population of 814,520, of whom 633,149 were French and the remainder of other European races, chiefly Spanish, Italian and Maltese. It is indisputable that the other Latin races in Algeria, more especially the people of Spanish blood in the province of Oran, have accepted without difficulty their new French nationality. Their conduct during the War was admirable. In any case it is worth noting that some of the objectors to the French naturalisation laws in North Africa themselves hold the *jus soli* as opposed to the *jus sanguinis*.

Frenchmen in Algeria are not, as some suppose, chiefly civil servants. A census taken before the War gave the number of French agriculturists, without their families, as 149,000. They were landowners, farmers, *métayers* and agricultural labourers. Foreign agriculturists numbered 74,000 only. The surface cultivated by European colonists, principally French, as we have just seen, amounted just before the War to 2,660,000 acres; the area under native cultivation was 6,257,000 acres; the total land owned by Europeans was 5,793,000 acres, on a total of about 38,000,000 acres appropriated lands in the three departments of Northern Algeria[1] under civil administration.

[1] Total surface, Northern Algeria—52,000,000 acres. Total Algeria with the military territories and the Algerian Sahara, 141,000,000 acres.

Appropriation of the Land.—A difficult problem in Algeria is precisely that of the appropriation of the land. The Government spent, from 1904 to 1920, 50,000,000 fr. for the creation of "centres of colonisation," which now number 1,000 in Northern Algeria. The land conceded, under prescribed conditions, on gratuity amounted to 132,000 acres, and the land sold to 320,000 acres. Fifty new villages were built and provided with roads, water, drainage, etc., and 140 already existing centres of French colonisation were increased. The legislation of 1902 on domanial land is on the eve of being amended. For a short time just after the War, especially in 1919 and 1920, the enriched natives were buying back the land from the French colonists, but this movement is distinctly on the wane. The natives seem to desire a simplification of the present procedure for private appropriation of the tribal lands still held in common and inalienable (*terres "arch,"* according to the native term; from 9 to 10,000,000 acres still available) but this change presents many difficulties.

Defence.—The military forces stationed in Algeria constitute the XIX. Army Corps (Metropolitan French Army). At its head is a General commanding a division who has also under his command the troops in Tunisia. A division is stationed in each of the departments of Algiers, Constantine and Oran, comprising, each, two infantry brigades and one cavalry brigade. Each infantry brigade consists of two regiments, one of natives (*Tirailleurs*) and one of Algerian Frenchmen (*Zouaves*); each cavalry brigade, also of two regiments, the *Spahis* (natives) and the *Chasseurs d'Afrique* (Frenchmen). There exist also divisional groups of artillery, of the Flying Corps (6 squadrons) and the medical, transport and commissariat services, technical sections of artillery (*ouvriers d'Artillerie*), Engineers, the *Gendarmes* (Military Police), etc. In the Southern territories, there are three special Camel Companies (*Méharistes*) stationed at Beni-Abbès, Timmimoun and In-Salah.

Algerian troops being constantly called upon to serve in France, on the Rhine or in other colonies (Morocco), it is impossible to give the exact number of troops present in the colony.

A vice-admiral, commander in chief of the maritime frontiers of Northern Africa, resides in Algiers, with the naval forces in Tunisia also under him, including the Bizerta Arsenal. There are five naval defence "sectors": Oran, Algiers, Bône, Bizerta and Sfax.

Conclusion.—The taxes have increased, but so has the national wealth. The native, except for the small, though doubtless increasing, nucleus of "Young Algerians," is peaceful and contented. Communist propaganda is limited to a few towns and is being taken in hand by the new governor, M. Viollette.

M. Viollette succeeded in 1925 to M. Theodor Steeg, who had been Governor General for four years. His immediate predecessors were M. Charles Lutaud (1911–8) and M. Abel (1919–21), with a short interim in 1918–9 when M. Jonnart, who held the post with great distinction from 1903 to 1911, acted as Governor. The policy of M. Viollette appears to be directed especially to the development of Algerian agriculture and of the medical and health services of the colonists and the natives, notably in the provision of a body of native midwives.

II. ECONOMIC HISTORY

Finance.—The special Algerian budget, which exists since 1900, is prepared by the Governor General under the control of the French Minister of the Interior. It is discussed and voted by the Financial Delegations—a tripartite body consisting of: (1) colonists; (2) taxpayers other than colonists, *i.e.*, the liberal professions, public servants, etc.; (3) natives, *i.e.*, Arabs and Kabyles—in plenary session, and afterwards by the *Conseil Supérieur*, a public body consisting of 23 high *fonctionnaires;* 16 delegates elected by the Financial Delegations; 15 members elected by the *conseils généraux;* three native *notables* and four public officers designated by the Governor-General, who, besides, can alone propose expenses for the *personnel*. The budget is approved by a decree of the President of the French Republic. The French Parliament authorises the taxes, but does not discuss the budget itself.

Just prior to the War (1913) the Algerian Revenue amounted to 252,000,000 fr., or £6,300,000. The "ordinary" receipts of the budget for 1924 were 394,894,000 fr., the "extraordinary," 141,051,000 fr., *i.e.*, a total of 535,946,000 fr., or, taking the mean exchange of 85 fr. = £6,305,253, but the transformation into sterling is deceptive. The Algerian debt amounts to 860,000,000 fr., and the charges for interest and amortisation to about 13% of the budget. The budget before the War regularly showed an excess of income over expenditure. The War deficit amounted to 372,000,000 fr., which was covered, by a law of March 30 1922, to the extent of 330,000,000, by a special loan.

Production.—The year 1924 was a bad one except for the vintage. Wheat did not give more than 494,000 metric tons, barley 450,000

tons, oats 115,000. Research is being made in the Government Agricultural Institute at Maison Carrée, near Algiers, and in different experimental farms on selected or new species of wheat. The average production on the colonists' farms is about double that on a native farm. The 1924 output was of 9,782,000 hectolitres or about one-tenth of the output in France itself. The quality improves steadily. Early vegetables and fruit growing have, as already mentioned, become an important factor, especially in the suburbs of Oran and Algiers, thanks to French, Italian, Spanish and Maltese growers. Much suitable land for both the above crops is available near the coast. The principal early vegetables are artichokes, tomatoes, French beans, green peas, early potatoes, etc. The pre-War figure was 45,000 tons. The best olive trees and nearly all the orange, citron and mandarine trees in the Blidah, Bonfarik and other districts are in the hands of French colonists, who have started of late the plantation of cotton, producing 18,000 cwt. in 1924, and the area is being increased.

French companies have undertaken well boring and the plantation of date palms to the south of Biskra. The exploitation of cork forests of the environs of Bougie and Philippeville is also in their hands. The export of alfa (esparto grass), principally in the hands of British concerns, is slowly returning to its 1913 level (109,000 tons in 1923), and there are large natural alfa tracts left on the high tablelands. The export of iron ore has begun again on a large scale, 1,775,000 tons in 1924. The splendid Ouenza deposits are at last being worked, and England remains the principal buyer. The export of lead, 45,000 tons, and that of phosphate of lime, 456,000 tons, as against 370,000 in 1913, is also increasing.

Industry.—Algerian industry is growing, already employing about 30,000 hands. Among the principal factories are flour mills, cement plants, sandal and esparto goods factories and tobacco factories. About one-half of the output of manufactured tobacco is exported. There is a rising industry in carpets, small but interesting, because it gives occupation to women.

Commerce.—Account being taken of the fall of the franc, it is interesting to note that the estimated value of Algeria's general commerce reached 5,085,000,000 fr. in 1923 (imports, 2,912,000,000; exports, 2,173,000,000).[1] The amount of the special trade, *i.e.*, goods consumed in Algeria and exports of Algerian products proper, was 4,402,000,000 fr. (imports, 2,545,000,000, exports, 1,857,000,000 in which France accounts for 2,039,000,000 fr. as seller and 1,329,000,000 fr. as buyer. The part of foreign countries is 506,000,000 fr. in the imports and 528,000,000 in the exports. In 1913, Algeria's total special commerce was of a value of 1,168,400,000 francs.

The tonnage weight of goods exported by sea amounted, in 1923, to 4,678,000 metric tons; imported, 2,235,000 tons; total, 6,913,000 tons. The ships' tonnage reached 13,285,000 tons (measurement) for all Algerian ports, Algiers heading the list and occupying the fourth place among all French ports.

Banking.—An estimate made in 1922,[2] ascribed a value of 2,547,000,000 fr. to the French North African stocks and bonds, to which Algeria brings by far the greatest contribution, though part is subscribed in France. The Banque d'Algérie (bank of issue) has a capital of 25,000,000 fr., the Compagnie Algérienne, 100,000,000, the Crédit Foncier d'Algérie et de Tunisie (mortgage bank) ,125,000,000.

Railways.—Algerian railways measured 3,715 km. in 1921; 1,820 km. are under construction or projected; 6,651,000 passengers and 4,155,000 tons of goods were transported. More than 5,000 km. of fine national roads are in working order. Thousands of foreign tourists travel over them, some in special motor cars, during the winter months, and up-to-date hotels have been built for the tourist traffic. To these roads can be added more than 30,000 km. of by-roads. Important irrigation dams are being raised in the valley of the Chelif and others are planned.

The Department of Algiers has an area of 54,540 sq. km. with 1,788,857 inhabitants; that of Constantine, 87,302 sq. km. with 2,162,512; Oran and three small "Territoires de commandement," 65,897 sq. km. with 1,305,051, and the Southern Territories (Military), 367,550 sq. km. with 546,044 inhabitants. The principal towns are Algiers, 206,595 inhabitants; Oran, 147,105; Constantine, 78,220; Bône, 45,171; Themcen, 37,000; Blidah, 35,800; Philippeville, 33,300; Bougie, 19,400; Setif, 18,500. The population in each case is for the urban district of that name and figures are those of the census of 1921.

III. EDUCATION AND CULTURE

The university at Algiers specialises more and more in Mahommedan problems, linguistic, ethnological and geographical; in Berber folklore and customs; in Mussulman law and its adaptation to modern North African conditions. The field is immense. In 1924 there were 59 native students; 23 students of law, 22 of literature and only 14 for medicine and science. The proportion is unfortunate, as there are already too many native lawyers and journalists. The Arab record of scholarship in medicine and science in the Middle Ages might well be invoked to reverse the present fashion in studies.

Primary education, which includes the teaching of French, is still in its infancy, but the number of school places is being increased as the budget permits. The total number of primary scholars in 1924 was 150,052, more than one-third of whom were natives. French and native children are allowed to attend the same schools. In the towns the proportion of French to native children is nearly 10 to 1; in certain country schools the proportion is the other way and French children form a small minority. The number of native girls attending the primary schools is increasing, as also the total number of natives in those schools since the War (gain: 14,400 since 1914). Technical instruction is provided for the natives, but more requires to be done, especially in agriculture. In the lycées and colleges there are 545 boys and 60 girls belonging to the Mahommedan population, out of a total roll of 9,391.

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ALIEN: *see* NATURALIZATION.

ALIMENTARY SYSTEM, DISEASES OF THE (*see* 1.663).—The advance in our knowledge of these diseases during the period 1910–26 may be attributed chiefly to three factors: (1) the opportunities of observation afforded by the performance of surgical operations on the abdomen—the study, as it has been termed, of "the pathology of the living"; (2) an improved X-ray technique; (3) the introduction of biochemical tests for estimating the "physiological efficiency" of important organs such as the stomach, pancreas, and liver. The information gained by these methods has rendered diagnosis of diseases of the alimentary system more precise (*see* DIAGNOSIS), but has not proportionately advanced their treatment except by surgical operation.

The Oesophagus.—In no section of the alimentary canal have the X-rays (*see* RÖNTGEN RAYS) proved of more value in diagnosis than in the oesophagus, and the indications they afford have been rendered more precise by the direct inspection of the interior of the gullet by the oesophagoscope. The commonest symptom of disease of the oesophagus is difficulty in swallowing (*dysphagia*) which results from its obstruction. This is most frequently due to cancer, which chiefly occurs in men and is generally situated at the lower end of the tube where it joins the stomach, though it may also occur at the entrance or at an intermediate point opposite the bifurcation of the trachea. Functional obstruction is much rarer and occurs at the lower end, being due either to a spasm of the muscular sphincter at the entrance to the stomach, or to a failure of the muscular ring to relax as the food passes on (so-called "*achalasia*"). However brought about, the obstruction leads eventually to "idiopathic dilatation" of the oesophagus (*oesophagectasia*). This variety of obstruction occurs in women perhaps oftener than in men and is compatible with comparatively good health. It is treated by dilatation with bougies passed through the mouth or, sometimes, by stretching the lower end of the oesophagus by means of instruments introduced through an incision in the stomach. *Diverticula* or pouches are a still rarer cause of obstruction which can be recognised by X-ray examination.

[1] The average exchange of 1923 was 75 fr. to the pound. The sterling values are not given, as they cannot be usefully compared with pre-War statistics.

[2] See Henry Blondel, *L'Intérêt de la France dans les placements coloniaux*.

The Stomach.—Cancer still remains the most serious disease of the stomach (*see* CANCER) and has increased rather than diminished in frequency in the last few years. It is commonest in men in the fifth and sixth decades of life and may be situated at the pylorus, which is the most frequent site, at the cardiac orifice (rarest), or in the body of the organ. Its early diagnosis, in time to afford a chance of cure by operation, is still a matter of difficulty, but improved X-ray technique is helping to solve the problem. The so-called " leather-bottle stomach " (*linitis plastica*) is now known to be generally due to diffuse cancerous infiltration.

Our knowledge of the next most serious disease of the stomach (gastric ulcer) has been rendered much more precise in recent years mainly by the work of the surgeons. Ulcer occurs in two forms, the acute and the chronic. Acute ulcers are usually multiple and may appear in the course of any septic infection, but when developing " idiopathically " they are most often met with in young women; chronic ulcers, on the other hand, are commoner in men of middle age, and are nearly always solitary. Acute ulcers are apt to perforate and may also cause profuse haemorrhage; chronic ulcers rarely perforate; but they, too, often bleed. The older statistics according to which " gastric ulcer " was chiefly a disease of women, were the result of including all the " acute " cases; the term as now usually employed refers to the chronic ulcer, chiefly a disease of men. The acute ulcer of young women is less often met with in recent years than it was formerly. The chief symptoms of the acute variety of ulcer are pain immediately after taking food, vomiting and, not uncommonly, haematemesis, with comparatively little disturbance of the general health. The chronic ulcer causes pain which occurs very punctually from one to two hours after meals whilst vomiting and haematemesis are less often met with. Some degrees of weakness, wasting, and anaemia are apt to be present. The symptoms of the chronic ulcer recur in bouts or attacks lasting a few weeks with long periods of more or less complete freedom from discomfort between. When the chronic ulcer is situated at the pylorus it leads to gradual occlusion of the latter with consequent dilatation of the stomach; when situated in the body of the organ it may bring about an " hour-glass " constriction. The most serious change which a chronic ulcer can undergo, however, is its conversion into a cancer. The frequency with which such a transformation occurs is disputed, but that there is a real risk of it, all surgeons are now agreed, and its possibility is one of the chief arguments for the surgical treatment of all cases of chronic ulcer. On the other hand there is no place for surgery in the treatment of the acute ulcer unless perforation has taken place. Haemorrhage from an acute ulcer is rarely fatal and is now never treated by operation; the question of operation in bleeding from a chronic ulcer is still *sub judice*, but opinion is moving in favour of it, transfusion being performed first if necessary.

Chronic ulcer of the duodenum is closely akin to chronic gastric ulcer. Over 80% of the cases are in males. As in gastric ulcer the symptoms occur in attacks lasting a few weeks and often separated by long intervals of complete freedom. Pain is the chief symptom and tends to come on when the stomach is empty and to be relieved by taking more food—hence the term " hunger pain " applied to it. Vomiting is very rare and the chief complications are perforation, which is much commoner than in chronic gastric ulcer, and haemorrhage which may lead both to vomiting of blood and its passage from the bowel (*melaena*). The ulcer is usually situated on the anterior wall of the first part of the duodenum and is apt, after it has been present for a long time, to lead to narrowing of the outlet of the stomach. On the other hand chronic duodenal ulcers—unlike gastric—never become malignant.

Gastric and duodenal ulcers are sometimes spoken of together as " peptic ulcers," and our knowledge of the pathogenesis of the peptic ulcer has advanced considerably, as the result of the work of Bolton in Great Britain and of Rosenow in America. The first stage in the development of an ulcer is the formation of a small area of necrosis in the mucosa in consequence of the lodgment in it of pathogenic streptococci. These organisms appear to reach the stomach or duodenum by the blood stream, either being swallowed or entering the blood from a focus of sepsis in the teeth, tonsils, appendix, gall-bladder, or some other source. According to Rosenow, the ulcer-forming organisms exhibit an " elective " affinity for the gastric mucous membrane whilst others may show a similar affinity for, say, the gall-bladder. Be this as it may, the result of the formation of an area of necrosis in the mucous membrane is that auto-digestion of the dead tissue takes place and a small acute ulcer forms. Most of these heal quickly, but in certain circumstances—for example abnormally high gastric acidity—one of them fails to heal, gradually enlarges, and becomes a chronic ulcer. The remaining organic affection of the stomach (*gastritis*) is now of less frequent occurrence than was formerly supposed.

The functional disorders of the stomach which are responsible for a great deal of what is commonly called " dyspepsia " are still but ill-understood although, by means of X-ray examinations and the use of " fractional " test meals, light is gradually being thrown upon them. Two chief types of functional disorder occur, secretory and motor, and each of these may be affected in the direction either of excess or defect.

Secretory Disorders.—It is now known that the gastric juice as secreted has an acidity of about 0·5%, but that this is reduced to the optimum acidity for digestion (0·2%) by dilution and neutralisation in the stomach, and that the most powerful factor in neutralisation is the regurgitation of duodenal contents through the pylorus. An excessive acidity of the stomach contents therefore (" *acid dyspepsia*," *hyperchlorhydria*) may be due either to over-production of gastric juice or to deficiency of neutralisation, or to both, and can no longer be regarded as a definite " clinical entity." Deficient acidity on the other hand (*hypochlorhydria*, *achylia*) may be due either to defective secretion or to excessive neutralisation. The secretion of gastric juice is controlled partly by the vagus nerve and partly by chemical hormones, and may therefore be affected either by variations in the excitability of the nervous system or by the quality of the food. Excess of secretion is perhaps commoner in men, defect is more often found in women, but over-acidity is more prone to cause symptoms than under-acidity.

Motor Disorders.—These are of greater importance as a cause of dyspepsia than disorders of secretion. The stomach has two motor functions (*peristalsis* and " tone ") and these may be disordered independently. Both are much under nervous influence, the vagus increasing tone and peristalsis, whilst the sympathetic has an opposite effect. Diminution of tone (*hypo-motility*, *atony*) is a commoner cause of symptoms than excess and is specially apt to occur in women. Emotional disturbances are prone to bring it about. Excess of tone and peristalsis are often associated with over-acidity, whereas deficiency of tone and acidity often, though by no means always, coincide.

The symptoms of the functional disorders of the stomach differ notably from those of the more serious organic diseases. Pain, vomiting, and wasting are absent, and the patient's chief complaints are of discomfort, flatulence, acidity, and so forth. As disorder of function is largely nervous in origin, treatment must be directed in great measure to the central nervous system, but acidity can be corrected by antacids, atony by strychnine, and so on. The diet of the patient must also be adapted to the weakened organ.

The Colon.—The investigation of diseases of the colon has been facilitated by the introduction of the methods of examination by the X-rays after an opaque enema and by the sigmoidoscope. Cancer is still the most serious affection, the sigmoid and pelvic colon being its commonest sites. Treatment is by operation and, if undertaken early enough, is often successful. Ulceration of the colon is now divided into (*a*) dysenteric and (*b*) non-dysenteric. Dysenteric ulceration (*see* DYSENTERY) may be caused either by the amoeba histolytica or by dysenteric bacilli of the Shiga or Flexner type. The distinction between these different forms can be made by a bacteriological examination of the stools and by the serum agglutination test. Non-dysenteric ulceration (*ulcerative colitis*) is not very uncommon as a

primary disease in Great Britain. Its symptoms are the same as those of the dysenteric variety (diarrhoea with the passage of blood and mucus, some fever, pain and tenesmus) and it can be recognised by the use of the sigmoidoscope. Nothing is yet definitely known of its bacteriology. Antidysenteric serum is a powerful aid in the treatment of acute bacillary dysentery whilst emetine is a specific for the amoebic form. Non-dysenteric ulceration is treated by lavage and, in severe cases, by the operation of appendicostomy.

The frequent occurrence of little pouches (*diverticula*) in the wall of the colon has been established by modern methods of investigation. Sometimes these become inflamed when the condition termed " diverticulitis " arises. It is not without danger. Much attention has been devoted in recent years to the alleged stagnation of the contents of the large bowel (colon stasis) with consequent absorption of poisons into the blood (auto-intoxication). Such stagnation is believed to be promoted by dropping or displacement of the colon or by the undue mobility of sections of it, and extensive operations have been undertaken for the correction of these conditions. Whilst, however, auto-intoxication may sometimes take place, it is beginning to be realised that it is not nearly so frequent as was supposed and that operation for it is rarely necessary or advisable.

The Pancreas.—The pancreas is still very largely the *terra incognita* of the abdomen, mainly on account of its inaccessible position. The introduction of tests for "pancreatic efficiency," however, has helped to make the diagnosis of its diseases easier. Amongst these tests are Loewi's adrenalin mydriasis reaction, the urinary diastase test, and the estimation of the unsplit fat in the stools. Glycosuria, also, is often an indication of the failure of the internal secretion (insulin).

New-growth (cancer) is the most serious disease of the pancreas and one of the commonest. It specially affects the head of the organ and usually shows its presence by the production of obstructive jaundice.

Acute pancreatitis (haemorrhagic necrosis of the pancreas) is one of the conditions which produce what is termed an " abdominal catastrophe." It is difficult of diagnosis and is only curable by laparotomy.

Chronic pancreatitis, an interstitial inflammation or fibrosis of the organ, may result from partial obstruction of the duct, *e.g.*, by gall-stones, or from an ascending infection of it. The symptoms are very much the same as those produced by cancer.

The Liver.—Recent work has thrown a good deal of light on the nature of jaundice. It is now known that bile pigment is not produced in the liver cells but is derived from the breaking down of red blood corpuscles in the " reticulo-endothelial system "—a network of cells widely diffused in the body but especially in the spleen. The pigment so produced is picked out of the blood by the hepatic cells and transferred to the bile. Two chief varieties of jaundice are recognised: (*a*) obstructive, (*b*) non-obstructive. The former is due to any gross obstruction in the bile ducts such as may be caused by cancers or other tumours pressing upon or involving the ducts, impacted gall-stone and so forth. It is characterised by the complete absence of bile from the stools and its presence in the urine.

Non-obstructive jaundice, as it is usually called, is of two varieties—the haemolytic and the toxic. The former is due to increased destruction of red blood corpuscles and occurs to some extent in Addisonian (pernicious) anaemia and also in the rare disease known as " family jaundice "; toxic jaundice on the other hand is brought about by severe damage to the liver cells rendering them incapable of transferring bile pigment from the blood to the bile. Many poisons act on the cells in this way, such as arsenic and phosphorus, as well as the toxins of certain organisms, *e.g.*, those of yellow fever and some septic infections; poisons of " endogenous " origin may act similarly, as in acute yellow atrophy of the liver and the toxic jaundice of pregnancy. In all forms of non-obstructive jaundice bile is present in the stools but it may or may not be present in the urine. So-called " catarrhal jaundice," formerly believed to be obstructive, is now, largely as a result of the van den Bergh test, known to be due, in part at least, to direct damage of the liver cells, although obstruction of the ducts from catarrh also plays a part in its production. Much work has recently been done on the pathology of gall-stone formation. It is generally agreed that infection of the gall-bladder is a predisposing factor, the infection being usually conveyed through the blood stream in the same way as in cases of peptic ulcer. In addition it is possible that an excess of cholesterol in the blood contributes to their formation. Of the other chief diseases of the liver, cancer and cirrhosis, there is nothing new to be said. (R. Hu.)

ALINGTON, CYRIL ARGENTINE (1872–), British educationalist and writer, was born in Ipswich, Oct. 22 1872 and educated at Marlborough College and Trinity College, Oxford. After being elected a fellow of All Souls College, Oxford, and taking Holy Orders, he taught at Marlborough and Eton successively. In 1908 he was appointed headmaster of Shrewsbury School and in 1916 succeeded his brother-in-law, Edward Lytelton, as head master of Eton. Dr. Alington was peculiarly fortunate in commanding the respect and affection of his pupils and, while not hostile to new ideas, sought to maintain rather than modify the public school tradition. His published works include *A Schoolmaster's Apology* (1914), a brief but discursive expression of his educational ideals; two popular novels, *Strained Relations* (1922) and *Mr. Evans* (1922); some humorous verse, and collections of sermons and addresses.

ALLBUTT, SIR THOMAS CLIFFORD (1836–1925), British physician, was born at Dewsbury, Yorks, July 20 1836. Educated at St. Peter's School, York and Caius College, Cambridge, he studied medicine at George's Hospital, London, and afterward in Paris, subsequently practising in London and Leeds. He carried out much valuable work on the pathology of the nervous system, and made important investigations of tetanus and hydrophobia, devoting, in addition, considerable time, to ophthalmoscopy and inventing the short clinical thermometer. He was consulting physician to many institutions and from 1889 to 1892 was a commissioner in lunacy. He was elected F.R.S. in 1880, and later became a member of many other British and foreign scientific societies, and received many honorary degrees and other awards. In 1892 he became regius professor of physic at Cambridge, in 1907 was created K.C.B. and in 1920 a privy councillor. Sir Clifford Allbutt was a member of many government committees, including the Home Office inquiry into trade diseases. He died at Cambridge Feb. 22 1925.

Allbutt's published works include *The Use of the Ophthalmoscope in Medicine* (1871); *On Scrofulous Neck* (1885); *Diseases of the Heart* (Lane Lectures, 1896); *Historical Relations of Medicine and Surgery* (1905); *Greek Medicine in Rome* (Fitzpatrick lectures, 1909–10); *Diseases of the Arteries and Angina Pectoris* (1915); *Science in the School* (1917) and *Notes on the Composition of Scientific Papers* (3rd ed., 1923). He also edited *A System of Medicine* and *A System of Gynaecology* (1896, 1899, 1907).

ALLEN, SIR JAMES (1855–), New Zealand politician, was born in South Australia on Feb. 10 1855, his parents settling in New Zealand a year later. He was educated in England at Clifton and St. John's College, Cambridge, and afterward studied at the Royal School of Mines, in London. Returning to New Zealand he was, in 1887, elected a member of the House of Representatives. He was Minister for Finance, Defence and Education from 1912–5, and, in 1915, when a separate Ministry of Defence was formed, he took charge of it, retaining the post until 1920. It was largely due to his efforts that, in 1914, the New Zealand Force was one of the most effective of the British Dominion armies. During the absence of Mr. Massey in England during and after the War he acted as Prime Minister for two years. He was made a K.C.B. in 1917 and was appointed High Commissioner for New Zealand in London in 1920. His long, practical experience as a Dominion administrator and his sympathetic understanding of the needs of the Empire rendered his presence in London especially valuable both to the Dominion and the Empire. He is the author of *New Zealand and Federation. The Financial Aspect* (1890), a pamphlet issued by *The Press*, Christchurch and *New Zealand's Possessions in the South Seas* (1903).

ALLEN, JAMES LANE (1849–1925), American novelist (*see* 1.691), died Feb. 18 1925. His latest books include *The Doctor's Christmas Eve* (1910), *The Lost Christmas Tree* (1914), *Sword of Youth* (1915), *A Cathedral Singer* (1916), *A Kentucky Warbler* (1918), *Emblem of Fidelity* (1919) and *The Alabaster Box* (1923).

ALLENBY, EDMUND HENRY HYNMAN, 1ST VISCOUNT (1861–), British field-marshal, was born April 23 1861, and joined the Inniskilling Dragoons in 1882. He saw active service early in the Bechuanaland expedition of 1884–5 and in Zululand 1888, and later passed through the Staff College. During the South African War (1899–1902) he took part in the cavalry operations leading to the relief of Kimberley, in the battle of Paardeberg, and in the advance to Pretoria. During the later stages of the war he won distinction as a column commander, and his command of the 5th Lancers from 1902–5 spread his reputation throughout the army. Then, after command of a cavalry brigade, he became inspector of cavalry in 1910 and in 1914 went out to France in command of the cavalry division.

The work of his troops, mounted, during the retreat from Mons and advance to the Aisne, and, dismounted, in holding the line south of Ypres during the critical weeks of Oct., won high praise in Sir John French's dispatches. When a second cavalry division arrived, Allenby was given command of the Cavalry Corps then formed, and in Oct. 1915 he succeeded Sir Charles Monro as commander of the III. Army. Throughout 1916 his army front was relatively quiet, but in the spring of 1917 it played a foremost rôle in the battle of Arras.

In June Allenby left France to succeed Sir Archibald Murray in charge of the forces in Egypt and Palestine. His first three months on the borders of Palestine, the season being still unsuitable for operations, were devoted to intensive preparations for an autumn offensive, reorganising the command, greatly developing the communications, and moving his own G.H.Q. from Cairo to the front at Rafa. Complete secrecy and many ruses misled the Turks as to the main point of attack. The strong defences of Gaza were bombarded from Oct. 26 onwards and serious attacks followed, on Nov. 1, to fix the enemy's attention and draw in his reserves.

Meanwhile, as a necessary preliminary to the real blow, the outlying bastion of Beersheba, 35 m. east of Gaza, was gained by a convergent manoeuvre on Oct. 31, a prelude to the decisive attack on Nov. 6 which broke through the enemy's weakened centre and into the plain of Philistia. This compelled a general retreat of the Turks, and the pursuit was pressed so relentlessly that by Nov. 14 the port of Jaffa had been seized, the Turkish armies driven apart in two divergent masses, and Allenby was able to wheel his forces to the right for an advance inland on Jerusalem. The British troops kept too closely on the heels of the Turks for the latter to block the narrow mountain passes, and, despite a stout Turkish resistance almost at the gates of Jerusalem the objective was gained with the surrender of the city on Dec. 9. By the time the winter rains set in the position of the British had been improved and their hold on Jaffa and Jerusalem had been made thoroughly secure.

The further advance initiated in the spring was interrupted by the crisis on the western front, which forced the dispatch to France of most of Allenby's British troops. The depletion was made up by reinforcements from India and Mesopotamia, and the summer of 1918 was devoted to reorganisation and the training of these new units. Finally, in mid-Sept., the carefully planned and prepared offensive was launched. Feinting towards the east bank of the Jordan, to distract the enemy's attention, Allenby secretly concentrated, on the Mediterranean flank, the mass of the infantry and behind them the cavalry. In this way he changed a two to one superiority on the general front into a four to one superiority at the decisive point of attack. On the night Sept. 18–19 the forces in the hilly centre had attacked to fix the enemy's attention, and at dawn on the 19th the western mass struck; the result was to roll the Turks back northeast, like a door on its hinges.

Through the open doorway the cavalry passed, riding straight up the coastal corridor for 30 m. before swinging east to cut the Turkish communications, and close all exits of retreat. Completely trapped, the main Turkish armies were rounded up, while the British cavalry exploited the victory of Megiddo by a swift and sustained pursuit, which gained first Damascus and finally Aleppo. The capitulation of Turkey rang down the curtain on this brief and dazzling campaign. Making all allowances for the British superiority in strength, it must rank as one of the masterpieces of military history, as perfect in execution as in design. For his services the victor was promoted field-marshal and raised to the peerage as Viscount Allenby of Megiddo and Felixstowe, receiving also a grant of £50,000.

Though his campaign had been waged beyond the borders of Egypt, Allenby had been throughout responsible for the protection and internal order of the Nile delta, where the military situation and the changed status of Egypt had led to considerable unrest. In 1919 he was appointed British High Commissioner in Egypt, and held the post until 1925, through the long sequence of political trouble and disturbances arising out of the agitation for independence. In such conditions criticism of the administration was inevitable, but it is a testimony to Allenby's impartiality and sympathy that it was rather of the velvet glove than of the iron hand. If the ultimate verdict rests with history, it can at least be recognised now that the prestige of his name was a unique asset, and indeed made him the only possible choice for the post at such a critical period. *See* PALESTINE, CAMPAIGNS IN. (B. H. L. H.)

ALLENSTEIN-MARIENWERDER, a region composed of districts of the former Prussian provinces of East and West Prussia.

Article 94–98 of the Treaty of Versailles provided that the East Prussian Circles (Kreise) of Allenstein, Ortelesburg, Osterode, Sensburg, Johannisburg, Lotzen, Lyck and Neidenburg, in so far as they had not already been ceded to Poland, and further the West Prussian Circles of Marienwerder (east of the Vistula), Stuhm, Rosenburg and the section of the Circle Marienburg situated east of the Nogat, should declare by a plebiscite whether they desired to belong to Germany or Poland. Until the plebiscite should take place the administration of these Circles was taken over by inter-Allied commissions for East and West Prussia respectively, supported by Allied garrisons.

The whole territory has an area of about 15,900 sq. miles. According to the German census of 1910, the East Prussian area had a population of 556,000 of which 288,000 were Germans; the West Prussian area, 24,000 Poles, 114,000 Germans. In East Prussia 172,000 were Masurians, who are Slavs, but Protestants. The plebiscite held on July 11 1920 was preceded by much agitation and band warfare. In the East Prussian region 98% of the population voted for Germany, in the West Prussian 92%. Both districts were assigned to Germany on the basis of the vote; but, in accordance with the terms of the treaty of Versailles, a zone 50 m. broad and some 30 m. long on the east bank of the Vistula near Marienwerder and four villages with the harbour of Kurzebrack on the same river were assigned to Poland in order to secure for the Polish state, at this point, the sovereignty over the course of the Vistula accorded to it by the treaty. The inhabitants of the adjacent East Prussian territory are at all times to have access for themselves and their boats to the Vistula. Three frontier communes in the southwest of East Prussia were also assigned to Poland. On Aug. 16 both the inter-Allied commissions left the plebiscitary areas.

ALLOTMENTS (*see* 1.699).—An allotment, in Great Britain, is any parcel of land above ¼ ac., but not exceeding five ac. in extent, which is cultivated as a farm or garden, or partly as a farm and partly as a garden. In other words, it is a small agricultural holding, subject to the same terms relating to notice to quit and compensation. Such allotments are almost exclusively confined to rural districts and are to be found principally in the fen district and where the soil is suitable for market gardening.

The word allotment, as popularly used, means something entirely different, and really refers to an allotment-garden. This is defined as an allotment not exceeding 40 poles in extent, which is wholly, or mainly, cultivated by the occupier for the production of vegetables and fruit crops for consumption by

himself or his family. The overwhelming number of allotments are of this kind, and in this article the term allotments must be taken generally in this sense.

The Small Holdings & Allotments Act, 1908, was followed by a great increase in the number of allotments. On Dec. 31 1909 there were 58,648 allotments covering an area of 17,529 ac., increased on Dec. 31 1914 to 130,526 allotments and 33,523 acres. During this period, land-renting associations were formed in all parts of the country with the object of procuring and managing land for their members.

The War Period.—The World War changed the whole aspect of the problem. The provision of allotments had been, hitherto, largely a rural question, but the food shortage which developed as the War went on transferred the problem from the countryside to the towns and cities. Home food production on a larger scale became an imperative necessity. To ensure this, emergency legislation under the Defence of the Realm Regulations was passed in 1916–7 and 1918 (since withdrawn), the effect of which was to give local authorities powers for the compulsory acquisition of land for allotments. The powers granted were at first confined to the appropriation of vacant land, *i.e.*, undeveloped building sites, but were afterwards extended so that practically any land could be acquired. Hitherto, the statutory right to an allotment was confined to the " labouring population," but this limitation was withdrawn. The result was that patriotic persons, of both sexes and from all classes of society, were to be found cultivating allotments, until, on Dec. 31 1920, there were 1,330,000 allotments, embracing 185,000 acres. Even then there remained 44,736 unsatisfied applicants waiting for land to cultivate.

The cultivation of allotments during the War created a new and absorbing interest for thousands of British citizens, so much so that, when the temporary allotments which had been used were taken for purposes of greater public utility, a widespread demand for alternative land on a more permanent tenure was made. This desire may be traced in a series of Acts of Parliament: The Land Settlement (Facilities) Act, 1919; the Agriculture Act, 1920; the Allotments Act, 1922; the Agricultural Rates Act, 1923; and the Allotments Act, 1925. This legislation has entitled the allotment holder, under normal circumstances, to a six months' minimum notice to quit; compensation for crops and manures when less notice is received; concessions in local rates; and representation on the statutory allotments committees of local authorities. The 1925 Act enables associations to borrow from the Public Works Loan Commissioners up to two-thirds of the value of land purchased, repayment being spread over a maximum period of 35 years. Local authorities providing allotments are also empowered, if necessary, to incur a loss not exceeding a 1d. rate when action is taken under the Allotments Acts. They may also obtain allotments in advance of the demand, as well as make provision for them in all schemes of town planning.

The great problem which confronts the allotment movement is insecurity of tenure. Allotment associations are helping to solve it themselves by the purchase of land where practicable, but this is impossible in congested areas where land is scarce and very expensive. Large allotment areas still exist where the tenancies may be determined by short notices to quit. An increasing number of temporary allotments have been surrendered for building purposes and the decrease in the number reported at the end of 1924 was due almost entirely to this cause.

Some Figures.—The Ministry of Agriculture gave the figures at the end of 1923 as 1,190,000 allotments and, at the end of 1924, 1,170,000, a decrease of about 1·5%, but they add: " It would be a mistake to conclude from these figures that interest in the allotment movement is waning." There were 15,000 registered applicants waiting for allotments at the end of 1924.

Allotments produce 700,000 tons of foodstuffs each year, worth, approximately, £7,000,000, and this produce not only increases the national wealth but makes a valuable contribution to the family budgets of over 1,000,000 families. From a small allotment-garden of 10 rods (just over 300 sq. yd.) it is estimated that £10 worth of vegetables are obtained during the season.

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ALMA-TADEMA, SIR LAURENCE (1836–1912), British painter (*see* 1.712), died at Wiesbaden June 25 1912. An exhibition of his works was held in London in 1913.

ALSACE, EARLY OPERATIONS IN: *see* FRONTIERS, BATTLES OF THE.

ALSACE-LORRAINE (*see* 1.756), two provinces of France, restored to her by Germany under the Treaty of Versailles. The area is: Bas Rhin, 1,848 sq. m.; Haut Rhin, 1,354 sq. m.; Moselle, 2,019 sq. m.; and the population Bas Rhin, 651,686; Haut Rhin, 468,943; Moselle, 589,120.

I. GERMAN ADMINISTRATION 1910–8

Under the constitution of July 4 1879, Alsace-Lorraine (das Reichsland) was administered by (1) a minister for Alsace-Lorraine, assisted by under-secretaries of state, acting for and on behalf of the chancellor; (2) a provincial delegation (Landesausschuss), possessing the legislative initiative, and the right of receiving and discussing petitions; (3) a statthalter, representing the emperor.

A new constitution was passed by the Reichstag on May 26 1911. The emperor, as direct sovereign of the Reichsland, continued to be represented in Strasbourg by a statthalter, who governed with the assistance of a secretary of state, responsible to the emperor alone. The *Landesausschuss* was replaced by a *Landtag*, consisting of an upper chamber composed one-half of ex-officio members, one-half of members nominated by the emperor; and a second chamber composed of 60 members elected directly by universal suffrage. The elections for the second chamber (Oct. 22 and 29 1911) returned 26 members of the Centre (Catholic party), 10 of the Lorraine Group, 11 Socialists, 9 Liberal Democrats and 4 Independents.

The Landtag and the Ministry came into conflict on April 29 1912, when the Govt. on the strength of secret reports from Berlin, demanded the dismissal of the director of the Grafenstaden locomotives works, on the ground of French intrigues, and threatened to withdraw their orders from the works. The second chamber passed an unanimous vote of censure on the ministers for failing to defend the accused. A second vote of censure was passed when the *Souvenir alsacien-lorrain* which tended the graves of 1870, was suppressed in 1913, and it was known that the Ministry was preparing further measures against the French Press and associations.

Far more serious was the incident of Saverne (Zabern). In Oct. 1913 the news spread that a young officer of the 79th Infantry, Lieut. von Forstner, had, on parade, addressed the Alsatian recruits as " Wackes " (street arabs), and promised 10 marks to every soldier who would bring in the skin of one of these " Wackes." Alsatian soldiers were obliged to parade before the Lieutenant, saying " I am a Wacke." In addition, Forstner had grossly insulted the French flag.

The *Elsaesser* and a Saverne newspaper protested. Public opinion was aroused. Forstner was pursued by lads in the streets, and had to go about under guard. The affair threatened a collision between the civil power and the military authorities. On the night of Nov. 9–10, Forstner had been besieged in his quarters by a mob. The sub-prefect and the mayor consented to summon the fire-brigade. But without awaiting orders, Col. von Reutter, who was in command of the garrison, had on his own initiative sent out military patrols and held machine-guns in readiness. The sub-prefect referred the matter to the Minister of the Interior, Mandel; the colonel referred it to Gen. von Deimling. As it happened, Mandel and Von Deimling were dining at Strasbourg in the same house, and the discussion between them was a stormy one.

On Nov. 28, when Forstner was being pursued in the street as usual, Lieut. Schadt ordered out the guard, and Col. von

Reutter had 29 persons arrested at random. The soldiers searched houses, and the procureur and several civil magistrates were shut up in the barracks. On Dec. 2 Forstner caused the arrest at Dettwiller of a shoemaker's boy, and struck him on the head with his sabre. The affair became daily more serious, and deep feeling was aroused. In the Reichstag on Dec. 4 1913, all parties, with the exception of the Conservatives, passed a vote of censure on Bethmann-Hollweg by 293 votes against 54, with four abstentions. In Alsace the second chamber violently attacked the Ministry in the sittings of Jan. 13 and 15 1914; even in the first chamber the vote of censure was unanimous but for the votes of two generals and a professor of public law, named Labaud, and two abstentions.

The military party accepted the challenge. Forstner, at first sentenced to 43 days arrest, was acquitted on appeal by the War Council, together with Reutter and Schadt. In Berlin the prefect of police, Herr von Jagow, published in the *Kreuzzeitung* a letter in which he declared that the officers garrisoned in the annexed provinces were serving in a practically enemy country. Finally the emperor, exasperated by the attacks against the military caste caused by this notorious case, accused in turn the statthalter and his ministers of weakness. Count von Wedel was replaced by Baron von Dallwitz and Herr Zorn von Bulach by Count von Roedern as minister of state. All parties of the Second Chamber formed a "league for the defence of Alsace-Lorraine" to repel the attacks and suspicion directed against the country.

During the War the German authorities took severe measures in Alsace-Lorraine. During the first months about 1,000 well-known persons were imprisoned or sent into Germany to be kept under police supervision. The sale of French newspapers was forbidden in Alsace-Lorraine, and the use of the French language in the streets. In 1918, according to official statistics, 1,640 persons were under preventative arrest and 1,900 exiled. Young persons and women were obliged to work for the army in bad and dangerous conditions. By 1917, 18,426 natives of Alsace-Lorraine had deserted from the German Army; 23,000 served as volunteers in the French Army during the War.

At the end of July 1918, conviction of the impending defeat of Germany became general in Alsace. The new chancellor, Prince Max of Baden, replaced the statthalter and the secretary of state by two Alsatians, M. Schwander, Mayor of Strasbourg, and M. Hauss, the leader of the Centre party. M. Schwander could not form a ministry, and in the beginning of Nov. the Chamber compelled his resignation, and itself formed a ministry, in which a Nationalist Alsatian, M. Pfleger, was Minister of the Interior. This was the constitutional position at the date of the Armistice of Nov. 11. But at the same time marines from Kiel arrived at Strasbourg and Metz, where they organised councils of workmen and soldiers. French flags, which had already been hoisted, were replaced by red flags. Finally, thanks to the mediation of the Socialist leaders Imbs and Peirotes, the two governments—of the Chamber and of the Soviets—reached an agreement. To put an end to the anarchy caused by the retreating German troops delegations begged the French generals to hasten their entry.

On Nov. 12 the Abbé Delsor proposed in the Alsatian Chamber an address of allegiance to France, which was unanimously agreed. Gen. Pétain entered Metz, Gen. Gouraud Strasbourg, Gen. de Castelnau Colmar, and were received with acclamations. The Treaty of Versailles returned Alsace-Lorraine to France as from Nov. 11 1918.

II. FRENCH ADMINISTRATION 1918–26

Alsace-Lorraine had constituted an artificial union under Germany. The French re-occupation avoided sudden changes of administration. "It was thought preferable," writes M. Delahache, "to limit as far as seemed possible immediate and absolute changes. It was not desired to reject, on principle and without discrimination, institutions and usages which had been established in Alsace after 1870. The Chamber of Trade, limited companies, the Land Register, social insurance—all of them novelties for the rest of France, but familiar in Alsace, were wórth conserving, and doubtless worth extension. It ought to be possible to profit by experience gained, to find useful models, to try new combinations."

The framework created by Germany was therefore maintained. A high commissioner, M. Georges Maringer, held office until March 21 1919, when M. Millerand was appointed with the title of commissioner-general. He was succeeded by M. Alapetite on Feb. 11 1920.

The three German departments became those of Haut-Rhin, Bas-Rhin and Meurthe et Moselle, each of them administered by a commissioner. The French Govt. promised to allow the population to retain German institutions, municipal government, civil law, education system, workmen's law, social insurance and confessional schools. It also retained the Concordat. The former offices of the Minister of the Interior of Alsace-Lorraine continued to function up to April 1919. There was then constituted a Department of the Interior, which grouped under its authority health, religion and prison services. Public assistance, which under the German régime was not a state administration, was organised as in other departments and attached to the Ministry of the Interior. The Ministry of the Interior had to create a system of sub-prefects, to form an elective regional council (bill of Dec. 24 1919), and to draw up elective lists on the principle of French electoral law, under the decree of May 6 1919.

Finance.—A decree of the Prime Minister's of Nov. 26 1918, made the circulation of the mark illegal from Dec. 19. It was conceded that for Alsatians, for Lorrainers, the Allies and neutrals domiciled in Alsace or Lorraine before the War, marks would be exchanged at the rate of 1·25 francs to the mark. In Dec. about 900,000 marks were exchanged. The customs frontier was moved back from the Vosges to the Rhine, and the French tariff was put in force on Jan. 30 1919. The general adjustment of indirect taxation to French practice was completed on Aug. 1 1919. Direct taxation (income tax) was introduced by the Chamber of Deputies on the initiative of the deputies of Alsace-Lorraine, to come into force in 1920. The state monopoly on tobacco growing was extended to Alsace-Lorraine by the decree of May 27 1920; the monopoly has not been extended to manufacture and sale.

Justice.—The decree of Nov. 30 1918, displaced all the magistrates of Alsace and Lorraine; the creation of a new personnel occupied 10 months. Commissions of five members were created to study the introduction of French law. Penal law and the law with regard to criminal investigation were introduced on Nov. 25 1919, Patents and copyrights law on Feb. 10 1920.

Education.—The new service was installed in place of the German system on Nov. 29 1918. The officials were removed and replaced as opportunity offered; the new organisation was only really established in April 1919. The professors left Strasbourg University; it was therefore closed on Dec. 8 1918; but reopened on Jan. 19 1919. In secondary and primary education, the change was made slowly, the teaching of French was enforced and that of German reduced; thus the readaptation of Alsace-Lorraine to French life has been gradual. Serious difficulties have not arisen, nor will they unless the central Govt. attempt to touch linguistic and religious liberties. In 1924 the proposal of the Herriot Ministry to suppress the confessional schools provoked lively opposition.

Administrative Changes in 1925.—On Sept. 9 1920, a consultative committee was added to the commissariat-general. These institutions are necessarily provisional. As early as Dec. 1921, a Socialist deputy, M. Uhry, asked in the Chamber for the abolition of the commissariat-general and the end of the transitional régime—a programme which was adopted from that date by the extreme Left. M. Uhry returned to the charge in Dec. 1922, when the Alsace-Lorraine budget was under discussion. The Chamber of Deputies refused to make the change, by an enormous majority. In the summer of 1923, the Govt. declared their intention of abolishing the commissariat-general on July 1 1924. M. Alapetite resigned in the course of that month; M. Cacaud, secretary-general of the commissariat, undertook his official duties on July 21 for the time being. On Nov. 8 a meeting of the Alsace-Lorraine deputies was held under the chairmanship of M. Herriot, then Prime Minister. It was decided that the commissariat-general should be abolished from Jan. 1 1925. The temporary council at Strasbourg was to be replaced by a council sitting in Paris. This council was definitely authorised by a decree of Nov. 14, and M. Painlevé, in a speech delivered on June 1 1925, at Strasbourg, promised that it would be promptly formed. An under-secretary of state—the first to hold the office was M. Georges Bonnet—was charged with matters specially concerning Alsace-Lorraine. (For the importance of Alsace and Lorraine in the general economy of France *see* FRANCE.)

BIBLIOGRAPHY.—G. Delahache, *Les Débuts de l'Administration Française en Alsace et en Lorraine* (1921); E. Wetterlé, *L'Alsace et la Guerre* (1919); René Henry, *Témoignage pour les Alsaciens Lorrains* (1925); Rod. Reuss, *Histoire d'Alsace*, 14th ed. (1918). (H. Bi.*)

ALTMAN, BENJAMIN (1840–1913), American merchant and art collector, was born July 12 1840 in New York City, and died there Oct. 7 1913. As a young man he became interested in early European and Oriental art. His collections of Chinese porcelains and Oriental rugs were remarkable. Of the works of Rembrandt he possessed probably the largest private collection ever assembled. He bequeathed his collections, including works by Velazquez, Van Dyck, Cuyp and Ruysdael, to the Metropolitan Museum of Art, New York City. Shortly before his death he secured the incorporation of the Altman Foundation, established for the welfare of the employees of the department store of B. Altman and Co., of which he was the head.

ALUMINIUM (*see* 1.767).—During the period 1911 to 1925 the annual production of aluminium showed a steady increase of from 45,000 to approximately 200,000 tons from all sources. The increase of 440% in the aluminium production is therefore a remarkable epitome of the wide uses which have been found for the metal. Of the foregoing productions the United States and Canada contribute about one half, whilst the remainder is made up by the European industry represented by independent interests in Great Britain, France, Switzerland and, latterly, Germany. Virtually all the producing interests are engaged on a policy of expansion.

No significant changes have been made in the methods of production, bauxite ore still forms the basic material from which aluminium is reduced and it is commercially mined in the South of France, Italy, Yugoslavia and Hungary, also in British and Dutch Guiana, while in the United States the ore is mined in Arkansas, Georgia and Alabama. Many other prospective deposits exist in other parts of the world, but have not yet been commercially exploited. Experiments to reduce aluminium from alunite (aluminium-potassium silicate) and kaolin (aluminium silicate) have been technically but not commercially successful. The average purity of metal now shipped by the leading European producers is 99%, a somewhat lower commercial grade being employed for castings and higher purity for conversion into sheet, wire and special alloys. The only significant impurities in high-grade aluminium consist of silicon and iron.

Uses of Aluminium.—The principal use for aluminium is in the form of castings, for which purpose the metal is usually alloyed with zinc or copper or both, the aluminium being from 85% to 95% of the content. Such alloys form the basis of motor car crank-case castings, transmission housings and a great multitude of other parts produced in sand moulds according to regular brass foundry practice. Wheels for motor omnibuses, rear axles and brake drums are among the important examples of commercial aluminium castings in regular production. These have been made possible by the development of high endurance alloys resistant to fatigue and shock. In the production of still larger and more difficult castings considerable use has been made of an alloy of 87% aluminium and 13% silicon. By melting this alloy under prescribed conditions it is possible to attain a tensile strength of 27,000 lb. per sq. in. and an elongation of 8% on two inches, together with a very dense structure, low shrinkage and absence of porosity. Individual castings have been made in this alloy up to a weight of 2,500 pounds.

Many aluminium castings are now produced in hot iron moulds and afterwards heat treated to bring out the best properties of the metal. An important alloy for this work is generally known as "Y" alloy and was developed at the National Physical Laboratory, Teddington, Middlesex. It contains 92% aluminium, 4% copper and the remainder nickel and magnesium, and will give a tensile strength of 44,000 lb. with 5½% elongation. Unlike many other alloys it is exceedingly strong when hot and is therefore widely used for pistons and cylinders of internal combustion engines (*see* INTERNAL COMBUSTION ENGINE; METALLURGY).

The development of new alloys has also expanded the field for aluminium sheet and forgings. Although pure aluminium sheet is extensively used for motor car bodies and for cooking utensils, certain uses demand alloys of particularly high strength.

This is so in the case of aircraft construction, in which the greater part of the machine is built of duralumin (*see* AEROPLANE). This alloy has been progressively developed and used since its invention by Wilm in Germany in 1910. Its average composition is 95% aluminium, 3½% copper and the remainder magnesium and manganese. The metal is hot rolled, forged and otherwise fabricated, heat treated and quenched with a resulting tensile strength of 60,000 lb. per sq. in. and an elongation of 20% on two inches. Not only is it comparable with steel on the basis of strength, but it has the merit of light weight attaching to aluminium alloys in general and its tensile strength per ton is practically 2½ times greater than 40 tons of steel.

A considerable tonnage of high-grade aluminium is hot rolled, drawn into wire and stranded into a cable for electrical transmission (*see* ELECTRICITY, TRANSMISSION OF). For a given conductivity aluminium is actually some 50% lighter than copper and generally more economical. At the present time (1926) it is estimated that there are not less than 200,000 m. of aluminium wire in use for overhead transmission lines, the bulk of which consists of a composite cable having a steel core around which the aluminium wires are stranded.

As now commercially produced, the summarised properties of aluminium are as follows (British Aluminium Company, Ltd.):—

Atomic weight	=	27·1
Melting point °C.	=	658·7
°F.	=	1217·7
Specific heat	=	0·214
Thermal conductivity (cal. per 1° C. per cm. per sec.)	=	0·504
Expansion coefficient °C.	=	0·00002268
°F.	=	0·0000126
Density	=	2·705
Tensile strength, wire, hard	=	28,000 lb. per sq. in.
Tensile strength, wire, soft	=	14,000 lb. per sq. in.
Modulus of elasticity	=	9,600,000 lb. per sq. in.
Resistivity of aluminium at 20° C.		
Standard annealed aluminium		
Ohms per metre gramme	=	0·0763
Microhms per in. cube	=	1·1102
Microhms per cm. cube	=	2·82
Standard hard drawn aluminium		
Ohms per metre gramme	=	0·0774
Microhms per in. cube	=	1·1260
Microhms per cm. cube	=	2·86

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(E. V. P.)

ALVEAR, MARCELO TORCUATO DE (1868–), Argentine politician, was born at Buenos Aires Oct. 4 1868, the son of Torcuato de Alvear, several times mayor of Buenos Aires, and grandson of General Carlos de Alvear, the first Argentine Minister to the United States. After graduating from the University of Buenos Aires he affiliated himself with the Radical party, and in 1912, after some years of study and travel in Europe, he was elected to the Lower House of the Argentine Congress, first from the city, and then from the province, of Buenos Aires. As a Congressman he promoted social-service legislation, notably for the improvement of housing and Civil Service conditions. He served as Argentine Minister to France from 1916 until his election as President of Argentina in 1922, when he received a large majority over his opponent, Dr. Lisandro de la Torre. On the whole he continued the policies of his predecessor, Hipólito Irigoyen, though his long residence in Europe enabled him to take a somewhat broader view of foreign affairs. As his term as president continued, he gradually became more influential in the affairs of the Radical party, in whose councils he assumed an outstanding position.

ALVERSTONE, RICHARD EVERARD WEBSTER, 1ST BARON (1842–1915), British lawyer (*see* 1.775), died at Cranleigh, Surrey, Dec. 15 1915.

AMANULLA KHÁN (1892–), Amir of Afghanistan, was born June 1 1892, being the third son of Habibulla Khán by his principal wife, Ulya Hazrat. On Feb. 20 1919 Habibulla Khán was assassinated, whereupon his brother, Nasrulla Khán, seized the reins of government. Six days later, however, Amanulla Khán declared himself Amir. In Aug. 1919, following fighting between British troops and Afghans, the new Amir successfully negotiated a treaty of peace by the terms of which Afghanistan was left officially free and independent. From this time onward

the Amir consistently adopted a policy of westernisation. He even went so far as to advocate the emancipation of women by female education, which roused the opposition of the Mullas and was one of the causes of the rebellion which broke out in Khost in 1924. (*See* AFGHANISTAN).

AMAZON (*see* 1.783).—The economic vicissitudes through which the Amazon basin passed in the period 1910–26 are traceable largely to changes in the rubber industry. Although crude rubber was sent from the Amazon as early as 1827, several decades passed before the annual exportation attained commercial importance. With the remarkable increase in the demand for rubber, prices rose, and gatherers in the forests were sent further afield.

About 1910–1 prices reached their highest point, yearly exportations amounted to thousands of tons and numerous river craft plied on the Amazon and its tributaries. The inhabitants of the valley were almost exclusively engaged in rubber exploitation. The growing of foods was largely abandoned, even necessary commodities being imported. About this period, however, plantation rubber trees of the East Indies were coming into bearing and the result was a collapse by 1915 of the one great industry of the region. At this juncture the World War reduced shipping available for trade in the Amazon; the scarcity of imported foodstuffs necessitated a rapid change in the occupation of the inhabitants, who reverted to fishing and the growing of such crops as sugar-cane, manioc, corn, tobacco, cotton and nuts.

Expeditions.—During the period 1910–26 there were numerous expeditions, exploratory and scientific, into regions watered by the Amazon and its tributaries. The most notable was that made by Roosevelt and Rondon (1913–4) down the Rio Duvida (River of Doubt), most of which had never been visited. The journey lasted two months and covered a distance of 470 miles. The river proved to be a branch of the Madeira, 940 m. in length, joining the main stream in lat. 5° 21′ South. Other expeditions were the Fleming expedition (1919), which studied the industrial possibilities of the region; and the Rice expedition (1924), which made valuable scientific observations, taking many aerial photographs. The Carnegie Museum also sent an expedition for the study of fishes; the Ellsworth, the Farabee, the Fawcett and other parties obtained geographic, geological and ethnological data. The Rusby party and other specialists investigated flora. Probably the most important commercial investigations in Amazonia were those undertaken in 1923–4 by the American Rubber Mission financed by the U.S. Government. Its leader, Dr. W. L. Schurz, was assisted by specialists from the Depts. of Commerce and Agriculture, and from the business world, and by experts from Brazil, Bolivia and Peru. This party investigated the regions of the rivers Tocantins, Xingu, Tapajoz, Madeira, Mamoré, Beni, Madre de Dios, Acré, Purus, Ucayali, Huallaga, Negro and Branco, conducting a survey along a total of 37 watercourses. Special parties penetrated inland and examined soils and agricultural possibilities, particularly with a view to the production of rubber and sugar-cane.

Trading Spheres.—Exporters and importers recognise three trading spheres; the regions, respectively, of Pará (or Belém), Manaos and Iquitos. Numerous European and American steamships call at Pará; some proceed to Manaos, while others go up the river to Iquitos. Motor-cars are numerous in Pará and Manaos, and are being introduced into regions such as Cobija in Bolivia and other primitive settlements. Electric-light plants are in operation in larger cities and in Obidos, Porto Velho, Riberalta, Cobija, Alemquer, etc. River steamers are also thus equipped. The Mamoré-Madeira Railroad, 220 m. around Madeira Falls, opened in 1912, provides access to additional virgin territory. Land telegraph and radio services operate between the several cities of the region and many smaller places, thereby lessening their isolation.

Estimates place the population of the Amazon basin at about 1,500,000, all but 200,000 being credited to Brazil. The city of Pará has 180,000; Manaos, 40,000; Iquitos, 8,000; Santarem, 5,000; Obidos, 3,000. It is estimated that in the Amazon basin about 30,000 labourers might be recruited for agricultural or other purposes. Considerable quantities of rubber, Brazil nuts, fish and other products were being exported in 1925. The region's imports were on the increase. (W. A. R.)

AMBASSADORS, CONFERENCE OF.—The term has been used in times past to denote the sessions or reunions of ambassadors at a certain centre, generally for the period of the execution of a treaty. The best example of this is the Ambassadors' Conference which sat at Paris and Vienna from 1815–22. It consisted of the ambassadors at Paris of Great Britain, Russia, Prussia and Austria. It was concerned with the execution of the Treaty of Vienna and cognate instruments, but naturally tended to interfere with other matters as well. But a strict limitation of its function to the Treaty of Vienna was insisted upon by Wellington as Allied Commander-in-Chief in France and by Castlereagh, the British Foreign Minister. On Canning's accession to power (Sept. 1822), this principle was so strictly observed as practically to withdraw England from the conferences altogether. The whole arrangement came to an end in 1826, after a period of eleven years.

Somewhat similar has been the experience of the Ambassadors' Conference between the years 1920 and 1925. With the coming into force of the Treaty of Versailles (Jan. 10 1920), the Ambassadors' Conference at Paris became one of the organs concerned with the execution of the Treaty. Another permanent one was the League of Nations (*q.v.*). A third, which was not permanent, but frequently superseded the Ambassadors' Conference, was the Supreme Council. None the less the Conference had considerable powers. It met every week at Paris and discussed the execution, first of the Versailles Treaty, and then of all the others. It consisted of the representatives of Great Britain, France, Italy and Japan, with the American Ambassador attending in the capacity of a spectator after 1921. Many of the technical decisions under the treaties were actually taken by the ambassadors, and in a large number of cases important interpretations were given. On the whole the Ambassadors' Conference tended to the advantage of France, for the full technical staff of her Foreign Office was available for every question, while the other Powers were generally represented only by their ordinary embassy staffs.

It is difficult to give details of their activities when so much mystery obtained concerning them. On the larger aspects of Reparations they were not influential. The German aspects were always withdrawn from them while Mr. Lloyd George was Prime Minister, and, after his fall, the same policy was continued by his two successors. Similarly the settlement of Austrian and Hungarian Reparations, though discussed in the Ambassadors' Conference, was decided by the League of Nations. On the other hand their decisions were sometimes final on questions of frontiers. In the case of Albania, a frontiers commission was appointed at Paris, and had thrashed out the question before the matter was transferred in Sept. 1921 to the League, which finally settled it in Nov. of that year. But, except in the case of Memel and the plebiscite areas, the complicated frontiers of Poland, left unsettled by the Peace Conference, were decided by the ambassadors. They also reorganised the frontiers established between Poland and Russia by the agreement of Riga.

The most important function performed by the Ambassadors' Conference was undoubtedly in Oct. 1921, when the ex-Emperor Karl for the second time returned to Hungary with the view of regaining his crown. The "Little Entente" (Czechoslovakia, Yugoslavia and Rumania) threatened very strong measures against Hungary. But, largely as a result of the ambassadors' intervention, Karl was arrested (Oct. 24), and a law was passed by the Hungarian Parliament which abrogated his sovereign rights (Nov. 3). The Ambassadors' Conference thus averted a dangerous crisis, and was held to have proved its value.

Its action in 1923, in connection with the Corfu incident, brought the Conference into some discredit, and produced considerable discussion as to the desirability of limiting its powers. Shortly after he became Prime Minister, Mr. Ramsay MacDonald

announced that its powers would be limited to the execution of the Versailles Treaty, and this policy seems in effect to have been continued. Much of its executive work has ceased since disarmament has been achieved in all ex-enemy countries, and since practically all financial matters have been transferred to other authorities.

The greater weight in the authority of the Council of the League, marked by the presence of British and French Prime Ministers in 1924, and of Great Britain's Foreign Minister and France's Premier in 1925, would appear to be a sign of the decline of the Ambassadors' Conference. It is significant that the Greco-Bulgar frontier dispute, which arose in Oct. 1925, was referred not to the Ambassadors' Conference, but to the Council of the League, at Paris. (*See* SUPREME COUNCIL.)

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AMENDOLA, GIOVANNI (1882–1926), Italian politician and journalist, was born at Naples April 15 1882. He entered journalism at the age of 18, and eventually became Rome correspondent of the Milan *Corriere della Sera*, which he left in 1921 to found a paper of his own, *Il Mondo*. In 1919 he was elected deputy for Sarno in the province of Salerno and re-elected in 1921 and 1924. After the War he devoted himself entirely to politics as a Democratic Liberal and a supporter of Nitti. On Nitti's fall, June 9 1920, he joined the opposition to Giolitti, and became Minister for the Colonies, first under Bonomi, then under Facta. He opposed Fascism from the first, and after Mussolini's advent to power he became in some sense the leader of the heterogeneous opposition groups. After the Matteotti crime he was the leader of those who withdrew from the Chamber to the Aventine (*see* ITALY). His devotion to constitutional principles led him during the election campaign of 1924 to declare the electoral law enacted by the Fascist Govt. to be unconstitutional and therefore null and void. Though generally respected for his honesty, he did not show the qualities necessary for a great political leader. His two publications *Una battaglia liberale* (1924) and *La Democrazia dopo il 16 Aprile 1924* (1924) made known his political faith. His death in hospital at Cannes April 6 1926, was thought to be the result of the two attacks on his life on Dec. 26 1923 in Rome, and in Aug. 1925, while on holiday at Montecatini.

AMERICANISM, a term first used by John Witherspoon, president of Princeton University, in 1781, designates (*a*) any word or combination of words which taken into the English language in the United States, has not gained acceptance in England, or, if accepted, has retained its sense of foreignness; and (*b*) any word or combination of words which, becoming archaic in England, has continued in good usage in the United States. The first class is the larger and has the longer history. The earliest settlers in Virginia and New England, confronted by plants and animals that were unfamiliar to them, either borrowed the Indian names or invented names of their own.

Examples are afforded by *raccoon* (1608), *chinkapin* (1608), *opossum* (1610) and *squash* (1642) among Indian words and by *bull-frog, canvas-back, cat-bird* and *live-oak* among inventions. The former tended to take anglicised forms. Thus the Indian *isquontersquash* (at least, that is how the early chroniclers recorded it) became *squantersquash* and was then reduced to *squash*, and *otchock* became *woodchuck*. Many other words came in as the pioneers gained familiarity with the Indian life. Such words as *hominy, moccasin, pone, tapioca* and *succotash* remain everyday Americanisms.

The archaisms, of course, showed themselves more slowly. They had to go out of use in England before their survival in America was noticeable. But by the beginning of the 18th century there was already a considerable body of them, and all through that century they increased. The English language in Great Britain, chiefly under the influence of pedantry in the age of Anne, was changing rapidly, but in America it was holding to its old forms. There was very little fresh emigration to the colonies, and their own people seldom visited England. Thus by the end of the century "*I guess*" was already an Americanism, though it had been in almost universal use in England in Shakespeare's day. So, too, with many other verbs: *to wilt, to whittle, to fellowship* and *to approbate*. And with not a few adjectives: *burly, catty-cornered, likely* and *clever* (in the sense of amiable). And with multitudes of nouns: *cesspool, greenhorn, cordwood, jeans, flap-jack, bay-window, swingle-tree, muss* (in the sense of a row), *stock* (for cattle) and *fall* (for autumn).

Meanwhile, American English had begun to borrow words, chiefly nouns, from the non-English settlers, and to develop many new words of its own. To the former class the Dutch contributed *cruller, cold-slaw, cockey, scow, boss, smearcase* and *Santa Claus*, and the French contributed *gopher, prairie, chowder, carry-all* and *bureau* (a chest of drawers). Other contributions came from the Germans of Pennsylvania, the Spaniards of the southwest, and negro slaves. The native coinages were large in number, and full of boldness and novelty. To this period belong, for example, *backwoods, hoe-cake, pop-corn, land-slide, shell-road, half-breed, hired-girl, spelling-bee, moss-back, crazy-quilt, stamping-ground* and *cat-boat*. These words were all made of the common materials of English, but there was something in them that was redolent of a pioneer people and a new world. In their coinage the elegances were disdained; the thing aimed at was simply vividness. At the same time, verbs were made out of nouns, nouns out of verbs and adjectives out of both.

In 1789 Benjamin Franklin, who had lived in England, denounced *to advocate, to progress* and *to oppose* as barbarisms, but all of them are good American to-day, and even good English. Noah Webster, the lexicographer, gave his imprimatur to *to appreciate* (in value); *to eventuate* was popularised by Gouverneur Morris; and no less a hero than Washington is said to have launched *to derange*. Many inventions of that daring era have succumbed to pedagogical criticism, *e.g., to happify, to compromit* and *to homologise*. But others equally harsh have gradually gained acceptance, *e.g., to placate* and *to deputise*. And with them have come in a vast number of characteristic American nouns, *e.g., breadstuffs, mileage, balance* (in the sense of remainder) and *elevator* (a place for storing grain).

Divergent Meanings of Words.—It was during the same period that a number of important words, in daily use, began to show different meanings in England and America. Some familiar examples are *store, rock, lumber* and *corn*. What Englishmen call a *shop* was called a *store* by Americans as early as 1770, and long before that time *corn*, in American, had come to signify, not grains in general, but only maize. The use of *rock* to designate any stone, however small, goes back still further, and so does the use of *lumber* for *timber*. Many of these differences were produced by changes in English usage. Thus *cracker*, in England, once meant precisely what it now means in the United States. When the English abandoned it for *biscuit* the Americans stuck to *cracker*, and used *biscuit* to designate something else. How *shoe* came to be substituted in America for the English *boot* has yet to be determined. There is indeed much that remains obscure in the early history of such Americanisms. Until very lately, American philologians kept aloof from the subject, which they apparently regarded as low. Until George P. Krapp, of Columbia University, took it up, there was not even any serious investigation of the history of American pronunciation.

Thus the American dialect of English was firmly established by the time the Republic was well started, and in the half-century following it departed more and more from standard English. The settlement of the West, by taking large numbers of young men beyond the pale of urbane society, made for grotesque looseness in speech. Neologisms of the most extravagant sorts arose by the thousand, and many of them worked their way back to the East. During the two decades before the Civil War everyday American became almost unintelligible to an Englishman; every English visitor marked and denounced its vagaries. It was bold and lawless in its vocabulary, careless of grammatical niceties, and further disfigured by a drawling manner of speech. The congressional debates of the time were full of its phrases; soon they were to show themselves in the national literature.

Policing the Language.—After the Civil War there was an increase of national self-consciousness, and efforts were made to police the language. Free schools multiplied in the land, and the schoolmarm revealed all her immemorial preciosity. A clan of professional grammarians arose, led by Richard Grant White; it got help from certain of the literati, including Lowell. The campaign went to great lengths. "*It is me*" was banned as barbarous, though it is perfectly sound historically; *eye-ther* was substituted in polite usage for *ee-ther*, though the latter is correct and the former is on the part of an American an absurd affectation.

But the spirit of the language, and of the American people no less, was against such reforms. They were attacked on philological grounds by such iconoclasts as Thomas R. Lounsbury; they were reduced to vanity by the unconquerable speech habits of the folk. Under the very noses of the purists a new and vigorous American slang came into being, and simultaneously the common speech began to run amok. That common speech is to-day almost lawless. As Ring Lardner reports it—and he reports it very accurately—it seems destined in a few generations to dispose altogether of the few inflections that remain in English. "Me and her woulda went" will never, perhaps, force its way into the grammar-books, but it is used daily, or something like it, by a large part of the people of the United States, and the rest know precisely what it means.

On higher levels the language of the Americans is more decorous, but even there it is a genuinely living speech, taking in loan-words with vast hospitality and incessantly manufacturing neologisms of its own. The argot of sport enriches it almost daily. It runs to brilliantly vivid tropes. It is disdainful of grammatical pruderies. In the face of a new situation the American shows a far greater linguistic resourcefulness and daring than the Englishman. *Movie* is obviously better than *cinema*, just as *cow-catcher* is better than *plough* and *job-holder* is better than *public-servant*. The English seldom devise anything as pungent as *rubber-neck*, *ticket-scalper*, *lame-duck*, *pork-barrel*, *boot-legger* or *steam-roller* (in its political sense). Such exhilarating novelties are produced in the United States every day, and large numbers of them come into universal use, and gradually take on literary dignity. They are opposed violently, but they prevail. The visiting Englishman finds them very difficult. They puzzle him even more than do American peculiarities of pronunciation.

Of late the increase of travel and other inter-communication between England and America has tended to halt the differentiation of the two dialects. It was more marked, perhaps, before the World War than since. But if it ever vanishes altogether the fact will mark a victory for American. The American cinema floods England (and the rest of the English-speaking world) with American neologisms, but there is very little movement in the other direction. Thus the tail begins to wag the dog. How far the change has gone may be observed in Australia. There a cockneyfied pronunciation holds out, but the American vocabulary is increasingly triumphant. In Canada it long ago overcame the last vestiges of opposition.

BIBLIOGRAPHY.—There is no satisfactory dictionary of Americanisms. The best is Richard H. Thornton's *American Glossary* (1912), but it is based wholly on written records and is thus incomplete. George Philip Krapp's *The English Language in America* (1925) is valuable to the student of American pronunciation, and contains much miscellaneous matter of interest, but there are gaps in it, and the author opposes his own evidence by arguing that English and American show few important differences. An extensive bibliography is in H. L. Mencken's *The American Language*, 3rd ed. (1923). In 1925 Dr. Louise Pound, of the University of Nebraska, began the publication of a monthly, *American Speech* (Baltimore).

(H. L. M.)

AMERICAN LEGION.—An organisation of World War veterans who served honourably in the armed forces of the United States or who, as American citizens, entered the armed forces of a government associated with the United States in the War. Organisation was effected at a series of meetings held at Paris, France, March 15–7 1919; at St. Louis, Mo., May 8–10 1919; and at Minneapolis, Minn., Nov. 10–12 1919. A national charter was granted by Act of Congress, Sept. 16 1919.

The membership attained its maximum (759,799) in 1921, standing at 609,407 in 1925. The legion maintains a national headquarters at Indianapolis, Ind., and publishes *The American Legion Weekly*, its official organ. Its activities have been directed effectively toward the passage of the National Defence Act (1920), the creation of the U.S. Veterans' Bureau (1921), the appropriation of government funds for the care of disabled veterans (total 1920–4, $2,044,944, 169), and the passage of bonus bills both by the Federal and state governments in favour of those who served in the World War. A programme for the aid of war orphans was devised in 1923; and in 1925, with the aid of the public, a fund of about $5,000,000 was raised to endow permanently the legion's child welfare and rehabilitation work. The legion also initiated the preparation of a code of national flag etiquette.

See Annual Reports to Congress; M. James, *A History of the American Legion* (1923); E. Putnam, "The American Legion—A Brief Outline of Its History and Accomplishments" (1923) and "The American Legion," in *Annual Report of the American Historical Association*, vol. 2; *ibid.*, vol. 1, p. 199 *seq.*

AMERICAN LITERATURE (*see* 1.831).—The years 1910 and 1911 were dates of real significance for literature in English. They marked with approximate accuracy the end of a period. It was then, and not later, when the turmoil of the World War had confused men's minds, that three literary movements lost their momentum, and a fourth became dominant. The brilliant but short-lived aestheticism of the 'nineties, with its wit and its vivid play upon sensation, died for lack of roots. The cult of force and moral manliness, which in Kipling's staccato style had captured the popular imagination on both sides of the Atlantic, lost its validity because it ceased to represent either the facts or the emotions of an era both more democratic and more sceptical. And finally, the premature romanticism which had swept America particularly into a sentimental enthusiasm for its own supposed past and made the presses reel with "best sellers," encountered the passion for reality which science had bred, and sank underground into that instinctive world where the interests of the demi-literate are forever fed by raw imaginings that have little place in literature.

It was, indeed, about 1910 that the scientists, the satirists, the philosophers in fiction, who since the 'eighties in Europe had been attacking the conventions upon which 19th-century literature rested, won their victory and scattered not merely the feeble remnant of Victorianism, but overthrew the Kiplings, the Stevensons, the sentimentalists and the aesthetes. Bernard Shaw and H. G. Wells were their protagonists in English, with the influence of the great Russians behind. About that time, both in Great Britain and in America, the prevailing interests of the literary changed. In prose and poetry, in fiction and on the stage, the attempt to escape from the conventional, to make literature square with new facts, to seek a fresher reality, is obvious. There is a break with the past which the World War only accentuated and the younger writers of the second and third decades accepted as their duty and heritage. The idea became more important than the form in fiction; the stage drifted toward satire; poetry, after a long dormancy, revived in realistic moods in which much that had been regarded as unpoetical was better expressed than beauty in its conventional aspects.

I. INTRODUCTION

At the beginning of the new epoch American literature was popular, diffuse and feeble, and Americans were far more influenced than influential; yet once the movement was under way it developed great energy and wrought wide changes in the literature of the United States. American writers who, except for Whitman and Mark Twain, had been of little world significance since the days of the great New Englanders, became again important, with definite achievements and still more definite promise. The effect of the War upon European literature was shattering. The story is different for America. That craving for a new reality which America had shared with Europe was reinforced and directed by the violent emergence of the United

States out of relative isolation into the current of world ideas. A new nationalism was born in American literature, due to a new perspective of America as a nation among nations.

This new nationalism was, from 1914 to 1920, in externals a new internationalism, engendered by a flood of European ideas (many of them wrapped round propaganda) which reached far beyond the bounds of literature and scholarship and led not only to a new knowledge of European thought, but, with more importance, to a vivid consciousness of ideas as a determinant of national beliefs and action.

The novels of Theodore Dreiser in the first decade of the century had expressed in powerful crudity the American attempt to get at the reality of American life; but in the *Spoon River Anthology* of Edgar Lee Masters in 1915, and in Sinclair Lewis' *Main Street* in 1920; a new spirit of self-criticism appears, which is quite as much due to a quickened national sense as to a search for truth.

In a romantic age the entry of America into the War might have led to a violent reaction from European ideas into a narrow and optimistic patriotism. In spite of victory and a vast prosperity afterwards, what happened was the reverse. The literature of the United States has become more critical, more realistic, more sophisticated. And although the American theme has been exalted as not before for many generations, what has been written is not " local colour " but studies of America as a part of world civilisation. The result has been a rapid increase of energy and effectiveness in American writing, due to the wealth of new subjects and the opportunity for experiment, with a much more uneven advance in the artistic value of the product. The years 1910–26 have been not so much an age of youth as an opportunity for all new talents, whether young or old. In poetry, the peak of energy was apparently reached in the second decade of the century, and the writers who established themselves then—such as Robert Frost, Amy Lowell, Edwin Arlington Robinson, Vachel Lindsay, Edgar Lee Masters and Carl Sandburg—have had no such virile successors; nor, with the exception of Frost, has their own later work been of sustained importance. American fiction, however, did not reveal its full power until 1920, and is still expanding in fertile experiment, and this is true also of drama and criticism.

The realism of this new American literature is thoroughly national in character. The work of Willa Cather, Booth Tarkington, Sherwood Anderson, Sinclair Lewis, Eugene O'Neill, Vachel Lindsay, for example, shows in effect the entrance into American literature, both as author and as subject, of the American democracy—not as Whitman conceived it, a band of equalitarian brothers, but as a bourgeoisie of everyday people, not class conscious, the product of industrialism and uplift. As industrialism tends more and more throughout the world to produce men and women of the American habit of life, this gives an importance to the new American fiction that is quite independent of its absolute artistic merit. In the American moving picture this social importance has often parted from aesthetic and critical values altogether. Sinclair Lewis' *Main Street* (1920) and *Babbitt* (1922), however, have a symbolic value comparable in kind, if not in degree, to *Hamlet* and *Anna Karenina*.

Still more closely related to the tendencies and influences noted above, is the striking drift toward satire, especially since 1920 and the disillusionment which followed the War. The inevitable comparison with European society arising from America's international experience resulted not so much in admiration of the foreigner as in criticism of home-made civilisation. Americans saw themselves in perspective as no earlier American writers had done—not even Mark Twain, whose satire was directed against humanity rather than America. Sinclair Lewis was the banner-bearer in this; but a surprising number of novels, plays and poems in the period can best be judged as satire, and a new criticism—literary, historical and social—has developed with either satire or analysis of the American mind as its chief motive. American literature has become fully self-conscious.

With self-criticism has come the sudden and almost complete sophistication of the advancing edge of American writing, both journalistic and literary, and especially of American dramatic writing. Naïveté has gone, except for the naïve assumption that comfort, wealth and triumphant love win happiness forever after, which is still current in broadcast magazine literature. American literary art has become critical, detached and often cynical to a marked degree. It is significant that this is least true in the American magazines of wide circulation which are a purely native product, and most marked upon the New York stage, which has been strongly influenced by European modes and ideas. There has also been a wide extension of the area in which experience is sought for art. The interest in the lower and middle levels of consciousness, so apparent in all of the stronger American writers, is of course common to all modern literatures, but in the United States it has been especially fruitful because it has led poets, dramatists and novelists to break through the standardisation of American experience to the incongruous emotions astir beneath. The uneven work of Sherwood Anderson, the sensational plays of Eugene O'Neill, the quiet penetration of Robert Frost, the fantasies of Christopher Morley, all are indicative of this new power. Inevitably the new area of investigation has spread to those questions of sex which psychology had revealed as of high importance, and the controversy as to the relations between art and decency has been an important part of contemporary criticism.

A direct result of these new extensions of interest has been a marked development of technique and a more uneven advance in literary craftsmanship. The novel and the drama have been especially fertile in experiment, and although the foreign influence of Proust, Dorothy M. Richardson, James Joyce and the German expressionists has been strong, the symbolism of Cabell, the realistic fantasy of Christopher Morley, the dramatic devices of O'Neill, the slow broodings of Anderson have been highly original in their application to the American theme. Craftsmanship, always the weak point in American literature, has notably advanced in the hands of such skilful workmen as Hergesheimer, Cabell, Frost, Elinor Wylie and Mrs. Edith Wharton, until crudity can no longer be regarded as a concomitant of strength in American writing. On the stage this sense of artistic fitness has been most notably displayed in the remarkable development of background and direction, where again the inspiration is European but the result often highly original.

The only " schools " of literary expression which may be said to have come into existence in the United States since 1910 are symptomatic of the tendencies at work. Free verse, of which the imagists, led by the late Amy Lowell, were champions, was essentially an attempt to get new vigour and new scope for American poetry. It was used and overused by writers whose interest in the American scene led them to desire, like Whitman, new rhythms to express perceptions not hitherto felt to be poetical. Having accomplished its main purpose, free verse as such has become again of minor importance. The curious outburst in American fiction of what the French many decades earlier had called naturalism, was largely a result of the new interest in American life. The novel of the Middle West, usually of farm experience, which became a familiar type in this period, was written in the closest possible imitation of the actual appearance of life, and was made vigorous, if not always interesting, by the sudden discontent of its authors with the monotony and narrowness of American rural existence. Here, as in free verse and in the handling of sex, honesty frequently outran art.

Outside of belles lettres, such work in biography and history as could properly be called literature was strongly influenced by the conditions of the era. The scientific, impersonal study of facts which had its great impetus in the 19th century became the foundation for more critical, more personal, and more imaginative books, which did not so much revert to the older methods of narrative as substitute criticism, philosophy and analysis for an unrelieved structure of uninterpreted fact. The new international interests brought by the War and the sudden discovery of the importance of the American frontier were stimulating factors. Such books as *The Education of Henry Adams* (1918) and such a series as the *Chronicles of America*, ed. Allen Johnson

(1920), reflected in the one case the more human note, and in the other the breadth of the new interest in the American past, which every year since their publication has seen increase. Such notable memoirs as the *Letters of Walter H. Page* (1922, 1925) and of *William and Henry James* (1920) have helped to increase the interest of Americans in themselves.

The history of the period 1910–26 in American literature is a story of new fundamental conceptions entering the American mind, which have conditioned all writing not strictly utilitarian or entirely superficial in its nature. The new premises upon which a part of American thinking and observation have been conducted, the sense of new values in beauty and the emotions generally, have combined with the influence of the innumerable translations and reprints from abroad to encourage technique, increase sophistication, lift the general level of literary accomplishment and sharpen and clarify the interest in the American scene. There are perhaps few great names in this period, although purely aesthetic criticism has had as yet little time or inclination to operate; but the violence of the attack by representatives of an older culture upon the typical books of the time is evidence of the energy inspiring change. Contemporary American literature is clearly both pioneer and transitional, and bears every mark of the beginnings of a new age. (H. S. C.)

II. POETRY

What has been called "the new era in American poetry" may be said to date from 1914. In that year various unformed tendencies suddenly crystallised into a set of movements, and the poets who were to become the leaders of the renaissance issued their first challenging volumes. Within 12 months there appeared Vachel Lindsay's *General Booth Enters into Heaven*, Amy Lowell's *Sword Blades and Poppy Seed*, James Oppenheim's *Songs for the New Age*, Robert Frost's *North of Boston*, and the first anthology of *The Imagists*, which, under the aegis of Amy Lowell, introduced the work of John Gould Fletcher and "H. D." A year later readers became familiar with four new names, through the immediate popularity of Edgar Lee Masters' *Spoon River Anthology* (1915), Sara Teasdale's *Rivers to the Sea* (1915), Edwin Arlington Robinson's *The Man against the Sky* (1916), and Carl Sandburg's *Chicago Poems* (1916). Edna St. Vincent Millay's *Renascence* had been acclaimed as early as 1912, and in 1917 these poignant verses, written by the poet at 19, became the title-poem of her most famous collection.

Her sonnets took rank among the best ever written in America, and her concise lyrics in *Second April* (1921), recalling influences as unlike as Catullus and Emily Dickinson, gave rise to a small army of imitators. Sara Teasdale won almost as many followers. Her *Rivers to the Sea* (1915) and *Flame and Shadow* (1920) contain love songs worthy of Christina Rossetti, poems which are as inevitable and artless as folk-songs.

Though some of the poets attained eminence in more than one *genre*, the tendencies of the period were so pronounced that much of the poetry fell naturally into certain divisions. The outstanding group—the one to interpret life from the realistic standpoint—included Edwin Arlington Robinson, Robert Frost, Edgar Lee Masters and Carl Sandburg. Each of these achieved an attitude and an idiom which, while strongly differentiated, were always indigenous. Robinson was the first to revolt from the rhetorical exaggeration and the "poetic diction" of the preceding period. Even his first volume, *Children of the Night* (1897), anticipated the later innovators by using a speech that was not the language of the poetasters but of the people. His *Collected Poems* (1921) and the subsequent *Dionysus in Doubt* (1925) revealed a precise and curiously astringent voice, a tone that, in its very clipped syllables, declared its New England origins. The dryness of his utterance was deceptive; beneath the congealed phrases there ran a warm flood of sympathy, particularly with those who, from a worldly point of view, were failures. His most highly coloured canvases are those of such defeated dreamers as "Miniver Cheevy" and "Captain Craig," mediocrities like the son in "The Gift of God" and battered derelicts like "Bewick Finzer." Robinson's spiritual godfather is undoubtedly Browning. More surprising than the tremendous extent of his gamut is the certainty of the smallest notes he strikes within it. He is as successful with a long philosophic monologue (*vide* the panoramic "Ben Jonson entertains a Man from Stratford") as with a concentrated sonnet; he is equally at home in a ballad, in dialogue and in the blank verse novel, "The Man who Died Twice" (1924), which won him the Pulitzer Prize for the second time. His brilliant condensations, his objectiveness, his very inability to surrender to the emotions, establish his individuality as well as his backgrounds.

Robert Frost, fully as representative, was even more obviously "native." His *North of Boston* (1914), *Mountain Interval* (1916) and *New Hampshire* (1923), constitute a New England trilogy. Here are the gaunt hillsides, the thinning homesteads, the physical and spiritual isolation of a people struggling among rocky pastures and dried-up brooks. In delineating his subjects, Frost showed himself, first of all, a lover of the fact. But Frost was no mere despondent statistician; he wore his rue and realism with a difference. If he was a farmer, he was also a philosopher, he was more concerned with the soul than with the soil. Nor was he a grim naturalist. His gravest narratives were pronounced with something akin to fantasy; a sly pucker was never absent from so straightforward a disclosure as "Mending Wall"; even that sombre masterpiece, "The Death of the Hired Man," was not without intellectual raillery. It was the "tone of voice" which characterised not only Frost's major efforts but the later lyrics which, though less known, bid fair to rank as high as his larger designs. Here—and this feature has already become an "influence"—was a natural speech so arranged that the accents of the speaker rose from the printed page.

The work of Edgar Lee Masters divided itself into two parts: *Spoon River Anthology* (1915) and the volumes which preceded and followed it. *Spoon River Anthology* was possibly most important as a document; there can be no doubt concerning its powerful translation of local drama, village gossip and universal passions. As art its value was less certain, but its concise epitaphs were far more arresting than the pedestrian blank verse which prevented the excellent thought in *Towards the Gulf* (1918) and *Domesday Book* (1920) from attaining literary distinction.

The realism of Carl Sandburg frequently approached mysticism. Sandburg had been termed "the laureate of industrial America"; and the appellation seems apt enough, for all his volumes, particularly *Chicago Poems* (1916), *Cornhuskers* (1918) and *Smoke and Steel* (1923), vibrated with the throbbing of immense machines. What Frost and Robinson did for New England, Sandburg did for the mid-west. His poetry, like his setting, was full of ferment; his irregular lines, exploring the borderland between poetry and prose, captured a dynamic energy which employed slang with gusto and, occasionally, with beauty. In spite of a frequent excess of violence in his utterance, the mystical element continually loomed above the brutal. If Sandburg gave voice to some of the most raucous declamations of his day, he also breathed some of its quietest phrases.

The aesthetic attitude, though limited in appeal, was responsible for three years of bitter controversy. The literary conflict started quietly enough with the publication of the first volume of *Some Imagist Poets* (1915), grew violent with Amy Lowell's belligerent championship, and finally developed into a prolonged battle over free verse. The Imagists themselves—Amy Lowell, John Gould Fletcher and "H. D." were the American contributors, although Ezra Pound was the first organiser of the group—placed their emphasis on a visual poetry ("the presentation of an image"), on "absolute freedom in the choice of subject," on "the language of common speech," on the "use of the *exact* word, not the merely decorative word." Though much of their work was the product of a programme rather than the result of a creative compulsion, their influence was that of a healthy corrective. The late Amy Lowell was the most tireless fighter against facile platitudes and the clichés of the period; her volumes are a series of brilliant protests, though she herself scorned propaganda in poetry. Even her two-volume biography *John Keats* (1925) caused almost as much discussion as her controversial criticism. *Men, Women and Ghosts* (1916) and *Pictures of the*

Floating World (1919) reveal an enamelled world whose glittering contours are as " hard and clear " as any artisan could desire. The group disintegrated; Amy Lowell turned to larger and more orthodox patterns; John Gould Fletcher and " H. D." amplified their *vers libre* with rhyme and an almost formal construction, the latter's *Collected Poems* (1925) proving to be one of the chief accomplishments of this movement.

Of the rhapsodists, the two most important were Vachel Lindsay and James Oppenheim. Where Lindsay used a drum-beat rhythm and percussive rhymes, Oppenheim employed a semi-Whitmanic, semi-Biblical free verse, but a broadly rhapsodic spirit dominated the work of both. Lindsay was essentially a populariser, capturing in his chants the syncopated sounds of modern American life. Although he disdained the appellation, he was called " the poet who united ragtime and religion," and an examination of his *General Booth enters into Heaven* (1913), *The Congo and other Poems* (1914) and *The Golden Whales of California* (1920) disclosed the influence of half-savage dance tunes, minstrel shows and the hurly-burly of " jubilee " camp-meetings. But Lindsay was as much the missionary as the minstrel, a street-corner evangelist pausing in the midst of his preaching to perform on the saxophone. Oppenheim achieved his effects by recalling the sonority of the Psalms. *The Sea* (1924), a collection of his previous volumes, was both prophetic and analytical; its key was major and its theme was " We are flesh on the way to godhood." Another poet influenced by Whitman though not imitative of him was Robinson Jeffers. Jeffers' *Roan Stallion* (1926), a sensational blend of beauty and violence, was hailed by even the more academic critics as a communication of almost elemental power.

Many of the critics of the " new " poetry, admitting its vigorous spontaneity and intellectual variety, objected that it lacked the sheer singing quality which had been the chief property of English verse. Nothing could be farther from the fact. Lizette Woodworth Reese was the forerunner of the lyricists who, reacting from the elaborate graces and coy affectations of the love-songs of the preceding period, delighted in a direct speech, sparse imagery and immediacy of contact. Of these singers the majority were women, of whom the best known was Edna St. Vincent Millay.

Adelaide Crapsey, Genevieve Taggard, Léonie Adams, Elizabeth J. Coastworth, Hazel Hall, Jean Starr Untermeyer were possibly the most ingratiating of this group, although a sharper and more cerebral type of lyric was patterned if not perfected by Elinor Wylie and the more impassioned Louise Bogan. Mrs. Wylie's verses, in *Nets to Catch the Wind* (1921) and *Black Armour* (1923), were particularly edged; here was a dazzling technique fitted to an unusually " jewelled brain." Among the more resonant singers, Conrad Aiken fashioned a curiously crepuscular music, which later, in *Punch; The Immortal Liar* (1921) and *Priapus and the Pool* (1925), developed into a dark lyricism of extraordinary plangency.

John Crowe Ransom perfected a subtly modulated accent in *Chills and Fever* (1924); John Hall Wheelock, beginning with the buoyant athleticism of *The Human Phantasy* (1911), ascended to a more controlled ecstasy in *The Black Panther* (1922); William Rose Benét and Stephen Vincent Benét, brothers in blood and balladry, struck their most vigorous chords in the former's *The Burglar of the Zodiac* (1918) and the latter's *Tiger Joy* (1925).

Following Edwin Markham's *The Man with the Hoe* (1899), social protest found voice in the extended *Poet in the Desert* (1915) by Charles E. S. Wood, *Arrows in the Gale* (1914) by Arturo Giovannitti and *Challenge* (1914) by Louis Untermeyer. The last was Untermeyer's most popular volume, although *Roast Leviathan* (1923), displaying a far greater restraint, was a decided advance in tone and technique. As parodist and translator, his performances in *Including Horace* (1919), *Heavens* (1922) and *Poems of Heinrich Heine* (1923) were well received, and his critical collections, *Modern American Poetry* and *Modern British Poetry*, were revised several times subsequent to their publication in 1919.

After America's entrance into the World War a great quantity of militant poetry was produced of which next to nothing remains. The names of only two "War Poets," both of whom were killed in action, have survived, and each of these persists by virtue of a single poem: " Trees " by Joyce Kilmer and " I have a Rendezvous with Death " by Alan Seeger.

As has been implied, Ezra Pound was the leader of the experimentalists. A pioneer in style and an innovator in metrics, he allowed his artistry to become theory-logged and to sink in a welter of erudition. The same is true of much of the work of T. S. Eliot, whose *The Waste Land* (1922) occasioned a fierce controversy.

Nor would the record of energetic experiment be complete without listing the euphuistic ironies of Maxwell Bodenheim, the staccato whimsicalities of Alfred Kreymborg, the abstract elegance of Wallace Stevens, the critical wit of Marianne Moore, the curious combination of typographical trickery and lyric gravity of E. E. Cummings. The traditional note, though less assertive, has not been silenced for lack of expression. Among the more conservative technicians were William Ellery Leonard, whose autobiographical *Two Lives* (1925) proved to be one of the most remarkable sonnet sequences ever produced in America; Arthur Davison Ficke; John G. Neihardt, whose *Song of Three Friends* (1919) is part of an epic series celebrating the winning of the West; and the rhetorical but often eloquent George Sterling. (L. U.)

III. FICTION

The death of Mark Twain in 1910 led to a change of opinion concerning him in the United States, which was symptomatic of a larger change of opinion, already under way, concerning fiction in general. Heretofore he had customarily been valued for his broad humour and his eloquent gusto. Now, however, the publication of *Mark Twain: A Biography* (1912) by Albert Bigelow Paine, *Mark Twain's Letters* (1917) and such posthumous works as *The Mysterious Stranger* (1916) and *What Is Man?* (1917 —but privately printed in 1906) called attention to a strain of naturalism, often profound and almost always pessimistic, which had grown upon Mark Twain during his later years. That this strain was noted after his death as it had not been noted before was due only in part to the further evidence which his posthumous books offered. Various other writers as well, since about the time of the war with Spain (1898), had been insisting, both in their theories and in their practice, that realism could no longer be bounded by the discreet and kindly limits set by William Dean Howells but must look more searchingly into various hidden paths and remote fields of human conduct; and there had come into existence a public which was impatient of a certain genteel smugness characteristic of much of the fiction produced at the close of the 19th century and the beginning of the 20th.

Of the predecessors of the movement the first place may be given to Stephen Crane, whose Civil War novel *The Red Badge of Courage* (1895) remains at once the most convincing and the most beautiful fiction commemorating that war. In this and in his other stories dealing with warfare, and in his *Maggie: A Girl of the Streets* (1893; 1896), Crane disregarded the expansive and sentimental moods ordinarily implied or evoked in fiction concerned with such themes, and fixed his eye upon specific facts with the intensity of genius. No one of his followers was quite so intense, but some of them learned from him, or shared with him, the method of concentrating upon individuals rather than upon types or social classes. Harold Frederic's *The Damnation of Theron Ware* (1896), a study of the disintegration of a clergyman under the influence of liberal ideas; Theodore Dreiser's *Sister Carrie* (1900), an account of the rise of a trivial woman to fame as an actress; David Graham Phillips's *Susan Lenox*, 2 vol. (1917), a record of the drab miseries and sober splendours of a courtesan; Hamlin Garland's *A Son of the Middle Border* (1917), an autobiographical chronicle of a pioneer—all these are devoted to exceptional individuals whose stories become more rather than less impressive in their application for the reason that they are so little muffled in generalisations.

This interest in exceptional individuals not infrequently gives to American naturalism a quality which makes it seem more or less romantic as compared to the official realism of Howells and his school, with their primary emphasis upon the normal ways of life. Frank Norris, in the two parts of his uncompleted trilogy, *The Octopus* (1901) and *The Pit* (1903), wrote with touches of epic magnificence about the growing and marketing of wheat. Jack London, in *The Call of the Wild* (1903), *The Sea-Wolf* (1904), *Love of Life and Other Stories* (1907) and in many other volumes of autobiographical and fictive adventure, dealt with animals and men waging a fierce evolutionary struggle against hostile environments, and may be said to have created the demand for " red blood " in fiction which still persists. Upton Sinclair, the chief spokesman in fiction of the American proletariat, made vigorous, if at times sensational, drama out of the warfare between social classes, in *The Jungle* (1906) and *100%* (1920), as well as in other equally characteristic, though not equally successful, books, all occupied with phases of the same conflict.

William Sydney Porter, better known as "O. Henry," brought a kind of vivacious Bohemianism to bear upon the little comedies of existence which he noted among the undistinguished inhabitants of New York City, as in *The Four Million* (1906), and extended the same spirit with the dexterity of an accomplished raconteur to other sections of the country, as in *Heart of the West* (1907).

Strictly speaking, however, American naturalism did not reach its full development until the second decade of the 20th century, when Theodore Dreiser (*q.v.*) published the bulk of his fiction: *Jennie Gerhardt* (1911), *The Financier* (1912), *The Titan* (1914), *The Genius* (1915), *Free and Other Stories* (1918), *Twelve Men* (1919). These, with *An American Tragedy* (1925) and the various autobiographic works, *A Traveler at Forty* (1913), *A Hoosier Holiday* (1916), *A Book About Myself* (1922), *The Color of a Great City* (1923), should have served to make Dreiser's attitude and aims clear. Instead, he has been misunderstood and misrepresented, mispraised and misdefended, with an abundance which falls to the lot of only those writers who, whether deliberately or not, become centres of controversy. The controversy about Dreiser is due simply to his habit of regarding human life with more attention to its personal than to its social aspects. His characters either move in the direction of their desires under the impulse of some primitive will or else drift at the mercy of capricious tides of fortune. Something romantic unquestionably appears in his preoccupation with such primitive elements and in his disposition to forgive whatever seems to be natural in the conduct of men. His brooding pity, however, does not reduce him to mere softness. He has been unwearying in his search for evidence in every case, and has assembled such a mass of rugged documents as no other novelist of his school has furnished. His best work, on the whole, may be found in *Sister Carrie*, *Twelve Men* and *An American Tragedy*.

With the school of naturalism may be associated certain novelists who, while technically not much akin to it, join with it, in effect, in swelling the literature of protest. Robert Herrick in such of his novels as *The Memoirs of an American Citizen* (1905), *Together* (1908) and *Waste* (1924) has bitterly arraigned the conventional American ideas about marriage and about money. Sinclair Lewis in *Main Street* (1920), *Babbitt* (1922) and *Arrowsmith* (1925), has won a hearing for an issue never before made popular in the United States. His heroes and heroines all revolt against the dullness of life and attempt, with varying degrees of success, to escape from it. Brilliant as a satirist, with an alert and decisive intelligence, Lewis has also the gift of rapid and persuasive narrative. He has also the knack of phrase which has enabled him to make "Main Street" synonymous with provincial dullness and "Babbitt" the generic name of any complacent business man. Less witty and clear-cut than Lewis, Sherwood Anderson has been engaged in the same assault upon stupidity. In a sense, *Winesburg, Ohio* (1919), *The Triumph of the Egg* (1921), *Horses and Men* (1923), *A Story Teller's Story* (1924) and *Dark Laughter* (1925), all tell the same story, of how a troubled spirit, bewildered by the complexity and apparent meaninglessness of American industrial life, makes an effort to break away from it toward freedom. The bondage is always obscurely felt and the goal is always dim, but the impulse is keen and irresistible. Anderson, who is a poet at heart, is profoundly devoted to the idea that life to be truly good must be mobile and creative, not fixed and obedient.

The literature of protest, of course, is far from including all the recent varieties of fiction. Booth Tarkington has been content, as in *Penrod* (1914), *Seventeen* (1916), *The Magnificent Ambersons* (1918) and *Alice Adams* (1921), to accept contemporary life on virtually its own terms and to make observant and agreeable fun of its follies. Something of the same impulse guides George Ade, whose work from *Fables in Slang* (1899) to *Hand-Made Fables* (1920) caricatures a generation in an inimitable idiom. The language of illiteracy has been employed with humorous shrewdness by Don Marquis in *The Old Soak and Hail and Farewell* (1921) and *The Old Soak's History of the World* (1924) which create a character in the honourable native line of Artemus Ward and Mr. Dooley, and by Ring W. Lardner in *You Know Me Al: A Busher's Letters* (1916), with its amusing burlesque hero, and with less illiteracy but no less vernacularity in *How to Write Short Stories* (1924), a collection of short narratives of notable veracity.

At the other extreme are the novels and tales by Edith Wharton, who has applied a method inherited from Henry James to the representation of fashionable life chiefly in New York City and in the parts of Europe frequented by cultivated and sophisticated Americans. *The House of Mirth* (1905), *The Custom of the Country* (1913), *Xingu and Other Stories* (1916) and *The Age of Innocence* (1920) are written with subtle irony and with an imaginative grasp of delicate situations. Mrs. Wharton's masterpiece, however, is generally conceded to be *Ethan Frome* (1911), a moving *tour de force* concerned with a tragic stroke of fate in rural New England. Willa Cather, almost as subtle though not so ironical as Mrs. Wharton, surpasses her in sympathy with simple, instinctive persons. The heroines of *O Pioneers!* (1913), *The Song of the Lark* (1915), *My Antonia* (1918) and *A Lost Lady* (1923) are among the most convincing women in the entire range of American fiction. The interpretation goes past all superficial judgments as to the goodness or badness, the intelligence or stupidity of these characters, and reveals an essence which somehow seems to lie deeper than any of their defining traits.

Considerably aloof from all these other tendencies are three novelists who are often put in a single class because they have in common a taste for exquisite decoration. They have little else in common. Elinor Wylie began her career as a poet, but turned aside to write *Jennifer Lorn* (1923) and *The Venetian Glass Nephew* (1925), dainty, exotic romances with plots as irresponsible as those of fairy tales and with the pungent, allusive manner of high comedy. Carl Van Vechten turned from musical criticism to write *Peter Whiffle: His life and works* (1922), *The Blind Bow-Boy* (1923), *The Tattooed Countess* (1924) and *Firecrackers* (1925), which with a witty erudition and some diabolism chronicle the lives of certain groups of emancipated intellectuals, mostly resident in New York City. Joseph Hergesheimer in *Mountain Blood* (1915), *The Three Black Pennys* (1917), *Java Head* (1919), *Linda Condon* (1919) and *Cytherea* (1922), to mention only his most characteristic novels, has set forth various American periods and localities with remarkable pictorial vividness and has also made striking drama out of various profound problems of character.

Most detached of all from contemporary life and from current modes of fiction is James Branch Cabell (*q.v.*) who is as eminent among modern American romancers as Dreiser is among the naturalists. Cabell's work consists of a series of novels, tales and poems, all bound together in a concerted scheme and furnished with a critical prologue and an autobiographical epilogue. The stories are gay, high-hearted and dramatic. The style, while now and then mannered, is uniformly rich and beautiful.

Information respecting most of the writers mentioned above and numerous others who cannot be mentioned for lack of space will be found in George Gordon, *The Men Who Make Our Novels* (1919); Grant Overton, *The Women Who Make Our Novels* (1918); Blanche Colton Williams, *Our Short Story Writers* (1920); Carl Van Doren, *Contemporary American Novelists 1900–1920* (1922). The "Modern American Writers" series includes studies of Dreiser (1925) by Burton Rascoe, *Edith Wharton* (1925) by Robert Morss Lovett, and *James Branch Cabell* (1925) by Carl Van Doren. (C. V. D.)

IV. HISTORY, BIOGRAPHY, ETC.

The effort toward realism characteristic of American literature since 1910 is apparent in history, biography and criticism, as well as in fiction and poetry. In historical writing this spirit of realism has shown itself in the collection and study of documents reflecting the social and economic life of different epochs, and the scientific interpretation of events in their light. The publication of Frederick J. Turner's *The Frontier in American History* (1920) was an important contribution to this movement.

While the continuation of the monumental works on the

history of the United States, by James Ford Rhodes and Edward Channing, is to be noted, a more important work is *The Riverside History of the United States* (1915), edited by William E. Dodd, to which Carl L. Becker contributed *Beginnings of American Life;* Allen Johnson, *Union and Democracy;* W. E. Dodd, *Expansion and Conflict,* and F. L. Paxson *The New Nation.* Other members of this school of realistic interpretation are James Truslow Adams in his studies of *Revolutionary New England 1691–1776* (1923), Charles A. Beard in his *Economic Interpretation of the Constitution of the United States* (1913) and *Economic Origins of Jeffersonian Democracy* (1915), Samuel Eliot Morison in his *Maritime History of Massachusetts 1783–1860* (1921) and his *Sources and Documents Illustrating the American Revolution 1714–1788* (1923). The contributions of American writers to European history are necessarily less striking, but at least *The Mediaeval Mind* (1914) by Henry Osborn Taylor and *Mont-Saint-Michel and Chartres* (1913) by Henry Adams should be mentioned. Certain American historians who maintained their scientific detachment were able to render a service of high value in the review of the documents bearing upon the origin of and responsibility for the World War, chief among them Prof. Sidney B. Fay.

In the philosophic interpretation of the forces which have underlain the unfolding of the national life of the country, such as the economic urge of the pioneer and the religious zeal of the Puritan, Herbert Croly's *Promise of American Life* (1909) and *Progressive Democracy* (1914) have exercised most influence on the new school of critics to be mentioned shortly. The founding of *The New Republic* in 1914 under his editorship brought together a group of journalists whose chief aim was the constructive criticism of contemporary politics, among whom Walter Lippmann with his *Preface to Politics* (1913), *Drift and Mastery* (1914) and *Public Opinion* (1922), and Walter E. Weyl with *The New Democracy* (1912) and *Tired Radicals* (1921) were outstanding figures.

The same tendency toward realism in the collection of fact and observation of phenomena shows itself in biography and autobiography. The period under discussion is remarkable for the number of narratives of personal experience which divided with fiction the favour of the reading public. Thus we have the self-revelation of a member of the Puritan aristocracy in *The Education of Henry Adams* (1918), the experience of the pioneer in Hamlin Garland's *A Son of the Middle Border* (1917), and the life-stories of immigrants in Mary Antin's *The Promised Land* (1912), *The Americanization of Edward Bok* (1920) and Ludwig Lewisohn's *Up stream: An American Chronicle* (1922). A rich experience among many of the various strains of our population is recorded in Jane Addams' *Twenty Years at Hull-house* (1910). Light is thrown upon the political life of the time in the *Autobiography* (1913) of Theodore Roosevelt and the *Autobiography: A Personal Narrative of Political Experiences* (1913) of Robert Marion La Follette. Biography during this period felt the impulse toward new and penetrating methods of interpretation afforded by the psychological investigations of the psychoanalysts and behaviourists. Among the more formal biographies, Albert Bigelow Paine's *Mark Twain's Biography* (1912) and Amy Lowell's *John Keats* (1925) are in the front rank. The specific effort to detach characters from conventional appraisal and to interpret them anew in the light of their behaviour and environment and by the aid of analytic psychology is seen in the biographical studies of Van Wyck Brooks, *The Ordeal of Mark Twain* (1920) and *The Pilgrimage of Henry James* (1925), the essays of Gamaliel Bradford, *Damaged Souls* (1923) and *Bare Souls* (1924).

With the possible exception of poetry, the field of most striking development in American literature in the years 1910–26 is criticism. Here we find at the beginning of the period a well-entrenched group of critics carrying on the traditions of Lowell and Whipple, devoted to maintaining the aesthetic standards of classicism, the ethical standards of Puritanism, the social ideals and individual tastes for which President Harding later coined the word "normalcy." In 1910 appeared *The New Laokoön* of Irving Babbitt in which he stated with much ability the case for classicism. During the period Paul Elmer More was continuing his *Shelburne Essays, 1904–10* and W. C. Brownell was adding to his acute studies of style in *American Prose Masters* (1909). Stuart Pratt Sherman began as a militant member of this school, with *Americans* (1922), but has steadily moved leftward with his acceptance of such realists as Sherwood Anderson and Sinclair Lewis. A critic who showed a marked departure from this group was James K. Huneker, who protested that he cared nothing for general ideas, and though possessed of sound technical equipment in the fields of music and literature, gave himself more and more to sheer impressionism. Following Huneker, Henry L. Mencken asserted the creed of creative criticism; but in the main he has devoted himself to attacking the social and aesthetic idols of traditional American culture, and defending realistic, out-of-door writers like Theodore Dreiser and Edgar Lee Masters. His first campaign was in behalf of the robust philosophy of Nietzsche, *Philosophy of Friedrich Nietzsche* (1911). In subsequent years his *Book of Prefaces* (1917) and successive books of *Prejudices: First Series* (1919), *Second Series* (1920), *Third Series* (1922), *Fourth Series* (1924), continued his challenge. With the establishment under his editorship of *The American Mercury* (1924), he became for the moment the greatest critical force in America. Among other critics who have extended the bounds of American appreciation are Ernest Boyd who as a cosmopolitan of the world of letters has brought foreign developments, particularly the awakening in Ireland—*Ireland's Literary Renaissance* (1916)—to notice, and Carl Van Doren, who with Professor Sherman Erskine and Trent edited the *Cambridge History of American Literature* (1917–21), and as literary editor of *The Nation* and later of *The Century* has been the foremost to greet newly arriving poets and novelists. The most original and distinctive summary of American literature is that by John Macy, *The Spirit of American Literature* (1913).

In the years before the War appeared a group of literary critics who joined hands with the new school of political critics to press questions of ultimate significance with reference to the bases of American culture and its relation to original creative art. These writers pointed out the close connection between the Puritan and pioneer origins and the subsequent development of a civilisation based on ideals of luxury and material success. They endeavoured to forward in national culture and creative effort the original and genuine in place of the imported and imitated. The ground was prepared for their effort by the gathering of a group of writers and workers in the arts about the personality of Alfred Stieglitz in his studio in New York. Out of this group sprang *The Seven Arts Magazine,* which had among its contributors James Oppenheim, Van Wyck Brooks and Randolph S. Bourne. The sceptical attitude of these critics toward the past extended itself to the contemporary crusade of America to make the world safe for democracy, and their magazine perished in the War. The attitude and purposes of the school found expression in Van Wyck Brooks' *America's Coming of Age* (1915) and *Letters and Leadership* (1918), Randolph Bourne's *Youth and Life* (1913) and *Untimely Papers,* published posthumously in 1919.

A definite and fundamental relation to these advanced schools of political and cultured thought is held by pragmatic philosophy. William James died in 1910; but his personal influence remained strong, revived by the publication of his *Letters* (1920). The chief formal promulgation of the pragmatic attitude in regard to conduct and education was made by John Dewey in *Human Nature and Conduct* (1922) and *Experience and Nature* (1925). The ablest opponent of the pragmatists was George Santayana in *Winds of Doctrine* (1913) and *Character and Opinion in the United States* (1920). In *Scepticism and Animal Faith* (1923), however, he seems to approach their point of view. Santayana has reached a high place in American letters as a literary and miscellaneous essayist in *Three Philosophic Poets* (1910) and *Soliloquies in England* (1922). Among other essayists, Dr. S. M. Crothers in *Humanly Speaking* (1912) and *The Dame School of Experience* (1920) continues the genial tradition of Dr. Oliver Wendell Holmes; Agnes Repplier, with considerable tartness, defends the conservative point of view in *Counter Currents* (1916) and *Under Dispute* (1924). Another tradition of the American essay, that of Thoreau, is continued in the nature studies of John Burroughs, *Studies in Nature and Literature* (1913) and John Muir, *Boyhood of a Naturalist* (1916). (R. Lo.)

V. NEGRO LITERATURE

The plight of the Africans brought to America during the slave trade and of their descendants is one of the most dramatic in human history. That there should arise a literature written by black Americans touching their own situation depended on many things—their education, their economic condition, their growth in group consciousness. Before 1910, the books written by American Negroes were with some exceptions either a part of the general American literature or individual voices of Americans of Negro descent.

There began, however, about 1910 something that can be called a renaissance. It came because of oppression, because the spread of education made self-expression possible, and because a larger number of these 10,000,000 people were raising themselves above

the lowest poverty. The first sign of this renaissance was naturally a continuation of the self-revelations current during the abolition controversy in the slave narratives, of which Frederick Douglass's *Life and Times* (1892) was the most striking and Booker Washington's *Up from Slavery*, published in 1901, the last great example. Since 1910, other autobiographies have followed. In these later stories there is, of course, less of the older spontaneity, little of adventure and more self-consciousness. John R. Lynch published his revealing *Facts of Reconstruction* in 1913. Alexander Walters (a black bishop), R. R. Moton (the successor of Booker Washington) and many others published autobiographies.

A more careful consideration of the Negro's social problems has characterised the period 1910–26. This is perhaps best illustrated by the three or four volumes of essays published by Kelley Miller, the trenchant work of William Pickens, W. E. B. DuBois's *Darkwater* (1920), and J. A. Rogers's *From Superman to Man* (1917), and especially by the files of the growing weekly Negro press. These general considerations have led to a number of scientific studies. Foremost among these are the series of Atlanta University studies covering 13 years and touching such matters as *Efforts for Social Betterment among Negro Americans* (1910); *The College-Bred Negro American* (1911); *The Common School and the Negro American* (1912); *The Negro American Artisan* (1913); *Morals and Manners among Negro Americans* (1915). There came also as a result of the Chicago riot the careful study of *The Negro in Chicago* (Illinois-Chicago Commission on Race Relations, 1922). The Tuskegee *Negro Year Book*, edited by M. N. Work annually since 1915, and the work of Dr. George E. Haynes have been along the same lines.

More striking work, however, begins with the rewriting of American history from the Negro point of view. The doyen of this effort since 1910 has been Carter G. Woodson, whose work has been prolific and painstaking. Beginning with 1916 he has published a considerable number of books, including the *Journal of Negro History*, 10 large volumes filled with documents, essays and research. Next comes Benjamin G. Brawley with his *Short History of the American Negro* (1913 and 1919), *Social History of the American Negro* (1921) and his study of *The Negro in Literature and Art in the United States* (1921). With these may be noted Steward's *The Haitian Revolution, 1791 to 1804* (1914), Emmett J. Scott's *The American Negro in the World War* (1919) and *The Gift of Black Folk: the Negroes in the Making of America* (1924), by W. E. B. DuBois, published by the Knights of Columbus.

But not in propaganda, science nor history has the essence of the renaissance shown itself. Rather the true renaissance has been a matter of the spirit and has shown itself among the poets as well as among the novelists and dramatists. In poetry, there are a dozen or more writers whose output has been small but significant. George McClellan, with his somewhat didactic and conventional verse, forms the link between past and present. Then comes James Weldon Johnson, Claude McKay, Leslie Hill, Joseph Cotter, Jr., Georgia Douglas Johnson, Countée Cullen and Langston Hughes, besides a half-dozen others. It is notable that already several critical anthologies (by James Weldon Johnson, Robert Kerlin, White and Jackson) have appeared. William Stanley Braithwaite has appeared as a widely read critic of poetry. The development in fiction is still newer and includes some earlier attempts like *The Quest of the Silver Fleece* by W. E. B. DuBois (1911) and James Weldon Johnson's *Autobiography of an Ex-Coloured Man* (1912), and newer and more significant work by Rudolph Fisher, Jessie Fauset, Walter White and Jean Toomer. In the drama, Willis Richardson and one or two others have been writing effectively, while in the explanation and collection of Negro music and folk-lore we have J. Rosamond Johnson, T. W. Talley and J. W. Cotter.

Perhaps the extent of this renaissance of Negro literature can be summed up in two works. One is the 15 volumes of *The Crisis* magazine, which began publication in Nov. 1910, and has since been a compendium of occurrences, thoughts and expression among American Negroes. Most of the newer Negro writers found first publication in its pages. The second is the book called *The New Negro*, published in 1925 and edited by Alain Locke, in which some 30 contemporary Negro writers express the spirit of their day. All these things are beginnings rather than fulfilments, but they are significant beginnings. They mean much for the future.

(W. E. B. DuB.)

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AMERY, LEOPOLD CHARLES MAURICE STENNETT (1873–) British politician, was born at Gorakhpur, Northwest Provinces, India, Nov. 22 1873, and was educated at Harrow and Balliol College, Oxford. He was elected a fellow of All Souls College in 1897, and, after travelling for a year in the Near East, in 1899 joined the staff of *The Times*, London, and acted as chief correspondent to that paper during the South African War (1899–1902), remaining associated with it till 1909; during this period he edited *The Times History of the South African War*. He began his political career as a strong advocate of tariff reform and, having contested in the Unionist interest seats at Wolverhampton and Bow and Bromley, was elected in 1911 M.P. for the Sparkbrook Division of Birmingham. From 1914 to 1916 he served with the British Army, first in France and later in the Near East, and from 1917 to 1918 was a secretary of the War Cabinet and on the personal staff of the Secretary for War. In Jan. 1919, he became Under-Secretary for the Colonies and in 1921 Parliamentary and Financial Secretary to the Admiralty. From Oct. 1922 to Jan. 1924 he was First Lord of the Admiralty in the Unionist Cabinet. In Nov. 1924, he became Secretary of State for the Colonies.

He has published various works, including *The Problem of the Army* (1903); *Fundamental Fallacies of Free Trade* (1906); *The Great Question* (1909); *Union and Strength* (1912).

AMIENS (*see* 1.855) had a population in 1921 of 92,780. The city is recovering slowly from the ravages caused by the bombardments of 1918, when the cathedral was struck nine times; the roof was pierced and the triforium, two chapels in the ambulatory, and some buttresses and window tracery were hit. The churches of St. Germain and St. Rémy, the Prefecture and the Musée de Picardie were partially ruined and much damage was done in the Rue de Beauvais. The wool and textile industries have regained their pre-War condition.

Amiens fell into German hands on Aug. 30 1914, but after the battle of the Marne it was cleared of the scattered German units who remained, and the front established some 20 m. eastwards, where it remained till 1918. Amiens formed the first concentration point for British troops disembarking at Boulogne in 1914, and the first aircraft park was established here. It remained of high importance owing to its position on the lines of communication, and in March 1918 the Germans made a great effort to break through between the British and French armies at the Amiens salient and "roll them up on either hand." They advanced to within eight miles of the town, which was evacuated by civilians and bombarded daily by heavy guns. But the tide was turned by the opening of the British strategic offensive in Aug., and on Aug. 15 Mass was said in the cathedral as a thanksgiving for the town's deliverance.

AMIENS, BATTLE OF: *see* VICTORY, ADVANCE TO.

AMIR 'ALI, SEYYID (1849–), Indian jurist and Moslem leader, was born April 6 1849, of an Arab family, tracing descent from the Prophet, which migrated from Persia and settled at Mohan in Oudh in the middle of the 18th century. At Hugli College, Calcutta, he graduated in 1867, taking his M.A. in 1868. He came to London and was called to the bar of the Inner

Temple in 1873. He had already published *A Critical Examination of the Life and Teachings of Mahomed*, the first of a series of books of Islamic modernist interpretation and apologetics, which have given him a recognised place in English literature. He was for some years a lecturer on Mahommedan law at the Presidency College, Calcutta, and afterwards president of the faculty of law at the university there. He was also chief presidency magistrate of Calcutta and in 1890 was appointed a judge of the Bengal High Court, being the first Mahommedan to reach the bench in India. He was made a C.I.E. in 1887. In 1904 he retired and settled in England. He was the first Indian to be sworn (Nov. 1909) of the Privy Council and to serve on its Judicial Committee. But his chief ambition in life was the advancement of the Indian Moslems, both morally and materially, along practical and constitutional lines and his activities paved the way for the Morley-Minto and subsequent reforms.

AMMONIA (*see* 1.861).—The production of ammonia and ammonium salts increased during the War period, due to the direct use of ammonium nitrate and, to a lesser extent, perchlorate, as mixtures for shell filling, and to the demand for nitrogenous fertilisers. Attention was also directed to the combustion of ammonia as a source of nitric acid and nitrates, and to the production of urea from ammonia and carbon dioxide.[1]

In obtaining ammonia and its compounds from the ammoniacal liquors of gas works and coke-oven recovery plant, continuous stills are usually worked in such a manner that the preheated ammoniacal liquor passes down a column similar in function to the columns of spirit or benzole stills, in which it meets an upward current of steam. The salts of ammonia with weak volatile acids are thereby dissociated and the ammonia, mixed with carbon dioxide, hydrogen sulphide, etc. usually passes into saturators containing sulphuric acid, where it is converted into ammonium sulphate. The remainder of the ammonium salts, which are not readily dissociated, react with heated milk of lime in a still at the base of the column, the remainder of the ammonia being expelled and subsequently converted for the most part into ammonium sulphate.

Ammonia obtained from gas works or coke-oven recovery plant, or from salts derived from this source, is usually contaminated with small quantities of pyridine bases. It is advisable to use synthetic ammonia when a high degree of purity of the ammonia is essential. In attempting, like Stas, to purify ammonium salts by treatment with oxidising agents, the resistance of the pyridine ring to oxidation should be kept in mind.

Compounds with Acids.—Whilst ammonium salts of weak acids are easily dissociated on heating in aqueous solution, the salts with strong acids are more stable but nevertheless lose some of their ammonia on boiling. Veley (1905) measured the degree of hydrolysis by boiling a definite volume of a salt solution containing a known amount of the salt for a definite time and determining the loss of ammonia. E. G. Hill (*Jour. Chem. Soc.*, 1906, vol. 89, p. 1273), by further experiments with greater refinement, showed that for monobasic acids the hydrolytic dissociation is inversely proportional to the "strength" of the acid.

Ammonium Perchlorate.—This salt may be obtained from an alkaline perchlorate, obtained electrolytically, and an ammonium salt. Its use in high explosive shell is limited owing to the liability to detonation by mechanical shock.

Ammonium Thiocyanate.—This can be obtained from ammonia and carbon disulphide, $CS_2+4NH_3=NH_4CNS+(NH_2)_2S$. In addition to other uses, its isomerisation to thiocarbamide, $CS(NH_2)_2$, has become of interest in relation to the rubber industry.

Solutions of ammonia in water apparently contain ammonium hydroxide, NH_4OH, in very small amount. An equilibrium exists in the solution which may be expressed by the combined equation

$$NH_3+H_2O \rightleftarrows NH_4OH \rightleftarrows NH_4^{\cdot}+OH'$$

which is not intended to exclude the formation of complexes $(NH_3)_m(H_2O)_n$. Accepting Bredig's value for the velocity of the ammonium ion (70·4 at 25°) and assuming that $NH_4^{\cdot}$ and OH' are the only ions existing in the aqueous solution, it appears that of the total ammonia approximately the following amounts are ionised: N/100, 4%; N/10, rather over 1%; N/1, about 0·3–0·4%. Information as to the form in which ammonia exists in aqueous solution is given by Hantzsch and Sebaldt, and T. S. Moore.

The definite, though small, electric conductivity of liquefied ammonia points to the existence of ions which may be NH_2', NH'', N''' and $NH_4^{\cdot}$, the latter from the union of ammonia with hydrion.

The dielectric constant of ammonia is 21 to 23, many salts dissolve in liquefied ammonia giving electrically conducting solutions. The conductivity is far inferior to that of the corresponding aqueous solutions, thus 1 mol of potassium iodide is ionised to the extent of 90% if dissolved in 20 litres of water but requires 2,000 litres of ammonia for an equal degree of ionic dissociation. The limiting value of ionisation of a salt is usually reached at 1,000 to 5,000 litres in the case of water and at 25,000 to 50,000 litres in the case of ammonia.

Constitution of Ammonium Salts.—The former view was that when ammonia combined with an acid, the tervalent nitrogen atom became quinquevalent. Werner thought that subsidiary valencies are called into play, representing, *e.g.*, ammonium chloride in the following manner:—

$$[(H_3N \ldots H)^{\cdot}Cl'$$

But ammonia also combines with the alkyl esters of strong acids, thus the first product of the action of ethyl chloride on ammonia is ethylammonium chloride, $N(C_2H_5)H_3C_2$. Since alkalies liberate ethylamine, $N(C_2H_5)H_2$, from this salt, the assumption has to be made that the additional ammonium salt undergoes intramolecular change in its kation

$$(H_3N \ldots R)^{\cdot} \rightarrow (H_2NR \ldots H).$$

The formation of di-, tri-, and tetra-alkyl ammonium salts by successive replacement of hydrogen by alkyl is explained similarly.

Whilst the ionisable acid radicle can be readily accepted as standing outside the rest (kationic portion) of the molecule, non-equivalence of the four valencies binding alkyl groups is difficult to imagine. A quaternary ammonium salt, in which all four alkyl groups are different, does not exhibit isomerism if the groups are introduced in different order. Moreover, if a salt or hydroxide be decomposed by heat, the alkyl group which escapes with acid radicle or hydroxyl depends on the nature of the group and not on the order in which it has been introduced into the molecule.

The firm attachment of the alkyl groups to the nitrogen atom is attested by the fact that quaternary ammonium bases are only liberated from their salts by the action of bases which form insoluble salts with the kations; *e.g.*, moist silver oxide in the case of the halides, barium hydroxide in the case of the sulphates.

The stability of the quaternary ammonium grouping is illustrated by the amalgam obtained when an absolute alcoholic solution of tetramethylammonium chloride is electrolysed with a mercury kathode (McCoy and Moore, *Jour. Amer. Chem. Soc.*, 1911, vol. 33, p. 273). The amalgam has a crystalline fracture and differs from ammonium amalgam in not becoming inflated below 10° C. In contact with air it becomes coated with an alkaline crust, it decomposes water with evolution of hydrogen and formation of colloidal mercury and tetramethylammonium hydroxide.

When all four alkyl groups of a quaternary ammonium salt are different, the compound can be resolved into optical isomerides. Pope and Peachey (*Jour. Chem. Soc.*, 1899, vol. 75, p. 1127) definitely resolved benzylphenylallylmethylammonium salts into dextro- and laevo-rotatory forms, experiments by Le Bel (*Compt. rend.*, 1891, vol. 112, p. 724) had not been conclusive. The probability that the four alkyl groups are arranged at the corners of a tetrahedron with the nitrogen atom at the centre has been made certain by the resolution of 4-phenyl-4[1] carbethoxypiperidinium-1:1[1]-spiran bromide into its enantiomerides (Mills and Warren, *Jour. Chem. Soc.*, 1925, vol. 127, p. 2507). On the electronic theory, it is probable that the ammonium ion, $NH_4^{\cdot}$, and the methane molecule, CH_4, have corresponding configurations since each complex is composed of a positive nucleus, four hydrogen nuclei, and ten electrons, this is confirmed by the experimental stereochemical evidence.

Ammonia and Metallic Salts.—Ammonia reacts with metallic salts in different ways. Either hydrogen in the metallic salt is replaced by metal or addition takes place. Besides the amides (or nitrides) of the alkali and alkaline earth metals, *e.g.*, sodamide, $NaNH_2$, obtained by the direct action of sodium on ammonia with liberation of hydrogen, compounds are known which may be regarded as ammonium salts in which hydrogen has been

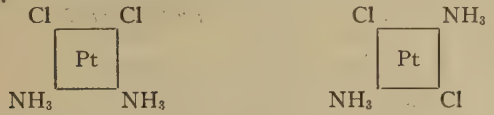
[1] The synthetical production of ammonia is dealt with under NITROGEN, FIXATION OF.

replaced by metal. Thus "infusible white precipitate" may be mercuriammonium chloride, NH_2HgCl, though possibly it is mercuric amide chloride, $Hg(NH_2)Cl$. The latter structure may be compared with that of zinc diamide, $Zn(NH_2)_2$, a stable compound obtained by the action of ammonia on ethereal solution of zinc ethide (Frankland, 1858). An amide-halide structure, NH_2-Mg-I, seems to be necessary for the substance produced with liberation of ethane by the action of ammonia on an ethereal solution of ethylmagnesium iodide (Oddo and Calderaro).

Co-ordination Compounds.—When ammonia is directly attached to a metallic salt, it is convenient to introduce Werner's idea of co-ordination. This may be illustrated by reference to quadrivalent platinum, whose chloride, $PtCl_4$, is a non-electrolyte. With two molecules of potassium chloride, we have potassium platinichloride, K_2PtCl_6. In hexammine-platinic chloride, $PtCl_4,6NH_3$, all four chlorine atoms are ionisable, the complex $[Pt,6NH_3]$ forming a quadrivalent kation. Compounds with intermediate proportions of ammonia are known, but in every case the sum of the atoms and ammonia molecules intimately associated with the platinum atom is six, the co-ordination number. Other atoms belonging to the molecule are ionisable as seen in the following list:—

$[PtCl_6]K_2$, gives the ions $[PtCl_6]^{\cdot\cdot}$ and $2K^{\cdot}$
$[PtCl_5,NH_3]K$, gives the ions $[PtCl_5,NH_3]^{\cdot}$ and $K^{\cdot}$
$[PtCl_4,2NH_3]$, is a non-electrolyte
$[PtCl_3,3NH_3]Cl$, gives the ions $[PtCl_3,3NH_3]^{\cdot}$ and Cl'
$[PtCl_2,4NH_3]Cl_2$, gives the ions $[PtCl_2,4NH_3]^{\cdot\cdot}$ and $2Cl'$
$[Pt,6NH_3]Cl_4$, gives the ions $[Pt,6NH_3]^{\cdot\cdot\cdot\cdot}$ . . . . and $4Cl'$

Many complex compounds of chromium, iron, nickel and cobalt are known in which the metal exhibits the co-ordination number 6, but in the case of divalent platinum and copper, the co-ordination number is four. Thus two non-ionisable compounds of the formula $Pt(NH_3)_2Cl_2$ are known, their isomerism may be explained if we suppose the platinum atom to be situated at the centre of a square of which the corners represent the positions occupied by chlorine or ammonia.



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AMMUNITION (*see* 1.864).—The normal modern shell, whether monobloc or made in parts and assembled, has the general form of a cylindrical steel body, hollow to receive the filling, with the base flat and the head pointed.

I. AMMUNITION FOR ORDNANCE

In designing projectiles for ordnance, it is necessary to consider the function of the shell at the objective, the capacity of the shell to withstand the forces of projection, the ballistic qualities of the projectile in flight and the suitability of the design for manufacture and supply. The design of a shell must therefore be considered as a compromise between these conflicting qualities, as it is obvious that a projectile designed solely for purposes of flight might prove incapable of sustaining the pressure developed in the gun.

It is necessary, however, to give due consideration to all the essential properties of a shell. The head was normally of true ogival shape, with the centres of the circular arcs in or near the plane of the front end of the body and with a radius varying from about $1\frac{1}{2}$ to $2\frac{1}{2}$ calibres. The driving band was pressed into a groove near the rear end of the shell to cause rotation of the projectile, to prevent undue escape of gas around the projectile when the gun is fired, and to provide a seating for the projectile. A fuse hole was prepared either in the nose or base of the shell.

Range and Accuracy.—Many experiments have been made since 1900 to improve the shape of projectiles with a view to obtaining longer ranges and greater accuracy, with the ultimate result that modern projectiles have generally long, tapering points which correspond to an ogive of from 6 to 10 calibres. Although, theoretically, there appears to be no limit to the length of the head, in practice, a head longer than that due to an ogive of 8 calibres radius has certain disadvantages affecting the accuracy of flight. As an alternative to increasing the length of the shell itself, a device known as a false ogive, or ballistic cap, has been much employed, particularly by the Germans; this consists of a light, hollow cap screwed on to the body of the shell proper, thereby improving the general shape and not substantially affecting the accuracy.

Attempts have also been made to obtain still greater ranges by stream-lining or boat tailing the base in varying degrees. A certain increase of range may thus be obtained, under certain conditions, but frequently a loss of accuracy results. The results obtained by varying the shape of projectiles depend, to a great extent, on the velocity of projection, and the effect on range and accuracy of any shape of head is influenced by the shape of the base of the same shell and vice versa. It may be stated that modern high velocity projectiles have long, tapering heads, sharp points and parallel bases. Projectiles fired at velocities lower than 2,000 ft. per sec. (f.p.s.) may also have stream-lined bases, but when the velocity falls to below 1,200 f.p.s., the head shape tends to bluntness but more attention is devoted to the shape of the base. These remarks are intended to apply merely to projectiles actually in use at present, and are not intended to define the optimum design.

Driving Bands.—The material generally used for driving bands is copper, in the form of rings, and no other substance appears completely satisfactory for this purpose. The chief disadvantage of copper is that it gives rise to metallic fouling in the gun, called coppering, which can be removed by chemical or mechanical processes, with special apparatus, but decoppering is difficult to carry out in the battery position in the field. Attempts have been made to incorporate in the cartridge or attach to the shell some material which will remove the copper from the bore of the gun during firing. A shell normally has one driving band, but two or three may also be used. The Germans, in large shell, normally used three bands.

Weight, Length and Diameter.—Other factors affecting design are the weight, length and diameter of the shell and, to a great extent, these factors are interdependent. In practice, a certain maximum weight of shell is found suitable for a definite gun, mounting and charge. The diameter is fixed, and the length therefore depends on the type of shell under consideration. There is a certain limit to the length of the shell, which is governed by stability. Approximately the weight of a shell in pounds suitable for a given gun is half the cube of the calibre in inches. The diameter of the shell body is slightly less than that of the bore across the bands, to ensure a free passage for the projectile up the bore. The modern practice is to keep this clearance as small as possible and in some cases it is as small as 0.01 inch.

Material.—With modern ordnance, the projectiles are practically all made of cast or forged steel. During the World War, cast iron was largely employed to assist in overcoming shell shortage in various countries, but its use is now generally discarded, except for projectiles used for practice and special purposes. The steel employed may be either straight carbon or alloy steel and in certain cases may be subjected to heat treatment. Normally, modern shell are manufactured by forging from steel ingot or bar, though in certain cases shell may be cast to the required shape.

Types of Projectiles.—Projectiles for ordnance may be divided into two main classes, shot and shell. The only shot now found in modern armaments are proof shot, practice shot, paper shot and case shot. Proof shot are solid shot used for proving ordnance and charges. Practice shot are solid shot used for practice purposes. Paper shot are used to test gun mountings which cannot fire service projectiles in peace time, owing to their siting. They are made mainly of paper or pulp, and their weight is calculated to exert the same stress on the mounting as a service round, but they break up in the bore when fired. Case shot generally consist of three or more long steel segments held in position inside a thin, tinned canister, the whole being filled with bullets. The top and bottom are formed of steel plates and, in larger natures, the shot is stiffened by a central bolt. It is not much used in modern equipments.

The natures of shell now used are: common pointed or C.P. shell; high explosive or H.E. shell; shrapnel shell; armour piercing or A.P. shell; and special shell, of kinds such as smoke, star (illuminating) and incendiary.

C.P. Shell.—Little development has taken place in C.P. shell, as such, in modern types of ammunition. Filled with powder, they are still to be met with in certain countries and used with or without soft steel caps they fulfil certain functions usefully. For many purposes they have been superseded by H.E. shell. They have not been utilised in British service with H.E. fillings but have been

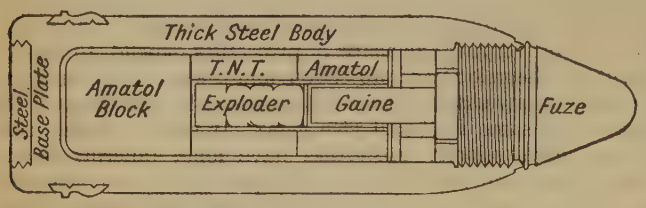

FIG. 1.—Modern British H.E. Shell.

developed as H.E. shell in the German naval service, in which case they have been filled with TNT, the method of filling agreeing with the usual German practice for H.E. shell.

H.E. Shell.—Modern British H.E. shell are normally of forged steel with solid bases, a special steel base plate being fitted in a recess in the base to give added strength and prevent any possibility of ingress of gases. The walls may be comparatively thin, which gives good effect against material, or, alternatively, the walls may be thick enough to give good effect against personnel. The nose of the shell is prepared to take a fuse. In other countries solid bases are not considered essential in these shell.

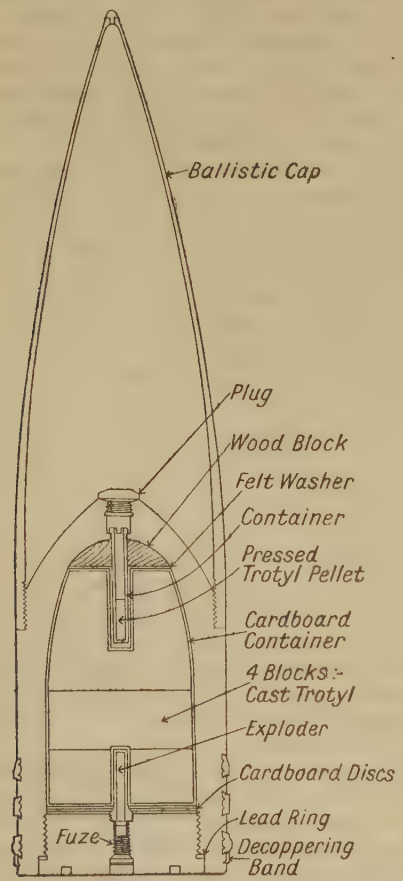

FIG. 2.—Modern German H.E. Shell.

Explosives used as shell fillings are ordinarily, picric acid, TNT (tri-nitro-toluene), and amatol, which is a mixture of TNT and ammonium nitrate. Other substances used are dinitrobenzene, trinitroanisol and guncotton, and, during the World War, many other substances were tried. The explosives are generally inert and not easily detonated, and hence an exploder system is ordinarily found between the fuse and the filling itself. In some cases, where detonation gives little or no smoke, some smoke-producing mixture is included in filled shell to assist observation. A typical modern British H.E. shell is illustrated in fig. 1. The steel body is stout, giving good fragmentation. The filling is amatol, with a proportion of TNT to facilitate detonation. The exploder system in this particular case is represented by a gaine and an exploder. Fig. 2 illustrates a modern German H.E. shell evolved during the War. The filling calls for little comment. There are several points of interest in comparison with earlier shell. The base is closed by an adapter, which is contrary to British practice. Three driving bands are employed and a decoppering ring is fitted. Two fuse holes are provided, which permit of either nose or base fusing, or even the use of two fuses at the same time. This shell also provides a good example of the ballistic cap or false ogive.

Shrapnel.—Modern shrapnel do not differ in principle from the earlier types. The walls are made as thin as is consistent with ability to stand the stresses on firing and in flight. The bullets are ordinarily of lead antimony alloy, 41 to the lb. for light shrapnel, increasing in weight for heavier shell and for special purposes. They are kept in position by resin. The body may be closed either by a fuse socket or by a separate head, the part in either case being so

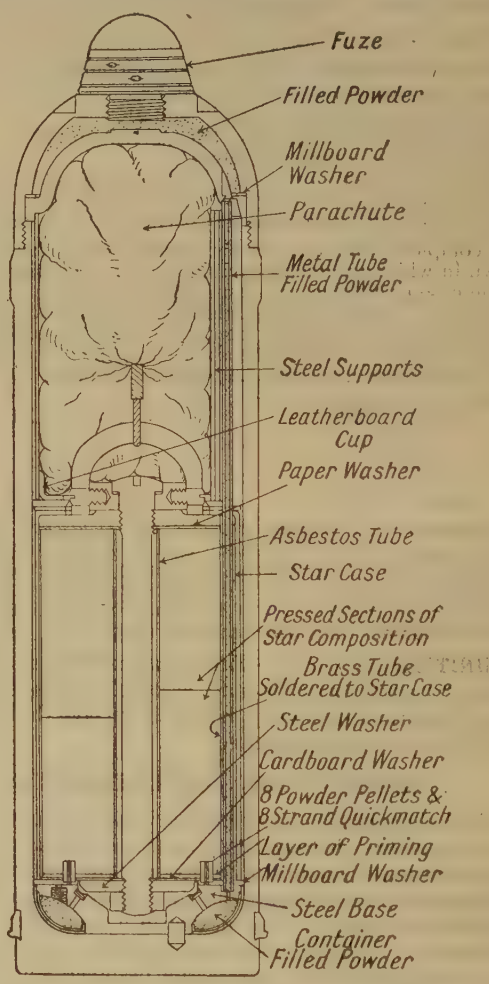

FIG. 3.—Section of German 15 cm. Star Shell.

secured to the body of the shell that its removal is easily effected by the small bursting charge of fine grain powder. The central tube may or may not be provided with powder pellets.

A.P. Shell.—Little change is to be seen in modern A.P. shell. An improvement in shape, by altering the shape of the cap, and the introduction of H.E. as filling instead of gunpowder are the only important changes in recent years.

Special Shell.—Gas shell were introduced by the Germans during the World War, and were developed by them into weapons of great offensive power. Ordinarily shell bodies of H.E. design were utilised and filled with a liquid or solid substance which volatilised on exposure to the air giving a concentration of gas sufficiently strong to disable an unprotected man. The shell were usually opened by a small charge of explosive, the fuse employed being of the instantaneous type. In later patterns of shell, the chemical ingredient was enclosed in a bottle which was buried in an ordinary H.E. filling. The shell functioned as an ordinary H.E. shell with the additional deleterious effect due to the chemical.

Smoke shell are really another product of the World War. In design they resemble gas shell and are filled with composition intended to give smoke clouds for purposes of concealment. They are

actuated by instantaneous fuses and contain small H.E. opening charges. Incendiary shell, also introduced by the Germans, contain incendiary substances and are used with either time or percussion fuses. They call for no further comment. The star shell has many advantages. The latest type of illuminating shell may be considered as well represented by that illustrated in fig. 3. There is a time fuse which can be set for any time up to 33 seconds. When the fuse functions, the flash from the magazine ignites the powder in the dome of the shell and blows off the head of the shell. The flash from the powder passes down a side channel to the powder charge in a small magazine in the base of the shell; the powder explodes and ejects the star and parachute from the body, and at the same time the star composition in its case, by means of quick match strands and powder pellets embedded in the composition, is ignited. After ejection, the parachute itself opens and supports the star until it burns out.

Cartridges and Ignition.—Cartridges for ordnance are divided into two main classes called technically breech-loading or B.L. and quick-firing or Q.F. and each class is subdivided into gun and howitzer cartridges. All modern ordnance is breech-loading and the terms B.L. and Q.F. merely indicate the system of obturation, or gas sealing, employed with the gun. Of recent years no radical changes have taken place in the make-up of cartridges and means of ignition, and, in principle, these stores have not varied since 1911. The World War imposed on the belligerents certain drastic changes in equipment owing to the lack of raw material, and these changes affected cartridges to a certain extent. For the main part such changes were inferior substitutions, which have disappeared.

Propellants.—Generally speaking, the propellants employed in modern cartridges are of the nitroglycerine or nitrocellulose type; the former class containing both nitroglycerine and nitrocellulose, whereas, in the latter, nitroglycerine is absent. All these propellants, generally described as smokeless powders, are somewhat difficult to ignite, and hence an igniter is a feature of cartridges, which may be found in the form of a separate store called an igniter, or be embodied in the primer or igniting medium. The igniter is ordinarily composed of fine grained gunpowder. The propellant is usually manufactured in cords, sticks or tubes, which shapes are known commonly as stick forms. It is, however, also prepared in flakes, discs and other small shapes which, for want of a better name are called granular forms. Well-known stick forms are cordite and Röhrenpulver. Well-known granular forms are NCT, Ballistite, Ringpulver and Würfelpulver. During the World War the Germans and Austrians were compelled to use inferior propellants owing to the scarcity of nitric acid. An example of this type of propellant is ammonpulver (*see* EXPLOSIVES).

B.L. Cartridges.—B.L. gun cartridges are built up of bundles of propellants of stick form cut to the required length, tied with silk and inserted into cylindrical silk bags of which the ends are closed by silk discs. An igniter is stitched on to one or both ends of the cartridge. This type of igniter consists of fine grain powder enclosed in a circular bag of shalloon and covers the ends of the cartridge in order to intercept the flash from the igniting medium, tube or other flash initiator. The exterior of the cartridge may be laced with silk cloth tape so as to form a stiff cartridge. The charges for heavy guns may be made up in separate portions, for convenience in handling and to permit the use of a reduced charge. In large cartridges a silk cloth becket runs up the centre and has a loop at the top for handling (*see* 1.872). Granular form propellant has been used for certain cartridges and, in principle, the method of making up is similar to that employed with the stick form, with slight modifications to compensate for the lack of rigidity of the cartridge. B.L. howitzer cartridges are similar generally to the earlier type (*see* 1.873). In modern practice, bundles attached to the core by tape may be used instead of rings.

Q.F. Cartridges.—In these cartridges, the propellant charge is contained in a brass case which effects the obturation of the gun. This class of ammunition is of two types, fixed ammunition and separate. The use of the brass case influences rapidity of fire, in that it obviates the operation of sponging out smouldering débris; it allows of the cartridge carrying its own means of ignition, thus saving one loading operation, and it also offers great safety against accidental ignition. On the other hand, the brass case is expensive in itself, and any defect in it may cause serious damage to the gun, the gas having to escape through a constricted channel; it adds to the weight of the cartridge, entailing increase in transport, and finally, where large output is required, the supply of raw material becomes a serious proposition. During the World War, the Germans were compelled to use steel as a material for Q.F. cases owing to the shortage of brass. The use of such cases was limited to ordnance of small calibre or ordnance with low velocities.

Means of Ignition.—B.L. cartridges are ignited by means of electrical or percussion tubes. Q.F. cartridges carry their own means of ignition, which may be caps, primers or tubes, the latter being fitted with adapters. A typical modern percussion primer is illustrated in fig. 4. The body is of brass, with a tapered flange to ensure a good fit in the cartridge case, and is suitably screwthreaded. A brass cap, filled with cap composition, is

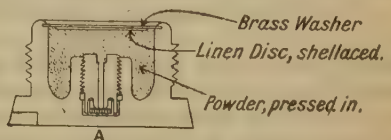

FIG. 4.—Percussion Primer.

seated in the body and a brass anvil plug with central hole screws down on to the cap. The upper portion of the primer forms a magazine which is filled with fine grain powder, and the primer is closed with a linen disc and brass washer, secured by the end of the body being turned over. The primer functions when the striker of the breech mechanism impinges on point A of the primer, the cap fires, the powder in the magazine is ignited and the subsequent flame ignites the propellant.

Fuses.—A fuse is employed to initiate the bursting, explosion or detonation of a shell at the required place or time. The mechanism of a fuse must fulfil two conditions: it must operate at the required time or place and it must not operate prematurely. The latter condition is fulfilled by embodying external or internal safety devices in the design. External devices are employed when it is impracticable to provide sufficient protection by internal means. These may consist of pressure plates, safety caps or pins and similar devices intended to prevent the fuse from arming or firing before loading, during transport or storage and preliminary handling, including accidental dropping. Caps and pins are removed before loading. Internal devices, while performing similar functions to the external devices, also give safety during acceleration in the bore and during the period of flight, and comprise such means as safety shutters, tapes, centrifugal bolts, ferrules, collars, pillars, detents and springs. Normally, they prevent premature collision between detonators and needles, or may prevent ignition of the bursting charge in the event of accidental firing of the detonator. The use of safety devices will be considered in connection with individual fuses described below.

Fuses may be classified as follows:

(1) Percussion fuses	(a) Direct action (D.A.).
	(b) Graze action, nose or base.
(2) Time, or time and percussion fuses	(a) Composition or burning.
	(b) Mechanical or clockwork.

1. (a) Direct action fuses function as a result of a direct blow on the nose, a hammer or needle being forced on to a detonator. A later pattern of D.A. fuse is the British fuse No. 106 illustrated in fig. 5, from which its general construction will be understood. It is protected before loading by a safety cap, which is removed by hand. A split steel collar is interposed between the underside of the hammer head and the top face of the fuse body and round this collar the safety tape is wound. On firing, the tape weight is gripped between the hammer head and body. When acceleration ceases, that is, when the shell leaves the bore, the weight is released, flies off, unwinds and carries the tape with it, tearing away the split collar. The hammer is then supported only by a thin shearing wire. On impact, the hammer is

driven in, shearing the copper wire, the detonator is fired, and in turn fires the magazine. A safety shutter is provided, which only opens after the shell leaves the bore of the gun. Fuse No. 106 may be taken as typical of a class of D.A. fuse which is rather more sensitive than an ordinary D.A. fuse, and is known sometimes as an instantaneous, or, in German, *empfindliche* fuse.

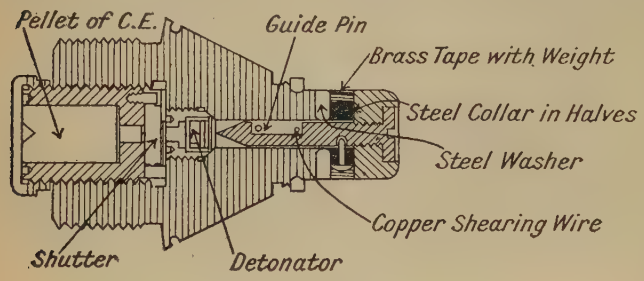

FIG. 5.—Percussion Direct Action Fuse.

Another type of D.A. fuse, somewhat less sensitive than the ordinary type, is the direct action impact type (D.A.I.). Such fuses merely differ from ordinary D.A. type, in that the suspension of the needle is very much stronger and hence the fuse requires a stronger blow on the nose in order to make it function.

(b). Graze fuses or check action fuses function as a result of the forward movement of a graze pellet relatively to the main body of the fuse. When the shell receives a check in velocity a pellet carrying a detonator moves forward onto a fixed needle or alternatively a needle pellet moves on to a detonator. A typical nose graze fuse is illustrated in fig. 6. The illustration represents the German fuse Kz. f. Spgr. m. K. and shows its

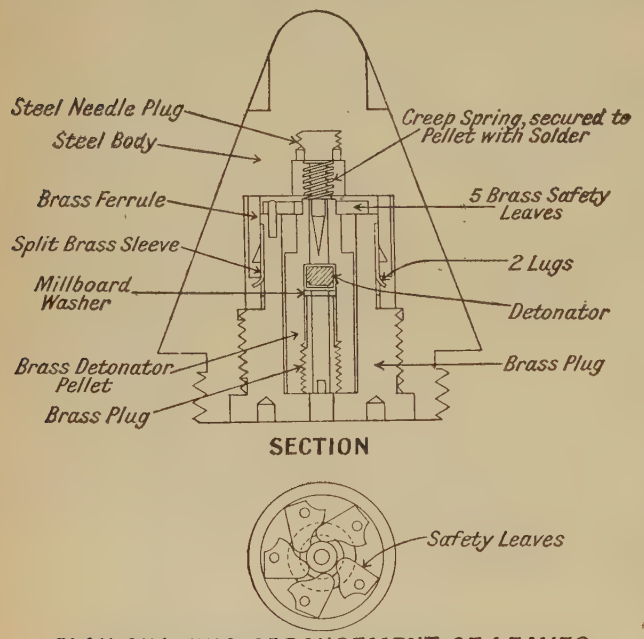

FIG. 6.—Percussion Graze Fuse.

general construction. Before firing, the detonator pellet is kept away from the needle by five interlocking brass leaves held in position by a brass ferrule supported on a split brass sleeve. On acceleration, the ferrule sets back clear of the safety leaves and rebound is prevented by two lugs on the sleeve. When acceleration ceases, the brass leaves open out one by one under the influence of centrifugal force, leaving the fuse in a sensitive condition or "armed." Creep action of the detonator pellet during flight is prevented by the so-called creep spring. On graze, the pellet flies forward on to the needle and the detonator fires, the flash passing through a hole in the pellet to the exploder in the shell.

A practice common in German design is to arrange a combination of direct and graze action effects in one fuse. In this type the detonator is housed in a movable pellet which functions in the usual way. The needle is formed on the inner end of a rod, the outer end of which projects from the top of the fuse. On impact, the detonator pellet moves forward on to the needle as in an ordinary graze fuse but in addition to this action the needle is also forced on to the detonator by direct action.

2. A time fuse is one which can be set to burst a shell at a certain predetermined time after firing. A time and percussion fuse, commonly known as a T and P fuse embodies, in addition to the time mechanism, a graze percussion mechanism which will function independently should the shell strike any object in flight or on impact with a target. Time fuses are divided into two main classes, (*a*) burning or composition and (*b*) mechanical or clockwork. The modern composition fuse is exemplified by the British T and P No. 80 (*see* 1.870).

Very little change has occurred of recent years in the design of these fuses. Attempts have been made to lengthen the time of burning by increasing the number of rings and by altering the

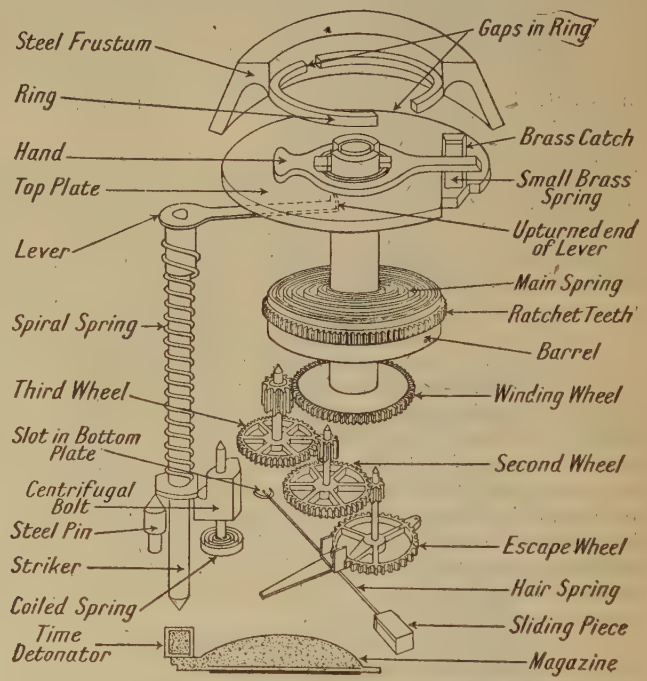

FIG. 7.—Diagram illustrating action of Mechanical Time Fuse.

composition in the rings but, fundamentally, the design remains unaltered. In the T and P No. 80 fuse, the escape of gas from the burning composition is facilitated by radial gas escape holes. In some foreign designs, gas escape through the nose is arranged, but the radial method is more general. The movable ring type of fuse is almost universal but a notable exception is noted in the French type of T and P fuse No. 23–31, which is set by punching a hole at the appropriate point in a composition-filled lead tube by means of a machine called a *débouchoir*. The simple time fuse is rarely found in the modern armaments, a percussion mechanism being almost invariably embodied in the design. Should a time fuse only be required, as in the case of anti-aircraft projectiles and star shell, an ordinary T and P fuse may be employed with its percussion mechanism removed. Nevertheless, fuses which are time fuses only may be found in use with various equipments.

The use of burning composition in time fuses is by no means ideal, and for many years experiments have been carried out with a view to obtaining a clockwork or mechanical apparatus. Various patterns were tried, but none were satisfactory until 1916 when the Germans brought into use a clockwork fuse *Doppelzünder 16* (T and P fuse 1916 pattern) which may be considered as typical of this class. This fuse is illustrated in

figs. 7 and 8, the latter illustration being merely diagrammatic and the description which follows is of principle and arrangement only. The clock train is driven, as in a watch, by a coiled spring in a barrel, but the escapement is original and peculiar. A straight steel spring takes the place of the hair-spring, which would be rendered useless by the effect of rotation and shock of discharge, and as the length of the straight spring is adjustable, the movement of the pallet of the balance, and therefore that of the escapement wheel and the clock train, is controlled and regulated. A horizontal hand, the position of which depends on the setting of the fuse, has, on its under surface, a notch, into which fits the upturned end of the lever at the top of the striker.

When the clock train is started, the hand moves round with it, but is prevented from rising and releasing the lever by a ring attached to the conical housing of the fuse. This ring is provided with two slots into which the hand can fit; thus, when the

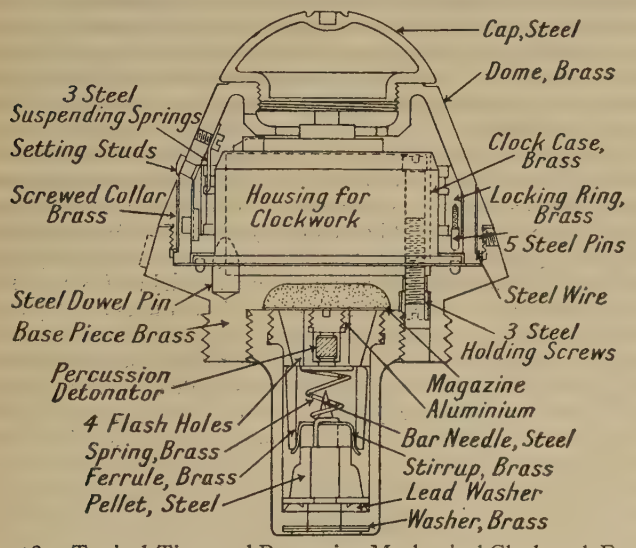

FIG. 8.—Typical Time and Percussion Mechanical Clockwork Fuse.

clock is working, the rotation brings the hand into coincidence with the slots, and when forced up by the action of a small spring, it releases the upturned end on the lever. The striker, previous to firing, has been held in the safe position by a collar on it, which rests on a shoulder of the centrifugal bolt, but when this bolt is moved away by the rotation of the shell, the outer end of this shoulder still rests on a steel pin. When the upturned end of the lever is freed from the notch in the lower side of the hand, as previously described, it flies out and rotates the striker, so that the collar clears the steel pin and allows the striker to fall and fire the detonator. The setting of the fuse and the hand is accomplished by turning the housing with a suitable key, this housing being free to move before firing. On discharge it is very ingeniously clamped to the body of the fuse by means of steel pins in a ring in its under surface. This ring sets back and the pins are driven through the flange of the clock case, a groove being turned on its under side to thin the metal, and thus to allow of easy penetration. The clock train, wound up like a watch, is started at the moment of firing by the setting back of a detent.

II. AMMUNITION FOR OTHER WEAPONS

Since 1910 rapid strides have been made in the development of new designs of ammunition for rifles and machine guns.

The Cartridge Case.—The general manufacture of the case has not altered except in detail, but special attention has been given to the hardening, so that, whilst the front end is left sufficiently soft to expand against the walls for gas sealing, the rear half of the case is left hard to stand up against the force of extraction.

Means of Ignition.—No change has been made in the cap or primer, but it has been realised that the composition may deteriorate, especially in conditions of warm, damp storage, or in contact with moist powders. This leads to missfires or hangfires, and slow or incomplete ignition is found to exercise a most deleterious effect on accuracy. The tendency is, therefore, rather to overcharge with fulminate composition in manufacture, so that the efficiency of the ignition shall not be destroyed, even though some deterioration may have taken place in the composition.

Charge.—It is still a debatable point whether purely nitro-cellulose powders are preferable to ones containing a proportion of nitro-glycerine. Nitro-glycerine has the advantage of making the powder more powerful, bulk for bulk and also of improving the gelatinisation, making the powder damp proof and better able to withstand adverse conditions of storage. On the other hand, pure nitro-cellulose powders give the same velocities with a lower maximum pressure than nitro-glycerine powders, and are claimed by some to give more accurate shooting. In the result, Britain has held to cordite, but other nations, particularly the United States of America, have adopted N.C. powder as their normal load.

Bullets.—Greater changes have been made in the bullet of the small arm cartridge than in any other component part. Not only has the form of the earlier bullet been materially changed, but several entirely new types have been evolved, such as the tracer and armour-piercing bullet and the normal, or service, bullet. During the last century the use of small arms at distances greater than 1,000 yards was never seriously considered, though it was realised that the actual range of these weapons was well in excess of that figure. With the gradual improvement of machine-guns and the increased care taken in teaching musketry to the infantry soldier after the Boer War, it was found that massed fire could be brought to bear on large targets with great effect at long ranges. The problem of increasing the range by improving the contour of the bullet at once came to the fore, and by 1914 most countries had discarded the round-nosed bullet in favour of a pointed one, the contour of the point being struck by a circle whose radius was about 8 times the calibre. Further improvement in range can be obtained by stream-lining or boat-tailing the base of the projectile, but as this involves certain difficulties in making the bullet take the rifling, the practice has not been universally adopted. As regards the make-up of service bullets the lead core with special envelope remains the standard practice, but efforts have been made to improve the material of the envelope so as to obviate fouling the bore with the metallic deposit left by cupro-nickel. In America a 90% copper envelope with 8% zinc and 2% tin has been found successful as an anti-fouler.

Tracer Bullets.—The value of a bullet which left a visible wake either of smoke or of flame, was recognised in the early days of air fighting during the World War. This led to the introduction of a bullet stemmed with burning composition, usually a mixture of barium salts and magnesium, in the base, which was ignited by the propellant gases on firing the rifle. The difficulty with a tracer bullet is to make it range identically with the service bullet, and the only solution so far found is to bring the two together at an optimum range, say 500 yards.

Armour Piercing Bullets.—The need for combating armoured cars, aircraft, tanks and snipers' plates with a missile having a better penetration than the service bullet, led to specially designed armour-piercing bullets for such purposes. These consist of jacketed bullets, having envelopes harder than those normally used, to withstand the increased charges which are needed to give penetration. Sometimes soft steel is used for this purpose. The core consists of a specially treated tool steel, and a lead surround is provided, since without this device the bullet would be too hard to take the rifling. The lead surround has the further function of supporting the point of the core at the moment of impact, thus preventing fracture of the hardened point which might otherwise occur.

Armour much over 0·25 in. cannot be penetrated by a 0·303-in. calibre bullet. On the other hand it takes a 1-in. plate to keep out a well-designed 0·5-in. calibre bullet, and this thickness of armour is nearing the limit of weight that any land or air vehicle can profitably carry. For this reason every first class nation has introduced or is contemplating the introduction of a 0·5-in.

calibre weapon with A.P. bullet for such purposes. For normal use by the infantry soldier, however, the weight that can be carried by the individual is the limiting factor, and any increase in calibre would materially reduce the number of rounds that could be taken into action.

Machine Gun Ammunition.—Progress in machine gun ammunition has run on strictly parallel lines to rifle ammunition and in most cases ammunition is mutually interchangeable between the two weapons. The problems are the same and may be summarised as the attainment of a high standard of accuracy, a minimum of erosion, wear and metallic fouling and elimination of flash. The adoption of large calibre ammunition (0·5 in. and upwards) will affect machine guns more than rifles, since for the former the question of transport is not so formidable.

Pistol Ammunition.—In the British Army the 0·455-in. calibre revolver with its heavy, unjacketed lead antimony bullet has remained unchanged for 30 years. As a man-stopping projectile at point blank range it remains unbeaten, but its weight and poor accuracy at longer ranges limit its value. Most nations have adopted automatic pistols for their subsidiary weapon, and for these, jacketed bullets, either of copper or cupro-nickel, are employed. The various nations differ as to optimum calibre for pistol ammunition, but the tendency appears to be away from the light comparatively high-velocity bullet such as the German 0·300 Mauser which was sighted up to 1,000 yd., thus holding the pistol to its true rôle, namely that of a man-stopping weapon at short range.

Aeroplane Bombs

Aeroplane bombs have their inception in the indiscriminate throwing of trench grenades from the rather crude flying-machines which were in existence during the early stages of the World War. Gradually bombs and bombing methods were improved till, before peace was concluded, the aeroplane bomb held an important place as an offensive weapon. The main difference between aeroplane bombs and gun projectiles is one of strength. The latter may have to attain a muzzle velocity of about 2,000 f.p.s. in the length of the piece, and this entails pressures running up to 20 tons to the square inch. The former is merely dropped, so that the stresses on it when falling are very little greater than those encountered in normal handling and transport, and it is only when penetration of concrete buildings or armoured decks is sought that anything more than a thin steel case is required to contain the H.E. filling. As regards shape, the terminal velocity of an aeroplane bomb is never above 1,100 f.p.s., hence the stream-lining of the tail is just as important as the contouring of the head. Most bombs are therefore pear-shaped with vanes attached to the cone of the tail to ensure that the bomb drops nose first.

Method of Detonation.—To detonate the H.E. filling on impact with the target, fuses or pistols are used. These are usually simple mechanisms depending for their arming on the unscrewing of vanes by the air stream whilst falling. The Germans gave a rotary flight to some of their bombs by twisting the vanes so that a safety device, worked by centrifugal action, could be incorporated, but this tends to slow down the flight of the bomb. In general a safety pin, which is only withdrawn from the fuse when the airman drops the bomb, is used as an additional safety precaution. The building up of the detonation wave is accomplished by a central exploder which may run the whole length of the bomb or, as in gun shell, only a few inches into the H.E. filling.

Magazines and Shell Stores

A magazine is a building with passages leading thereto, in which are stored explosives in bulk which must be under special magazine conditions with regard to precautions against fire or explosion. An explosive store is a building, standing apart from others, used for storage of explosives which are not necessarily kept under magazine conditions. A shell store is a store in which filled shell are kept.

Although in England the Explosives Act, 1875, expressly exempts government magazines from its provisions, the conditions imposed by the Act apply generally to them. *Magazine Regulations, 1922*, lays down in detail the principles governing the arrangement for a magazine in Great Britain as regards site, construction and working conditions. For explosive stores the regulations for magazines are modified as regards the necessity for special clothing and certain minor conditions, but otherwise magazine regulations should generally be strictly enforced.

For the purpose of storage and transport all service explosives are classified in *Magazine Regulations, 1922*, into groups, and the regulations specify the class of store in which each group is kept. The principles on which this classification is made are based on the stability of the explosive, its liability to decomposition, the ease with which it ignites or explodes and similar properties. For example, explosives liable to decomposition and bearing an explosion risk must be kept in a magazine. In fortresses and defensive works magazines and stores require special protection from enemy fire, which is ordinarily provided by heavy traverses. Magazine safety regulations are rigidly enforced, but certain variations in storage are permitted under special conditions.

Arrangements for War.—In a theatre of war arrangements must be improvised to conform as far as possible to magazine regulations as regards the provision of buildings or shelters, but safety regulations should be invariably observed. Wooden huts, with corrugated iron roofs, can be employed in connection with storage of explosives and ammunition; a height of 8 to 10 ft. from floor to eaves would be suitable, and such huts can be made splinter-proof by layers of sandbags. A large storage hut may occupy a space 30 ft. wide by 300 ft. long, and would be divided into compartments or bays by traverses made of double walls of galvanised iron sheeting. A floor of road metal, rammed hard, would suffice. When a building is not available, a raised floor with tarpaulin supported on a framework so as to allow of ventilation, is readily improvised. All explosives should be kept in substantial cases or receptacles where possible. All ammunition necessarily kept in the open should be stored on battens and covered with tarpaulins, which covering should be removed whenever conditions are favourable, in order to permit of ventilation and to prevent sweating. When shells are piled in the open they should never be exposed to the direct rays of the sun.

At base depôts and advanced depôts arrangements for storage of ammunition can be made on more or less semi-permanent lines. From these depôts, the ammunition passes to ammunition parks and columns where the arrangements have to be improvised as local conditions permit. With mobile warfare the movements of parks and columns would prevent any arrangements for storage, separate from the vehicles, of more than a temporary character, as the principal object would be to deliver, as rapidly as possible, ammunition from the depôts to the particular batteries where it might be most urgently required.

For trench warfare, the system of dumps was employed to facilitate ready supply of large quantities of munitions. These dumps would be classified according to the nature of the ammunition and might be mere stacks in the open, separated by traverses of sandbags. Convenience of transport and local conditions would be the main factors in determining the position and extent of these dumps. (C. W. F.)

AMPLIFIER: *see* Broadcasting; Microphone; Telegraph; Telephone; Wireless Telegraphy.—Amplifiers are used generally either in connection with systems of electrical communication or for rendering sounds and other vibrational waves perceptible that would otherwise be too faint to be heard. The essential features of an amplifier are a source of energy, such as a battery, and means whereby the flow of energy from this source may be so controlled by the wave to be amplified that the variations of the original wave are reproduced upon an enlarged scale in the wave set up by this flow.

Practically all of the amplifiers in use up to 1910 depended upon variations in the electrical resistance of a mass of granular

carbon which result from variations in mechanical pressure, as in the telephone transmitter. Here the power associated with the electric wave may be as much as 1,000 times that of the sound wave. For amplifying weak alternating electric currents of voice frequency, a combination of telephone receiver and transmitter having a common diaphragm was used. This so-called "mechanical repeater" was used on telephone lines. Various other devices based on changes in resistance with mechanical motion were developed to meet particular needs, notably those of submarine cable telegraphy.

Types in Use.—With the beginning of the period 1910–26, the amplifying possibilities of electric discharge devices were coming to be recognised. Amplifiers of this kind fall into two classes—the so-called negative resistance devices, which have only two terminals; and those having separate input and output terminals corresponding to those of the mechanical repeater. The former include discharge devices such as arcs, in which the voltage between the electrodes decreases with increasing current. Owing to their extreme instability, very little practical application has been found for them.

Of the second class by far the most important is the three-electrode thermionic discharge type variously known as audion, valve, triode, vacuum tube and pliotron. In this type the path of the current from the battery includes a discharge between two electrodes in an evacuated vessel. The discharge is made possible by the emission of electrons from a hot cathode, usually a filament through which an auxiliary heating current is passed. The anode may be either a plate or a cylinder concentric with the filament. The flow of current is controlled by the potential of a third electrode, or grid, situated between the anode and the cathode. The discharge passes through openings in this electrode. The source of the wave to be amplified is connected, usually through a voltage step-up transformer, with the grid and the filament, so that the potential of the grid relative to the filament varies in accordance with the wave to be amplified. The output circuit, which includes the path between the plate and the filament together with a load circuit, has set up in it an amplified copy of the impressed wave.

The carbon amplifier, besides its use as a telephone transmitter, has been applied to submarine and subterranean signalling and to the detection or location of airplanes, submarines, mining operations and gunfire. Thermionic amplifiers are widely used in wire telephone and loud-speaker systems, in submarine cable telegraphy, and in high-frequency telephony and telegraphy by wire and by radio for amplifying both high- and low-frequency currents. They make possible more refined electric and other measurements, and have a variety of miscellaneous applications in special fields such as in aiding the deaf to hear and in making heart sounds more readily audible. (R. V. L. H.)

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AMRITSAR (*see* 1.895), the wealthiest town after Delhi in the Punjab, had in 1921 a population of 160,218, mostly Moslem and Hindu. There are about 200 looms engaged in the carpet-making industry, and the town has some commercial importance, as apart from the entrepôt trade in piece goods, a large business in skins and hides is carried on. The two yearly fairs are the most widely attended in the province. The foundation stone of a new hospital was laid in 1917.

As a result of the intense feeling aroused by the Rowlatt Act, banks and other buildings were pillaged and burnt and Europeans murdered in the town in 1919, and the civil authorities called for military assistance. On April 13 the so-called tragedy of Amritsar occurred, when Gen. Dyer found it necessary to disperse an unlawful gathering in the Jallianwala Dagh, and as a result nearly 400 natives were killed by gunfire, and probably three times that number wounded. This, and the administration of martial law proclaimed the following day aroused bitter indignation, which was not allayed by the appointment later of the Hunter Committee to enquire into the disturbance. Owing to this incident many moderate Indian politicians were alienated from British rule, but among the British community in India and elsewhere General Dyer found many sympathisers in the difficulty in which he had been placed. *See* INDIA.

AMSTERDAM (*see* 1.896) had in 1923 a population of 706,194. The city suffered considerably during the World War from the loss of a great part of the former extensive financial business. The Stock Exchange was closed in Aug. 1914, but reopened on Feb. 9 1915. There followed a stagnant period, with little international business. Immediately after the War a very difficult period set in; but the sound tactics pursued by Amsterdam bankers resulted in the florin reaching par before the end of 1924; shipping on the Rhine increased after the German mark had been stabilised and conditions in the Ruhr had improved.

The total goods traffic of the port increased 50% between 1913 and 1924. The Coen harbour, on the south side of the Y, with 3,112 ft. of quays for seagoing ships and 2,000 ft. for river craft, was opened in 1924, and plans were prepared for a new lock 1,292 ft. long at the entrance to the North Sea Canal at Ymuiden. The canal itself was dredged to a depth of 33 ft., and a new canal to improve the connection between Amsterdam and the Rhine was recommended, which would accommodate the largest barges in use on the Rhine, connect with the existing canal at Utrecht and be carried across the Dutch Rhine to Tiel. The railway line between Amsterdam and The Hague was being electrified in 1926.

AMUNDSEN, ROALD (1872–), Norwegian explorer, was born July 16 1872, in Borge, a country district near Sarpsborg in southeastern Norway. Educated at Christiania (now Oslo) he took his B.A. degree in 1890 and began to study medicine, but gave it up and went to sea in 1894. During the following nine years, Amundsen, with the tenacity of purpose which was one of his chief characteristics, prepared himself for his future career as an explorer, and in 1903–6 he led an expedition consisting of himself and six companions through the North West Passage, on board the "Gjöa," a little sloop of 47 tons. Simultaneously he succeeded in fixing the position of the magnetic North Pole. His next expedition, on board the "Fram," originally intended as a North Polar expedition, by a dramatic surprise, became a South Polar expedition (1910–2), and was the first actually to reach the South Pole. After his return in 1913 he resumed his preparations for a North Polar expedition but was stopped by the outbreak of the World War. He remained inactive until 1918 when he left Norway on board the "Maud," a new vessel, with the aim of drifting from the North Siberian Is. across the Polar basin. Baffled in this undertaking owing to the fact that the Polar stream did not prove to be constant, he decided to force the Polar basin in an aeroplane. On his fourth attempt he succeeded, using the semi-rigid dirigible "Norge," built in Italy. Starting with the American Ellsworth, from Spitsbergen, May 11 1926, he flew to the pole, which he circled twice, thence across the unexplored Arctic basin to Point Barrow, Alaska, and finally landed May 14 at Teller on Behring Sea. The total distance traversed was 2,700 m., the time occupied in the flight being only 71 hours. *See* POLAR EXPLORATION.

ANAEMIA.—A generic term for various forms of disease characterised by a defective constitution of the blood, or more specifically, by a reduction in the oxygen-carrying power of the blood. This reduction is due, either to a decrease in the number of red blood corpuscles, or to a decrease in the amount of

haemoglobin they contain, haemoglobin being that constituent of the red corpuscles which makes it possible for them to carry oxygen to the tissues and to play an important rôle in the transfer of carbon dioxide from the tissues to the lungs. The amount of haemoglobin that each red corpuscle contains is represented by a term known as the colour index, which is derived by dividing the percentage of haemoglobin by the percentage of red corpuscles.

Types of Anaemia.—The existence of several kinds of anaemia is recognised. A satisfactory classification is impossible because of the incompleteness of our knowledge. The customary division is as follows: (*a*) the primary, those in which the cause is yet unknown; and (*b*) the secondary, those due to some known cause. Chlorosis and pernicious anaemia are primary anaemias. The anaemia caused by haemorrhage, malaria, chronic poisoning by known chemical and biological agents, parasites, malnutrition, malignant disease, etc., is secondary. As our knowledge increases, all the different anaemias in the course of time will probably become secondary.

Symptoms.—Since the chief derangement in all anaemias is a reduction of the total amount of haemoglobin in the blood, the symptoms and pathological anatomy are quite similar in the different kinds of anaemia. Pallor of the skin and mucous membranes, shortness of the breath, palpitation, faintness, weakness, languor, headache, and usually gastro-intestinal disturbances, are the general symptoms. A special tendency to haemorrhage is frequently present. The physician frequently finds the heart to be dilated and hears systolic murmurs in the heart on auscultation. Anatomically the internal organs are pale, sometimes smaller than normal and atrophic, and their cells contain an excessive amount of fat. The spleen is enlarged in some anaemias and is usually of denser consistency than normal. The red bone-marrow, which forms the red corpuscles and haemoglobin, is increased in amount except in rare cases. The diagnosis depends on the clinical picture, the examination of the blood, and a number of other findings.

Causative Factors.—Obviously anaemia must be due to either one or a combination of the following factors: loss of blood, increased destruction of red corpuscles, or a disturbance of the red bone-marrow (erythroblastic tissue), leading to a decrease in the normal supply of red corpuscles or to a decrease in the amount of haemoglobin they contain. The red bone-marrow in health continually supplies the blood with red corpuscles which contain a constant amount of haemoglobin to take the place of those destroyed in the liver, spleen and other tissues; so that the number of red corpuscles and the total amount of haemoglobin in the blood remain quite constant.

If blood is lost, or if there is an increase in the destruction of red corpuscles, the red bone-marrow compensates by producing red corpuscles at a more rapid rate than normal. In such a case, especially if the loss, or destruction, is great, the red corpuscles so produced are frequently small, contain a subnormal amount of haemoglobin and may even contain a nucleus, which denotes that the cell is young. In the course of time these abnormal cells are replaced by normal cells and the red bone-marrow returns to a normal rate of production. But if the loss or destruction is continuous or intermittent, as in chronic anaemias, the blood contains more and more abnormal red corpuscles. The erythroblastic tissue further attempts to compensate for this continuous demand for red cells by invading and replacing the yellow marrow which does not form red corpuscles. If the demand is in excess of the capacity of the erythroblastic tissue to respond, the condition of the blood seen in the chronic anaemias develops, namely, a decrease in the number of red corpuscles, the presence of abnormal types of corpuscles, and a diminution of the total amount of haemoglobin in the blood.

In some of the anaemias it is possible to state definitely which of the above factors are concerned; in others opinion can be based only upon an interpretation of the known facts. In the anaemia that follows repeated haemorrhage, as occurs in ulcers of the gastro-intestinal tract, the obvious factor is the loss of blood. In the anaemias caused by haemolytic toxins, the destruction of red corpuscles is the chief factor concerned, although these toxins may also act on the erythroblasts or embryonic red corpuscles in the bone-marrow. In the anaemia secondary to malignant disease, *e.g.*, gastric cancer, the anaemia is due to a combination of several factors: the loss of blood from haemorrhage; an increase in the destruction of red corpuscles in some cases; a disturbance of nutrition leading to a lack of proper food supply for the erythroblastic tissue; and the possible action of the autolytic products of the cancer cells which may inhibit the activity of the bone-marrow. The evidence of increased red corpuscle destruction can sometimes be obtained by examination of the spleen and liver, their cells containing a larger quantity of iron than normal, by examination of secretions or excretions, such as the bile and urine (haemoglobinuria), and by determining the fragility of the red corpuscles. The fragility of the red corpuscles is ascertained by determining their ability to withstand a hypotonic solution of sodium chloride without disintegrating, normal red corpuscles being able to resist a 0·4% solution, whereas "fragile corpuscles" will discharge their haemoglobin in a 0·5% solution. The evidence of disturbance of the red bone-marrow is obtained by detailed examination of the blood, the cellular constituents being markedly altered. In the chronic anaemias regeneration and destruction, or loss, occur simultaneously, so that the blood picture gives an idea more of the capacity of the erythroblastic tissue to respond than of the amount of destruction that is occurring. In aplastic anaemia, a rare condition, the red bone-marrow does not respond, and as a result the anaemia runs a rapid and progressive course without remissions, contrary to the usual course of the chronic anaemias.

Chlorosis.—Chlorosis and pernicious anaemia are primary anaemias that deserve special discussion because of their common occurrence. Chlorosis occurs almost exclusively in females between the ages of 14 and 25, the most frequent ages of onset being 14 and 15. This disease is characterised by a pronounced haemoglobin deficiency without a proportional decrease in red corpuscles. It is rarely directly fatal and is fortunately very amenable to treatment with iron preparations, blood transfusions being required only in advanced and stubborn cases. The administration by mouth of bone-marrow and spleen is also beneficial. Recurrences of the disease are quite common. The cause of chlorosis is unknown. All evidence shows that a haemolytic agent is probably not responsible. The erythroblastic tissue is at fault, particularly in the formation of haemoglobin. The fact that iron is so beneficial suggests that iron starvation is in some way related to the primary cause, which is also related in some way to the age of puberty and the function of menstruation. Because of this latter factor, some believe that the glands of internal secretion, especially the ovary, are at fault; but no conclusive evidence is as yet available. An improper diet, overwork, worry and lack of fresh air are predisposing factors. Chlorosis does not occur frequently in country-bred girls, which is probably due to the greater exposure to sunshine and "outdoor life," which these girls enjoy. The symptoms of chlorosis are in general those of anaemia.

Pernicious Anaemia.—Pernicious anaemia is a common disease but is less frequent in occurrence than chlorosis. It is a disease of middle life and is twice as common in males as in females. It is characterised by a progressive anaemia interrupted by periods of temporary improvement, and by a fatal termination almost without exception in from two to five years, the body being rarely emaciated. The onset of this disease is slow and insidious. The skin is pale and later takes on a lemon tint. Languor, weakness and breathlessness are not marked at first, but later become extreme. The heart palpitates readily. The mucous membrane of the mouth is glossy and appears bloodless; the tongue is sore. The appetite fails and quite early in the disease acid disappears from the gastric secretion. Attacks of diarrhoea and abdominal pain frequently occur. There is a tendency to bleed into the skin and serous surfaces. Some patients experience sensations of numbness and tingling and complain of neuritic pains.

The blood picture is very abnormal, the red corpuscles being markedly reduced in number and very abnormal in shape and size, as well as in other respects. The red corpuscles contain an abundance of haemoglobin, the colour index being greater than 1·0. The white blood corpuscles are generally normal or diminished in number, but frequently abnormal forms are present. On post-mortem examination the bone-marrow is red and hyperplastic, except in cases of aplastic anaemia; lesions of the spinal cord are found; the gastric mucosa is frequently atrophic; the internal organs show fatty degeneration; the lymph glands may be deepened in colour (haemo-lymph glands), and there is much iron pigment in the kidneys, liver and spleen.

In contrast to chlorosis, there appears to be no serious difficulty in the formation of haemoglobin in pernicious anaemia. Many evidences of excessive blood destruction are present, particularly the increased iron content of the organs, free haemoglobin in the blood serum and urine, the frequent occurrence of jaundice, and the increased fragility of the red corpuscles. A condition simulating pernicious anaemia occurs on continued poisoning with toluylendiamine and ricin and in patients infected with bothriocephalus, an intestinal parasite that produces an haemolytic agent.

Haemolytic substances are said to be present in the intestine of anaemic patients that have chronic intestinal disorders, and recently a condition similar to pernicious anaemia has been observed to occur following intestinal stasis. B. aërogenes capsulatus, which frequently inhabits the intestine of man, produces an haemolytic agent, and it is reported that they occur in increased numbers in the intestine of patients that have pernicious anaemia and that their number decreases during the remissions. The feeding of this bacterium in large numbers, or the intravenous injection of their products, produces in animals a condition quite like pernicious anaemia in man. Buckman and Horrall report that an haemolytic substance is present in the serum of pernicious anaemia patients.

Some observers believe that the stomach is in some way related to the cause because of the high incidence of absence of acid in the stomach (achlorhydria) of patients suffering with this disease and because this disease sometimes occurs after total removal of the stomach. The absence of the acid in the stomach is said to favour the growth of bacteria that produce haemolytic poisons. After total gastrectomy in dogs a grave anaemia is found, which, however, has been controlled by the administration of iron and cod-liver oil. It is impossible to state at this time whether the change in the stomach is primary or secondary. Although the more recent evidence seems to show that it is primary, it is commonly held to be secondary, as are the changes in the bone-marrow and nervous system, to the action of a toxin, irrespective of its source.

All treatments at present can be said to be only palliative. The source of the toxaemia should be looked for. Nutritious and readily digestible foods should be ingested, and plenty of fresh air, sunlight and cod-liver oil are indicated. Dilute hydrochloric acid by mouth improves digestion. Removal of the spleen has been tried extensively, but without definite benefit. It is of great benefit, however, in splenic anaemia. Repeated blood transfusion quite probably offers more for pernicious anaemia than any other form of treatment.

Other Forms of Anaemia.—There are other diseases of the blood and blood-forming organs, such as lymphosarcoma, Hodgkin's disease, chloroma, leucaemia and anaemia pseudoleucaemia of children, in which anaemia occurs. In these diseases the disturbance chiefly involves the white corpuscles, or leucocytes, and hence these diseases are not to be considered in a general discussion of anaemia.

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ANAESTHETICS (*see* 1.907).—The agents for producing general surgical anaesthesia which were the first to be introduced, that is, nitrous oxide gas, ether and chloroform, not only remain in general use, but actually provide in greater part for the requirements of modern surgery. Local anaesthesia, which has in part supplanted general anaesthesia, has still only a very limited application.

Nitrous Oxide.—The War showed that persons suffering from severe shock and loss of blood from wounds did not progress favourably following operations under chloroform or ether, but that the prospects of recovery were distinctly improved when performed under the continuous inhalation of nitrous oxide gas. The reasons for this cannot be stated precisely, but it may be said in general terms that nitrous oxide is less depressing, and further that owing to its exceedingly rapid excretion, consciousness and normal bodily conditions are quickly restored after completion of the operation.

Nitrous oxide or " laughing gas," as it was formerly termed, is familiar as an agent for producing brief periods of narcosis, as for the extraction of teeth. When administered thus in a pure state it excludes the admission of air to the lungs and if continued would cause complete asphyxia. The problem of continuous administration is therefore the admission of sufficient oxygen to the lungs to satisfy the needs of the body. Air contains about one-fifth of its volume of oxygen, but if nitrous oxide were diluted to this extent its partial pressure would be reduced to about 80%, which is too weak for the convenient production of its full anaesthetic effect, at least in the early stages of its administration. Oxygen may in fact be reduced to a proportion of one-tenth of an atmosphere without causing discomfort to the patient or even under ordinary circumstances causing the discolouration of the face known as cyanosis. It may even be reduced lower than one-tenth and yet be capable of sustaining life. The continuous administration of nitrous oxide mixed with oxygen requires a sufficiently delicate mechanism to regulate and indicate the relative proportions of the gases, but it is not a method which is adapted for all classes of cases; the relaxation of the body muscles is not sufficient for the convenient performance of certain operations; the narcosis is not always sufficiently deep and it may have to be supplemented by an admixture of ether vapour; nor is it absolutely free from danger. Its advantages in the cases of profound shock referred to appear to be undoubted, but it can not be classed for precision of action with the routine anaesthetics, chloroform and ether.

Ether.—The use of ether as an anaesthetic has received considerable stimulus from the introduction of the " open " method of administration. In order to induce anaesthesia in a muscular person, or " to get him under " in ordinary phraseology, a strong vapour may be required, this being as strong as 25% to 30% in some cases.

In the " open " ether method the breathing is noiseless, effortless, and only slightly exaggerated, so that delicate abdominal operations can be performed with comfort. The flow of saliva is considerably less than in the closed method, probably from the absence of asphyxia, and this can be entirely abolished by the subcutaneous injection of a minute dose of atropine previous to the administration. There is no sign of cyanosis, and the patient's face remains a healthy colour throughout; the only restriction of oxygen is by reason of the displacement of air by ether vapour which at a maximum will be less than one-third its volume, and as in the later stages of an administration much less vapour is required, the restriction becomes entirely negligible. The after-effects of ether, such as vomiting and malaise, are considerably less pronounced than those that follow a " close " administration.

The application of the " open " method to ether inhalation has been brought about by an exceedingly simple adaptation. The liquid ether is applied to a pad of open-wove fabric, such as " stockinette " or a number of layers of absorbent gauze stretched over a framework mask of which the margin is roughly adapted to the contours of the face; the mask rests lightly upon the face, a soft pad being interposed between its edges and the

skin to prevent the entrance of air in this direction. In this way the inhaled air passes through the meshes of the fabric and in doing so every portion of it comes in close contact with the ether and takes up a greater proportion of vapour than it would if it merely passed over the surface of the fabric.

The induction of anaesthesia by the "open" method is liable to be somewhat prolonged, an undoubted disadvantage, but once full anaesthesia has been produced it is maintained without difficulty and the results attained are in general more satisfactory than those of any other form of inhalation anaesthesia.

The "intratracheal" method of etherisation is conducted by passing a narrow tube through the larynx into the trachea almost to the level of its bifurcation. Through this tube a continuous current of air and ether vapour is forced into the lungs at a pressure which keeps the lungs moderately distended, but not so much as to abolish the natural respiratory movements. The air returns through the chink of the vocal cords by the side of the tube and this continuous return blast blows away any solid or fluid particles, blood or pieces of tissue, in the neighbourhood, and prevents their entering the trachea, an accident which may possibly occur in ordinary inhalation methods. The advantage of intratracheal ether in operations involving the respiratory passages is therefore obvious; it is likewise a convenient arrangement for operations upon the face, which is left entirely uncovered, and in operations upon the interior of the thorax a proper aeration of the lungs can be thus ensured.

Chloroform.—The form of sudden death which is occasionally encountered under chloroform anaesthesia has acted as a deterrent to its more extended employment in spite of its manifest conveniences.

It is now becoming realised that the typical sudden chloroform fatality is not conditioned by an overdose as formerly supposed. It has long been known that the majority of deaths occur in the very early stages of anaesthesia before the patient is fully narcotised, and further examination of reports of fatalities shows that there is generally some evidence of light anaesthesia preceding death, or else that overdosage can be ruled out of question. There is a further point brought out by these reports, which was in fact fully appreciated by John Snow in the middle of the last century: whereas in overdose the respiration is paralysed before the circulation, in the typical chloroform death the outstanding feature is an absolutely sudden failure of the circulation, and the failure of the respiration is a secondary result.

Dr. A. G. Levy, in 1911, reported certain cases of sudden cardiac failure that he had observed in animals obviously in a light stage of chloroform anaesthesia, and he succeeded in reproducing this death by the intravenous injection of small doses of adrenalin in lightly chloroformed animals, but the experiment failed under full chloroform narcosis. This at once accounted for those cases of syncope and death, a number of which had been recorded, following the injection of adrenalin into the mucous membrane of the nose for the purposes of certain nasal operations which were always conducted under light anaesthesia, the form of this syncope being the same as in an ordinary chloroform fatality.

By following up this line of research it was shown that sudden cardiac failure could be induced likewise by various procedures—excitation of the cardiac accelerator nerves either directly or through a reflex mechanism, stimulating the excretion of the adrenal glands, by intermitting the administration of chloroform, or by withholding the chloroform during excitement and struggling; the event never occurred during deep narcosis. The underlying condition of the cardiac syncope was shown to be that of fibrillation of the ventricles, in which the ventricles are entirely deprived of their power of propelling the blood through the arteries.

On this theory death under chloroform can be prevented by simple precautions, by making the induction of anaesthesia continuous and expeditious and thereafter continuously maintaining a full degree of narcosis. Chloroform should never be employed if the conditions of the operation forbid the observance of these rules and especially in those special cases in which a light degree of anaesthesia is required. (*See* ETHYL CHLORIDE; ETHYLENE.)

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ANATOLIA: *see* ASIA MINOR; TURKEY.

ANATOMY (*see* 1.920).—While during the period 1910–25 the policy of appealing to the legal custodians of unclaimed bodies to hand them over for anatomical examination followed the course previously pursued by licensed teachers of anatomy, the government authorities not only supervised the administration of the Act, but also helped the schools to obtain an adequate supply of material to meet their needs. The immediate result has been an extension of sources of supply so as to improve considerably the state of affairs which prevailed in Great Britain in 1910.

In recent years there has been much confusion with regard to the nomenclature used in the science of anatomy. This arose from an attempt to revise and improve the terminology which had previously been in common use. At present either the original or the new "Basle" terminology or a combination of both are employed, but it is very desirable that a unanimous understanding should be arrived at by anatomists for the good of the science in general, and for its application to medicine and surgery in particular.

While advances in the science of anatomy since 1911 have been important, but of a highly technical nature, many contributions have been made largely in association with cognate subjects such as comparative anatomy, physical anthropology, embryology, physiology, pathology, medicine and surgery.

There has been much elaboration and improvement in apparatus designed for the examination in the living person of the organs of sense, alimentary canal, respiratory and genito-urinary systems. The technique of preparing the tissues of the body for microscopic examination has also advanced.[1] Perhaps the most important step forward in recent years has been the application of X-rays in the study of macroscopic anatomy particularly of the living body—an advance which has proved of immense importance in the practice of medicine and surgery.

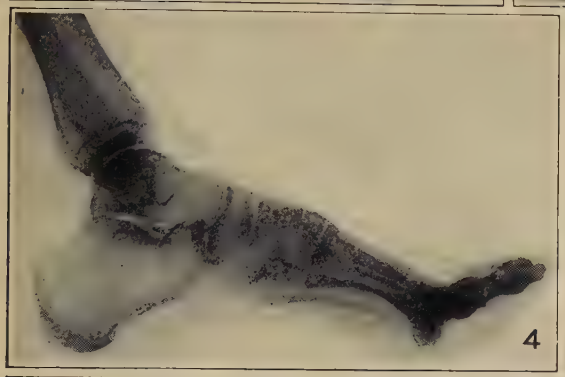
Osteology.—Advances in connection with the skeleton have been largely concerned with its development. The controversy regarding osteogenesis has continued and new views have been expressed as regards the origin, growth and fate of osteoblasts and osteoclasts. Important contributions have been made dealing with the human clavicle, ribs and bones of the face. With regard to the descriptive aspect of osteology an interesting account has been given of the human sinus maxillaris at all ages. Sexual differences in the human skull and sexual and racial characters of the human ilium have been recorded. Important papers have also appeared upon the morphology of mammalian teeth and sternum.

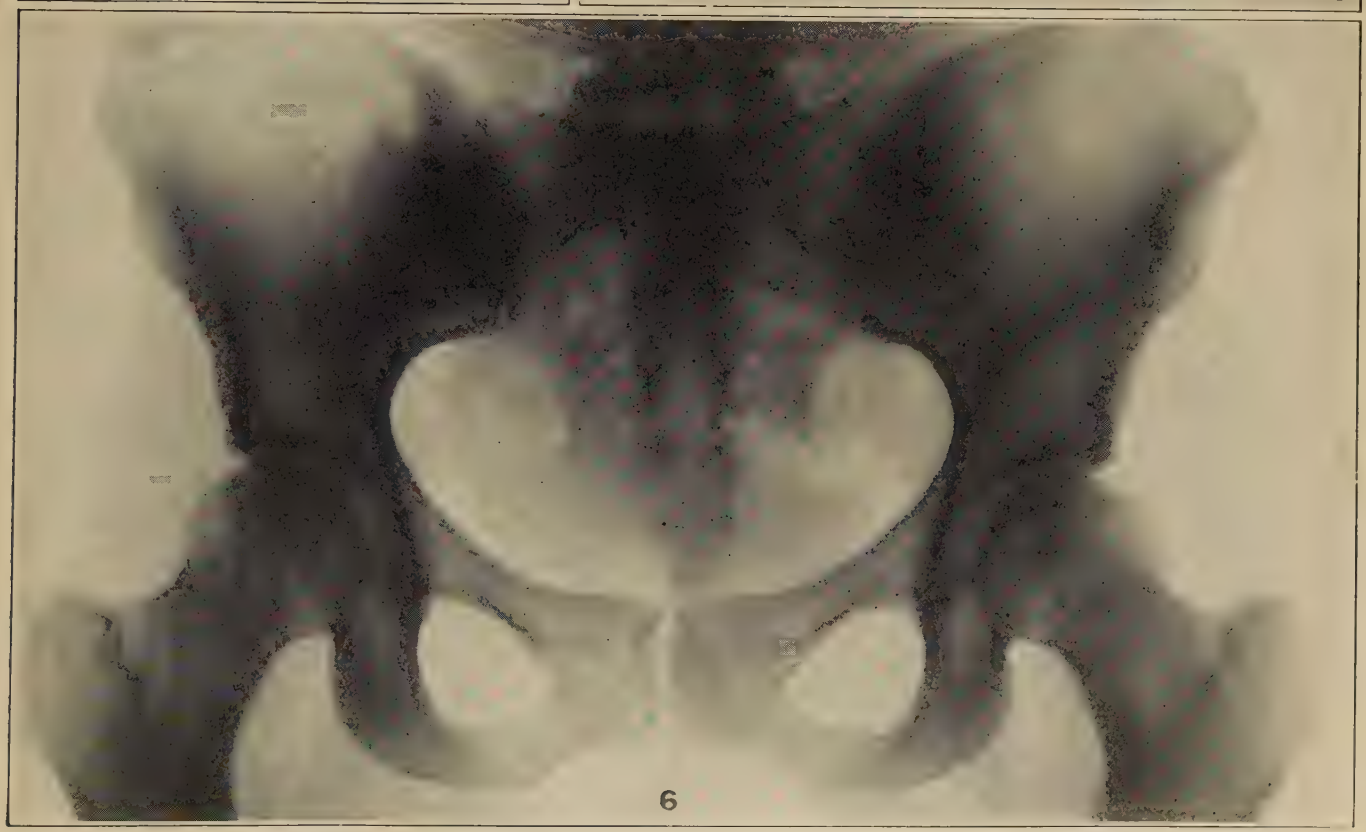
Muscular System.—The World War, with its immense train of injuries to muscle and nerve, was directly responsible for renewed intensive study of these systems. The investigations of Prof. Kulchitsky upon the innervation of muscle fibres, the consequent and subsequent suggestions by Prof. Hunter that muscle fibres are of two kinds with separate nerve supplies from the central and autonomic systems, and the actual designing of surgical measures for amelioration of muscle spasm based upon these ideas, have not yet been sufficiently confirmed. The morphological aspect of the muscular system has also received its due measure of attention.

Nervous System.—C. W. Ariens Kappers has demonstrated that control is exercised upon the grouping of brain cells by forces, probably of a bio-electric character, emanating from the nerve tracts with which these are functionally associated.

Much attention has been given to the comparison of particular areas of the central nervous system in a series of vertebrates with a view to elucidating the evolutionary significance of these areas in man. Considerable work has been directed to the relative

[1] A. B. Lee, *The Microtomist's Vade-Mecum*, eighth edition by J. Bronte Galenby (1921).





RADIOGRAPHY AS APPLIED TO ANATOMY

FIG. 1. Lateral view of Head. FIG. 2. Side view of Knee. FIG. 3. Normal Stomach and first part of Duodenum immediately after ingestion of barium meal. FIG. 4. The Ankle and Foot. FIG. 5. Lower part of Forearm and Hand. FIG. 6. Pelvis and Hip-Joint.

(Photographs by courtesy of Dr. Levack, Aberdeen; Dr. Spriggs, Ruthin Castle, N. Wales; and Dr. Salmond, Univ. Coll. Hospital, London.)

anatomy of the origin, course and distribution of the motor and sensory nerves, with the acquisition of knowledge, highly detailed, but of great practical importance.

Organs of Sense.—Very important and extensive investigations have been carried out by Karl Pearson, E. Nettleship and C. H. Usher on the subject of albinism in man, showing that eyes, hair and skin may alone show perfect albinism, and that perfect albinism in eyes may be accompanied by imperfect or wholly absent albinism in hair. Anatomical science is indebted to S. Ernest Whitnall for an exhaustive account of the anatomy of the human orbit and accessory organs of vision, and to Sir Frederick Smith for anatomical notes on the accessory organs of the eye of the horse. As regards the ear much attention has been given to the study of the structures concerned in the mechanism of hearing, and attention may be directed to comprehensive accounts of the anatomy of the ear in man and animals by Albert Gray, Glasgow.

Vascular System.—During the years 1910–25 additions to the knowledge of the vascular system have been chiefly in relation to function. Recent advances in connection with structure have been with regard to the blood supply of the valves, the muscular architecture and the development of the human heart. Further information has also been gained with respect to the arterial supply of the pons, medulla, and fore-brain, and the development and comparative anatomy of the arteries of the extremities.

Digestive System.—The chief advances in the anatomical knowledge of the digestive system have been along the lines of development and morphology. Particular attention has been paid to the teeth, the shape and size of the tonsils at different ages, the minute structure of the oesophagus in mammalia, the form and immediate relations of the abdominal viscera with special reference to their peritoneal attachments, their blood and nerve supply and lymphatic connections.

Respiratory System.—Numerous papers of importance have been written upon the human and comparative anatomy and development of this system with special reference to the lobes of the lungs and the nerve supply of the larynx. Recent knowledge, which has been acquired by means of X-rays regarding the position of the diaphragm and thoracic viscera, will be found in the paragraph below, *Radiography as Applied to Anatomy.*

Genito-Urinary System.—The problem of the descent of the testis has attracted renewed investigation and given rise to new opinion. Comparative anatomy, development and clinical methods have been studied for light upon the various parts of this system, and the most valuable additions have been made to our knowledge of the appearance of the urethra, bladder and ureter by the cystoscope and of the kidney by radiography.

Ductless Glands.—Much attention has in recent years been focused on the function of these glands and a renewed interest has been taken in their morphology and microscopic anatomy.

Radiography as Applied to Anatomy

Human anatomy has been greatly advanced by the application of radiography to the study of the body especially in its living state. In recent years the apparatus in connection with radiography has been enormously improved (*see* Röntgen Rays). Advances have been made in the preparation of the human body, prior to its exposure to the X-rays, by the employment of substances to which the rays are highly impervious.

In order to interpret the photographs obtained by radiography it is essential that the person who takes the photograph and the person who interprets it should be one and the same, as it is of primary importance that the interpreter of the photograph should have first-hand knowledge of the exact relation between the source of the rays, the object to be examined and the photographic plate.

The Skull.—An instructive radiogram of the skull is obtained by placing the tube generating the rays on one side of the head and by laying the photographic plate flat against the other. Fig. 1 on plate shows a lateral view of the head resting upon the upper part of the spinal column. On detailed examination a good view is obtained of the extent of the cavity which contains the brain. The orbital and nasal chambers with their accessory air sinuses (antrum of Highmore and sphenoidal air sinus) are well seen. Particularly there is noticeable, immediately behind the sphenoidal sinus, the saddle-shaped sella turcica for the lodgment of the pituitary gland which is chiefly concerned in the growth and metabolism of the body.

Shoulder.—A front view of the shoulder and neighbouring part of the chest when the arm hangs by the side of the body, discloses the relative position of the bones of that region. The ribs pursue an obliquely downward course in order to allow of their movements in respiration.

The clavicle passes outwards and slightly upwards toward the acromion process of the scapula, with it to form a bony arch overhanging the shoulder joint and thus helping to prevent upward displacement of the humerus at that joint. The body of the scapula rests on the ribs thickening at its axillary border and upper and outer angle where it expands to form the glenoid fossa for the reception of the head of the humerus. The coracoid process which is swung by fibrous tissue to the clavicle in the recent state is very evident.

The ball and socket character of the shoulder joint is so arranged as to allow of extensive movement of the arm at the joint, the socket (glenoid cavity) being small as compared with large articulating surface of the ball. The upper extremity of the humerus with its articular surface and tuberosities are well seen.

Elbow.—A good picture of this region is obtained by taking a radiograph from its inner side with the elbow joint slightly bent and the forearm in such a position that the palm of the hand is directed toward the median plane of the body. The lower end of the humerus shows the internal condyle with a ridge running upward from it and a groove behind it for the passage of the ulnar nerve (funny bone) from the arm into the forearm. The upper end of the ulna shows the deep concavity by which it articulates with the pulley-shaped surface of the humerus and its helmet-shaped upward extension (olecranon process) for the attachment of the triceps muscle—the great extensor of the forearm. The head of the radius supported upon its conical neck articulates with the humerus above and the ulna at the side. The whole picture emphasises the hinge-like character of the elbow joint and the pivot character of the joint between the bones of the forearm at the elbow.

Wrist and Hand.—Fig. 5 on plate shows the lower part of the forearm and hand viewed from the palmar aspect. The radius and ulna, the carpal, metacarpal and phalangeal bones form distinct shadows. The outline of the wrist joint shows that the hand is supported mainly by the expanded lower end of the radius, the head of the ulna being separated from the carpus by an interval which in the recent state is filled up by a fibro-cartilaginous pad.

The outlines of all the eight bones of the carpus can clearly be made out forming a group consisting of two rows of bones with an ∽-shaped joint between them. The os magnum is the largest bone of the group and lies with its long axis in line with the middle finger, the semi-lunar and the radius. Its rounded head fits into a cup formed by the scaphoid and semi-lunar; its body is flanked by the trapezoid and unciform, and its base supports the third and to a lesser degree the second and fourth metacarpal bones. The pisiform is rather indefinitely seen immediately below the ulna and in front of the cuneiform. The trapezium partially hides the trapezoid.

The four inner metacarpal bones lie close to one another, while the first or that of the thumb is separated from the second by a wide interval. A small sesamoid bone is seen lying upon the inside of its head.

The phalanges of the fingers and thumb are shown very distinctly and the ball and socket character of the metacarpo-phalangeal and the hinge-like nature of the inter-phalangeal joints are also manifest. The whole radiogram affords a striking illustration of the adaptation of the hand for prehensile purposes as compared with the foot which is constructed essentially for supporting the weight of the body and for locomotion.

Pelvis and Hip-joint.—The architecture of the bony framework of the pelvis which transmits the weight of the trunk and upper extremities allowing at the same time room for viscera is well seen in fig. 6 on plate.

The relation of the wedge-shaped sacrum with its coccygeal appendage to the rest of the body girdle is apparent. The sacrum is seen to be interlocked between the ilia of the innominate bones so as to form with them an arch transmitting the superincumbent weight either to the lower extremity in the erect posture or to the ischial tuberosity in the sitting position. The tendency towards the spreading of the arch is prevented by the front portions of the pelvic girdle acting as tie beams and there are three "buffers" which break shocks; one at the symphysis pubis in the middle of the front part of the girdle and the other two at joints between the sacrum and ilia. The foramina for the exit of nerves from the spinal cord to supply the lower extremities and soft parts of pelvis are apparent. The general character of the female as compared with the male pelvis is well exemplified in fig. 6, *e.g.*, the widely spreading ilia, the great width of cavity below the ilia and the wide sub-pubic angle.

To get a good radiogram of the region of the hip-joint is a somewhat difficult matter. One taken from the front shows the thigh occupying its position in the erect posture, revealing the socket or acetabulum, the head of the femur with its pit for the round ligament, the oblique neck, and the upper part of the shaft with the great and small trochanters. The arrangement of the cancellous bone tissue is such as to bear the superincumbent weight in the best possible way. Unlike the shoulder-joint which is constructed essentially for prehension, the hip-joint is formed for support and locomotion.

Knee.—Many radiograms of this region show that the bones which form its foundation come near the surface of the limb especially in front and that they are consequently liable to mechanical injuries and to the effects of other adverse influences from without.

A good general idea of the region is obtained by taking a radiogram from the side (fig. 2 on plate). It shows the lower part of the femur with its condyles, upper part of the tibia with its spine, tuberosities and tubercle, and the upper part of the fibula with its head.

There is seen to be but little interlocking between the femur, tibia and patella which enter into the formation of the knee joint. The tibia articulates by a relatively small surface with the relatively large articular surface of the femur, the joint so formed being an example of a hinge joint with the pin of the hinge a movable one. The spine of the tibia is seen projecting upward between the condyles of the femur acting like the flange of a wheel and so helping to prevent lateral displacement of the tibia from the femur at the joint. The knee-cap, to which are attached the great extensor muscles of the leg, moves upward and downward on the femur only. The fibula is seen articulating with the tibia, the joint surface being oblique in direction in order to break shocks between the two bones.

Ankle and Foot.—In fig. 4 on plate a view of the skeleton of the lower part of the leg and of the foot is given from the inside. The tibia and fibula of the leg, and the tarsal and metatarsal and some of the phalangeal bones are shown.

The tibia articulates with the astragalus at the ankle joint, and on close inspection the relative positions of the malleoli of both the tibia and fibula to the astragalus can be made out, the bones of the leg and the astragalus forming a hinge joint. The tip of the outer malleolus which forms part of the fibula reaches to a lower level than the tip of the inner malleolus which belongs to the tibia. The foot as in the case of the hand is seen to consist of a number of bones by virtue of which its mobility and elasticity are increased, while the chances of fracture or dislocation are lessened.

The antero-posterior and to a less extent the transverse arch of the foot are shown, the pillars of the former consisting of the great tuberosity of the os calcis behind and of the heads of the metatarsal bones in front. The astragalus forms the keystone of the arch, and transmits the weight of the body from the tibia to the astragalus and os calcis behind and to the scaphoid, cuboid, cuneiform and metatarsal bones in front. The spicules of the cancellous tissue in these bones are arranged so as to bear the weight of the body transmitted through them. The so-called tunnel of the tarsus and the mediotarsal joint across the foot between the astragalus and os calcis behind and the scaphoid and cuboid in front are very apparent, showing at the same time that the articulation between the os calcis and cuboid forms a separate joint. The front of the middle cuneiform is indicated by a narrow vertical shadow situated a little behind the shadow indicating the anterior border of the internal cuneiform.

The radiogram illustrates vividly the essential difference between the hand and the foot, in that the big toe is seen to be closely applied to the second toe and not opposable to the rest of the foot as the thumb is to the rest of the hand.

Ossification.—Ossification begins in each bone of the skeleton at one or more spots called "primary centres of ossification." Each appears before birth and by their spreading they form the main part of the bone. After birth "secondary centres of ossification" begin to show themselves independently of the main mass, form what are known as "epiphyses" and join it at various periods after birth to make the adult bone. Radiography, when applied to the living body, affords very valuable information as to the forms, times of first appearance and times of junction of the epiphyses with the main parts of bones to which they belong. It has shown that there is very great variability in the times of appearance and of fusion of epiphyses in different individuals, a fact which is of great importance in the practice of surgery.

Thorax and its Contents.—Apart from revealing the skeleton of the thorax, radiography permits inspection of the position and contour of the heart and great vessels, the lungs and mediastinum.

Abdomen and its Contents.—Subsequent to the introduction of matter opaque to X-rays such as barium or bismuth salts into certain organs, radiography has played a very important part in elucidating the anatomy of the alimentary canal and the urinary tract.

Fig. 3 on plate shows a normal stomach and first part of the duodenum immediately after the ingestion of a barium meal. The clear area at the upper part indicates the air-containing portion of the cavity in the neighbourhood of the entrance of the oesophagus.

The writer of this article is indebted to Dr. Levack, Radiologist, Royal Infirmary, Aberdeen, Dr. Spriggs, Duff House, Ruthin Castle, North Wales and Dr. Salmond, Radiologist, University College Hospital, London, for the radiograms that are reproduced in figs. 1 to 6.

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(R. W. RE.)

ANDERSEN, HANS NIELS (1852–), Danish shipowner and merchant, was born at Nakskov in poor circumstances. He went to sea and in 1884, having gained experience by trading with the

East, he founded the business of Andersen & Co., at Bangkok, opening in 1894 a branch house in Copenhagen. In 1897 he established at Copenhagen Det Östasiatiske Kompagni (The East Asiatic Company) which soon became the largest commercial enterprise in Denmark and one of the few Danish undertakings of world-wide renown. In 1912 at Copenhagen, the company launched the first large motor-ship. Owing to his powers of administration and his extensive connections throughout the world he rendered important services to his country during the World War. He received the Order of the Elephant, the highest Danish order, in 1919. He is the author of *Tilbageblik* (1920).

See A. Fraenkel, *Verden med dansk Maal eller Danmark med Verdensmaal* (1916).

ANDERSON, ELIZABETH GARRETT (1836–1917), British medical practitioner (*see* 1.959), died at Aldeburgh, Suffolk, Dec. 17 1917.

ANDERSON, SHERWOOD (1876–), American author, was born in Camden, O., Sept. 13 1876. After trying various occupations, he entered the advertising business and eventually left his native state for Chicago. His first literary work was a story, *Sister*, which appeared in the *Little Review* (1915). His first novel was *Windy Macpherson's Son* (1916). In 1921 his novel, *Many Marriages*, was awarded the *Dial* prize of $2,000. Among his other works are *Marching Men* (1917); *Mid-American Chants* (1918); *Winesburg, Ohio* (1919); *Poor White* (1920); *The Triumph of the Egg* (1921); *Dark Laughter* (1925) and the autobiographical *A Story Teller's Story* (1925). Mr. Anderson's fiction is mainly psychological in interest, and pessimistic in tone. The frankness with which he treats the relations of the sexes has frequently provoked criticism.

ANDORRA (*see* 1.965).—This little country has a population of 5,231 and an area of 191 square miles. The poorness of communication remains the principal hindrance to the country's development. A motor road from the French side runs as far as Soldeu; and from the Spanish side a road from Seo de Urgel reaches Encamp, 5½ m. beyond Andorra la Vella, the capital. A motor omnibus service is in operation between Seo de Urgel and Andorra la Vella. From Soldeu to Encamp, a distance of 8 m., there is only a mule track. The track passes between high cliffs containing valuable deposits of iron ore and occasional small veins of silver and lead. For the exploitation of these minerals a good road is essential; the construction of such a road has become Andorra's chief political issue, but at the end of 1925 the question remained unsettled. The tobacco crop is the main source of the wealth of the country.

ANDRÁSSY, JULIUS, Count (1860–), Hungarian statesman, was born June 30 1860, the son of Count Julius Andrássy (*see* 1.967). He was elected deputy in 1885, and in 1906 became Minister of the Interior, in the so-called Coalition Cabinet (*see* 13.921). At the collapse of this Ministry in 1910, he refused to join the Khuen-Héderváry Govt. but declared that he would not actively oppose it, and dissolved the constitutional party, of which he was leader. In 1913 he delivered three speeches in the Hungarian Delegation against the conduct of foreign affairs, advocating a policy of European *détente*, and in Parliament he opposed the plan for the centralisation of the internal administration of Hungary. At the outbreak of the World War he supported the Tisza Ministry, but opposed Burian on the Polish and Italian questions. In 1915 he pleaded for peace, and urged a wide extension of the franchise. Upon the resignation of Burian in Oct. 1918, he became Foreign Minister in Vienna and, in a note to President Wilson, made a last attempt to conclude a separate peace. He then retired from office, but in Jan. 1920 was returned for Miskolcz to the Hungarian National Assembly and later became leader of the Christian National party. In Oct. 1921, at King Charles's second attempt to regain his throne, he was taken prisoner with the King and was imprisoned for several months. In 1922 he was returned to the Nationalist Assembly as a Legitimist deputy.

His works include—*Ungarns Ausgleich mit Österreich vom Jahre 1867* (1897); *Die Ursachen des Bestandes des Ungarischen Staates und dessen verfassungsmässiger Freiheit* (3 vols., Budapest, 1901–11); *The Development of Hungarian Constitutional Liberty* (1908); *Wer hat den Krieg verbrochen?* (Leipzig, 1915, Eng. trans. by E. J. Euphrat, New York, 1915); *Interessensolidarität des Deutschtums und Ungartums* (Munich, 1916); *Diplomatie und Weltkrieg* (1920, Eng. trans. by J. H. Reece, 1921), and *The Antecedents of the World War*, vol. 1, Hungarian (1925).

ANDREE, RICHARD (1835–1912), German geographer (*see* 1.971), died at Leipzig Feb. 22 1912.

ANDREWS, ROY CHAPMAN (1884–), American naturalist and explorer, was born at Beloit, Wis., Jan 26 1884. After his graduation from Beloit College in 1906, he went to Alaska on his first exploring trip. In 1909–10, he accompanied, as a naturalist, the "Albatross" on its voyage to the Dutch East Indies, Borneo and Celebes; in 1911–2 he explored northern Korea; and in 1913 was with the Borden Alaska expedition. From that date he devoted himself to the exploration of the lesser known portions of Central Asia, China and Borneo. The fruits of his expeditions in 1921 and 1925 into Central Asia included the discovery of new geological formations, large fossil fields, dinosaur eggs and the skull and other parts of the baluchitherium—the largest known land mammal. Evidence was discovered also pointing to Central Asia as a place of origin and centre of distribution for much of the reptile and animal life of the world. Mr. Andrews became chief of the division of Asiatic exploration of the American Museum of Natural History and wrote: *Whale Hunting with Gun and Camera* (1916); *Camps and Trails in China*, with Yvette Borup Andrews (1918); *Across Mongolian Plains* (1921) and numerous scientific bulletins of the American Museum of Natural History.

ANDREYEV, LEONID NICOLAIEVICH (1871–1919), Russian novelist, was born in Orel June 18 1871. Educated at the government school, in 1896 he received the diploma of the University of Moscow. Poverty and an unhappy heredity drove him in 1894 to an attempt on his own life, as a result of which he suffered from a weak heart which ultimately caused his death. For a long time Andreyev was unable to find a place in literature, and he became a reporter on the paper *The Courier*. In 1899, his story *They Lived* appeared in the monthly *Zhizn* (Life) and attracted universal attention. It is the only one of Andreyev's stories in which a happy love-story is told in an attractive manner.

In 1901, when the first series of his stories appeared in a separate edition, N. K. Michailovsky, the most influential critic of the time, paid a high tribute to the genius of the young author. This series included the stories *The Grand Slam*, *The Tocsin*, *The Wall*, in which Andreyev's creative genius and its characteristics were clearly visible. His subsequent works: *The Story of Serguey Petrovitch*, *Thought*, *In the Mist*, *The Life of Father Vassili Fiveisky*, *Ghosts*, etc., are similar to his first work in spirit and philosophical outlook.

His works are permeated by a horror of life, which appeared to Andreyev, as to James Thomson, a "City of Dreadful Night." His manner is original and he follows the great precept that "In literary works, there should be little room for words and large space for ideas." The same terror of life is expressed in Andreyev's plays *The Life of Man* (1907), *King Hunger*, *Anathema* (1909). He was not a morbid pessimist who derided the misery of mankind, but a mournful humanist. He pities the sufferers and is filled with scorn for those who add nightmare to nightmare. Andreyev's best known works reflect this attitude: his protest against war, *The Red Laugh* (tr. 1905); against capital punishment, *The Seven that were Hanged* (tr. 1909), which appeared during the reign of the White Terror in 1909; and the passionate *S.O.S.* (1919), directed against the Red Terror.

Andreyev refused to follow Gorki's example and to recognise the Bolshevik régime, declined the honours offered by the Bolsheviks and fled to Finland. He thus lost the fortune he had accumulated by his writings, and during the last years of his life he once again experienced poverty and even want. *S.O.S.*, one of the most remarkable works of Russian literature and Andreyev's swan song, was published in Finland. He died in Helsingfors Sept. 12 1919. (I. W. S.)

ANGELL, JAMES ROWLAND (1869–), American educationalist, was born at Burlington, Vt., May 8 1869. He was a

son of James Burrill Angell (d.1916), first president of the University of Vermont and fourth president of the University of Michigan (1871–1901). He was educated at the Universities of Michigan (A.B., 1890; A.M., 1891) and Harvard (A.M., 1892), and spent a year in Europe, chiefly at Berlin and Halle. In 1893 he was appointed instructor in philosophy at the University of Minnesota. In 1894 he was called to the University of Chicago as assistant professor of psychology and, after 1905, was professor and head of the department. He was dean of the university faculties after 1911, and acting president during 1918–9. In 1906 he was elected president of the American Psychological Assn., in 1914 exchange professor at the Sorbonne, and in 1915 special lecturer on psychology at Columbia. In 1921, on the resignation of Arthur T. Hadley (*see* 12.798), he was elected president of Yale University.

He was the author of *Psychology* (1904; 4th ed., revised, 1908); *Chapters from Modern Psychology* (1912); and *An Introduction to Psychology* (1918).

ANGLICANISM.—The years 1910–26 constituted a period of extraordinary interest and importance for the Anglican Communion, especially for the Church of England. It is probable that future historians will register as the most important fact from the point of view of general church history the great advance in the prestige of this communion in relation to Christendom as a whole. This was largely due to the circumstances of the World War and the post-War years and to the personal influence of the Archbishop of Canterbury.

Ethos and External Relations.—But a still deeper cause may well be the peculiar ethos of the Church of England itself—the riches of which are the more clearly shown the more that church comes into contact with other and especially foreign churches. Most notable has been the growth in cordiality and understanding between the Anglican Communion and the Orthodox Eastern Church. From 1918 onwards appeals have come to the Archbishop of Canterbury from the leaders of the persecuted Russian Church, and there is no doubt that the strong moral support consistently given by the archbishop and others in the Church of England proved of great value and encouragement to Christians in Russia, besides having a decisive influence in the saving of the life of the Patriarch of Moscow (Tikhon).

Similarly the Church of England was regarded by the Greek Orthodox Church and the Eastern Churches generally as their principal spiritual stay in face of the Turkish attacks on Armenians, Assyrians and Greek Christians; and the archbishop's public appeal on behalf of the Patriarch of Constantinople during the Treaty discussions at Lausanne is generally held to have secured the promise then given that Constantinople should continue to be the spiritual centre of the Oecumenical Patriarchate. In a different field, it was during this period that the Patriarchate of Constantinople was officially represented for discussion on Anglican-Orthodox relations in connection with the Lambeth Conference of 1920. Again, in 1922, the Patriarch and Holy Synod of Constantinople formally acknowledged the validity of Anglican ordinations, an acknowledgment subsequently endorsed by the churches of Jerusalem and Cyprus. In 1922, in pursuance of a resolution of the Lambeth Conference, the Eastern Churches' Committee was constituted by the Archbishop of Canterbury for maintaining regular relations with these churches under his supervision.

Christian Unity.—It is perhaps even more remarkable, and an outcome of the "Appeal to all Christian People" on Christian Unity issued by the Lambeth Conference in 1920, that certain Anglican divines, including Bishop Gore and the Bishop of Truro (Dr. Frere) from time to time since 1921 have held conversations with Roman Catholic divines at Malines under the presidency of the late Cardinal Mercier, for the purpose of elucidation of difficulties, and a better understanding of each other's position. These conversations, from the second in 1923, were held with the "cognisance" of the Archbishop of Canterbury and Pope Pius XI.; but were in no sense negotiations, and in fact left the fundamental difficulties, spiritual and juridical, practically unsolved.

Other illustrations of the widening range of the Anglican communion are the recognition of Anglican ordinations by the Old Catholics of Holland in 1925; the establishment of occasional intercommunion with the Church of Sweden in 1920; the participation of two Anglican bishops in the consecration of two Swedish bishops the same year; the liaison work carried on by the Protestant Episcopal Church in the United States of America with European churches and their "colonists" in America; as well as the prominent part played by Anglican bishops, clergy and laity in the World Conference on Faith and Order which first proposed in 1910, was to hold its first meeting in 1927, and in the Universal Christian Conference on Life and Work held at Stockholm in 1925.

The Lambeth Conference.—The Lambeth Conference of 1920, the sixth of the series of decennial conferences of Anglican bishops, provided a further evidence of the general mind of the Anglican communion, and its report aroused wide-spread interest. The date of meeting, a year after the signing of the Treaty of Versailles, and the importance of the subjects treated, gave force to the discussions and freshness to the 80 resolutions adopted. In particular the "Appeal to all Christian People" created a profound impression throughout Christendom; while the conference itself did much to strengthen the fellowship between the different Anglican provinces.

The subject of Reunion is treated elsewhere (*see* REUNION); but it is essential to an appreciation of Anglicanism to emphasise clearly the great part played in the reconciliation of the churches by the Anglican communion, especially as a result of the Lambeth Conference. The breadth of the Lambeth Appeal is the more remarkable in view of the stir caused by the Kikuyu controversy of 1913–4, when Dr. Weston, Bishop of Zanzibar, formally appealed to the Archbishop of Canterbury against a measure of intercommunion with Protestant churches in East Africa proposed by the bishops of Uganda and Mombasa. The archbishop had replied to the appeal that full intercommunion was for the present impossible; but that members of non-episcopal churches, isolated from their own, would be welcomed at Holy Communion in Anglican churches. Special attention should be directed to the joint conferences on the appeal held between Anglican and Free Church representatives under the Archbishop of York's presidency at Lambeth Palace in 1921 and 1925, and to the changed spirit shown in such instances as the addresses given by both archbishops at annual assemblies of different Free Churches, and the occasional preaching of sermons in cathedrals and churches by Free Church ministers with episcopal sanction and in conformity with resolutions adopted by both convocations.

Modernism.—One grave issue, hardly if at all touched in the Lambeth Conference of 1920, which the Anglican communion, like other churches, has been compelled to face since 1910 may be briefly but loosely described as Modernism. The problem has been before the Church for many years, largely in relation to Biblical criticism. A good deal of interest was aroused by the publication of *Foundations* in 1912, a volume of liberal (but hardly radical) essays by seven Oxford theologians, edited by Rev. B. H. Streeter, whose article on the historic Christ formed the principal target of criticism.

But greater anxiety was caused a few months later, partly by the Bishop of Zanzibar's letter to the Bishop of St. Albans on questions of faith and order, partly by Dr. Latimer Jackson's Hulsean lectures on The Eschatology of Jesus. A critical debate took place in the Upper House of Canterbury Convocation in April 1914, and the discussion closed with a resolution affirming "that the denial of any of the historical facts stated in the Creeds goes beyond the limits of legitimate interpretation, and gravely imperils that sincerity of profession which is plainly incumbent on the ministers of the Word and Sacraments"; and "at the same time" in view of "new problems raised by historical criticism" emphasising "the need of considerateness in dealing with that which is tentative and provisional in the thought and work of earnest and reverent students."

Here the matter rested for a while. But in 1917 a serious crisis

was caused by the nomination by Mr. Lloyd George, as Prime Minister, of Dr. Hensley Henson to the bishopric of Hereford. The Archbishop of Canterbury was urged to refuse consecration, on the ground of heresy, but after explaining the reasons of his disagreement with the objectors in a letter to the Bishop of Oxford, Dr. Gore (who later withdrew his objection), the archbishop consecrated Dr. Henson in Feb. 1918.

A further crisis was provoked in 1921 by certain addresses delivered at the Conference of Modern Churchmen held at Cambridge, but both Canterbury and York convocations dealt with the situation with a reassuring effect. Other provinces in the Anglican communion have had similar problems, notably the Protestant Episcopal Church in the United States of America, where special attention should be called to Bishop Lawrence's autobiographical (modernist) sketch *Fifty Years* as well as to the Bishops' Pastoral Letter (anti-modernist) both appearing in 1923. On the whole it may be said that while particular dioceses or societies have had unusual difficulties, the Anglican communion as a whole has handled the problem with a considerable measure of success.

The Services of the Church.—Questions of public worship have also aroused wide interest. The Royal Commission on Ecclesiastical Discipline reported in 1906. The principal step taken as a result of the report was the issue of Royal Letters of Business to the convocations of Canterbury and York. From 1906 to 1920 the two convocations prepared their replies, which involved a general revision of the Prayer Book (*see* PRAYER BOOK, REVISION OF). The revision thus proposed was then brought before the Church Assembly and amended by the House of Clergy and the House of Laity; and in 1926 the House of Bishops submitted a final revision to the Church Assembly for acceptance or rejection *en bloc*. A new lectionary had already received legal sanction (1922) and is now in use as an alternative.

The leading motive for revision at first, no doubt, was the need of introducing order into churches where illegal practices were alleged to prevail. But the work done has covered the whole field of Divine Service. The War gave a new impetus to devotional practice and experiments of all kinds, and many interesting suggestions have been made with a view to greater freedom and variety by different groups, *e.g.*, by the authors of *A New Prayer Book*. The chief experimenters in devotional practice have been the party known as Anglo-Catholic. Many of their experiments have been of value.

But keen controversy has arisen, especially with regard to Reservation and "Devotions" connected with the consecrated elements. The bishops in 1917 passed a resolution which, while recognising the need of Reservation in certain circumstances, laid down the principle "that the Reserved Sacrament is to be used for the communion of the sick and for no other purpose whatsoever." It may be said that the two chief issues in Prayer Book revision are Reservation, much the more acute, and the question of providing an alternative Order of Holy Communion. The earlier problems, such as the ornaments rubric, the use of the Athanasian Creed and Prayers for the Dead, can no longer be considered central or, indeed, critically difficult. The results of the revision are eagerly awaited by various provinces of the Anglican communion. Canada has already issued a revised Prayer Book and the Protestant Episcopal Church in the United States hopes to complete a similar revision in 1928.

Spiritual Progress.—The spiritual work of the Church has naturally been much affected by the War. In the Church of England 3,060 clergy were commissioned as naval or military chaplains, and 100 laid down their lives. Many others served with the Church Army and the Young Men's Christian Association. They learnt much of the religion of the ordinary Englishman, and the results of an inquiry initiated by the Young Men's Christian Association were published in a volume *The Army and Religion* (1919). Special attention was called to the widespread ignorance of ordinary religious truths and to the need of dealing afresh with the whole method of religious education. In 1916 a National Mission of Repentance and Hope was organised in the Church of England to deepen religious life at home, and a number of useful reports on evangelistic work, Christianity and industrial problems, etc., were published.

Increasing interest has been taken in social questions. Crusades, in which labour plays a part, have been held, and the last Sunday of April is observed in many churches as industrial Sunday. The War has had a severe effect on the supply of ordination candidates, though the numbers had been declining since the beginning of the 20th century. Over 1,500 "Service" candidates have been ordained in the Church of England since the War, but the total shortage for the years 1915–24, as compared with the preceding 10 years, was about 2,850. Proposals for reviving the sub-diaconate as a means of relieving the shortage are under consideration.

Women in the Church.—The ministry of women has made a distinct advance. Boards of Women's Work are being formed. Women messengers and pilgrims are increasingly used. Proposals for admitting women to the priesthood were made in certain quarters, but received very little support. The most important step taken was the resolution of the Lambeth Conference in 1920, recommending that "the Diaconate of Women should be restored formally and canonically, and should be recognised throughout the Anglican communion." This recognition has been accorded in the Church of England, and a form of ordination of deaconesses approved.

Missionary Work.—The missionary work of the Church has gone steadily forward. There has been an increased recognition of the world call to the Church. The Church Assembly now has a missionary council. Further there is an increasing desire that the Church itself should act as a missionary body. There has been a steady growth in indigenous churches, and for the first time native priests have been consecrated as bishops in India, China and Japan. India has been the scene of very large mass movements. Co-operation with other churches in the mission field has been a marked feature of modern Anglican mission work, the result in part of the World Missionary Conference at Edinburgh, 1910. The value of such co-operation is especially proved in education and in dealing with governments.

Church and State.—Important changes in the relation of Church and State have taken place or are in contemplation in several provinces. Thus, in Australia the General Synod is steadily considering the difficult question of the *nexus* between the Church of England in Australia and the home church. The Indian Church Measure seeks to give a definite autonomy to the Church in India. The disestablishment of the Welsh Church was effected in 1920, and the Bishop of St. Asaph (Dr. Edwards) was enthroned as Archbishop of Wales. Two new dioceses have been added to the former four since disestablishment.

In England a special committee on Church and State was appointed by the two archbishops at the request of the Representative Church Council in 1913, and its report, published in 1916, led to the passing of the Church of England Assembly (Powers) Act in 1919, a great deal of popular support having been previously gained by the Life and Liberty Movement and the bill being strongly pressed by the Archbishop of Canterbury. This Act gives power to the Church Assembly, consisting of the House of Bishops, the House of Clergy and the House of Laity (Men and Women), to pass measures "relating to any matter concerning the Church of England"; such measures to have the force and effect of an Act of Parliament after the passing of resolutions in both Houses approving the measure and the receiving of the royal assent. Up to date (1925) 15 measures have received the royal assent including measures dealing with the union of benefices, the sale of advowsons, ecclesiastical dilapidations and the formation of five additional bishoprics.

Church Reform.—The two Convocations have reformed their Lower Houses. Parochial church councils are required to be established in every parish, and have powers relating to property and finance. The total number of qualified electors in 1924 was 3,537,020. The Church Assembly, regarded as an instrument for Church legislation, has done a great deal of necessary work which would not have been possible without it, and is steadily overtaking the arrears that have been long outstanding.

There has been a general overhauling of machinery throughout the Church of England. A Central and Diocesan Boards of Finance have been created. Five new dioceses (Chelmsford, St. Edmundsbury and Ipswich, Sheffield, Coventry and Bradford) were formed between 1913 and 1919. A commission on the Property and Revenues of the Church of England reported in 1924, and its recommendations are being considered by the Church Assembly. It is hoped that these recommendations will in some measure deal with the pressing problem of clerical poverty. A similar commission is now engaged on the cathedrals. The Ecclesiastical Commissioners have agreed to augment benefices in public patronage to a minimum income of £300 (for parishes with a population of over 300 and under 1,000), £350 (under 4,000), £400 (over 4,000). In 1925 a Tithe Act was passed securing the complete redemption of ecclesiastical tithe in a period of 85 years, the tithe rent charge being fixed at £105, of which clerical tithe owners receive £100 free of rates.

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ANGLING (*see* 2.21).—Since 1910 there has been little change in either the practice or theory of angling as a sport, though there has been some progress in knowledge, and a considerable widening of scope due to the discovery of possibilities in remote seas and rivers, made chiefly by anglers of the United States and of the British Empire. There has also been further development of the resources of acclimatisation, the most interesting result, perhaps, being the ultimate success of the efforts, which began so long ago as 1868 and had been given up as hopeless, to introduce salmon to New Zealand. In 1919 a genuine *Salmo salar* from the Waiau river was sent to England in a block of ice. Since then the establishment of the species in New Zealand has been confirmed. The country, therefore, now possesses Atlantic and Pacific salmon, as well as brown and rainbow trout.

In regard to the salmon, reference should be made to the new light on its history shed by what is known as scale-reading. The fact that the markings on fish scales gave a clue to the age and growth of the fish was suggested about the end of the 17th century by the Dutch naturalist, Leeuwenhoeck. The idea was applied to salmon by H. W. Johnston in *The Field* of Oct. 29 1904, and has since been followed up with great zeal by various investigators. The result, summed up in the briefest form, is a general conclusion that the salmon usually spends one year or two in fresh water as a parr, and then feeds in the sea for two or three years before returning to spawn. The old notion of yearly spawning has been greatly modified, and it is now considered exceptional for a salmon to spawn more than twice in its life. Scale-reading has had another result for it has led to the conclusion that the sea trout is not essentially different from the river trout except in habit.

Salmon Fishing.—The only changes of note in methods of angling for the salmonidae have been: (*a*) increased popularity of the light-rod idea and its application to salmon fishing, together with the extended use of the dry fly for salmon, especially in North America; (*b*) the restoration of the wet fly to typical dry-fly waters in the method known as nymph-fishing. For other forms of freshwater angling in the British Is. there is nothing new to record, the most notable event, perhaps, being the authentication of a pike of 53 lb., caught on Lough Conn in 1920. Before, 50 pounders, though possible, were legendary.

Legislation.—A Fishery Act for England and Wales, passed in 1923, improves and consolidates previous legislation. The pollution of rivers has inspired a new movement of co-operation between industrial and fishing interests. The British Govt. set up a pollution committee, which has been at work for several years, and from its labours some good results are apparent. A new source of danger is the dressing of roads made necessary by increased motor traffic. It has been established that tar, very largely used at first, may have disastrous effects when road washings get into streams. The trouble is in some cases being removed by the use of bitumen instead, and experiment is being carried on by the pollution committee in regard to other safeguards.

Big game fishing with species running to several hundred pounds is established now in many seas, America, Africa, Asia and Australasia all offering great opportunities. Several important freshwater species have also become a regular part of angling enterprise, notably the dorado of South American rivers, the "Euphrates salmon" of the Euphrates watershed, a fish resembling the mahseer in character but reaching much greater weights, and the Nile perch and tiger fish of the big African rivers.

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ANGLO-JAPANESE ALLIANCE.—On Jan. 30 1902, owing to the threat of Russian aggression in the Far East, Great Britain and Japan concluded an alliance of a defensive character which provided for mutual assistance in the safeguarding of British interests in China and Japanese interests in China and Korea. The agreement was a valuable asset to Japan in the war with Russia, which broke out in 1904; but it did not involve Great Britain in active hostilities.

In 1905 the agreement was revised; its scope was extended to India and eastern Asia generally (*see* 15.241), and Japan's paramount position in Korea was more definitely emphasised. The general changes of situation in the Orient after the Russo-Japanese War, notably the annexation of Korea to the Japanese Empire in 1910, led to a further revision. The negotiations in London between Sir Edward (Viscount) Grey and Baron (Viscount) Kato ended in the renewal of the alliance on July 13 1911. An important feature of the new agreement was the inclusion of an article exempting either high contracting party from the obligation to come to the armed assistance of the other in case of war against a Power with whom either party had concluded a general arbitration treaty (Article 4). At that particular time a treaty of such a description was under negotiation between the British and the United States governments, and it was with the particular object of excluding the United States from the possible application of the alliance that this article was inserted. The proposed general arbitration treaty, however, failed to obtain the consent of the United States Senate to its ratification, but the British and Japanese governments made it unmistakably clear that the spirit in which the article was conceived had not on that account been altered in the least; and the British Govt. have held that the Peace Commission Treaty with the United States, signed in 1914, constituted a general arbitration treaty within the meaning of Article 4. The Alliance of 1911 was to last for ten years, and in the absence of a year's notice from either contracting party to terminate the agreement it would automatically continue in existence, even after July, 1921, until such denouncement was made.

The Treaty and the World War.—The World War, into which Japan readily entered on account of the Anglo-Japanese Alliance, ended with the Treaty of Versailles, which brought forth the League of Nations. The question was then mooted, though more academically than politically, whether the military clauses of the Anglo-Japanese Alliance would not be in contravention with the letter of the Covenant of the League (Article 20) and on July 8 1920 the two high contracting parties addressed a joint note to the secretary-general of the league to the purport that the agreement would, in case of its renewal, take a form which would not be inconsistent with the Covenant. The renewal of the alliance was discussed at the British Imperial Conference in London in June 1921; and it was then announced that, under the terms of the

treaty, it could continue without definite renewal. At the same time a second note was addressed to the League of Nations (July 7 1921) stating that the Covenant should prevail over the agreement on points where there might be inconsistency between them. But, apart from doubts as to whether the alliance was not inconsistent with the obligations of the Covenant, both Great Britain and Japan were becoming aware that it was increasingly unpopular in the United States and in China. So, at the Washington Conference (*q.v.*) in Dec. 1921, the agreement made for a four-Power Pacific treaty (United States, France, British Empire, Japan) provided for the Anglo-Japanese Alliance being brought to an end. The alliance, therefore, ceased to exist on the deposition of the ratifications of the above treaty on Aug. 17 1923. For 21 years it had been the most stable influence in the Far Eastern position, and a cardinal factor in British and Japanese policy. (*See* JAPAN: HISTORY.)

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ANGOLA (*see* 2.38), the name commonly given to the Portuguese possessions on the west coast of Africa south of the equator. Although large areas of southern Angola have proved to be suitable for European colonisation and for stock-raising, the progress of the colony has been very slow. The population (1925) was approximately 4,000,000 natives and 10,000 Europeans. Loanda (São Paulo de Loanda), the capital, had about 18,000 inhabitants.

Production.—Up to 1911 the manufacture of rum was the leading industry. In that year the Govt. closed the factories, compensating the owners and the planters who grew sugar and sweet potatoes for the production of alcohol. Coffee, rubber, maize and sugar became the chief exports, followed by palm oil and palm kernels, wax and dried fish. In 1916 diamonds, usually small, but of good quality, were discovered in the extreme northeast of Angola near the Belgian Congo frontier, and 161,000 carats had been mined by the end of 1920. In 1921 the production was over 100,000 carats; in 1925 it had risen to 150,000. Imports are mostly cotton and hardware goods and foodstuffs. In consequence of a highly protective tariff, trade is chiefly with Portugal and in Portuguese ships. From 1920, however, Germany took an increasing share of the trade. Of the tonnage of vessels entering Loanda in 1923, a total of 465,000, Portugal's share was 261,000 and Germany's 121,000. The average annual value of the external trade in 1910–24 was from £3,000,000 to £4,000,000. The value of exports had reached £1,210,000 by 1913; in 1923 it was £1,237,000, exclusive of diamonds worth £730,000.

Improvements and Reforms.—A measure granting Angola a degree of autonomy was passed by the Portuguese Parliament in 1914, followed in 1920 by a more liberal measure. In 1920, also, Senhor Norton de Mattos, a former governor, returned to Angola as High Commissioner with an ambitious programme of development and colonisation. Chief attention was to be paid to harbour improvements and railways, the deficiency of means of communication being a leading cause of the backward state of the country. For two years there was much activity, but then a crisis arose, due in part to the lack of sufficient produce for export to pay for the imports of the Govt. and the trading community, and in part to the inability of Angola to raise more than about a sixth of the authorised loan of 60,000 gold contos (about £13,300,000). The crisis was acute throughout 1924. In 1925 the Portuguese Govt. voted 9,000 gold contos (£2,000,000) to enable the colony to carry out the most needed public works. These included the reconstruction of the Loanda Railway, which had been bought by the state in 1918 and serves valuable coffee areas. Apart from the cost of development works, public expenditure frequently exceeded revenue. Between 1910 and 1925 the revenue increased from about £500,000 a year to over £1,000,000. The 1924–5 budget showed revenue £1,080,000 and expenditure £1,580,000. The public debt was approximately £4,500,000.

A Native Affairs Dept. was created in 1913 and it effected various reforms, but the principle of compulsory labour was maintained. From 1918 to 1921 the authorities took an active part in the recruitment of labour for private enterprise. The system led to abuses and was abolished in 1921. Continual complaints that labour was not procurable resulted, however, in 1925 in a partial return to the old system, chiefs being required to produce the men and both chiefs and officials receiving payment per head for the labour obtained.

The Benguella Railway, which starts at Lobito Bay, was intended primarily to serve the copper fields of Katanga, Belgian Congo, but in crossing the plateau of southern Angola it opened up the territory best suited to European settlement. By 1914 the railway had reached Chingwari, 323 m. from Lobito. Construction then stopped till 1922–3, when the line was extended another 60 m. to Silva Porto (Bihé), while in 1925 additional funds were forthcoming. The company owning the railway then entered into an agreement with Portugal to complete the line to the Congo frontier by the end of 1928. The railway, upon which over £7,000,000 has been spent, is a British enterprise.

Germany, whose colony of Southwest Africa adjoined Angola on the south, had for many years looked upon Angola as a field for economic, and ultimately for political, exploitation. A treaty with Great Britain recognising German economic interests as supreme in the greater part of Angola was negotiated in 1913–4 and would have been signed but for the outbreak of the World War (*see* AFRICA).

The loss of Southwest Africa, conquered in 1915, deprived Germany of a base for penetration; nevertheless after the War German influence and trade within the colony steadily grew, so that by 1925 Germans exceeded in number all other European residents combined with the exception of the Portuguese. British capital in the Benguella Railway represents about 90% of the whole, and unsuccessful efforts to buy this stock were made by the Germans both before and after the War.

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ANGORA (*see* 2.40) the capital of the Turkish Republic had an estimated population in 1924 of about 35,000. The Turkish Nationalist Movement, which was organised by Mustafa Kemal in 1919, led to the setting up of a Nationalist Govt. at Angora in April 1920, the city being chosen owing to the fact that, while it was far enough from the coast to be reasonably safe from attack by the Greeks, or the principal Allied Powers, it was in touch with other parts of the interior of Anatolia, and was the railhead of the northeastern branch of the Anatolian Railway. The ability of the surrounding area to supply the food requirements of the population and the raw materials needed by local industry was also of importance. On Oct. 13 1923, by a decision of the Great National Assembly, Angora was declared the capital of Turkey.

The city is connected by the Anatolian Railway with Constantinople, and a line to Sivas was nearing completion at the end of 1925. In view of its increased importance and growing population, Angora was badly equipped as regards accommodation for its population and for the Govt., and as regards sanitary arrangements, etc. During 1925, however, considerable progress was made by the municipality in house building, road construction and sanitation. A beginning was made with the drainage of the swampy fields between the station and the town, a breeding ground for the malarial mosquito, and with the construction of a public park; modern systems of drainage and of water supply were commenced. A new Parliament House and buildings for the Ministry of Finance, Courts of Justice, General Post Office, etc., were approaching completion at the end of the year, and a

modern hotel was being built. The industrial development of the city was being actively encouraged, and German engineers were called in to erect factories and workshops for the production of tiles, cotton and flax goods, etc. The installation of a power station capable of furnishing electric light throughout the city was completed, sawmills constructed, and a flourmill equipped with modern machinery. The Government decided in 1925 to install a telephone exchange and erect a powerful wireless station. By the end of 1925 certain foreign legations had moved their headquarters from Constantinople to Angora, and the others were represented by secretaries.

ANIMALS, DISTRIBUTION OF: *see* DISTRIBUTION OF ANIMALS.

ANKYLOSTOMIASIS: *see* HOOK WORM.

ANSON, SIR WILLIAM REYNELL (1843–1914), British jurist (*see* 2.84), died at Oxford June 4 1914.

ANTARCTICA (*see* 21.960).—The Antarctic regions may be generally defined as that portion of the globe which lies within the 60th parallel of south latitude, and for purposes of reference it is now customary to divide it into four quadrants of 90° which, reckoning eastwards from the meridian of Greenwich, are named the Enderby, Victoria, Ross and Weddell Quadrants. A less precise division into sectors referred to the contiguous continents is perhaps more useful to the general reader; and the African, Australian and American sectors denote the portion of the regions to the south of those continents respectively.

The 60th parallel passes through no land whatever, but it does in fact roughly coincide with the northern limit of a belt of floating ice which surrounds the regions and forms an efficient barrier to a ship's progress except in the late summer and autumn. It therefore includes nothing which does not share in the general characteristics of these polar regions, though it does exclude the south Georgia and south Sandwich groups of islands in the southern Atlantic which are definitely Antarctic in character.

Contrast between Northern and Southern Regions.—In considering this parallel as a boundary we are at once impressed with a marked contrast between the amenities of the northern and southern polar regions. Within the area poleward of 60° north latitude live more than 1,000,000 human inhabitants and countless land animals. Some of the largest and most valuable timber forests are north of 60°, and not a few industries connected with lumber, mining and fishing flourish. In the similar area in the southern hemisphere, there is not a single permanent human inhabitant, nor a single land animal larger than an insect. There are no trees and very few plants of any kind at all. The sole industry which can be said to exist in the Antarctic regions is that of whaling, which is now carried on during a few months in each year in the American and Australian sectors. The reasons for this contrast naturally depends largely upon temperature.

The explorations of the 20th century have shown us that the south polar region, again in complete contrast to the north, is largely occupied by a continent of more than 5,000,000 sq. m. in extent, that is to say, equivalent in size to Australia and Europe without Russia. The South Pole is placed centrally in this continent, which, though far from being symmetrical, may for general purposes be considered as bounded by the 70th parallel.

Characteristics of Antarctica.—The most noticeable feature about the continent is its unique isolation. It is possible to traverse all the other continents without crossing more than about 60 m. of shallow sea, but to reach the Antarctic continent one must voyage over at least 600 m. of practically oceanic depths and that across the roughest seas and fiercest winds in the world.

Between 55° and 65° south latitude there is no land to interfere with the west to east circulation of sea and air, and that zone is therefore the home of the permanent west winds, the westerly drift and the wandering albatross, all of which encircle the Antarctic continent ceaselessly. There are, in short, none of the interchanges of warm and cold air and water between temperate and polar regions which in the northern hemisphere lead to such curious anomalies as an almost ice free Spitsbergen in 79° N. and an almost icebound Labrador coast 20° farther south.

In this fact, therefore, we have an almost complete explanation of the strange contrasts in climate, and consequently in habitability, between the opposite polar regions, and the remainder of the explanation is forthcoming when we consider the relief of this vast deserted continent. The South Pole itself is situated on a plateau nearly 10,000 ft. in height, and there is every reason to suspect that the greater part of the continent is continuous plateau. Allowing for the incomplete nature of the data we can with some fairness compute the average height of the continent as of the order of 6,000 ft., which is just twice as high as Asia, the next in order of magnitude.

When we add to this conception of a high and isolated continent the fact that, of its 5,000,000 sq. m. probably less than 100 sq. m. is free from a permanent covering of ice we can well understand that here there is no attraction for man or beast or plant. We have further to conceive of a climate in which, south of 70°, it never rains and rarely thaws, except in the neighbourhood of exposed rocks, where in fact any land animal would have to lead the life led by the two or three minute insects so far discovered, consisting of an active life of some few days in the height of summer followed by some 360 days of hibernation, frozen solidly in the rock pool or clump of moss which is its home. The continent is thus in the grip of an ice age, more rigorous than that which has left its marks upon Europe and North America, and naturally the study of such a region resolves itself largely into a study of its manifold ice forms.

Of these the least known and the most impressive is the ice-cap, whose lateral dimensions are those of the continent itself and which supplies the myriad glaciers which everywhere fringe the coast, sometimes in ice-worn valleys, but more often as a continuous glacier-front running down into the sea for hundreds of miles along the coasts. The thickness of the inland ice is probably not so great as its extent would suggest. No direct measurements have been made, but from an examination of the outlet glaciers it appears unlikely that the sheet is ever more than 2,000 ft. thick except in basins, and in general is much thinner, a conclusion which is confirmed by the fact that many hundreds of miles inland from the coast the ice sheet appears to follow closely the form of the underlying ground.

The Barrier.—The general features of the Antarctic ice-cap are reproduced on a smaller scale in Greenland, but the floating ice sheets which are to some extent derivatives of the ice-cap are met with nowhere else in the world. When Ross in 1841 first penetrated the pack ice into the ice-free Ross Sea he sailed due south until he was brought up in about 77° south by an ice wall from 50 to 200 ft. high, barring his way to the south. He sailed along the greater part of its 400 m. seaward face. He called it the barrier and the name has remained though it is sometimes replaced by the name shelf-ice. The Ross barrier, as it is now called, is the greatest of these floating ice sheets, but is typical of many others to be met with in the Antarctic. It is roughly the size of France and consists of a sheet of ice varying from 500 to 1,500 ft. in thickness, the outer end being open to the ocean and the inner end held fast to the continent by the glaciers which act as feeders and by being aground close to the actual coast. Its surface is smooth, and it forms the easiest approach to the Pole itself, since it reaches to within 30 m. of that spot.

It is formed by the snow of countless ages collecting, it may be, upon an originally thin crust of sea ice, and it moves at a rapid rate, up to 1,500 yd. in a year, as a result of its own tendency to spread. There is reason to suppose that in some places it also increases by freezing from below. The tabular icebergs so typical of the southern hemisphere, with their flat tops and stratified appearance are obviously derived from this and similar barriers, and their immense size, up to 30 m. in length of side, is only natural considering the size of the parent masses. Each summer, when the break up of the winter sea ice has allowed the full force of the ocean swell to reach the face of the barriers, large fragments are broken off, or "calved," and these float away to the northward until they reach warmer and stormier waters where they disintegrate into low but massive pieces known as "growlers," which are the terror of the ship-master sailing those latitudes in the winter.

Sea Ice.—The sea ice itself is comparatively temporary. It begins to form in sheltered bays as early as the end of Jan. and by the beginning of March any ship is liable to be frozen in unless its harbour is a windy one. There are probably large variations from year to year in the area of sea solidly frozen over, since a strong wind, and such are very frequent, will prevent sea ice forming, or will blow out any which is not of considerable thickness, but in sheltered bays the ice will continue to increase in thickness until Oct. or Nov., by which time it will be anything up to seven feet through. This will begin to break up and float northward from the beginning of Dec. onwards, but the innermost bays may not lose their ice until late in Feb., or occasionally not at all for two years in succession. The belt of drifting pack ice which rings the continent is made up of the ice from this summer break-up and it is least dense in autumn after the summer heat has caused a great deal of it to melt.

The Continent.—The continent, thus hidden or protected, is formed for the most part of old rocks amongst which the most prominent are of Permo-Carboniferous age and bear coal, which is found in the Australian sector up to within 300 m. of the Pole. In this sector the rocks have been above sea level since Palaeozoic times, except where the Ross Sea area has broken and sunk below it, giving rise to a series of volcanic centres, of which the largest, the Ross Island group, still has an active volcano, Mount Erebus, 13,000 ft. high. On the South American side, however, there has been no wholesale sinking of the crust, but the rocks have been folded into mountains similar in origin to the Andean chain. The coal which has been found is of doubtful quality, and on account of the small area of bare rock to be seen it is exceedingly improbable that any other minerals of value will ever be discovered.

Products of the Continent.—Since there are no land animals or plants the resources of the region are limited to the products of the sea. Of these the most striking are the various species of penguins, which inhabit all zones of the region. Fortunately for the preservation of such harmless and delightful birds their blubber coated skins do not possess a marketable value. The seals also, not being of the fur bearing kind, are more or less immune from human exploitation. There remain the whales, which in large numbers frequent Antarctic seas to feed on the minute animals there to be found which in their turn ultimately depend for their food upon diatoms, the typical marine plants of the region, microscopic in size but so countless in number as to colour the sea ice. The rorqual, the humpback and the huge blue whale are now all hunted in these seas by modern methods and the annual value of the products obtained exceeds £2,000,000 sterling. (*See* WHALES.)

Until the rise of the whaling industry the Antarctic can be said to have had no political significance whatever, but since the beginning of the century the territorial waters of the continent, if not the land itself, have acquired a value and, as will be seen from the map, two sectors are now portions of the British Empire and are known as the Ross Dependency, administered by New Zealand, and the Falkland Islands Dependency administered by the Govt. of the Falkland Islands. (*See* also POLAR EXPLORATION.)

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ANTHROPOLOGY (*see* 2.108).—*See* also ARCHAEOLOGY; COLOUR AND RACE PROBLEMS; FOLKLORE; HUMAN GEOGRAPHY; MAN, EVOLUTION OF; PHILOLOGY; RACES OF MANKIND; SOCIAL ANTHROPOLOGY.

THE PROBLEM STATED

Anthropology is the science of man and of his culture at various levels of development. It includes the study of the human frame, of racial distinctions, of civilisation, of social structure and of man's mental reactions to his environment. We confine our attention to the science of culture, and, since the study of living peoples uses methods and controls sources of information entirely different from those at the disposal of archaeology and pre-history, we restrict our scope to the study of the modern living representatives of primitive mankind.

Toward the end of the 19th century there was an increasing realisation of the specific nature of cultural process and of the complexity of culture. The vastness of the problems, the human interest and the dramatic beauty of anthropological facts were brought home to scholars and laymen alike by the monumental works of Sir James Frazer. At the same time, important scientific movements were developing on the Continent (Durkheim and Wundt), and, most important of all, the man of science began to go out into the field himself and to study native races personally by direct observation.[1]

THE EVENTS OF 1910

Thus was gradually prepared the last period. At or about that date, a number of important anthropological events occurred.

In 1910 Sir James Frazer published his treatise on *Totemism and Exogamy*, by which a lively and voluminous discussion of both subjects was started anew. In the same year Prof. Seligman's *Melanesians of British New Guinea* appeared—an admirable record of specialised scientific fieldwork, followed in 1911 by the monograph on *The Veddas*, which embodies the joint research of himself and Mrs. Brenda Z. Seligman. From the African field, Joyce and Torday produced *Les Bushongo* (1910, Eng. trans. 1925). On the continent of Europe, Van Gennep issued *La Formation des Légendes*, followed on his *Rites de Passage* of a year earlier. Lévy-Bruhl launched an interesting controversy regarding the mentality of primitive man. The same subject was discussed by Prof. Boas a year later. In 1911, Dr. Rivers, at the Portsmouth meeting of the British Assn., started in this country the conflict between Diffusionism and Evolutionism. Ankermann and Graebner had already opened a similar controversy among German anthropologists in 1905. In America a discussion of methods and aims was inaugurated as far back as 1896 by Professor F. Boas ("The Limitations of the Comparative Method in Anthropology," *Science*, N.S. iv.).

About 1910, again, the results of one of the most important achievements in fieldwork were brought out in the works of Prof. Thurnwald. In 1912 Prof. Durkheim issued his book on *Elementary Forms of the Religious Life* (Eng. trans. 1915), and in 1914 there appeared the two volumes of the *History of Melanesian Society* by Dr. Rivers, Prof. Westermarck published his *Marriage Ceremonies in Morocco* and Sir Baldwin Spencer his *Native Tribes of the Northern Territory of Australia* completing the triad of excellent monographs by Spencer and Gillen. Two important anthropological events close this period. In 1925 Prof. R. Thurnwald began to publish the *Zeitschrift fur Völkerpsychologie und Soziologie*, a journal which sets out to give a comprehensive survey of anthropological facts and relevant socialogical theory. In the same year M. Marcel Mauss reissued *L'Année Sociologique*, which for 12 years (1900–12) had been one of the most important and valuable contributions to science, with its comprehensive interest in human culture and its attempt at unifying humanistic disciplines on the basis of anthropology.

PROGRESS SINCE 1910

In spite of much fuller knowledge of primitive cultures, modern anthropological theory presents great diversity, and the subject is dominated by a number of one-sided and incompatible tendencies.

Psychological Interpretation of Culture.—Continuing the direct tradition of German folk-psychologists, as well as of the British classical school, Wundt, Vierkandt, Krueger and their collaborators attempt to explain systematically the phenomena of language, custom, belief and social organisation by reference to psychological processes. Quite as exclusively psychological are the contributions of the psycho-analysts, who account for totemism, taboo, initiation ceremonies, in fact for the whole field of primitive cultures, by unconscious mental mechanisms. Psychological interest is also predominant in the works of Frazer, Van Gennep, Crawley and Westermarck. All these writers belong on the whole to the evolutionist school.

The extreme representative of the diffusionist school, Graebner, maintains that all the regularities of cultural process are "laws of mental life" and that "their scientific and methodical study is possible only from the psychological point of view" (Graebner, p. 582, 1923), while Pater Schmidt, Wissler, Lowie

[1] Cambridge Expedition (A. C. Haddon); Spencer and Gillen; Jesup Expedition (F. Boas); the work organised by the German Colonial Office and the Dutch Govt, by the Bureau of American Ethnology, and the excellent museums and other institutions of North America.

and Rivers constantly use psychological interpretations. Thus, no anthropologist nowadays wishes completely to eliminate the study of mental processes, but both those who apply psychological explanations from the outset and those who want to use them after culture has been "historically analysed" forget that interpretation of culture in terms of individual psychology is as fruitless as mere historical analysis; and that to dissociate the studies of mind, of society and of culture, is to foredoom the results.

The Distribution, Contact and Diffusion of Culture.—As influential and one-sided as the psychological trend is the interpretation of similarities and analogies of culture by the principle of mechanical transmission. First vigorously propounded by Ratzel as the main problem of ethnology, the study of distribution and diffusion has been followed up by Frobenius, Ankermann, Graebner, Pater W. Schmidt, Pater Koppers and subsequently by the late Dr. Rivers.

Whether the doctrines recently propounded by Prof. Elliot Smith and Mr. Perry about the universal spread of culture from Egypt will have to be classed with other discarded hypotheses or whether they contain a permanent contribution to the history of culture remains to be seen. Their use of anthropological data is unsatisfactory[1] and their argument really belongs to archaeology, in which field their views have met with adverse criticism.[2] One or two competent anthropologists, however, have given these theories their vigorous support (Rivers, C. E. Fox).

The merit of the moderate anthropological diffusionism lies in its geographical rather than in its historical contributions. As a survey of facts correlated to their geographical substratum, it is a valuable method of bringing out the influence of physical habitat as well as the possibilities of cultural transmission. The distributions mapped out for America by Boas, Spinden, Lowie, Wissler, Kroeber, Rivet and Nordenskiöld; the survey of Melanesian cultures given by Graebner; of Australian provinces given by W. Schmidt; of Africa prepared by Ankermann, will possess lasting value.

The historical hypotheses of Frobenius, Rivers, Schmidt and Graebner, the sweeping identifications of "culture complexes" all over the globe, will not so easily pass muster. They suffer from a lifeless and inorganic view of culture and treat it as a thing which can be preserved in cold storage for centuries, transported across oceans and continents, mechanically taken to pieces and recompounded. Historical reconstructions within limited areas, such as have been done upon American material for instance, in so far as they are based on definite records or on archaeological evidence, give results which can be empirically verified, hence can be of scientific value. Dr. B. Laufer's study on the potter's wheel and certain contributions to the history of American culture (T. A. Joyce, A. V. Kidder, N. C. Nelson, H. J. Spinden, L. Spier) are methodologically acceptable, though they belong to archaeology rather than to the science of living races and cultures. Such sound works must be clearly distinguished from the productions in which a conjectural history is invented *ad hoc* in order to account for actual and observable fact, in which therefore the known and empirical is "explained" by the imaginary and unknowable.

Sociological Theories of Culture.—Robertson Smith is undoubtedly the spiritual father of this movement. He was the first to see that religion must be accounted for quite as much by its social nature, by what it does for tribal cohesion, as by its meaning and value for the individual. The great American anthropologists, Powell and Morgan, also contributed toward our understanding of clan solidarity in savage societies. Durkheim, inspired by their work as well as that by Bachofen, Wilken and Sir James Frazer, developed a sociological theory of early culture.

[1] A. A. Goldenweiser, *Early Civilization*, p. 311; R. H. Lowie, *Amer. Anthrop.*, pp. 86–90 (1924); B. Malinowski, *Nature* (March 11 1924).

[2] O. G. S. Crawford, *Edinburgh Review*, pp. 101–116 (1924); T. D. Kendrick, *Axe Age*, p. 64 *et seq.* (1925); J. L. Myres, *Geographical Teacher*, No. 71, pp. 3–38 (1925); Presidential Address, *Folk-Lore*, xxxvi, 1925, p. 15; Flinders Petrie, *Ancient Egypt*, pp. 78–84 (1923); T. E. Peet, *Journal of Egyptian Archaeology*, vol. 10, p. 63 (1924); A. M. Blackman, *ibid.*, pp. 201–209.

Kohler and the school of comparative jurisprudence in Germany, Steinmetz in Holland and later, Rivers in England, also studied primitive society from the sociological point of view, over-emphasising perhaps the solidarity and the lack of differentiation within the early horde and clan. The doctrine of primitive legal cohesion and of social structure by direct solidarity given by Durkheim, Steinmetz and Kohler; the subtle and stimulating interpretation of primitive magic, sacrifice and religion by Durkheim, Hubert and Mauss; the recent analysis of contract and gift by Mauss and Davy, show an enormous advance upon any previous work in the greater precision of concepts, in the consistent application of the sociological method side by side with psychological interpretation, in the conscious attempt at following native classification, nomenclature and perspective. It is impossible to adopt these views unreservedly because they tend to lapse into metaphysical vagueness. In order to avoid the explanation of culture in terms of individual mental processes, yet fully aware that psychology cannot be excluded, these anthropologists compromise by introducing the conception of collective consciousness, which sociologists and anthropologists alike (Ginsberg, MacIver, Radin) have shown to be untenable. The sociological school exaggerated the social nature of primitive man, the importance of the clan and the solidarity of kinship. They neglected the rôle of individual initiative and variation, the part played by self-interest and the institution of the individual family.

Theories of Specific Difference of Primitive Mentality.—Grown on the soil of the sociological school, but laying more stress on the purely psychological side, other theories seek to account for savage belief and custom by the alleged specific character of mental structure in primitive man. Basing their conclusions on a number of interesting but probably exaggerated and distorted statements by such observers as Cushing and Dennett, and on a mass of obviously immature and superficial accounts by missionaries and other amateurs, the writers of this school aver that the savage is prelogical and mystical, impervious to experience living in a world of "dim participations" (Crawley, Lévy-Bruhl, Vierkandt, Danzel, H. Werner, Graebner). These views have but limited currency among the theoretical anthropologists, whose position has been well expounded by Carveth Read. Modern field-workers, equally competent to speak about the savage from first-hand knowledge and to deal with problems of comparative psychology and epistemology through training, have one and all criticised adversely these points of view (Boas, Rivers, Radin, Kroeber). None the less, by posing the problem of primitive knowledge and mentality, by stirring up opinion and forcing anthropologists to make up their minds, the writers of this school, above all M. Lévy-Bruhl, have made a serious and valuable contribution to Science.

The Functional Analysis of Culture.—This type of theory aims at the explanation of anthropological facts at all levels of development by their function, by the part which they play within the integral system of culture, by the manner in which they are related to each other within the system, and by the manner in which this system is related to the physical surroundings. It aims at the understanding of the nature of culture, rather than at conjectural reconstructions of its evolution or of past historical events.

Two factors contribute toward the development of the functional point of view. The modern specialist field-worker soon recognises that in order to *see* the facts of savage life, it is necessary to understand the nature of the cultural process. Description cannot be separated from explanation, since in the words of a great physicist, "explanation is nothing but condensed description." Every observer should ruthlessly banish from his work conjecture, preconceived assumptions and hypothetical schemes, but not theory.

Modern field work thus regards a theory purely empirical, never going beyond inductive evidence, serving only to gain an insight into the mechanism of culture in its various phases: social organisation, belief and material outfit. The field-worker who lives among savages soon discards the antiquarian outlook. He

sees every implement constantly used; every custom backed up by strong feeling and cogent ideas; every detail of social organisation active and effective. He perceives that culture, above all, provides primitive man with the means of satisfying his wants, and of mastering his surroundings. The functional view of culture insists therefore upon the principle that in every type of civilisation, every custom, material object, idea and belief fulfils some vital function, has some task to accomplish, represents an indispensable part within a working whole.

It keeps always in mind the biological basis of human civilisation, the correlation of culture to human wants, hence to human instincts and emotional dispositions. Instincts, emotions and ideas cannot, however, be treated by biology alone but must be approached through the study of mental process. Psychology, therefore, is indispensable for due understanding of culture.

At the same time the functional view teaches that man in the very fact of culture transcends his biological outfit. In his implements, weapons, clothes and ornaments he extends his anatomical endowment, whether to protect his life, to charm his fellow-beings or to procure his nourishment. Knowledge supplies man with responses which go far beyond anything implied in instinct. In dogmatic belief we have a new type of mental attitude not observed in animals. Biology is therefore not enough to explain human adjustments through culture. Psychology again is not sufficient, for man does all important business in common, while every individual contribution has to be translated into cultural fact, imprinted upon material objects and linked with social organisation. The other approach to the functional method is from the evolutionary point of view, nowadays generally discredited and discarded, yet fundamentally sound when correctly set forth. The development of culture consists in the gradual crystallisation of well-defined institutions out of mixed and non-specialised behaviour. The essential features of each institution remain permanent while the less relevant ones change considerably. In order to understand, however, what is essential and what is not, it is necessary to define each institution and custom by its function. Again since the essence of evolution consists not in a sequence of different forms changing one into another, but in a better adaptation of an institution to its function, the more precise way of posing the evolutionary problem leads inevitably to the functional point of view.

The functional view of culture can be traced back to the inchoate but stimulating writings of A. Bastian, to the suggestions of Lazarus and Steinthal, to the work of E. B. Tylor and W. Robertson Smith. It is implied in the best achievements of modern field-work (notably of the American anthropologists, F. Boas; J. W. Fewkes; C. Wissler; A. Fletcher and La Flèche; A. E. Jenks; A. L. Kroeber; Elsie C. Parsons; J. R. Swanton; P. E. Goddard; J. O. and G. A. Dorsey; R. H. Lowie; F. C. Cole; P. Radin; E. Sapir; Ruth Benedict). It has been active in the work of the French school, where it is constantly gaining ground (compare the latest publications of MM. Davy, Fauconnet, Granet, Mauss and Rivet). Functional interpretations will be found predominant among the soundest theories of the comparative school (Brinton; H. Schurtz; W. Wundt; J. G. Frazer; H. Webster; E. A. Crawley; Westermarck; Van Gennep; Marett). The comparative school however has allowed the evolutionary view to overshadow the functional method, while most American anthropologists have failed to disentangle the empirical interpretation of culture in terms of function from reconstruction in terms of conjectural history. They have thus lapsed into a type of explanation which at its best belongs to archaeology, and thus have greatly sterilised their otherwise splendid field-work and stimulating theory.

Recently, however, and among a small number of anthropologists only, the functional method has been applied systematically and exclusively in field-work and theory (W. Hoernlé; B. Malinowski; A. Radcliffe-Brown; Richard Thurnwald).

The functional method, by showing what culture does for a primitive community, establishes its value and thus utters a warning against too hasty interference with native belief and institution and too wasteful an exploitation of native labour and resources. By demonstrating how primitive custom and law work, it furnishes the administrator with practical hints of how to frame and administer native regulations. By inquiring into savage economic organisation, the functional method can teach how to manage indigenous labour and how to trade with the natives. By a sympathetic study of early belief and ritual, it can instruct the missionary how to graft a new creed upon the old one without destroying what is good and sound in it.

The functional method, concerned as it is with the actual working and mechanism of primitive culture, supplies the right theoretical foundation for the practical application of anthropology (*see* ANTHROPOLOGY, APPLIED), for which mere antiquarian reconstructions, whether historical or evolutionary, are irrelevant.

The following analysis of concrete problems is carried out from a functional point of view.

THE CULTURAL FUNCTION OF MARRIAGE AND FAMILY

This is perhaps the most debated and the most instructive of all anthropological problems.

The Institutions of Marriage and Family.—Careful inductive comparison reveals one important indication: marriage and family are almost universal, and can be traced through all types and levels of culture. Their universality can be accounted for by the functional analysis of these institutions. Two functions of paramount importance are fulfilled by any institution which regulates mating and propagation; the maintenance of racial quality and the maintenance of the continuity of culture. Sociological considerations prove that the individual family based on monogamous marriage provides the best opportunities for effective sexual selection. It also supplies the best training for the future cultural work and sociological orientation of the young individual (Lowie, Kroeber, E. C. Parsons). The importance of the family as the early social and cultural pattern for later life has been independently established by anthropology and psycho-analysis (A. Radcliffe-Brown, J. C. Flügel). The family is the link between instinctive endowment and the acquisition of cultural inheritance, in that it permits the biological bonds between parent and infant gradually to ripen into social ties. It also eliminates a number of dangers due to the disruptive factors of the sexual instinct.

Regulated Licence.—This phenomenon does not allow of a simple and satisfactory solution. As culture advances and larger numbers of men and women come into contact, the experimental component of the sexual instinct drives people to indiscriminate mating. Freedom in pre-nuptial intercourse, festive licence, religious prostitution, lewd marriage ceremonies are the rule in savage and barbarous communities, with the exception perhaps of those on the lowest level (Schmidt and Koppers). Again, in some tribes the institution of marriage suffers temporary obliteration in the form of wife-lending or exchange, *jus primae noctis*, sexual over-rights of chiefs and magicians and similar relaxations of the matrimonial type. These customs have been explained as " survivals of primitive promiscuity." That such an explanation is untenable has been convincingly shown by Westermarck. There are two ways of regulating the intercourse between the sexes: either by suppressing all irregular mating, or by allowing a well-defined and limited licence. Biology and psycho-analytic theory teach that stern repression and rigid sex morals are not a complete solution of the problems here involved. Anthropology, moreover, shows that this problem is especially present at low levels of culture. According to some authorities, a regulated and limited licence should be considered as an imperfect but effective way of dealing with the disruptive forces of sex. Such regulation, moreover, is in no savage tribe found to be subversive to the fundamental institutions of marriage and the family which exist in spite of it everywhere.

At the same time, there is not one single tribe where sexual licence is found untrammelled, where anything approaching promiscuity obtains. Two forms of regulation are found everywhere:

the strict prohibition of the wife's adultery safeguards the bonds of marriage and is only now and then over-ruled by exceptional customs; the prohibition of incest within the household safeguards the integrity of the family. This is very often extended to exogamy which embraces the whole clan.

The Clan.—The clan and the classificatory principle of kinship appear on a closer sociological analysis not to be substitutes for the family and household, but the outcome of more extended co-operation in matters other than sexual mating and the rearing of children (A. Radcliffe-Brown, A. L. Kroeber, Thurnwald). The clan functions principally in economic, legal, and above all, in ceremonial matters. It is also closely connected with age-grades, secret societies and men's clubs wherever these exist; with the ceremonial distributions of wealth (the *kula*, the *potlatch* or the *hakari*), with magical specialisation and co-operation. Thus, in its functional definition, the clan represents the non-sexual and non-genetic extension of the kinship principle beyond the household and above the natural function of the family. Exogamy again appears as an additional bond of solidarity—a natural extension of the principle of incest running side by side with the extension of the kinship principle. As the link between the individual family and the wider groupings of local and political type, the clan is of special importance.

The clan is always due to the over-emphasis of one side of kinship—an over-emphasis necessary to eliminate any ambiguity in the transmissions of heredity rights and obligations. This has been aptly summed up by Dr. Lowie in his terminology of bilateral and unilateral kinship. The clan appears therefore as the natural result of the two influences which come into the foreground as culture advances: the continuity of tradition on the one hand and the extension of co-operation on the other. The clan allows of the establishment of greater cohesion within each generation and across succeeding generations. The explanation here given accounts for the institution, neither by an accident nor by specific ideas, nor by a hypothetical primitive communism in sexual matters, but by reference to certain deep-seated influences of cultural progress working before our very eyes. With all this, although the clan is of great benefit for society and culture, it never becomes an absolute necessity like the family. It is rather a symptom of advancing social differentiation than its inevitable effect. Thus, although the family and marriage are found to be universal, there exist tribes without any subdivisions into clans, moieties or matrimonial classes. Further, since the clan is associated with the general scheme of development, it cannot be regarded as a fortuitous index of this or that culture.

Mother-right and Father-right.—The correlated phenomenon of unilateral kinship also plays a very important part in diffusionist schemes. Mother-right and father-right respectively have been taken by Ankermann, Graebner, Rivers, W. Schmidt and Koppers as principal indices in their classification of cultures. But the question arises, is either mother-right or father-right an independent element, or are they both always correlated? It seems, however, that mother-right and father-right are never found in isolation, but always co-exist—one of them emphasised by the tribal law and the economic arrangements, the other, though subordinate, never completely absent. Until the problem thus raised has been solved, until the proof is given that mother-right and father-right can exist as exclusive, sharply defined stages or sociological principles, their use as indices of culture, and evidence of its spread must remain meaningless. Here again, functional analysis of the methods of reckoning descent leads to a clear definition of such concepts, indispensable for their use in any speculative constructions.

Problem of Sex.—Thus the family, the clan, sexual restrictions, as well as sexual liberties, are not the stages of a transformation nor fortuitous indices of cultural type or cultural stratum, but correlated, component parts of one big institution: the institution which controls the mating of sexes, the procreation of offspring and the education of the young, and fulfils the integral function of racial and cultural continuity. The nature of its component elements is explained by the part which they play within this integral scheme. The functional method might also be extended to all the other aspects of organisation—territorial, political, legal and economic. Each is related to an essential need of human society and culture, distribution over its locality, defence, maintenance of order, and the production of necessaries and values.

Economic Organisation

Until the researches of anthropologists in Melanesia, in New Zealand, in North-West America, in Africa, and in Micronesia revealed a wealth of material, and theoretical students laid stress on the cultural importance of primitive economics, there reigned in anthropology the simple, occupational view of primitive husbandry. Schemes of occupational stages or types, the collecting of food, hunting, fishing, the tending of herds, the raising of crops and industrial production were set forward as the only subject matter of descriptive or analytical economics, as it is called.

In all such views, primitive man is regarded as having but simple elementary needs, and proceeding reasonably and naturally to satisfy them. The little spare time he has left over he devotes to the casual production of superfluities, and to the satisfaction of his hobbies, which latter activities, however, are usually placed outside the domain of economics. Thus we read in an authoritative work, *Notes and Queries in Anthropology:* "The first essential of maintenance is a supply of food; and in many simple communities the actual food quest and operations arising from it . . . occupy by far the greater part of the people's time and energy, leaving little opportunity for the satisfaction of any lesser needs." And again, we are told by another writer (Buxton) that generally the savage "has no means to acquire more wealth than he can carry about on his person or on the persons of his family." The main questions cut short by such *a priori* assumptions are those of the incentives to production, of the organisation of labour and of the primitive forms of the apportionment of wealth.

The Economic Motive.—Is it true then that primitives work only to satisfy their primary needs? In the lowest stages of culture people are ready to endure thirst and hunger, but bent upon stimulants or narcotics. We know of tribes without clothing, but of none without ornaments. There are natives without fixed habitations, yet keen on the display of such wealth as they possess. At higher levels, under more favourable conditions, certain commodities are actually produced far in excess of actual needs. And this is not done "in exchange for food or for the means of obtaining it," as runs the usual opinion (*Notes and Queries*).

Nor is it carried out through economic foresight. Large quantities of accumulated food and wealth are employed instead for festive display, for ceremonial yet useless donations, sometimes even for mere destruction, often on a gigantic scale. All such customs serve merely for the manifestation of the wealth of the owner, of his generosity, of his economic power. In the South Seas, the accumulated food is employed for the production of objects of value by the feeding of artisans, who devote themselves to the polishing of axe-blades, to carving, to the making of shell ornaments or of mats (Thurnwald, Müller-Wissmar). Some of these early forms of valuable tokens of wealth have a distinctly religious character, serve in ritual ceremonies, are associated with belief and possess elaborate mythical pedigrees (Mauss). Finally, there is one very important fact which contradicts the merely utilitarian view of primitive economic incentives: the products of savage industries in general, far from being made with the minimum of effort required for their utility, show a lavishness of artistic detail, of decoration and pedantic finish, which often put to shame any civilised artisan. The joy in the work, the satisfaction of perfect craftsmanship, the artistic passion for the general appearance of the finished product dominate savage industries and enterprise.

It is clear from this evidence that the "first essentials of maintenance," the primary needs and the requirements of practical utility, do not exclusively control the economic effort of primitive man. Nor is their aim always to achieve the utilitarian maximum of effect by the minimum of effort. To understand the

driving forces of early production, it is, therefore, not sufficient to make reference to man's animal needs. It is necessary to realise also the native ideas of value: their pleasure in the integral effect of their work in which artistic, sporting, social and even religious motives are mixed with those of pure utility.

The Character of Early Production.—The well-known scheme of K. Buecher, who would place the whole range of primitive husbandry within the limits of the "individual search for food" and of "closed household economy" is the clearest expression of the view that primitive man works for himself and his family alone, and that he knows no production on a wider, a communal or tribal scale.

A fuller insight into the nature of primitive labour reveals the existence of organisation. Even in the lowest cultures there are tasks which transcend the forces of one individual or of one family—the felling of trees, drive-hunting, the very collecting of food. At higher stages, such pursuits as communal hunting and fishing, the making of gardens, the construction of houses and canoes require some type of organised labour. This points to a definite specialisation, distribution and synchronisation in time, a division of functions, an integration of the individual contributions to the common end. If we enquire what are the elements of the economic organisation, it soon becomes clear that we must distinguish between moral or persuasive, and social or coercive factors. K. Buecher in a later work (*Arbeit und Rhythmus*) has drawn attention to the great importance of rhythm for successful work. Many other stimulants and incentives could be mentioned, the most efficient of which is unquestionably work in company. Conversation, jokes, mutual assistance and interest relieve the tedium of solitary labour, while emulation, example and the satisfaction of pride are under primitive conditions possible only in communal work. The best worker is always recognised as such among savages, and his leadership is followed. Much more important, however, is the moral prestige enjoyed by supernatural expert knowledge which, in the form of magic, always controls vital and difficult economic pursuits. Marking the dates, inaugurating the successive stages, imposing periods of rest and setting the time limits, it acts as an organising, co-ordinating influence.

Social coercion is the other important force of economic organisation. As soon as distinctions of rank and power arise they are used as means of extorting labour, while, on the other hand, economic inequalities function as indices of social status.

Primitive Ownership.—This economic problem has been discussed with some detail by anthropology. But while, on the one hand, the writers, who, like Buecher, assume an atomised economic production, admit only of individual or personal ownership, those following Morgan, and influenced by a strong socialistic bent, Engels, Bebel, Cunow, make the savage into a communist. As a matter of fact, property, which is but one form of legal relationship, is neither purely individualistic nor communal, but always mixed (*cf. Nature*, Supplement, Feb. 1926, on "Law and Order").

The misuse of such conceptions as "communism," associated with an incorrect application of the concept of "money" may be exemplified on a scheme recently put forward by the late Dr. Rivers. Dr. Rivers designates certain forms of valuables found in Melanesia, such as mats, arrows, pigs' jawbones and, above all, shell discs, as "money," following the usage of white traders, missioners and planters. Dr. Rivers, to justify the use of this word, insists that these objects "are used for no other purpose" and "have a very definite scale of value," but he gives in other contexts a definite and concrete account of several ways in which these objects are used "for other purposes," and thus stultifies his first criterion. The second criterion is obviously insufficient for identifying a commodity as "money." All objects have in our economy "a very definite scale of value," yet we do not apply the word money to a pair of slippers, a motor-car or a picture by Raphael, nor use these things as such.

Now the taking of terminological liberties with well-defined concepts has its dangers. "Money" has no sooner been introduced into the argument than communism crops up and the two are related by a remarkable piece of reasoning:

> The subject of communism in property is closely connected with that of money. A thoroughly communistic people can have no use for money among themselves. If they possess anything which can be regarded as currency, it can only be used in transactions with other peoples. The use of money should therefore be associated with the disappearance of communism; if it can be shown that Melanesian money is due to immigrant influence, and especially to that of the Kava people, we shall have gone far to establish the conclusions already suggested. (*History of Melanesian Society*, vol. 2, p. 385.)

And again:

> A thoroughly communistic people would have no need for money, and any explanation of the communism of Polynesia will therefore furnish also the explanation of the absence of money (p. 392).

And as an "historical explanation" of these facts:

> The explanation of the absence of money in Polynesia and of the communism of its people is to be found in the special mode of settlement of the Kava people (p. 393).

These passages furnish a conspicuous example of how ill-defined concepts lead to far-fetched schemes and unsound constructions.

Summary.—To sum up briefly, it is incorrect to assume that man for a long time has lived in a semi-natural primitive stage of individual acquisition of food and primary utilities. Equally untrue is the correlated assumption that he lifted himself out of this condition by the gradual application of the economic principle of maximum of effect for the minimum of effort. Instead, from the outset, artificial, cultural, non-instinctive aims have been indispensable to him and his culture. Early types of value and symbols of wealth have spurred him from the outset to economic effort. This effort is organised and standardised by tradition. The real problem, therefore, consists in gaining insight into the primitive forms of condensed wealth, into the mixture of motives and impulses which drive man; and in studying the manner in which these primitive incentives control organised effective effort. All the conclusions arrived at show that for the discussion of economic problems it is necessary to consider the relation of early wealth to religion and to magic as well as its function in primitive social structure.

The borderland questions—the influence of economics on social structure; the problem of wealth as the foundation of rank, power and status; the rule of give-and-take in social obligations; ceremonial distribution of goods and its economic importance—are gradually coming into the forefront of anthropological interest, and open up entirely new horizons in theory and observances. They bring it into close contact with the disciplines of economics, history and sociology (Bücher, Schwiedland, M. Weber, K. Lamprecht).

The relation between the various larger aspects of culture opens a new type of problem. Social organisation is largely dependent upon economic foundations, while economics cannot be studied without a knowledge of the various groups within the tribe. Religion and magic are not independent, but are intimately associated with economic pursuits, with power and prestige, with domestic life and everyday necessities.

The Supernatural

Here the functional view is put to its acid test. What can be the function of primitive belief and superstition, of animism considered as valueless, crude and mistaken, of magic, regarded as a spurious and fallacious pseudo-science, of totemism, of barbarous burial ceremonies and of cruel initiation rites? And yet the method here set forth stands and falls with the possibility of defining the whole of the supernatural. It is bound to show in what way belief and ritual work for social integration, technical and economic efficiency, for culture as a whole—indirectly therefore for the biological and mental welfare of each individual member.

The Current Theories.—Most modern theories in fact come near to the posing of this problem and to its solution. It is implied in the whole structure of Frazer's *Golden Bough*, in the contributions of Westermarck to the moral side of religion, in Durkheim's analysis of the integrative function of public ceremonial, in the additions of Hubert and Mauss to his theories, in Marett's analysis of magic, in Crawley's vitalistic view of religion,

above all, in the analysis of Andaman belief and ceremonial by A. Radcliffe-Brown. But too often the functional view is still smothered by evolutionary or historical discussions—as to whether magic preceded religion, as to what was the primitive form of religion, and so on.

Magic.—The great number of modern theories dealing with magic range between two apparently opposed views, which label magic as primitive science or primitive stupidity (*Urdummheit*) respectively. We must reject the implication of the first theory, that magic preceded science, and that it once did fulfil that function. It must be placed to the credit of this theory, however, that it does full justice to the practical context of magic. The second theory emphasising the central conception of impersonal ubiquitous force—*mana, orenda, wakan* rightly appreciates the difference between belief and knowledge; and brings out the mystical character of magic (Marett, Hubert and Mauss, Preuss).

The functional theory reconciles both points of view. Let us start from the close association of magic with practical activities. First, every practical pursuit amongst savages is always primarily based upon knowledge and is never exclusively controlled by magic. There are in all savage cultures certain activities in which technical ability, guided by knowledge, completely suffices. In others, the help of magic is also invoked. What are the respective contributions of knowledge and of magic to such a mixed activity? In its essentials the division of function between the two is very simple: as far as his knowledge goes, as far as he can safely rely on experience, reason and technical ability, the native—whether in his gardening or fishing, in the building of craft, in warfare or sailing—does not use magic. No savage has ever been observed to select the tree for his dug-out by divination, to bring forth seedlings by formulae without having planted them. Only where, in spite of knowledge and effort, the results still turn unaccountably against him, only when forces completely beyond his mental grasp and practical control baffle him—in dealing with garden pests, with the supply of fish and animals, in securing wind or weather, in preventing disaster at sea or in war, above all, in dealing with bodily decay, disease or personal accidents—does the savage resort to supernatural means of filling the lacunae in his practical power.

The type of belief met in magic is always an affirmation of man's power to deal with the situation by a rite or spell. This belief simply repeats in a standardised manner, what hope all the time has whispered within the individual's own mind. Again, the rite repeats in a fixed, definite form what the natural expression of emotions already contains, only, as a rite, it is carried out with a purpose and with the conviction that it is a means to an end.

When we compare the forms of the fixed magical ritual, they are remarkably akin to the response of upset equilibrium occurring under similar conditions. Black magic, which corresponds to the sentiment of hate, and which replaces the outbursts of impotent rage, contains in its most typical ritual of stabbing, pointing the bone, mimic destruction, in the text of its formulae, a reproduction of the various gestures, words and types of behaviour, which we can watch in the natural vent of the emotions. Exorcism of evil powers repeats in word and deed the reactions of fear.

In all practical activities, the successful ends, which hope vividly brings before the mental vision at moments of uncertainty and suspense, are connected in such ritual, which bridges over the fateful moments. Sir J. Frazer's apposite term of " imitative magic " and his exhaustive illustrations of his point of view illustrate also the present theory. Here it is only suggested that the association of " ideas," designated by Frazer as the cause of " imitative magic," can only be accounted for by our theory of imperfect biological adjustment induced by culture. Baffled instinct arouses emotional tension as well as a conflict of ideas and an impasse in conduct. Through magic, culture prescribes the adequate ideas, standardises the valuable emotional tone and establishes a line of conduct which carries man over the dangerous moment.

This new type of explanation, based on the functional method, shows how cultural behaviour, in the very act of bestowing immense benefits and advantages on man, also opens up new problems and creates new needs. To satisfy these a new type of behaviour, ritual practices and a new mental adjustment, faith or mystical outlook, come into being, thus providing an answer to the question which is always essential: What actual benefit does magic confer upon man, what is its positive contribution to culture? It is a remedy for specific maladjustments and mental conflicts, which culture creates in allowing man to transcend his biological equipment.

Social Consequences.—In its traditional aspect, magic leads to important social consequences. It is the essence of magical lore that every word of a formula must be spoken correctly without omission or alteration, every detail of the rite performed. Since magical knowledge can live only in man's memory, the correct transmission, the legitimate filiation of magic are essential to man's confidence in its efficiency. The inheritance of magic is always one of the most important problems of descent and of the modes of reckoning kinship. As a rule, magic is handed on within the family circle.

In this connection it is important to stress that *all* forms of magic usually perform an important social rôle. No magic can be regarded as anti-social in the sense in which Durkheim and his school attempt to define it. Even sorcery or black magic functions as a legitimate though dangerous weapon, of which one of the main uses is in the enforcing of an established power and the biddings of law. The actual manner in which magic is connected with practical activities makes it, as we have seen, into the very skeleton of economic organisation. It supplies most of the co-ordinating and driving forces of labour, it develops the qualities of forethought, of order, of steadiness and punctuality, which are essential to all successful enterprise. Thus magic fulfils an indispensable function within culture. It satisfies a definite need which cannot be satisfied by any other factor of primitive civilisation.

Totemism.—Totemism is a belief which affirms an intimate bond between a group of men and an animal or vegetable species, sometimes a class of objects. It raises therefore two problems, the first as to the nature of the belief, the second as to the social organisation with which it is linked.

Most theories saw its origin in some small or accidental detail of social organisation or belief, as in nicknames, guardian spirits, transmigration of souls and, recently, in the Freudian theory of parricide. To the functional theory the real problem, however, is: what is the function of a type of belief which affirms the affinity between man and animal, is correlated with clan organisation and leads to moral and ritual rules associated with the multiplication, killing and eating of animals?

Man's interest in his surroundings is primarily practical. He has to collect food, construct his dwelling, roam about his district to hunt or fish. In the forefront of importance are the animals in his territory—those which feed him, those whose skins clothe him, whose feathers, teeth and claws supply him with ornaments and those which threaten his safety or comfort. Hence the whole of animal life has an intense interest and significance for him.

Now in dealing with the animal kingdom, in obtaining the useful species to eat, in defending himself against the dangerous or repulsive ones, primitive man, where his natural means fail him, has recourse to supernatural ones. The magical claims over any aspect of nature lead always to an assertion of a sort of affinity or kinship between the magician and the object controlled. Indeed most magic implies mythological descent from animals or affiliation to them. Thus we see that the native's practical interest in the animal or vegetable kingdom leads through magic directly to the assertion of a mutual bond.

Magic has a tendency to become specialised and departmental, exclusive and hereditary in a kinship group or clan. The subdivision of the tribe into totemic clans seems to be best explained, therefore, by the hypothesis that such clans were originally magical bodies engaged in controlling, through spell and rite, certain animal or vegetable species for the welfare of the tribe.

Thus is assigned to totemism a definite cultural function. Selective interest in vitally relevant factors of the environment, man's capacity to control it, are embodied in a system of beliefs which standardise, enhance and sacralise these culturally valuable mental states. By endorsing man's confidence and his hopes of effective control, by making these tendencies substantial in an explicit mythological dogma, totemism contributes to individual happiness, to social cohesion and to the general efficiency of culture.

Summary.—In recent work (Frazer, Crawley, Van Gennep, Miss Jane Harrison) much stress has been laid upon the association of religion with the crises of life. In fact in most religions, savage or civilised, the main phases of human life history—conception and pregnancy, birth and puberty, marriage and death—are associated with belief, ritual and mythological stories. Religion therefore fulfils at vital crises an indispensable function in the scheme of human culture.

Culture entails a transformation of direct instinctive response into a mode of behaviour governed by purposive ends, that is, by cultural values. The super-instinctive type of behaviour leads man into impasses and difficulties out of which he can be extricated only by rules of thought and of behaviour which also have to be supplied by culture. In practical pursuits magic helps man over the difficulties. The rôle of Religion consists in the establishment of spiritual ends, dogmatic realities and moral rules of conduct. In totemism, which sacralises important factors of the environment; in the belief in immortality and in the associated ideas about communion with spirits and their influence on human fate; in the consecration of food and of indispensable elements of culture, such as fire, standard implements, tokens of wealth; in surrounding tribal tradition and order by the halo of sanctity, religion is the source of social and cultural values.

Primitive Knowledge

Reason, the capacity to know, to invent and to evolve theories, has been regarded as the distinctive mark of man, dividing Homo sapiens from other living beings. Perhaps over-confident exaggeration of this has led to the recent reaction which denies to the primitive mind any power of reasoning and of observation.

But had primitive technique been studied not as a self-contained object, but in its functional dependence upon knowledge on the one hand and magic on the other, the theory of a primitive mystical and prelogical mentality could never have been erected. Primitive man shows a rational behaviour, an unimpeachable logic and a definite power of empirical observation, not only in his technology, but also in his major economic pursuits and in his sociological behaviour.

Language.—This subject has been so far but imperfectly studied by anthropologists, and its cultural theory is as yet hardly outlined. The study of dead languages by grammarians and philologists has caused speech to be regarded as a self-contained phenomenon governed by special laws of its own. It was a considerable step forward when, some time ago, the study of language was taken up by psychologists, who began to treat it in correlation with thought and other phenomena (Lazarus, Steinthal, Wundt). The structural features of language were explained as an adequate expression of reasoning, of emotional states, of aesthetic needs and of the characteristics of the human will. Even this, however, is not sufficient.

Recent developments in linguistics, as well as in the philosophy of language, have set forth the view that language cannot at any stage of development be regarded as an adequate expression of logical, metaphysical, aesthetic or scientific categories (J. Dewey, Jespersen, Ogden and Richards). Language, in all societies and at all stages of development, is an essential part of human action (Dewey). Communication by spoken word is indispensable for any concerted activity and enters into all aspects of culture as a working element. (*See* Philology.)

From the functional point of view, a word which designates an implement is as much an essential manner of using that implement as is any type of bodily skill required to handle it. The master of a craft, however primitive, must be able to give his orders in case of emergency in a technically adequate and theoretically correct manner, and the bodily reactions of his vocal apparatus are as essential to the practical issue as the manual dexterity of his crew. Language plays a similar part in warfare, in economic pursuits, in ceremonial activities. In religious and magical ritual, the spoken word is conceived and felt by man to be a creative act which produces a definite practical effect.

But if speech, in its primitive forms, is an indispensable instrument of cultural behaviour, its structure must be correlated to pragmatic needs and to the requirements of action rather than to logical, reflective or oratorical necessities. Hence the categories of primitive speech must be a compromise between logical and rational conditions, sociological and practical needs, and certain limitations imposed by material culture.

The problem of meaning cannot be treated by the study of language, torn out of its cultural context. The classical philologist has already summoned the archaeologist to his assistance. The study of living languages of the primitive type, helped out by the study of living cultures, would, no doubt, reveal to us infinitely more than can be reached by the study of dead speech. A word is as sterile without the knowledge of how it is used in live context, as behaviour remains mysterious without its accompanying flow of speech. Life is neither mere verbiage nor a pantomime. Speech has been given man for action, and as mere loquacity it is a disease of culture. (*See* Philology.)

Mythology as Primitive Science.—In order to vindicate the autonomy of knowledge within primitive culture, it is still necessary to deal with the view that, at low levels of culture, myth is a substitute for science. We read in an authoritative handbook:—

> Myths are stories which, however marvellous and improbable to us, are nevertheless related in all good faith, because they are intended, or believed by the teller, to explain by means of something concrete and intelligible, an abstract idea, or such vague and difficult conceptions as creation, death, distinctions of race or animal species, the different occupations of men and women; the origins of rites and customs, or striking natural objects or prehistoric monuments; the meaning of the names of persons or places. Such stories are sometimes described as *aetiological*, because their purpose is to explain why something exists or happens (*Notes and Queries*, pp. 210 and 211).

We are thus told that primitive man evolves stories and believes in them, in order to explain abstract ideas. As a matter of fact myth is not a form of primitive science, but an aspect of religion, magic and morality; its function is not to explain queries nor to illuminate abstract or obscure points, but to strengthen belief, to substantiate morals and to enhance tradition, in short to bring home to primitive man all that has to be believed, obeyed and accepted.

To establish our point, we have to place myth within the scheme of primitive culture and to show its pragmatic function. Myth is a part of folklore in the narrower sense of the word, that is, of oral tradition. Man in all ages and all climes possesses a body of concrete stories which can readily be divided into several classes.

Of these, the first serves predominantly for amusement and recreation. Stories of this class describe more or less dramatic or funny adventures of men and animals, ogres and hobgoblins, all of which are not regarded as real. Such tales, when studied within their cultural context and regarded from the native point of view are found to play an important part in native life, in that they enhance sociability, fill out seasons of enforced idleness or make up the substance of amicable gatherings.

Another class of stories, taken more seriously, refer to important exploits and heroic deeds of past generations and are considered to be true. The sociological function of such stories is that they develop family pride, knit the kinship bonds and serve to increase communal or tribal solidarity.

There are finally stories which are regarded as sacred and connected in a specific manner with magical and religious cult, with social organisation and with the body of tribal custom and moral rules. These and these only could be regarded as " explanatory " stories, in that, among other subjects, they account for the origins of the world, give the reasons for death, furnish revelations of

future existence, and promise immortality, narrate the beginnings of magic, and so on. The explanatory character, however, is prominent only as long as the story is considered without its cultural context. In all cases where the associated ideas and feelings have been observed; where we know the conditions under which the myth is recited or enacted; above all where the practical influence of the myth has been studied—we are able to assign a definite cultural function to it. Thus, in connection with magic, we find stories which are not intended to *explain* the ritual or the phenomenon governed by magic, but are meant to substantiate the belief in magical efficiency. All such stories give us an account of an extremely successful, miraculous precedent. Around the various religious rites and ceremonies, there cluster stories which vouch for the efficiency of the religious acts in obtaining the desired effect.

Again, we have a class of myths which confirm the existence of privileges, give the antecedents of rank and power, or enforce duties and which, in general, strengthen traditional law and order. Wherever myth, that is a sacred story, has been studied in connection with the sources of its sanctity as well as with its sacralising results, it can be shown that it has served to strengthen faith by reference to an original Golden Age, to miraculous precedents in the dim past. The study of myth in conjunction with ritual and institution has been carried out only in limited areas, for instance in the Andaman Is. (A. Radcliffe-Brown), in Central Australia (Spencer and Gillen), in Melanesia (B. Malinowski), in Northwestern America (Boas and others), in Polynesia (Elsdon Best). All the facts we know, however, prove that myth is in no way comparable to primitive science, but that instead it functions as a religious warrant, vouching for the truth of belief, the efficacy of ritual, and the fitness and justice of moral or social duty.

The Identification of Culture

The functional method seems at first sight to be of especially easy application to artifacts, to material objects fashioned by man for his cultural uses. Food stuffs ready for consumption, man's equipment in protective shelter and clothing, his tools and his weapons, are all obviously means to an end.

The Place of Artifacts in Culture.—But this very facility has its dangers. The purposive character of most artifacts has made the *implement* into the typical representative of material objects: hence, all these have generally been regarded as representing the *technique* of culture. It is deemed sufficient to state how these objects are *made* and how they are *handled*. In *Notes and Queries* one-third of the space is devoted to "technology," the description of manual production and of the handling of artifacts. In the *Handbook of Folklore*, this study is defined as an anthropology with technological considerations cut out. All this is incorrect, since "material culture" is not an autonomous, self-contained province of culture, such as religion, law or economics, each of which fulfils a specific function. Material culture is an indispensable accessory of every single aspect, every pursuit and institution and thus fulfils a general function.

On the other hand, the bald technological treatment is not sufficient to do justice to any class of artifacts. The objects of immediate consumption or use, as well as tools and implements, are essentially correlated to economics and must be studied within its context. The same applies to a weapon, the proper analysis of which immediately leads to the description of the manner in which it is wielded, thus to the methods of warfare and war magic and, finally, to the political organisation of the tribe.

There is no single type of human activity without its material accessories. There is not one artifact, however practical or simple, which could be properly understood without its context of living culture, including belief as well as technique, social organisation and traditional knowledge.

Any general theories of culture or of progress which ascribe all driving power to either the material or the moral aspect of culture alone are guilty of one-sided exaggerations. Philosophy of history without a scientific basis is of little value. Functional anthropology on the other hand finds great help in the conception of culture as a form of biological adaptation on a gigantic scale, which empirically analyses the concepts of progress and of cultural reality and seeks to place the study of culture within the scheme of other sciences. Modern empirical philosophy has also been in turn greatly influenced by anthropological work, above all, by the theories about primitive knowledge, its relation to faith and to practical activities (W. Wundt, L. T. Hobhouse, K. Lamprecht, M. Weber; above all, J. Dewey and the Columbia School of Culture Philosophy).

The Criteria of Cultural Identity.—The other danger which the study of material culture harbours for the anthropologist is the fallacy of *fixed form*. The strict determination of shape imposed upon many artifacts, especially tools, by their use, has made many objects appear perfectly defined by their form. An axe-blade, a knife, a bow and arrow, a spoon, a walking stick, "will be, as a rule, recognised at once as such" (Graebner, p. 56). Again we are told that the concepts and means of identification "are so much matters of everyday use to the ethnologist that the activity of the intellect, as it compares the objects, remains below the threshold of consciousness" (p. 57). These statements contain a very serious fallacy, obvious when it is remembered that nothing of any scientific value can be achieved by the study of isolated aspects, or, worse still, of isolated objects. And any definition by form treats an object as a self-contained isolated entity. As soon as an object is defined by relation and by function it has to be considered as a part of a larger whole, and it is the form of the whole which becomes the relevant factor in our definition.

The criteria of form and of quantity, as defined by Ratzel, Graebner, Schmidt and others constitute the foundation of the historical method. When studying the problem of the identification of cultural objects and the complexes of such objects, writers of this school seek to show to what extent similarities and ideas found in different parts of the world can be explained by diffusion, by the hypothesis that they "have been developed at a single culture centre in the far distant past and have been disseminated thence over the whole world" (Kroeber, *Anthropology*, p. 200). They have thus not only to prove the identity of two objects, but to prove it so that their genealogical kinship, their identical birth in a parent culture, is established.

In order to do that, the "infallible and objective criteria" of form and quantity have been elaborated. We are told that two things belonging to two different cultures can be regarded as the same, "when identities appear, which are not founded in the essence of the object or, speaking of material goods, in its material" (Graebner, p. 98; *ibid.*, p. 108; Schmidt and Koppers, p. 68; Kroeber, p. 199). A classical example is the identification of West African and Melanesian bows, made by Ratzel on account of the similarity of their section, means of attachment of the cord and the material (lawyer cane) of which the cord is made. Not one of these features, we are told, can be explained by its function or by the limitations imposed through material or purpose.

On this example, we may also observe the second criterion, that of quantity. The bow in the two regions shows not one, but a number of features apparently not related to each other.

> If a trait is composed of several elements which stand in no necessary relation to each other, and these several elements recur among distinct or remote peoples in the same combination . . . one can be reasonably sure of the real identity of common origin of the complex trait,

says Kroeber summarising the diffusionist point of view (*Anthropology*, pp. 199–200).

The "quantity" criterion applies not only to details found on one object, but to objects, customs and institutions, provided these are not related to one another. Such an *ensemble* is then usually called "a cultural complex," such as the cultural complex consisting of the bow already mentioned as well as shields, houses, masks, drums and clothing. This, Frobenius believes, forms a really identical stratum of culture both in West Africa and Melanesia.

When the two criteria are carefully examined, the functional anthropologist perceives that the assumption of wide occurrence of meaningless and irrelevant objects and unrelated complexes rests primarily upon a mere deficiency of knowledge. An object, or a detail of it, appears to us "inessential," "arbitrary,"

" devoid of function " only as long as we do not understand the function of that detailed feature or object. Since the study at first hand of savage races has been conducted mostly in an amateurish manner, and our collections are crammed with unlabelled, undefined, misunderstood specimens, the argument from irrelevance, *i.e.*, from our ignorance, has no value in anthropology. The fact is that the more we know about the culture of a region, the fewer features appear to us " extrinsic " or " arbitrary," the more all is revealed correlated, determined, provided with a function. And this brings us to the crux of the argument: form without function is an empty concept in the science of culture.

A pointed stick can be used as a spear in war or in the hunt, as a digging or punting pole, as a ceremonial staff or magical wand, as well as for many other purposes. The details of its form are adapted to the function and defined by it. And this holds good with regard to every item of material culture.

Once we begin to define form by function, both criteria, that of *meaningless form* and of *fortuitous coincidence*, break down completely. An object can be defined and identified only by its use, the study of use leads us again to connect the object with the pursuit, the institution, the aspect. The real identities of culture appear to lie in the organic connection of its parts, in the function which a detail fulfils within its scheme, in the relation between the scheme, the environment and the human needs. Meaningless details disappear, shape becomes alive with meaning and with function, and a testimony of irrelevant form falls away as worthless. The method of formal treatment breaks down even more completely in the study of primitive sociology, economics and supernaturalism than in that of material culture.

And this entails a partial qualification of the criticism of the historical method. First of all, many students in mapping out distributions apply functional identifications of culture instead of formal ones (especially Wissler, Kroeber and Lowie). In the second, it is always possible to profess a bad method and to use a good one. The coincidence of details in an object or simultaneous appearance of objects is an important fact, whether we try to find out its organic relations or rest satisfied with denying them. The distribution of such objects or complexes does raise a problem. The objection is that in the opinion of the upholders of the historical doctrine, the problem is solved. For to them a distribution of such similar traits or complexes is a proof of common origin, a proof just because they affirm the absence of any inner relation or function. To the functional school, on the other hand, who cannot rest satisfied with dogmatically abiding by a gap in our knowledge, distribution raises a series of problems. In the first place how far we can regard the complex as an organic unity; secondly, what is the function of this coherent whole; thirdly, in view of this function, have we to assume independent development along similar lines, convergence along dissimilar lines or mechanical transmission? The real explanation, however, underlying any of these hypotheses, lies in the discovery of correlations and of permanence through function.

Summary.—The outer framework of material culture is correlated in a clear and direct manner to the satisfaction of man's biological needs. It constitutes the *milieu* which man evolves to interpose between himself and the rigours, dangers and insufficiencies of his physical surroundings. But this material apparatus has to be operated by men collectively, organised and controlled by the body of tradition, scientific as well as religious and magical. Thus indirectly most elements of social cohesion as well as certain beliefs and ideas can be correlated with man's primary needs, and explained by the biological function which they fulfil and the survival value which they possess. But this is not sufficient, and here an extremely important addition has to be made: the facts of social organisation impose certain conditions upon human behaviour, imply restrictions and create new wants, which again call forth specific cultural arrangements. Thus, higher forms of organised labour need some compulsion, supplied by political inequalities, and some moral framework, supplied by certain forms of magic.

Mental development running side by side with higher technical ability brings about fear, thought and reflection which make man anticipate his destiny and probe into the past and future of his world. The beliefs of primitive man about future life, the beginnings of the world and spiritual powers have to be correlated with his increasing mental outlook as well as with the widening social horizon and the development of cultural values. Social cohesion requires some means of enforcing the various rules imposed upon the individual for the common good, and this brings about the sanctions and inducements, which constitute the essence of primitive law. In all this the functional view avoids the error of attributing any priority to one or the other aspect of culture. Material objects, social grouping, traditional and moral values, as well as knowledge, are all welded into a functional system. To explain any item of culture, material or moral, means to indicate its functional place within an institution, which has to be thus explained with reference to its aspect and this again has to be placed within the system of culture.

Finally, anthropology hopes, with the help of her sister sciences, to state the place of culture in the scheme of organic evolution; to show how it is correlated to the instinctive animal equipment of the human species; to demonstrate how it has allowed man to rise above the brute level, to control his surroundings, to develop his knowledge, his faith and his conscience.

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ANTHROPOLOGY, APPLIED.—Public recognition of the advantages to be gained by the practical application of anthropological knowledge had scarcely begun before the War, and naturally suffered a severe setback from which it only slowly recovered. There were administrators who recognised the native point of view, and were even prepared to study the sociology of their charges, and in a few cases, recorded the results of their observations; yet nowhere was there any general official recognition that the acquisition of such knowledge should be part of an administrative officer's duties, and adequacy in native affairs was not generally regarded as necessary for promotion. Nevertheless a healthy spirit is abroad even if performance at times lags behind the demands of both theory and common sense.

Divisions.—Applied Anthropology has two main aspects:—(1) Cultural (or in the broader sense psychological). (2) Physical, embracing especially the great problems of racial characters both physical and mental, miscegenation, immunity and so forth.

Both aspects are of the greatest importance to humanity as a whole, for both are compact of the basic factors which must be considered in the solution of some of the most urgent world problems of the present day. Here no general consideration of the philosophical or ethical questions concerned is possible, but a reasonably kindly attitude of the dominant race toward the weaker peoples, and a desire to preserve and serve them, will be taken for granted, as well as the fact that the development of a territory involves the exploitation of its native inhabitants to a greater or less degree. There will also be assumed the determination on the part of the governing races to modify and if necessary to terminate the anti-social practices of their less desirable members, even where this directly or indirectly limits the exploitation of the "natives." Further, while every people presents its special problem, all these are but different aspects of the greater problem of adaptation, which must be worked out afresh in many instances if the widest range of physical and cultural types are to be given their best chance of survival and development within the conditions besetting them.

Hunting Peoples.—First, there is no possible future for the few scattered remains of the hunting peoples that still exist; only in certain instances is the white man responsible for their disappearance, and at the time of the European colonisation of the tropics superior "native" cultures were, in a number of instances, destroying these humbler groups with the same certainty as our own.

Agricultural Peoples.—With regard to the agricultural peoples but recently in the Stone Age, it is yet too early to speak with confidence, for although the natives of the smaller islands of the Pacific have been blotted out or exist only as degenerate remains, it is permissible to hope that under considered efforts those of the larger islands (such as New Guinea) may not only survive but even enjoy a measure of happiness.

Methods.—As to method, there is little to guide us in the past, for though culture contact (*see* CULTURE CONTACT, PSYCHOLOGY OF) is no new thing in history, the economic needs of today present entirely new conditions. Moral ideas have also changed, and it is no longer possible to enslave or exterminate all peoples unable or unready to adopt or adapt a higher civilisation. Yet in spite of these apparently favourable factors there has been nothing before comparable with the persistence and energy with which the higher race is imposing itself on the backward peoples.

For practical purposes, then, we can only be guided by the knowledge gained during comparatively few years, backed by the experience of our more successful administrators, the whole tempered by a quality of prevision and a capacity to "think black" which experience has not shown to be unduly common. Yet there is this encouraging feature: those who have for some years been associated with the teaching of anthropology to African civil servants from the practical standpoint have been struck both by the quickness and avidity with which many of these men—some fresh from college, with no experience of natives—have assimilated the basic elements of native thought and custom, and in a number of instances by the definitely successful results of the methods set forth in the classroom when wittingly applied abroad.

Use of Existing Knowledge.—What then are the means by which the store of knowledge we already possess may be used, and how far is a practical rather than theoretic interest in native peoples likely to introduce new methods of acquiring knowledge, or eliminate methods known to be of scientific value? Nothing suggests that the practical or applied outlook makes, or should make any change in the method of the field worker. For if it be urged that attention to any particular theory is likely to distract the observer from a fair all-round study of facts, the reply is obvious that theory can only stimulate the field worker to fresh observations, which should neither limit his area of outlook nor discourage him from seeking the fullest knowledge of the folk he is investigating in their present and past environment. The more complete the apparatus of the observer, whether government official, missionary or professional anthropologist, the more likely is he to form a complete picture of a people in which due weight is given to the activities both mental and physical of its members, enabling the administrator to foresee their behaviour as individuals, as members of a family or of a larger social group.

Unity and Complexity of Social Life in the Lower Cultures.—Ethnic and historical connections naturally are important, but stress must be laid from the practical point of view on the interaction of existing ideas and customs. It is impossible to understand the ideas regulating inheritance and bride price—two most important matters with which the administrator is concerned—without at the same time inquiring into the religion, sociology and economics of his people. Unforeseen and undesired ends have resulted from arbitrary interference with native custom. The native has a point of view of his own, and before sweeping away seemingly objectionable customs, the white man with knowledge of anthropology should seek to preserve the driving force which runs through native life, while changing those features which are anti-social according to civilised ideas, though in those cultures in which they occur they instigate much praiseworthy social activity.

Head Hunting.—One of the best examples that can be cited is offered by head-hunting, a widespread habit which white civilisation cannot tolerate. Yet its suppression was regarded by W. H. R. Rivers as one of the main factors in the depopulation of Melanesia.

No one could be long in Eddystone without recognising how great is the people's lack of interest in life, and to what an extent the zest has gone out of their lives. This lack of interest is largely due to the abolition of head-hunting by the British Government. This practice formed the centre of a social and religious institution which took an all-pervading part in the lives of the people. The heads sought in the head-hunting expeditions were needed in order to propitiate the ancestral ghosts on such occasions as building a new house for a chief or making a new canoe, while they were also offered in sacrifice at the funeral of a chief.

Moreover, head-hunting was not only necessary for the due performance of the religious rites of the people, but it stood in the closest relation to pursuits of an economic kind. The actual head-hunting expedition only lasted a few weeks, and the actual fighting often only a few hours, but this was only the culminating point of a process lasting over years. It was the rule that new canoes should be made for an expedition to obtain heads, and the manufacture of these meant work of an interesting kind lasting certainly for many months, probably for years. The process of canoe building was accompanied

throughout by rites and feasts which not only excited the liveliest interest but also acted as stimuli to various activities of horticulture and pig breeding. As the date fixed for the expedition approached, other rites and feasts were held, and these were still more frequent and on a larger scale after the return of a successful expedition. In stopping the practice of head-hunting, the rulers from an alien culture were abolishing an institution which had its roots in the religion of the people and spread its branches throughout nearly every aspect of their culture, and by this action they deprived the people of the greater part of their interest in life, while at the same time they undermined the religion of the people without any attempt to put another in its place.[1]

This example is valuable from two standpoints. It demonstrates the interlocking of departmental activities, as a white man might be tempted to call them, in native life, and it furnishes the very type of practice which no white administration can permit. The *impasse* seems absolute, yet in Sarawak, where almost the same necessity for head-hunting exists, the difficulty has been overcome by sympathetic officials who have themselves taken charge of some of the old skull trophies of the people, and thereafter when the demand for the ceremonial use of a skull arose one of the old skulls was lent to the community, the whole transaction being put on a business footing by the careful recording of skulls "in" and "out." Again, in an inland district of Papua, where no man could hope to marry unless he had taken a skull, the officer in charge was able to persuade the tribe that the killing of a wild boar offered at least as good a test of pluck and skill, and so was able to substitute the taking of a boar's head for that of a man (often a woman or child). The Kula, the great trading expedition of the Trobriand Islanders, described by B. Malinowski,[2] is another excellent example of the interlocking of native activities. From the administrator's point of view there are no anti-social features in this complicated system of ceremonial exchange, yet so sympathetic a governor as Sir Hubert Murray states that it will surely be superseded by modern methods—no government, "however sympathetic, can keep it alive." True, modern methods must eventually supersede the Kula, but what attempts are being made to keep it in being, and if it is doomed what ingenuity is being exhibited in the attempt to keep up interest in the competitive garden making and canoe building and racing which play such an important part?

Importance of Ceremonial.—No one doubts the close relationship between social organisation, ceremony, morals, economics and even ethics among ourselves; everyone recognises the psychological value of display, ceremonial and sport; yet in the administration of the backward races this common knowledge is too frequently ignored. What government at home would presume to stop royal processions, the Oxford and Cambridge boat-race or public football matches? Yet the corresponding expressions reproduced by natives in dances, initiation ceremonies and public feasts are frequently suppressed, by the influence either of the administrator or the missionary, long before it is understood whether they are harmful or not. Active teaching is needed, now as much as ever, that the interests of people cannot be cut off with impunity, and the substitution of harmless for anti-social features in savage ritual and institutions is sound social psychotherapy.

Positive Interference.—Frequently new regulations are introduced which undermine the native social structure of which the Europeans had remained entirely in ignorance.

There are tribes in Africa in which chieftainship is unimportant but age classes are well developed. The Govt. found difficulty in dealing with people among whom appeared no vested authority, and administrators appointed "chiefs." The position of these men was anomalous, they had no native prestige, and appeared to be government servants. Later researches brought to light the fact that an efficient form of government had been all but destroyed by the foreign appointment of chiefs. The age grade system, with its elaborate initiation ceremonies, had provided a sound basis for both civil and military organisation: the younger men formed one class, while civil administration was vested in an older grade. The elders complained that they no longer had any authority in the villages, the young men did as they chose, no longer respecting the age-class regulations and taboos, some so obviously useful, as that prohibiting the use of intoxicating liquors to the younger grades. Later in places the system was resuscitated, but much harm had been done; for the authority of the elders had been undermined, the younger generation had lost respect for the elders, and the steady rise in social importance that the age-class system provides had gone.

Kingship.—In other instances trouble has been caused by ignorance of the fact that a chief may belong to that exalted class of beings called by Frazer "Divine Kings," or if not actually of this order be at least of semi-divine nature, and responsible for rain and generally for the prosperity of the land. Here it may be wise to recognise frankly the hierarchical superiority of the priest-king, and to appoint under him an administrative government chief; indeed, besides the priest-king there are often one or more men recognised by the tribe as executive officers in everyday affairs.

Magic.—The administrator cannot ignore magic and sorcery, and it is useless for him to affirm that the British Govt. cannot countenance a belief in sorcery; magic may be a fiction, but the belief in it is a potent reality in all the ruder cultures, and is not extinct in higher cultures. Cases of death alleged to be caused by magic or by poison—the two often being synonymous—are continually brought before administrators, yet rarely is evidence produced against the magician which on the white man's laws of evidence can lead to conviction. In parts of Melanesia it is doubtful whether there is any authentic evidence for the use of poisons by a sorcerer; yet folk undoubtedly die as the result of his machinations; they die from no other ostensible cause, and their death is ascribed to magic. The sorcerer is not convicted, but if the people take the law into their own hands and kill him the Govt. steps in and punishes the slayers, who according to the ideas of their peers have courageously performed a public duty.

Another factor which greatly adds to the difficulty of dealing reasonably and justly with sorcery and witchcraft is that generally speaking the darker races are far more suggestible than ourselves; unfortunately, space is lacking to elaborate this statement or to set out a tithe of the evidence on which it is based.[3] It is small wonder then that many natives believe that the Govt. encourages sorcery; indeed, the relative immunity of the sorcerer from all vengeance in certain instances may actually produce this result.

But as a general plan of treatment, probably an ordinance of the kind in force in Papua is useful, in which it is stated that though there is really no such thing as sorcery yet the practice is so harmful that it is treated as criminal. At any rate, the administrator is not the only person in a dilemma; witness the plaint of one Tata Ko, a well-known sorcerer, to Capt. Barton, then Governor of Papua: "If a man falls sick his family come to me and ask me to make him well. If I don't do something for him they say, 'Tata Ko, the sorcerer, desires to kill our brother,' and they are angry and will perhaps try to kill me. If I do give them something they insist on paying me well for it; should I refuse to take their presents they would not understand it and they would think I was trying to kill their friend, but when I do take what they give me, you arrest me on a charge of sorcery blackmail."[4]

Magicians not Charlatans.—In most instances magicians are not charlatans; though they may impose upon the credulity of their clients they do believe in their own power; they have inherited the gift and perfected their craft by means of hard training. Though legislation may be useful, magic cannot be disposed of by law, for every death except perhaps of the very old is attributed to magic, and it is only when a man has some appreciation of the natural causes of death and the benefits of medicine that he relies less upon magic. Missionaries have long been aware that their best weapon is the hospital; administrators should start clinics shortly after administrative posts, as in the case of the splendidly fitted hospital ship, with its medical officer and orderlies, placed by the Sudan Govt. in 1922 for service on the White Nile and its tributaries.

Social Side of Magic.—Yet, however perfect administration, magic cannot die a sudden death; and this has its advantages, for magic has its social as well as its anti-social side.

White magic will persist, and in Melanesia, for instance, its benefits are well seen in connection with the Kula. In the Trobriand Is. the specialists in magic are experts in the various crafts, in gardening and canoe building, etc., and it is under their auspices that the good traditions of gardening and building are maintained. Though no canoe could sail unless the appropriate magic had been performed at each stage of its construction, good magic would never be used to counteract the effects of bad material or bad workmanship. Thus, the continual magical observances guarantee a careful selection and tests of material, and are an incentive to good work. A successful

[1] *Essays on the Depopulation of Melanesia*, p. 106 (1922).
[2] *Argonauts of the Western Pacific* (1922).
[3] C. G. Seligman, *Anthropology and Psychology, J.R.A.I.* (1924).
[4] C. G. Seligman, *Melanesians of British New Guinea* (1910).

trading expedition is the result of good magic, and, just as magic is the most important regulator of the Kula, so is it of prime importance in garden work. The islanders, like most natives, are notoriously unthrifty, and it is doubtful if any native would cultivate sufficiently for his needs if left to individual responsibility. For man does not live by bread alone, and a garden which will make a fine display and be much talked of appeals to the mass of the population more than the knowledge of a supply against famine.

African Cases.—Again in Africa, where the evil side of magic is so prominent, it also has its beneficial side. Many events bring a curse or *thahu*. The consequences of the *thahu* are severe. Many of the breaches of custom producing *thahu* may seem to us ridiculous or hampering, yet Mr. C. W. Hobley notes that in about one-third of the instances the *thahu* is brought upon the offender, or brought upon a third party, by the intentional act of the offender, who "goes about with the burden of the misdeed on his conscience, and this worries him so much that he gradually gets thin and ill. . . . It therefore ends by his confessing to the elders and begging them to free him from the curse."[1]

Practical Suggestions.—In order to save the backward races from extinction and enable them to adapt to new circumstances two courses seem advisable: (*a*) that all government servants, and others—especially missionaries—coming into direct contact with natives should take as part of their preparatory studies a course in anthropology; (*b*) that every government should appoint trained anthropologists, in order to make detailed investigations and to act, when needed, as advisers to the administration. Each of these plans has its definite sphere of usefulness, and calls for further consideration.

Training–Anthropology.—Apart from a degree in anthropology, which as matters stand at present it is idle to expect more than a small minority to possess, the preparatory course in anthropology may be of two kinds: a six to twelve months' course at one of the universities—actually three academic terms—in which, besides the social anthropology which is of prime importance from the administrative standpoint, a certain amount of technology and physical anthropology will also be taught. If three terms be taken the course will in fact be, or approximate to, that required for a diploma in anthropology. Such a course, if more stress than is sometimes the case be laid upon practical difficulties and details, is no doubt excellent in those few instances in which a man has already a strong, almost a "natural" interest in anthropology; but this plan yields disappointing results when applied as hitherto to men who have had no foreign experience.

Better results appear to be obtained by the plan applied to the preliminary training in native modes of thought of the men selected by the Colonial Office as African civil servants. A course, known as the Tropical African Services Course, gives an intensive training for two six-weekly periods, with a short holiday between them, in law, accounts, tropical products, tropical hygiene and sanitation, ethnology and the principles of African languages. Less than a dozen lectures are given in ethnology, but these have been carefully thought out to show the special characteristics of savage—especially African—thought, and the practical difficulties which the beginner will have to face, the actual syllabus being roughly as follows:—

Some fundamental conceptions; Definitions; Race and Language; Methods; The Classificatory System and Clan Organisation; Awe; *Mana; Taboo;* Magic; The Cult of the Dead, its simple and more complex manifestations; Developments in the Higher Religions; Heroes; Divine Kings and Gods; Animism; Polytheism; Persistence of both beliefs in the higher cultures, and their importance in the more advanced religions; The relation existing between man and animals; Totemism; Animal Cults; The part played by occupation and environment in the expression of religions; Migrations and cultural contacts; The fusion of peoples and the formation of sub-races; Some social and religious complexes.

Experience shows that a certain small number of men will be sufficiently interested to study the tribes they live among and to record their habits and customs, or at least to keep in touch with their teachers.

A further development is for the Colonial Govt. to pay the expenses (fees and sustenance allowance) of men with administrative experience who are keen enough to spend two to four months' leave working intensively at anthropology at one of the universities. Few have so far availed themselves of this plan, yet such are their knowledge and keenness that this scheme is likely to prove of the utmost value both administratively and scientifically, one feature of special importance being that such students have a knowledge of at least some native language, and so are in a position to apply the technical knowledge they have gained directly on their return to Africa.

In France, the *Institut d'Ethnologie* and the *Facultés et Établissements Publics d'Enseignement Supérieur* of the University of Paris provide instruction in the various branches of ethnography and linguistics, having special regard to the French colonies. Instruction is given in the languages of the native populations of the French possessions, Arabic, Berber, the Sudanese languages, Malagasy, as well as the more important languages of the Far East, Siamese, Annamese and Cambodian. The social, family and religious organisation of Islam and the social habits and religious beliefs of the natives of the French colonies are described and compared by a band of experts of European reputation. In Austria, instruction in languages and, to a lesser degree, in ethnology, is given to missionaries at the Missionary College of St. Gabriel, near Vienna.

Professional Anthropologists.—The appointment of professional anthropologists stands on a different footing. No arguments need be employed in favour of their administrative and scientific value. The ordinary official has neither the leisure nor the training, even if he has the desire, to make intensive investigations, and as time goes on and means of communication improve, and his journeys take place increasingly by car, he will have less and less opportunity of meeting his people unofficially and studying them at first hand. A further difficulty that stands in the way of the administrative official is that the native knows that his attitude to many customs such as human sacrifice, cannibalism and black magic must be hostile, and however sympathetic he may be he is still regarded as the man in authority. The anthropologist stays at native villages remote from government headquarters, and, once he has been able to gain the confidence of the people and let them know that his only object is to learn, one of the chief obstacles to obtaining reliable information will be removed. Anthropology as a profession presents a vicious circle. There are few men ready to become government anthropologists, though the machinery for training them exists at our universities. Men are not trained because there are no prospects; and then, when opportunities offer, there are insufficient candidates available. Should it be possible to anticipate a regular demand the men would soon be forthcoming.

Encouragement to anthropological research has been given by the Sudan Govt.; the Gold Coast and Nigeria have appointed as anthropologists officers who had qualified by taking courses in anthropology. There is a trained government anthropologist in Papua, and chairs in Anthropology have been founded in the Union of South Africa and at Sydney, where special training is provided for administrative officers in Papua. Such action shows the trend of enlightened opinion, but the advantages that anthropological knowledge offers are appreciated only in minute proportion in comparison with needs and opportunities. All governments have their experts in geology, botany, agriculture and zoology in its many branches: it is a strange paradox that so often man alone should be unstudied.

Physical Problems.—Turning to the physical side, it may be useful to recall the old saying, "God made the white man, God made the black man, but the devil made the mulatto," if only to consider how far this proverb embodies a truth, and, if it does, how the facts are to be faced in practice. There are broadly two types of racial combination. In the first, the races coming together are so far apart as to make hybridisation a real breaking down of the inherent characters of each, while in the second the fewer differences present offer only a moderate variability as a basis for recombination and selection which may be quite desirable. The latter, socially constituting the "melting pot," is perhaps best represented in history, and can best be appreciated anthropologically by a study of the *Völkerwanderungen*, with the broad result that an outburst of vigour and capacity is found to follow the mixture of peoples belonging to the same great racial groups. From the political standpoint this form of miscegenation has become of increased importance since the opening of the 20th century.

Mixed Marriages.—The proverb is intended to apply to moral values, and before accepting it it is necessary to remember that such children are almost invariably relegated to the inferior race (in practice, the mother's) for their upbringing, and so are

[1] C. W. Hobley, *Bantu Beliefs and Magic*, p. 142 (1922).

socially and morally at a grave disadvantage, except where a sufficient number of mixed unions occur, when a hybrid community, with its own social habits and values, is established, allowing a fair estimate to be formed of the physical and mental qualities of its members.

The Reheboth Community.—The only all-round study of such a community is that of Prof. Eugen Fischer of the Reheboth community of southwest Africa.[1] This consists of the descendants, some 150 in number, through five or more generations, of the hybrid offspring of a group of trek Boers and Hottentot women, and includes the offspring of a number of unions with members of the parent races. The genealogies are not always easy to follow, but the Reheboth bastards show extreme variability, and are divided into "European," "Hottentot" and "Intermediate" groups. They are a strong, healthy and fruitful people, taller than either parent race, *i. e.*, they show a common indication of hybrid vigour. There is no predominance of heritage from either race, but the inheritance of facial characters and colour is described as alternate, and in spite of the three groups there is no special tendency for the inheritance of groups of characters the unit elements of which are combined in either parent race.

Psychologically the most important observation is that the Hottentot mentality predominates; there is neither European energy nor steadfastness of will. Further, though several subjects show a fairly high degree of intelligence, the Bastards live entirely in the present; they are typically *Augenblickmenschen*, while this character is not compensated by any special power of imagination or in the arts and crafts, in which they are distinctly weak.

Other Groups.—As instances of other hybrid groups, with their own adequate social organisation, certain Arab tribes of the Sudan carrying much black blood, the mixed European-Chinese population of the Straits Settlements, and the negro-Amerind hybrid population of Guiana may be added. Owing to lack of precise knowledge of the building up of these groups little of importance can be said on the physical side, for terms having no precise connotation are used; *e.g.*, it is obvious that there is a vast difference genetically and socially between the tall dolichocephalic Dinka and the short mesaticephals of the Bahr-el-Ghazal, though both would be classed as "negroes" by Arabs and Europeans; while with regard to the Arab stocks there can be no certainty whether any particular strain carries Armenoid blood. All that can be said at present is that the members of these tribes appear to have adapted themselves admirably to their mode of life, which is predominantly Arab, socially, economically and religiously, and that the majority of individuals appear to present an intermediate type with regard to two of the most easily observed characters, namely skin colour and breadth of nose, though striking individual variations occur, *e.g.*, a "black" skin may be associated with a face and nose almost typically Caucasian. Further, darkness of skin tends to be predominant, and there are certain families in which this tendency is so marked that it would perhaps be fair to speak of these as exhibiting dominance in the true Mendelian sense. Mentally and morally these tribes are Arab, not negro; thus socially and morally the inferior stock may be said to have been improved by the mixture. How far the Arab has suffered must remain an open question, and whether the improvement may not be in part due to the direct influence of Islam. It is at least worth noting that the reconquest of the Sudan demonstrated the truth of an observation made years before in Arabia by Robertson Smith, namely that not the pure Arab but the mixed Arab-negro population exhibits the quality of religious fanaticism.

In both the other two examples quoted, whatever the physical differences between the races concerned, they stand on equal or more nearly equal level. The mental and physical alertness of the mixed Chinese-White population of Singapore is striking, and they form a definite social class furnishing many highly efficient civil servants and clerks. Generally, Mongolian traits of feature predominated, and it appeared that the Mongolian eye, at least in the F.1. generation, was dominant, as it was in Malay-Melanesian matings observed in New Guinea. It may indeed be found that Mongolian-White matings give particularly interesting, and perhaps desirable, combinations. In one Japanese-White marriage the children (all female) exhibited a high degree of hybrid vigour, considerable artistic ability, and in type approximated to Polynesian; unfortunately, they passed out of observation before maturity, and it can be stated as a matter of experience that five other children, the result of two Japanese-White matings, did not reproduce this type.

With regard to the negro-Amerind mixture of Guiana, there seems no doubt that a definite type has been produced which has largely taken to a special mode of life as boatmen on the rivers, for which it is well fitted, and that this hybrid population exhibits much of the physical efficiency of the negro without his laziness and excitability. For books on the subject see the Bibliography to the article ANTHROPOLOGY and the works quoted in the text. (C. G. S.)

[1] *Die Reheboth Bastards und das Bastardierungsproblem beim Menschen* (Jena, 1913).

ANTIMONY (*see* 2.127).—Normally, the world's consumption of this metal is not large, and in pre-War years was almost entirely met by the production of a few countries, principally Borneo, France, Austria-Hungary, Asia Minor and, since 1900, China. By the terms of the Peace Treaty of 1919, the larger part of the Austro-Hungarian ore-producing areas was included within the territory of Czechoslovakia, which in 1921 attained an output of 1,573 tons. During the War, belligerent governments became large buyers of the metal for ammunition purposes, principally for the manufacture of shrapnel bullets. The greatest production was reached in 1916, since when there has been a steady decline. The following table compares the production of antimony ore in the principal countries during the years 1913, 1918 and 1923.

Metric Tons

	1913	1918	1923
British Empire			
Australia	1,270	779	518
Other parts	26	55	..
Other Countries			
Austria-Hungary	1,878	..	78
France	4,472	1,650	543
Italy	360	404	660
Asia Minor	240	400	400
China	13,032	18,112	16,383
Mexico	2,340	3,269	482

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ANTIOCH COLLEGE.—Antioch College, an institution of higher education at Yellow Springs, Ohio, is governed by a board of 20 trustees, the president of the college being *ex officio* president of the board. As reorganised in 1921, with Arthur E. Morgan as president, Antioch entered upon a distinctive career that has attracted widespread attention both on the part of the general public and of educationalists. The enrolment is limited to about 600. The course for undergraduates commonly requires five or six years, and leads to the B. S. or A. B. degree. In choosing students, consideration is given to reports on required physical examinations, secondary school records, intelligence tests, life sketches by the applicants and reports of references. The traditional dominant purpose of the American College is the "stimulation and development of those gifts of intellect with which nature has endowed the student." Antioch has endeavoured to restate the proper purpose of the college. According to its philosophy, that purpose is nothing less than the integration of life and its symmetrical development.

In America the college, including the technical school, is becoming recognised as the chief and almost the only ordered means for preparing intelligent young people for life. Students should be concerned, not with scholarship or technical skill alone, but with learning what life means, and how to make the most of it. Antioch holds that there is no single faculty, not even intelligence, which is the chief element of human excellence, or which chiefly needs systematic development. Excellence lies in symmetry, in the development of every part of personality in proper relation and proportion to every other part. Every element necessary to a well-proportioned life should have recognition in a college programme; not simply those which traditionally have been associated with formal education. Specialisation must take its due place as a normal concern of education, but not as the chief concern. Antioch undertakes to make an appraisal of personality and of life, and to determine

what programmes will best stimulate and develop all the gifts of personality, always being controlled by a sense of relative values.

The work of the college falls under four main heads; required physical education, a required liberal curriculum, technical or professional training, and part-time practical economic work. Physical education includes periodic physical examinations, necessary corrective exercises, athletics for everyone and a course in personal and social hygiene. Required liberal studies aim to introduce students to all major fields of human interest, rather than to a few special interests, and to be the medium by which significant gains of human knowledge and outlook become the common property of educated men and women. These required courses include two years of English and literature; five years of history, economics and government; one year each of mathematics, chemistry, physics, biology, earth science (a combination of physiography, geology and astronomy); psychology; and a study of scientific method. A year of philosophy is required; and a year of "applied aesthetics," this last an effort to stimulate a sense of beauty, and to direct its application to everyday affairs. "Personal Finance" teaches the rudiments of personal financial management.

These subjects require about half the total classroom time for six years. Elective courses provide advanced work for qualified students. "Autonomous courses," similar to undergraduate seminars, are open to students of proved ability, who pursue advanced work with minimum supervision. There are no required courses in religion. The temper of the institution as a whole reflects the controlling desire to understand the significance of life and to guide conduct by that understanding. Free, critical inquiry is encouraged. All students must take the liberal courses.

Technical and professional courses prepare for business, engineering, scientific research, education, journalism and home and institutional management. They aim at mastery of fundamental principles rather than specialised application. Nearly all occupational programmes include courses in administration and management. The first two years are exploratory, the required liberal work dominating, while the students consider possible vocations. Gradually the occupational lines are defined, first in general, and then in specific callings.

To develop traits not easily reached by classroom work, such as initiative, self-reliance, responsibility, courage and adaptability, and to help practical adjustment to life, both men and women students spend half their time at college and half in practical economic occupations, in alternate five-week shifts. Each working position is continuously filled, one student working while his or her alternate studies. These "co-operative" students work over a radius of 1,000 m., with 150 employers, in a wide variety of callings; the positions being chosen because of their educational value to the particular students. Self-support is incidental, but the students to a large degree themselves meet college expenses. The work develops stamina, helps students recognise and prepare for appropriate callings, acquaints them with practical life, and helps them appreciate professional studies. The alternation allows more intense application to college work, since the students do not grow stale from unrelieved application to books. The "personnel department" furnishes vocational counsel, locates positions, visits students at work, and helps them realise its educational value. Credit toward the degree is given for suitable practical accomplishment. (A. E. Mo.)

ANTISEPTICS (*see* 2.146).—During recent years the study of antiseptics has gone mainly along two lines—to produce more efficient antiseptics for use in the ordinary way by external application, and to elaborate chemical substances which can be injected into the circulation and destroy the infecting microbes. At the same time many studies have been made on the natural antiseptics by which the body rids itself of infection.

Natural Antiseptics.—These exist in greater or less degree in almost every cell of the human body, as well as in most of the secretions. Metchnikoff showed that some cells (phagocytes), and especially the white corpuscles of the blood, could ingest and digest microbes, and Wright discovered that this ingestion or phagocytosis only took place after the microbes had been acted on by the blood fluids. The blood fluids also have a considerable power of destroying or restraining the growth of many pathogenic bacteria (*see* IMMUNITY). Fleming showed in 1922 that the cells and secretions of the human body have a remarkable antiseptic power toward certain microbes by virtue of their containing a ferment which has been called "Lysozyme." Of all the secretions the tears are the richest in this ferment, and it has been shown that human tears, even when diluted six million times, have a markedly destructive action on some of the microbes found in the air—obviously a natural means of protection against infection.

Chemical Antiseptics.—Research has been directed to the action of these on the natural defences of the body, and the body cells are, in general, found to be much more susceptible to the action of these chemicals than are bacteria. If an ordinary chemical antiseptic, *e.g.*, carbolic acid is added to blood infected with staphylococci or streptococci (the ordinary microbes of suppuration), the blood itself has such a power of killing these microbes that with a moderate implantation some 95 to 99% are destroyed; but when the concentration of carbolic acid in the blood reaches 1 in 600 the whole of the natural antiseptic power of the blood is lost and every microbe implanted survives and multiplies. Of course, more concentrated solutions of the chemical will, in addition to killing the blood cells, inhibit or destroy the bacteria and so exert an antiseptic action, but this is only manifest after the natural defences against infection have been destroyed.

Chemotherapy.—The ideal method of using an antiseptic for the treatment of a bacterial infection is to introduce it into the circulation so that it reaches every portion of the infected focus and destroys the microbes. For ordinary bacterial infections this ideal has not yet been attained, but remarkable advances have been made in this direction in certain infections. In 1910 Ehrlich prepared an organic arsenical product which when injected into the body, rapidly destroyed the microbe of syphilis, and this product, salvarsan, together with the more recently introduced substances of similar constitution, has revolutionised the treatment of this disease (*see* VENEREAL DISEASES). Following Ehrlich, Morgenroth prepared a quinine derivative (Optochin) which had a remarkable affinity for the pneumococcus (the microbe which causes pneumonia), while it had little action on other microbes; but unfortunately this substance had certain toxic qualities which rendered it unsuitable in practice. In some other infections, also, drugs have been found which can destroy the infecting agent without exercising any serious toxic action on the human body; notable among these are Emetine in amoebic dysentery (*see* DYSENTERY), and "Bayer 205" in sleeping sickness. The fact that drugs can be prepared which have a very specific action on one microbe offers some hope that in the near future there will be produced chemicals which will destroy the ordinary disease-producing bacteria without damaging the tissues, and so furnish an easy and certain remedy for the common infections.

Chemical Antiseptics and Wounds.—Prior to the World War the use of antiseptics in surgery had been largely discarded in favour of aseptic methods which aimed at preventing the access of microbes to the wound. During the War, however, it was found that all the wounds were infected with septic microbes, and many antiseptic methods were employed in the hope of destroying these microbes. Briefly, the results obtained were these: none of the antiseptics was able rapidly to sterilise a wound; most of them were without any evident effect on the bacterial infection; those which have appeared to have some influence on the course of the infection had, in addition to their "antiseptic" action on the bacteria, a stimulant effect on the infected tissues, and this probably contributed largely to their success. The popular pre-War antiseptics, such as carbolic acid, iodine and the salts of mercury, were found to be without effect on the progress of an infection, although outside the body, these are powerful bactericidal agents.

Chlorine derivatives obtained great popularity in the form of eusol (hypochlorous acid), sodium hypochlorite (Dakin's fluid)

or chloramine-T, a more complicated organic derivative, and this type of antiseptic is still in common use under various trade names. Some of the aniline dyes also are used as antiseptics, and outside the body these are probably the most powerful of all the chemical bactericidal agents. Gentian violet, brilliant green and acriflavine have been largely used, but in all these cases the action on the bacteria is slow and the dyes are rapidly absorbed by the tissues and dressings of the wound. Acriflavine differs from almost all other antiseptics in that it has a more powerful action in blood serum than it has in water, and it was hoped from this that it would prove very effective in killing bacteria embedded in the tissues; this hope, however, has not been fulfilled, although the dye still obtains some popularity in the treatment of certain infections.

Another method of using an antiseptic is to fill the wound with an almost insoluble substance which slowly gives off an antiseptic substance. A good example of this is iodoform, and although this in itself has no power of killing microbes it slowly breaks down in contact with the body fluids and liberates small quantities of iodine, to which the antiseptic action of the iodoform is attributed. This substance, iodoform, used to be very popular in the treatment of septic infections, but it possesses a very penetrating odour and has been largely given up on this account. In addition to its direct antiseptic action, it possesses, in common with some of the chlorine antiseptics, the power of inducing a large flow of lymph from the wound and so aiding the natural defensive mechanism of the body.

Sterilisation.—While antiseptics have not been very successful in killing bacteria in infected tissues in the body, they are invaluable in sterilising apparatus, instruments and infected matter of many kinds outside the body. An infected water supply can be efficiently and economically sterilised by the use of a small quantity of chlorine (*see* WATER, PURIFICATION OF); the infective excreta from cases of typhoid fever and similar diseases can be rendered harmless by treating them with carbolic acid or other similar antiseptic; catgut for use in surgical operations can only be sterilised by the use of chemical antiseptics, and there are innumerable other ways in which these chemicals fulfil their function of destroying bacteria.

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ANTWERP (*see* 2.155) had an estimated population in 1923 of 300,000. The decision taken in 1878 to change it from a fortress to a fortified position by the construction of an outer line of forts at a distance of from 5 to 11 m. from the city had been to a great extent carried out by Aug. 1914, though no one of the 17 forts involved in the scheme had been completed. The Belgian Govt. left Brussels for Antwerp on Aug. 17 1914; and three days later the Belgian Army, retiring before Von Beseler's forces, took up a position behind the fortified lines. The bombardment began on Sept. 28 and on Oct. 9 the city surrendered. By that date only about a tenth of the population remained in the city. The damage included the destruction of some 300 houses, mostly in the Marché-aux-Souliers, the Avenue d'Amérique and the suburbs near the forts. On Nov. 19 1918 the King and Queen of the Belgians entered the city in state.

Restoration Work.—After the German evacuation in 1918 the restoration of the city proceeded rapidly. The Zoological Gardens were restocked, various new streets were laid out, a large railway station was built and at the end of 1925 work was begun on a great boulevard to Brussels. More important, however, are the extensions and improvements in the harbour works undertaken after the World War. They include the construction of a canal dock over three miles long which stretches from the old wet dock No. 3 to the bend of the Scheldt at Kruisschans, where it ends in a maritime lock approximately 886 ft. long and 115 ft. wide, with a depth ranging from 33 to 48 ft. The dock itself is maintained at a constant depth of about 39 ft., and is connected with the other docks in the harbour by a channel about 440 yd. long and 110 yd. wide. It was estimated that the lock would be completed by the end of 1926. Further schemes of extension included the construction of wet docks adjoining the canal dock and in 1925 the building of two wet and three dry docks was undertaken. The complete plan was designed to give the port a total dock water area of 1,334 ac. and a quayage length of 28 miles. The necessary railway extensions bring the length of the port railway system up to 500 miles.

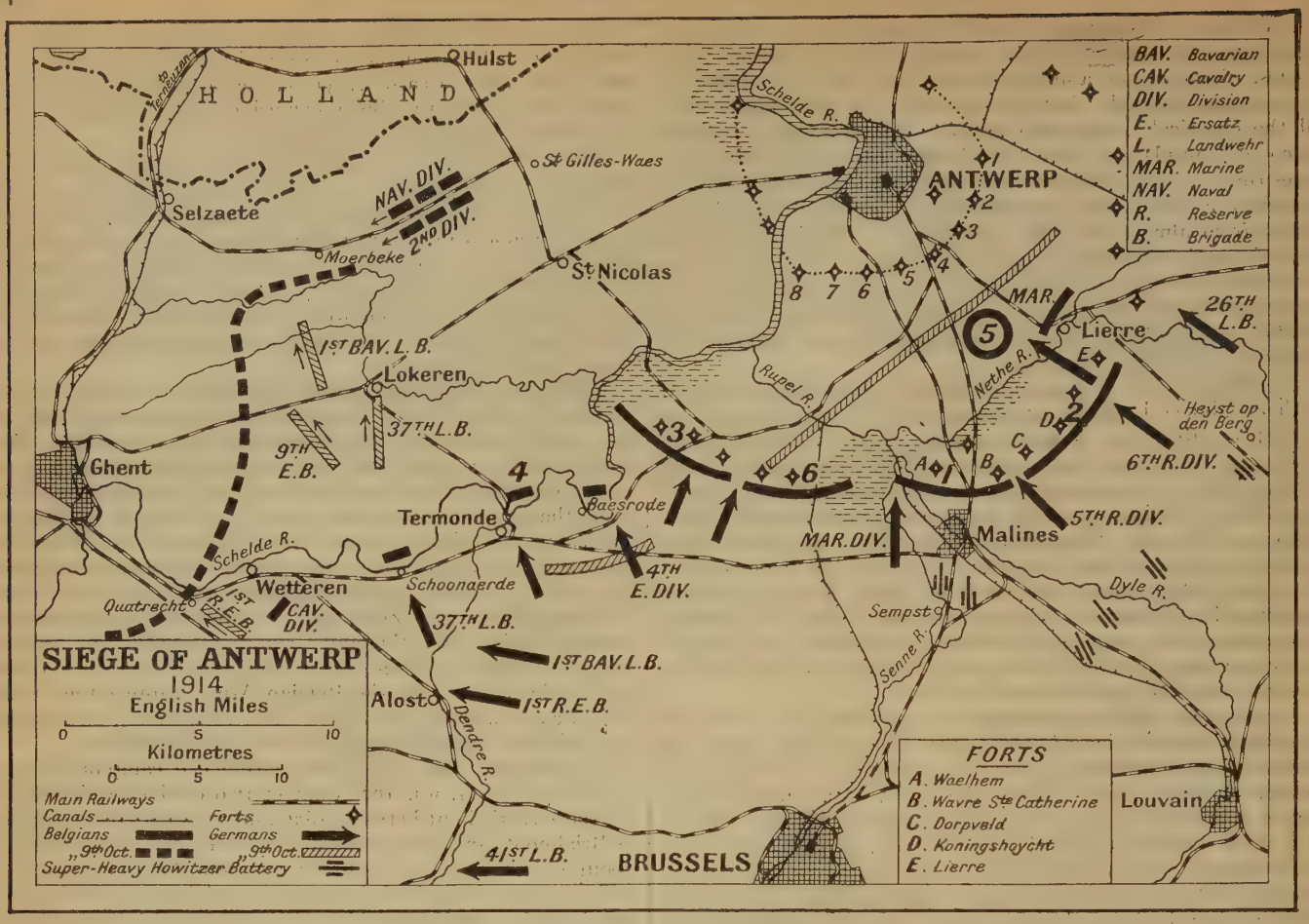
During the German occupation Antwerp remained to all intents and purposes a dead city. From the close of 1918 onwards its trade and industry showed a steady revival, and in 1924 the tonnage of shipping using the port was 17,496,900. The construction of river boats for export to Africa was resumed after the War, and this industry rapidly returned to something approaching its former importance. Shipbuilding proper showed little sign of prosperity, although a good deal of ship repairing was attracted to the port.

ANTWERP, SIEGE OF.—After the Meuse the natural line of defence for the Belgian Army against an adversary from the east is the Schelde and the entrenched camp of Antwerp. As a commercial metropolis Antwerp was an obvious centre for arsenals, hospitals and stores of munitions and provisions, and it became the army's base of operations. By reason of its situation the fortress was also a refuge, if only a temporary one; it was also an excellent flank position for use against the lines of communication of the German Armies operating in the north of France. Through Ostend and Zeebrugge, Antwerp had easy means of communication with England. Under the shelter of Antwerp and the Schelde, British troops could safely land in Flanders, operate in liaison with the Belgian Army, protect the Pas-de-Calais coast with its sea traffic, vital to England, and prevent the Allied left wing from being turned and enveloped.

The Defences Described.—The entrenched camp of Antwerp, as it was in 1914, was the result of two distinct undertakings, (1) those carried out between 1859 and 1870 under the direction of Brialmont, and comprising a line of detached forts placed at about a distance of two to three miles from the agglomeration of buildings and built both in masonry and in earth, and a polygonal enceinte on the outskirts of the city; and (2) those undertaken after 1906, which provided a principal line of defence, composed of 17 forts about 3 m. apart, with permanent redoubts in the intervals. The forts were placed at a distance of 5 to 11 m. from the city proper and were armed with one or two cupolas for twin 15-cm. guns, two cupolas for single 12-cm. howitzers and four or six cupolas for single 7·5-cm. guns. The redoubts had only one 7·5-cm. cupola. Forts and redoubts were constructed entirely of ordinary concrete, with vaults 2·50 metres thick at the crown and surrounded by wet ditches, 33 ft. wide. The old fort line was about to be transformed into an *enceinte de sûreté*, the forts being organised for small weapons and connected by concrete redoubts and a grille.

These extensive works had necessarily to be spread over several years and on the outbreak of hostilities in 1914, not one of the forts planned in 1906 was completed. Some lacked cupolas; others had cupolas without concrete aprons, and these had to be improvised by pouring gravel, iron rods and cement, in some cases sacks of cement soaked with water, or even simple sandbags, round the cupolas. Communications and drainage were not established either inside or outside the forts, neither was the machinery in place. No equipment for fire observation and no observation posts existed and the necessary survey work for firing by the map was incomplete. The substructures and the armouring, constructed to resist the 21-cm. mortar, were not calculated to face 30·5- or 42-cm. projectiles. The total perimeter was 60 m. of which 6 m. were protected by inundations. The defence force numbered only 40,000 men, most of whom had seen no military service for 10 years. The staff was entirely inadequate for the duties.

Operations Begin.—The retreat of the Belgian Army behind the Nethe on Aug. 20 was only temporary. When the German I. Army wheeled through and past Brussels on its way to France, it dropped the III. Res. Corps under Von Beseler, and three Landwehr brigades, to face northward as a flankguard against the Belgian Field Army in Antwerp. Von Beseler took up his position on the line Grimberghen-over-de-Vaert-Aerschot. On



Aug. 25 and again on Sept. 9 the Belgians, in co-operation with the Allied attacks on the frontiers and the Marne, made sorties from Antwerp and attacked his lines. On the second of these occasions his situation was at one time critical. A third sortie was being prepared toward Sept. 20, when reports began to come in of important German movements and of a quantity of very heavy artillery on the roads in the region north of Brussels. Falkenhayn, acting as chief of the general staff, had given the order to carry the fortress and the powerful *matériel*, which had laid in ruins the forts of Liège, Namur and Maubeuge, was being established in position between the Senne and the Grande Nethe, from Sempst to Heyst. The total artillery strength of the Germans before Antwerp was 186 pieces of field artillery, 48 long guns of 10, 13 and 15 cm., 120 howitzers of 15 and 21 cm. and 13 super-heavy howitzers of 30·5 and 42 cm.

Von Beseler's army group comprised at that time the 37th Landwehr Bde. between Alost and Termonde, where it had served in flank guard since Sept. 14; the 4th Res. Div. between Termonde and the Willebroeck Canal; the Marine Div. between this canal and the Dyle about Malines; the III. Res. Corps from the Dyle to the Antwerp-Aerschot railway and the 26th Landwehr Bde. north of Aerschot, with a group furnished by the III. Res. Corps further to the right front at Westerloo.

On Sept. 27 the Belgian Field Army was distributed as follows: The 1st and 2nd Divs., between the Senne and the Nethe, from Willebroeck to Lierre, with the 5th Div. in reserve north of the Nethe; the 6th and 3rd Divs. between the Senne and the Schelde; the 4th Div. at Termonde and the Cavalry Div. about Alost–Wetteren to cover the communications between Antwerp and the sea.

The German Bombardment.—On the morning of the 28th the German bombardment was let loose along the whole front between Termonde and Lierre. It at once became clear that the attack was being concentrated on the south front of the fortress. Von Beseler had not the necessary forces to prosecute a siege on another side while still covering the communications through Brussels against a sortie. Trusting in the proved powers of his weapons of attack which, installed beyond the range of the Belgian gun, could fire as deliberately as on an experimental range, he decided to spare his infantry, to destroy the forts and throw into confusion the lines of defence by gunfire, controlled by aircraft. The results attained, he proposed cautiously to advance his infantry and gain a footing in the shattered forts and pulverised lines of defence.

The bombardment was continued for four days with clocklike regularity. It was directed against four forts (Waelhem, Wavre Ste. Catherine, Koningshoycht and Lierre) and the spaces between them. The concrete was inferior in quality to that of Liège and Namur, and galleries were pierced, men's quarters destroyed, cupolas destroyed, jammed or made inaccessible; powder magazines blew up, fires broke out and the air in the shelters became unbreathable. Forts and trenches had been reduced to rubbish heaps by the time that the enemy, on Oct. 1 at 5 P.M., delivered his assault. Resistance was offered everywhere except at Wavre Ste. Catherine, where the garrison had been driven away by the flames.

The bombardment recommenced on Oct. 2, increasing in precision, and the inevitable happened. The Dorpveld redoubt and Fort Waelhem, which had been reduced to the last extremity, now surrendered. The Tallaert redoubt blew up; the Koningshoycht and Lierre forts, which had been ruined, were evacuated. On the night of Oct. 2–3, and on Oct. 4, all the defence troops were transferred to the north of the Nethe from Waelhem to Lierre. The Belgian troops now began to be seriously disheartened. For a fortnight past the race to the sea had been in progress in France, the battle front had reached Arras and Béthune and fresh German masses were traversing Belgium in a westerly direction. The question was, would the Allies win the race in time to join hands with the Belgians on the Schelde? This junction was essential, even if it entailed the abandonment of the fortress. The King was strongly in favour of holding the fortress until the last extremity, in order to keep occupied the German

troops and material now concentrated before it, and also to gain time for the formation of a Franco-British-Belgian front on the Dendre or on the Schelde, leaning on the Dutch frontier.

Assistance from Britain.—Mr. Winston Churchill, at that time First Lord of the Admiralty, fully realised the rôle of the fortress as the bulwark of the Pas-de-Calais. When he heard that the Belgian Govt. was to leave the city he came to take stock of the situation. The King informed him personally of the task he proposed for the Belgian Army on the extreme left of the Allies. Entirely in agreement, Mr. Churchill returned to London to push forward the dispatch of English and French reinforcements to Antwerp and, above all, to Ghent.

The immediate result of Mr. Churchill's intervention was the arrival at Antwerp on the evening of Oct. 3 of a brigade of 2,000 men of the British Royal Naval Division. The appearance of these, the first Allies the Belgian soldiers had set eyes on during the two months of the War, roused enthusiasm, but unfortunately this assistance could be no more than a moral stimulus. Meantime, Von Beseler was bringing up his heavy batteries to crush Fort Kessel, while his infantry was making its way slowly into Lierre, being held up on the northern boundary of that town by the fire of the marine brigade on the fifth. To the south of the town four German battalions crossed the Nethe under cover of the bombardment and on the night of Oct. 5–6 the 5th Belgian Div. attempted to push them back into the river.

This counter-attack, with bayonets fixed and unloaded rifles, reached the Nethe at one point and caused the enemy serious alarm for a moment, but the fatigue of the attacking troops and the superiority of the German artillery rendered any permanent success impossible. In the course of the day (Oct. 6) the remainder of the 1st, 2nd and 5th Divs. and the British Marine Bde. fell back to the line Contich–Bouchot. Meantime, along the Schelde, the enemy was becoming more and more agressive at Baesrode, Termonde and Schoonaerde, where the 6,000 men of the 4th Div. lay extended on a front of 18 miles. In the region of Lille the enemy's right wing was only 30 m. from the sea, whereas the distance from the Nethe to Nieuport was 85 miles. It was essential to save the Belgian Army from being surrounded, and the King decided that the field troops should cross the Schelde on the night of Oct. 6–7 and march to join the British 7th and 3rd Cavalry Divs. then landing at Zeebrugge and Ostend, which were to move to Ghent in conjunction with a brigade of French marines. The decision came just in time, for on Oct. 7 the Germans forced the Schelde at Schoonaerde and pushed on toward Lokeren.

The City Abandoned.—The continuation of the defence was entrusted to Gen. Deguise with the garrison troops, the 2nd Div. and the British Naval Div. which had been brought up to 10,000 men. The general placed these two divisions on the line of forts 1 to 8, where throughout the days of the 7th and 8th they stoically endured the usual bombardment. An attempt to intimidate the governor by the bombardment of the city had no effect. The departure of the field army, on the other hand, did affect the morale of the population and the fortress troops. The British Admiralty did not want the Naval Div. to be surrounded and telephoned for it to be withdrawn, whereupon Deguise decided to withdraw the 2nd Div. also, to abandon the city and to continue the defence on the left bank. But the fortress troops had now reached the limit of their endurance and the general, knowing the Germans to be near Lokeren, authorised officers and units to leave the fortress and rejoin the field army. Meanwhile the civil authorities, seeing the city empty of troops and threatened with destruction by the fires which had been started by the bombardment, sent a deputation to Von Beseler to save the city from a disaster which could have no military advantage. The fortress was empty, the works out of action; on Oct. 10 the governor signed the capitulation. (*See* BELGIUM, INVASION OF.)

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AOSTA, EMANUELE FILIBERTO, DUKE OF (1869–), Italian general, was born Jan. 13 1869, the eldest son of Prince Amedeo of Savoy, Duke of Aosta (*see* 1.804), and thus a cousin of Victor Emmanuel III. He adopted a military career, but this was interrupted by a serious illness and when the World War broke out he was on the retired list. Later, however, he was appointed to the command of the III. Army. After the War the rumour of the possibility of his being proclaimed king in place of Victor Emmanuel III., owing to the latter's reluctance to adopt Fascism in its entirety, gained a certain amount of credence in foreign circles.

APARTMENTS: *see* ARCHITECTURE.

APPENDICITIS (*see* 2.217).—Experience during the period 1910–26 has shown quite definitely the extent to which inflammation of the appendix is prevalent.

Many valuable lives are needlessly lost from appendicitis every year, chiefly due to ignorance and delay in diagnosis and treatment. The significance of abdominal pain, especially in children, is not sufficiently recognised by the public. Time is wasted on purgatives and sedatives, both of which do much harm, for the former precipitate perforation and hasten the spread of the disease; and the latter, by relieving pain, mask the symptoms and often lead to fatal delay in treatment. No one can tell whether an attack is going to subside under medical treatment or proceed with great rapidity to a fatal issue. The risk of immediate operation is practically negligible, whereas that of waiting is great and uncertain. The experience of surgeons all over the world shows that there is practically no mortality from operations for appendicitis undertaken within 12 or even 24 hours of the onset of the attack, whereas the death-rate for operations delayed until the third or fourth day is about 10%.

When the inflammation is limited to the appendix there is little risk in operation, but the complications of the disease are very grave. Fortunately they take time to develop and therefore can be avoided by operating sufficiently early. There are many different degrees of appendicitis such as: (1) *appendical colic*, due to intermittent obstruction of the appendix and usually associated with no signs of inflammation, such as fever: (2) *acute appendicitis*, which varies in degree from the mildest inflammation to gangrene or mortification with perforation of the appendix, causing local or generalised peritonitis: (3) *chronic appendicitis* or "*appendix dyspepsia*." Here chronic inflammation of the appendix leads to irregular spasm and flatulent distension of the stomach and intestine with nausea and vomiting, a condition often mistaken for gastric or duodenal ulcer.

Symptoms.—The most important symptom of acute appendicitis is the sudden onset of severe pain in the middle of the abdomen, settling later in the right flank, above the groin. Here a medical man, who should be called at once, will find superficial and deep tenderness and rigidity and fixation of the abdominal wall, the significance of which is unmistakable. When the appendix is misplaced, so are the local signs. The pulse and temperature usually rise, but unfortunately they may sometimes remain normal, or suddenly fall below it, in grave cases. A falling temperature and a rising pulse are of the greatest significance. Other symptoms are nausea and vomiting, a flushed face and furred tongue; a rigor is not uncommon. Instead of constipation there may be diarrhoea and irritability of the bladder from spread of the inflammation. Either local or general swelling of the abdomen is usual in late cases and sometimes an abscess may point and even discharge on the skin or into the bowel.

Diagnosis.—This depends chiefly upon the detection of local tenderness and rigidity in the right flank and the presence of fever and a quickening pulse; indiscretions of diet, although they may cause vomiting, do not give rise to these signs.

Palliative Treatment.—When symptoms suggestive of acute appendicitis develop it is of vital importance to put the patient to bed and give him nothing but water until the diagnosis has been made and an operation can be performed. When, for some reason, an operation cannot be performed, complete rest and careful diet must be continued until the attack has subsided.

Only liquids are given by the mouth, and purgatives and sedatives are entirely avoided; but local sedatives, such as moderate heat, may be applied to the abdomen.

Operation.—It is a common mistake that the patient needs elaborate preparation for an operation for appendicitis, but fortunately this is not the case, and the rapid progress of an acute attack will not allow of it.

A valvular incision, which should leave no weakness of the abdominal wall, is made over the site of the appendix; the latter is removed and the wound completely closed except in late cases, when abscess or peritonitis has developed, in which temporary drainage may be necessary. In very late grave cases with abscess formation, the surgeon has sometimes to be content with mere drainage, deferring the removal of the appendix to a later date. Appendicitis usually recurs with increasing frequency and severity, therefore it is generally agreed that when an attack has subsided it is wise to remove the appendix soon, in a quiet interval, in order to prevent the recurrence of a grave or fatal attack. It is, however, a foolish policy to defer operation when an opportunity offers of having it performed early in an attack, for under medical treatment or deferred surgical treatment the mortality is about 10%, whereas the risk of early operation is certainly under 0·5%.

See W. H. Battle and E. N. Corner, *The Surgery of the Diseases of the Vermiform Appendix* (1911). (R. P. R.)

APPONYI, ALBERT, Count (1846–), Hungarian statesman (*see* 2.226), was from 1906–10 Minister of Education in the Wekerle Cabinet. He succeeded Kossuth as president of the party of Hungarian Independence, and advocated universal suffrage. At the outbreak of the World War he adopted the standpoint of a " truce of God " with regard to all internal dissensions. He retired into private life after the outbreak of the revolution of Oct. 1918. In 1919 he was elected as a non-party deputy to the National Assembly and was head of the Hungarian peace delegation in Paris. He became a member of the League of Nations Union and in 1924 and 1925 represented Hungary at the Assemblies of the League of Nations. He stands above rather than outside party politics, and his authority as the " Grand Old Man " of the nation carries unusual moral weight.

His published works include *Recollections of a Statesman* (1912); " Die rechtliche Natur der Beziehungen zwischen Österreich und Ungarn " in the *Osterreichische Rundschau* (vol. 28); in Hungarian: *My Memoirs: 50 years*, vol. 1; *Youth, 25 years in Opposition* (1922). Two volumes of parliamentary speeches have also been published relating to the 25 years' activity mentioned in the first volume of the Memoirs.

APPRENTICESHIP (*see* 2.228).—In Great Britain the gradual decline of apprenticeship, which had become apparent in the early part of the century and was due mainly to the increasing use of automatic and semi-automatic machinery, was accelerated during the War. All available boy and girl labour was employed on the mass production of munitions of war, and in many of the skilled occupations the recruitment of boys and girls as apprentices practically ceased, while the training of boys who had become apprentices was cut short by military service or prejudiced by the fact that skilled journeymen, working under great pressure, had no time to instruct.

Reconstruction Scheme.—The consequent shortage of apprentices might have been accentuated by the loss of those apprentices whose training had been interrupted by military service had it not been for the interrupted apprenticeships scheme, under which the Ministry of Labour paid to the employer a grant of one-third of the journeyman's weekly rate to enable the apprentice to receive, during a reduced period of renewed apprenticeship, approximately the wage which he would have been earning if he had been continuously employed. The co-operation of organisations of employers and workpeople was secured and appropriate schemes were issued for each industry. Thus some 45,000 apprentices, who might otherwise have drifted into unskilled or semi-skilled employment or have remained unemployed, completed their training and qualified as journeymen, while it is estimated that an equal number of apprentices was re-absorbed under schemes similar to the government scheme but not assisted by a government grant.

Post-War Difficulties.—Since the War the recruitment of apprentices has been handicapped by trade depression. Many employers have been reluctant to engage apprentices when it has not been certain that there would be work on which to train them or when for economic reasons it was essential that the whole time of the skilled worker should be spent on productive work. On the other hand, boys have been deterred from binding themselves as apprentices by the marked rise of wages of the " sheltered " semi-skilled or unskilled worker, who might be receiving as much or more than the unsheltered skilled worker; by the high rate of unemployment in certain of the skilled trades; by the inability of his parents to support him on the low wages usually paid during the early years of apprenticeship; or by the urgent need in the home for the high immediate wage which can frequently be obtained in comparatively unskilled occupations which offer no " prospects."

Industrial Organisations.—The possibility of a shortage of skilled workers due to a decline in the number of apprentices has not been overlooked by employers' and workers' organisations and such joint industrial bodies as Joint Industrial Councils. Certain of the more important industries are taking steps to augment the supply of apprentices, while special schemes for the training and employment of apprentices have been prepared by a number of joint industrial bodies. A definite attempt to increase the number of apprentices in the building industry in connection with housing schemes has been made by the National Building Industry Committee, a joint body which works in co-operation with the Ministry of Health.

New Conditions and Problems.—It is difficult to forecast the future of apprenticeship in Great Britain. The increasing use of " mass production " methods of manufacture will, no doubt, reduce the proportion of skilled men required, but the skilled men who are employed when such methods are used must be highly trained, and in most industries the view is held that this training can best be given under a system of apprenticeship.

There is a tendency in certain industries, however, to provide for the recruitment of skilled workers by a carefully regulated system of " up-grading " selected semi-skilled workers instead of by a system of apprenticeship. Possibly in the future the two systems will be found side by side. But the following important industries still look to apprenticeship to supply most of their future skilled workers:—Printing and bookbinding, engineering and ironfounding, shipbuilding, building, furniture, electrical contracting, vehicle building, gold, silver and jewelry manufacture, hand-sewn boot and shoe making and repairing, surgical and optical instrument making, heating and domestic engineering, dress and mantle making, millinery and the manufacture of women's dress generally.

Change of Status.—During the last generation a change has taken place in apprenticeship itself. The apprentice who lived with his employer's family had largely disappeared in the latter half of the 19th century and his place had been taken by the " indentured " apprentice who was bound by written articles. In his turn the indentured apprentice is slowly disappearing. Many of the so-called apprentices in Great Britain to-day are not indentured; they may be employed under written agreements other than indentures or merely in accordance with a " verbal understanding." A boy may work with journeymen and may be recognised by them and possibly by the trade union as an " apprentice," but the employer may not be under any definite obligation to the boy. Broadly speaking, a young worker is regarded in Great Britain to-day as an " apprentice," if, during the early years of his employment, he receives wages which are definitely less in amount than the worth of his services and concurrently obtains from the employer such training as will enable him to qualify as a journeyman.

Attitude of Employers.—Since 1910 the number of employers in Great Britain who take definite steps to encourage the technical training of apprentices has steadily increased and at the present time (1926) there are believed to be in England and

Wales alone at least 70,000 learners and apprentices who are aided or encouraged by their employers to pursue courses of instruction. The methods used vary from industry to industry and from firm to firm. The " sandwich " system may be adopted under which the apprentice or learner spends alternate periods in the works and in the technical school or university faculty of engineering: young workers may be released for one or two half-days a week in order that they may attend classes; apprentices may be permitted to leave work early in order that they may attend technical schools: classes may be established in the works by the employer with or without the assistance of the local education authority: or an apprentice supervisor may be appointed to ensure that apprentices receive proper instruction. Many joint industrial councils have education committees or apprenticeship committees which concern themselves with the industrial training of apprentices, while some trade boards have prepared schemes for the training of their young workers.

Government Policy

Great Britain.—The policy of successive British governments since the conclusion of the War has been to leave each industry to determine questions of apprenticeship in accordance with its own needs but to encourage consideration of the subject by organisations of employers and workers and by joint industrial organisations.

Other Countries.—In other countries there has been a tendency on the part of the state to intervene and a disinclination to leave such an important matter as the recruitment and training of potential skilled workers to be settled by the industries themselves. In New Zealand and in certain of the Australian states statutory awards are made, closely regulating the conditions under which apprentices may be engaged and employed. A bill at present under consideration in New Zealand enlarges the powers of the state and lays emphasis on the need for relating apprenticeship and technical training, whilst similar proposals are being considered in South Africa. In Germany the Industrial Code regulates generally the employment of apprentices and includes a provision determining the number of apprentices that may be employed by an individual employer, but detailed regulations are left to industrial organisations. In France and in most other European states apprenticeship is regulated to a greater or less extent by legislation, which has regard primarily to the importance of technical training. Legislation proposed in France in effect compels employers who do not make reasonable provision for the training of their apprentices to contribute to a fund for the support of technical training provided by the state. In Sweden comprehensive legislation regulating apprenticeship is under discussion.

In the United States, however, apprenticeship as understood in Europe has largely decayed; questions of apprenticeship are determined by the custom of the trade or in accordance with the views of individual employers having regard to the internal organisation of the industry from the point of view of methods of production; increasing emphasis is being laid on the need for training young workers in the quickest and most efficient manner possible, and rapid strides have been made in the provision of technical instruction, inside or outside the workshop, for apprentices and other young workers. (*See* Technical Education.)

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AQUEDUCTS (*see* 2.240).—In the domain of pressure conduits for water supplies, cast-iron pipe continues to be most in favour in Great Britain on account of its durability, but the trend of recent development is towards the substitution of riveted or welded steel for cast iron especially for medium and large sizes, and for situations where settlement of the ground is expected. The advantages of steel are its lightness, reliability, watertightness and security from cracking, and experience now shows that well-coated steel pipe when buried in normal soil will endure for many years. Examples exist of pipes about $\frac{3}{16}$ in. thick which are still in use after 40 years service.

Pipe Linings.—Efforts have been directed for some time by manufacturers towards the application to steel and iron pipes of an interior lining which will permanently adhere and prevent rusting, pitting and incrustation. The bases of two such linings, which are put on by a process of centrifugal spinning, are Portland cement and bitumen, and experience is now being accumulated as to their endurance under various conditions.

The new pipe-line [1] from Lake Tansa for the Bombay Water Supply is a good example of riveted steel construction for pipes of 57 in. to 72 in. diameter under moderate head. The pipe is formed of single plate rings $\frac{3}{8}$ in. thick and 7 ft. 4 in. long, alternately in and out, with the longitudinal joints double riveted and circumferential joints single riveted.

Hydroelectric Aqueducts (*see* Hydroelectric Engineering).—The greatest developments in aqueduct construction in recent

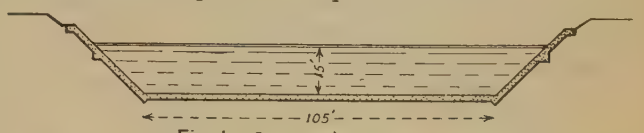

Fig. 1. *Basse Isère Canal*

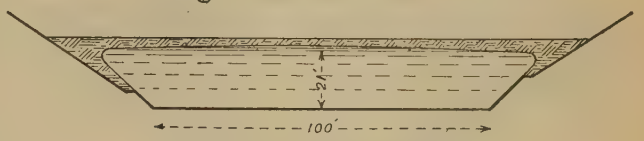

Fig. 2. *Humber Arm Canal*

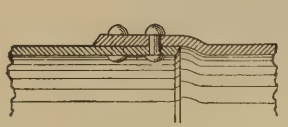
Fig. 3.
Spigot & Socket Riveted Joint

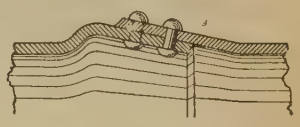
Fig. 4.
"Bump" Joint

years have taken place in connection with hydroelectric power supply schemes. Almost every class and size of conduit is concerned, from enormous open canals, lined and unlined, to tunnels and great pipes of steel, wood or concrete for moderate pressures and smaller pipes of steel for high heads up to over 5,000 feet.

Canals.—A concrete-lined canal for conveying water to the low head power station at Beaumont Monteaux on the Basse Isère, France (fig. 1), is 105 ft. wide on the bottom with 15 ft. maximum depth of water, side slopes of 1 to 1 and cement concrete lining 12 in. thick on floor and sides, finished with a surface rendering of cement mortar $1\frac{1}{4}$ in. thick. The lining is laid in sections with a transverse expansion joint every 23 feet. The maximum flow is 10,000 cusecs and maximum average velocity $6\frac{1}{2}$ ft. per second. The fall is 1 in 6,400.

At the Humber Arm Hydro-electric Works of the Newfoundland Power and Paper Co. there is a large unlined canal in conjunction with seven large wood-stave and steel pipe-lines for a maximum head of 250 feet. The canal has a base width of 100 ft. and water depth of 21 ft. for a minimum winter flow of 5,000 cusecs. A typical cross-section is shown in fig. 2, which also indicates the restriction of water area expected in winter from the formation of thick ice. The lessened water area and increased wetted surface together give rise to serious reduction of capacity which must be allowed for in regions such as this, which are subject to severe and prolonged frost. The gradient is 1 in 7,450 and the maximum velocity of flow is about 3 ft. per second. The dimensions of this unlined canal should be compared with those of the lined canal at Beaumont Monteux designed for a flow twice as great.

Wood Stave and Riveted Steel Pipes.—Each of the seven pressure pipe-lines is formed of an upper part in wood-stave construction and a lower part of steel riveted construction. The wood-stave portion is used up to a maximum head of 167 ft. and is 9 ft. 6 in. diameter with machined staves $3\frac{1}{4}$ in. thick in widths of $5\frac{1}{2}$ in., and having mild steel bands $\frac{3}{4}$ in., $\frac{7}{8}$ in. and 1 in.

[1] *Engineering*, Oct. 7 1924.

diameter at spacings varying from 2¼ in. to 8 in. It is carried on piled foundations at intervals of 12 ft. 6 in., the direct support being on curved cradles of reinforced concrete formed over the piles (fig. 8).

The riveted steel portion has diameters of 9 ft. 6 in. and 8 ft. 6 in. and thickness from $\frac{9}{16}$ in. to $\frac{13}{16}$ inch. The maximum flow

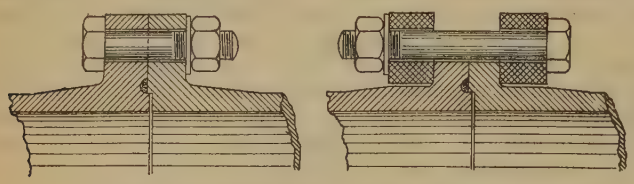

Fig. 5. *Flanged & Bolted Joints.* Fig. 6.

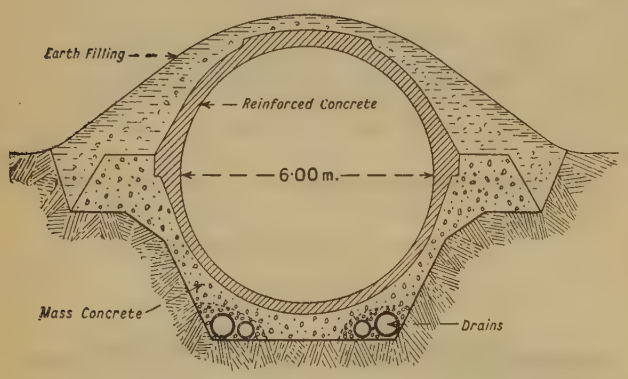

Fig. 7. *Drac-Romanche Conduit.*

and velocity are 550 cusecs and 9.7 ft. per sec. respectively. The pipe is formed in rings 8 ft. long alternately in and out, each ring being made with two plates and having two longitudinal lap joints. The pipe-lines are protected with a bituminous coating and surrounded with earth as protection against freezing.

Covered Conduits and Tunnels.—Free-flowing contour conduits, where practicable on steep hillsides, are usually made rectangular in concrete or reinforced concrete and covered over as protection against slides and rock falls. Tunnelling is, however, often preferred on the score of shorter distance with less loss of head, less risk of accident and smaller cost of maintenance. Free-flowing tunnels are commonly lined with concrete on bottom and sides, but not on the roof if the rock is sufficiently sound.

Low-pressure Tunnels.—Low-pressure tunnels are now largely used in mountainous districts to convey the water from the reservoir or intake to the top of the high-pressure pipe-line while conserving the maximum possible head. In hard, sound unfissured rock they may be unlined, but lining of rich concrete, in conjunction with sealing of fissured places by injection of cement through drill holes, is generally desirable. The hydraulic flow conditions in unlined tunnels are very uncertain and smooth concrete lining is often used on this account alone. Kutter's

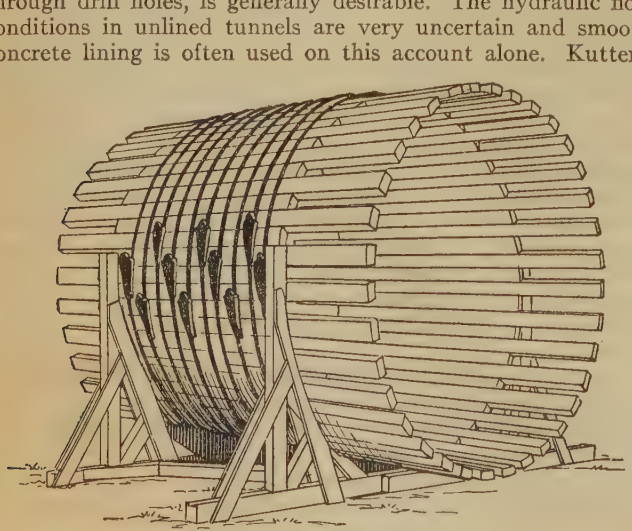

FIG. 8.—Pipe constructed of wooden staves and steel hoops.

coefficients may be taken as ·012 to ·014 for concrete lining, and provisionally as ·024 to ·032 for unlined tunnels. Where the weight of rock cover over the tunnel is not sufficient to balance the water pressure, the lining may have to be reinforced to withstand the pressure, and the possibility of water under pressure finding its way into extensive fissures must be guarded against.

High-pressure Welded Pipes.—High pressure portions of pipe-lines are now almost exclusively made of hammered lap-welded mild steel in lengths up to a maximum determined by the rolls available for bending the plates to circular form, lengths of 20 to 26 ft. being common. With suitable welding apparatus having long reach, two or three such lengths can be joined together by circumferential welded joints to make single smooth-bore pipes of 40 to 60 ft. in length. Such pipes have less weight, offer less resistance to flow and require less field work for installation as compared with riveted pipes. The steel used requires to be of extra mild, ductile and weldable quality for which, when allowance of about 90% efficiency for the welded joint is made, a working tensile stress of about 5 tons per sq. in. is appropriate. A hydraulic test to at least 50% but preferably to 100% above the working pressure should be made on each pipe at the maker's works. The joints form a vital part of a high-pressure pipe and the trend of development is to make them strong and rigid, and avoid the use of bolted, packed and expansion joints wherever possible. Welded pipe with riveted end joints represents, for medium and large-size pipes, the best modern practice, the riveting being single, double or treble, according to the pressure which may be applied.

Two forms of riveted joint are shown in figs. 3 and 4. Fig. 3 shows a spigot and socket form turned and bored to slight taper to ensure perfect fit and water tightness. Fig. 4 shows the so-called "bump" joint with coned and swelled ends, arranged so that the rivet heads do not project within the skin of the pipe. For the smaller sizes, where the room inside is too cramped to permit proper riveting, flanged and bolted joints of various types are used, generally with a packing ring to ensure watertightness. Two broad classes of joint may be noted: (1) flanges rigidly fixed to the pipe by riveting, welding or screwing; (2) a pair of loose flanges bolted together so as to grip the swelled or slightly flanged ends of adjacent pipes. Typical forms of the two classes are shown in figs. 5 and 6.

Welded pipe, and especially bends and junction pieces, are manufactured with great difficulty when the thickness exceeds 1¼ inches. Usually the thickness can be kept within necessary limits by sub-division of the flow, but for exceptional cases welded pipe, with weldless steel bands shrunk on at intervals, has been used. The thickness of the tube is then fixed from considerations of manufacture and the additional strength required to resist bursting is furnished by the bands. The tube must be of extra mild, weldable steel; the rings may be of ordinary or high tensile steel.

Security Measures.—High-pressure pipe-lines and precipitous and difficult locations usually go together. Security of installation is of the utmost importance in view of the serious damage that may follow the release of great uncontrolled power due to failure. The principal forces to be dealt with are the weight of the pipe and contents, and the inclined components thereof which cumulatively may be very large, the outward thrust at bends arising from the water pressure, and the large, longitudinal forces of tension and compression produced by changes of temperature. The latter forces can only be modified by the introduction of expansion joints, they cannot be eliminated.

Two contrasting methods of installation are in use, which may be designated the Swiss and the French method respectively. In the Swiss method a heavy concrete anchorage surrounding the pipe is provided at every bend, horizontal or vertical, the pipe-line being thus divided into a series of straight lengths, each of which is provided with an expansion joint near its upper end. The anchorages are designed to resist the maximum forces transmitted by the section of pipe-line attached thereto. In the French method main anchorages are provided at top and bottom only, there are no expansion joints, subsidiary intermediate

anchorages are provided to hold the pipe in position and take care of the stresses produced by local variations of temperature and generally bends and elbows are left free to spring somewhat under extremes of temperature.

There are numerous successful examples of each method, one of the latter class worthy of mention being the pressure pipeline of the Eget Station in the Pyrenees. The fall is about 2,470 ft. and there are seven parallel pipes of 22 in. diameter serving seven Pelton wheels, each of 5,000 horsepower. There are no expansion joints, and the final joining up was done at medium temperature to limit the range of dilatation and contraction stresses. Pipes were used in lengths of about 40 ft. with heavily bolted flanges of the type shown in fig. 6. The pipes rest on inclined metal saddles which are bolted to the tops of concrete or masonry piers about 3 ft. thick.

Reinforced Concrete Pressure Conduits.—Reinforced concrete is finding increasing use for low-pressure pipes and conduits, there being definite advantages on the score of maintenance and security against collapse from partial vacuum together with, in suitable cases, a saving in first cost. Essential requirements to success are fine, well-graded aggregate and sand, with a rich admixture of cement, and careful and thorough mixing and working into place, all combined with careful designing and proper disposition of reinforcement to take account of principal and secondary stresses in both the circumferential and longitudinal directions. For moderate diameters and pressures, precast, reinforced concrete pipe with joints of the "lock joint" or other special type and in lengths up to 12 ft. has found considerable use. The site must be accessible as the weights are heavy.

For large diameters the conduit is manufactured "in situ." Probably the largest reinforced pressure conduit yet constructed is that of the Drac-Romanche Hydroelectric Development at Pont de Claix near Grenoble, France. The diameter is 19·7 ft. and the section is as shown in fig. 7. The outer mould for the lower half of the reinforced tube is formed of mass concrete, steel shuttering being used for the rest of the construction. The fine concrete for the tube was mixed in the approximate proportions of 500 kgm. cement; .400 cu. metres sand; .800 cu. metres aggregate, say by volume 1:1·1:2·2. The maximum head is about 50 ft., maximum flow and velocity 2,800 cusecs and 9·2 ft. per sec. respectively and loss of head about 1 metre in 1,500 metres. A covering of earth serves to minimise temperature variations. (J. Wi.)

ARABIA (*see* 2.254).—By the end of 1925 considerable progress had been made toward determining the political boundary of Arabia on the north. In 1921 the boundary between Nejd and Kuwait was fixed by agreement between Ibn Sa'ud and the high commissioner for 'Iraq. In the same year the boundary between Nejd and 'Iraq was fixed at the Conference of Mohammerah. In Oct. 1925 a British Mission under Gen. Sir Gilbert Clayton visited Ibn Sa'ud in the Hejaz to fix the boundaries between Nejd and Transjordan.

The northern boundary resulting from these arrangements is as follows: Starting near Haql on the Gulf of 'Aqaba it runs eastwards, south of Mudawara station on the Hejaz railway, to the 38th meridian. Thence from lat. 30° it strikes northwest to 'Amari wells leaving all Wadi Sirhan to Nejd. Thence it runs east to Jabal 'Anaiza leaving a corridor of British mandated territory between Nejd and Syria. And thence it follows the 'Iraq-Nejd boundary in a southeast direction through the Batu depression and the wells of Ansab to Riqa'i in the Batin valley, whence it circles round the Kuwait principality to the Persian Gulf coast.

In the southwest corner of Arabia the boundary between the Aden protectorate and Yemen was delimited by an Anglo-Turkish com-

mission in 1902–4, and runs from a point opposite Perim island in a roughly northeast direction to Qa'taba beyond which a due northeast line continues it into the virgin desert. Apart from these frontiers the land boundaries of the various Arabian states are indeterminate. (H. St. J. B. P.)

I. EXPLORATION AND TOPOGRAPHY

In 1904 Dr. D. G. Hogarth in *The Penetration of Arabia* gave a full history of the exploration of the peninsula up to that date. Since then considerable progress has been made in the exploration and mapping of the country and the results of this are described below.

Central Arabia.—In 1917, when on a mission to the Emir of Nejd, H. St. J. B. Philby crossed the peninsula from sea to sea, a feat previously accomplished by only one other European—Capt. Sadlier, in 1819—his line being from 'Oqair ('Ojair) on the Persian Gulf to Jidda, by way of Hufuf, Riyadh and Taif. He attributes the exceptional fertility of the Hufuf group of oases to the re-appearance at the surface there of the rainfall of a very large area. Beyond Riyadh, Philby was the first European to follow, for most of the way, the great central pilgrim route to Mecca. He passed Ghat Ghat, a centre of the Wahhabist revival. After 80 m. of limestone desert alternating with belts of dahana, his route lay across the highlands of Nejd, a granitic tract 150 m. in breadth, where he found altitudes up to 3,100 ft.; this tract forms part of the great divide between the northeast and southeast slopes of Arabia in which, in about lat. 23½° N. and long. 43½° E. lie the head-waters of W. Sahaba. For no less than 200 m. between the small settlement of Qusuriya, long. 44° 30′ E. and Khurma, lat. 22° N., long. 42° E. —a village of mud huts on the confines of the Hejaz and a point of conflict between the King of the Hejaz and the Emir of Nejd—he found no settled habitation, but encountered vast herds of gazelle. After crossing the Rakba plain he reached Taif and, following down the gorge of W. Fatima, reached Jidda.

In a subsequent journey, May–June 1918, Philby explored southern Nejd, going 300 m. southward from Riyadh to Dam and back. He determined astronomically the positions of a number of places, including Riyadh (lat. 24° 37′ N. long. 46° 41′ E.), Abu Jifan (lat. 24° 29′ N.), Hair (lat. 24° 21′ N.), Sulaiyil (lat. 20° 25′ N., long. 45° 29′ E.) and Dam (long. 44° 40′ E.), and ascertained various heights by aneroid readings. As a result of the journey, the hydrography of the Tuwaiq plateau, the backbone of central Arabia, is now as well known as any part before the World War. Philby's estimate of the population of Riyadh is 12–15,000, and its most conspicuous buildings are the palace of the Emir and the great Wahhabi mosque. The oases of Nejd were found to comprise, usually, a nucleus town with scattered hamlets, with not more than a few square miles of cultivated land around in each case, and populations never exceeding 10,000. In Aflaj and Kharj he made a notable discovery of ruin fields of considerable area, which suggest burial mounds of an early era.

In both districts, the peculiar system of irrigation from natural reservoirs or deep well pits by means of subterranean channels, or *karez*, was unexpectedly found to prevail. At Umm al Jabal, just south of Laila, is a lake ¾ m. by ¼ m., possibly the largest sheet of permanent water in Arabia, and also a number of reservoirs of unusual size, one measuring 500 by 600 yards. In the Makran depression, south of Badia (lat. 22° N.), are other perennial pools of water surrounded by woods of well-grown trees. The oasis of Dam locally known as " the wadi," consists of some 20 separate settlements with a total population of 9,000, mostly of negro origin or of the Dawasir tribe. It was found that the Nejd oases are not tropical paradises; that there is no chain of oases linking Nejd with either 'Asir or Yemen; and that there is no region of fertility between southern Nejd and Oman, nor any settled spot between it and either Oman or Hadhramaut.

Northern Arabia.—As a result of two journeys in Arabia in 1910 and 1912 Lt.-Col. G. E. Leachman drew attention to W. Khar, an important affluent of the Euphrates, and discovered its possibilities as a line of communication between Syria and 'Iraq via the oasis of Jauf, noting that water is obtainable at regular intervals along it. He was first among Europeans to visit the wells at Leina, of which there are several hundreds, spread over an area of 5–6 sq. m.; and he is the only European who has made any record of a journey from J. Shammar to Suq'ash Shuyukh. His travels were equally important politically, for he laid the foundations of a good understanding between Britain and the Emir of Nejd; he was treacherously shot, Aug. 1920, in Mesopotamia.

In 1913–4, Miss Gertrude Bell travelled alone, except for native guides, from Damascus to the neighbourhood of Taima. Thence she passed eastwards over new ground along the southern margin of the Nafud to J. Shammar and visited Hail; then northwards by Loqa to Najaf and Baghdad, adding considerably to knowledge of a region hitherto traversed only by Wallin in 1848. Miss Bell was at that time the only woman traveller in Arabia, with the exception of Lady Anne Blunt, and one of the few women who can lay just claim to the title " explorer," for she surveyed her route by prismatic compass from start to finish.

Capt. Shakespear, British political agent at Kuwait, who became political officer in Nejd in 1914, and was killed in action in 1915, crossed the peninsula in 1913–4 from Kuwait to Suez by way of Riyadh, Buraida, Haiyaniya and Jauf al 'Amir, following an entirely new course beyond the last-named place. Other expeditions—by Douglas Carruthers in 1909, by Alois Musil in 1908–9 and 1910 and by Barclay Raunkiaer in 1912,—yielded valuable results.

The Hejaz.—The Arabian section of the Hejaz railway was so ill-known before the World War that even the stations could not be enumerated correctly. Determination, in 1917, of the lat. and long. of Ma'an and the observation of the long. of a few stations to the south enabled valuable adjustments to be made in the trace of the line. A belt of the Hejaz slope, some 300 m. in length between Wejh and Rabigh and a smaller tract immediately south of 'Aqaba were explored as a result of War operations, and a Turkish staff map of the country within a 30-m. radius of Medina added further useful data, so that a great part of the Hejaz can now be mapped with fair accuracy. The Billi tribe who people the rolling country between Wejh and the railway were found to be pure nomads without a single settlement in their district except one small garden at Al Kurr; the Juheina and Harb to the south of them are less nomadic.

'Asir and Yemen.—Toward the end of 1918, in the course of Idrisi's final campaign against the Turks, British officers met tribesmen from the least known parts of the interior, and gained much topographical, social and political knowledge, especially on the composition and distribution of the chief tribes of 'Asir and Yemen. The position of Ibha (formerly Menadhir), the headquarters of the Turks, was ascertained, though no European got there even when they surrendered. Sabia, Idrisi's capital, about 23 m. east-southeast of Jizan, was visited by an Indian medical officer. In Yemen, in 1909, a considerable amount of survey work was done by M. A. Beneyton, a French engineer, for a proposed railway from Hodeida to San'a and 'Amran and much unexplored territory was mapped on a scale of 1:250,000. G. Wyman Bury went from Hodeida to Sa'na in 1912 and has thrown light on the topography and economic conditions of Yemen. A. J. Wavell visited San'a in 1911 and gave the best description of the city since Manzoni, 1884. He found the population reduced to 18,000 as compared with Harris' computation of 50,000 in 1891. The decline in population and the commercial depression prevalent in Yemen may be attributed largely to the lawlessness of the intractable Zaranik and Qahtan tribes who occupy the country between the highlands and Hodeida.

Aden Protectorate and Hadhramaut.—Bury, in 1911, described his penetration of the Kaur watershed (alt. 7–9,000 ft.), north of the Yafa'I Fadhli country. He visited Yeshbum (population 4,000), the capital of the Upper 'Aulaqi, situated in a plain producing cotton and indigo and carrying on an industry in cotton fabrics, and got as far as Beihan, 110 m. inland of Shughra and almost in touch with Marib.

The Red Sea Coast.—The naval patrol during the World War explored the intricate coastline from 'Aqba to Aden. The triple coral reef fringing it had kept this coast almost inviolate, but the very numerous openings through the reefs are now known and have been charted.

The desert north of lat. 30° N. may be considered as well known, thanks largely to the activities of the Royal Air Force, which has maintained a regular fortnightly mail across it from Cairo to Baghdad, and to the enterprise of the British Nairn Motor Transport Co. (Beirut to Baghdad *via* Damascus) and of a Syrian motor company (Damascus to Baghdad *via* Palmyra). Various schemes have also been under consideration to connect Baghdad with Haifa by a trans-desert railway and preliminary surveys have been made in this connection, notably by Maj. A. L. Holt of the 'Iraq Railways. South of latitude 30° there has been little exploration since 1921, but a notable exception is an expedition made in the winter of 1923–4 by Maj. R. E. Cheesman to the hitherto unvisited oasis of Jabrin on the fringe of the Great South Desert. A British commercial syndicate has also been engaged in prospecting for oil in the province of Hasa, and similar work was begun in Oman late in 1925.

A notable addition to the maps of Arabia is Sheet No. 32, Persian Gulf (Scale 1:4,000,000) published by the War Office in 1924 and including the whole peninsula above latitude 20 degrees. This sheet is based on all the latest available information and is certainly the best map ever published of Arabia. The million-scale map of Arabia now covers the whole peninsula north of lat. 24° N. and a sheet (Laila), issued in 1923, covers the central area south of that line down to lat. 20° North. Million-scale maps, issued by the Survey of India, cover the southwest, south and eastern extremities of Arabia but have not been brought up to date. (H. W. M.)

II. POLITICAL HISTORY

The political situation in Arabia has undergone a remarkable change since 1911. At that time the Ottoman Govt. was able to maintain authority over the Red Sea provinces of Hejaz, 'Asir, Yemen and the Persian Gulf province of Hasa. In Central Arabia supremacy was divided between the Emirates of Jabal Shammar and Nejd; while the principalities of Kuwait, Bahrein,

Qatar, Trucial Oman and Muscat, the territories of Hadhramaut and the Aden hinterland were in varying degrees under effective British protection.

In 1912 Amir 'Abdul 'Aziz ibn Sa'ud—who, as a youth of 20, had in 1900 rescued the territories of his ancestors from the rule of the Ibn Rashid dynasty of Hail and had since then effectively established his own rule throughout Nejd from Qusaiba in the north to Wadi Dawasir in the south—planted at Artawiya, a desert watering east of Zilfi, the first of the many Ikhwan colonies which have since formed the very basis of his power. (*See* WAHIBI MOVEMENT.) By doing so he formally revived in its most puritanical and fanatical form the long-dormant Wahibi movement, which had a century before made one of his ancestors for a short time undisputed master of all Arabia. His plan was to make the centrifugal elements of nomad society serve his own political ambitions under the banner of a great religious revival, for the furtherance of which he established these colonies—their number is reputed now to be about 50—as depots or rallying points for the Bedouin. He provided the funds necessary for the building of mosques therein and arms and ammunition for the use of each colony, which thus formed a contingent of what was in effect a conscript army. For five years the essential character and immense possibilities of this movement were not appreciated outside the limits of Nejd itself.

During the winter of 1913–4 Ibn Sa'ud suddenly descended upon the Hasa province with quite a small force. The citadel of Hufuf was captured by a night attack almost without resistance on the part of the Turkish garrison, which took refuge in the fort-like precincts of the Ibrahim Pasha mosque, but surrendered almost immediately. The Turkish troops were escorted to the coast and with the garrisons of Qatif and 'Oqair, which also surrendered, were allowed to depart in peace by sea.

The World War.—Before the Turks had had time to avenge this blow, they were involved in the World War, as the result of which they lost the whole of their Arabian Empire. Early in the War, Captain W. H. I. Shakespear of the Indian Political Service was appointed British representative at the court of Ibn Sa'ud, and the latter immediately began hostilities against Jabal Shammar, whose ruler Sa'ud ibn Rashid, who had succeeded to the Emirate in 1908, stood by the Turks to the end. Captain Shakespear was unfortunately killed in the first and only battle of the campaign at Jarrab in Jan. 1915 and, the battle having proved indecisive, Ibn Sa'ud became inactive till the summer of 1918, when he again advanced against Ibn Rashid but had gained no substantial success before the end of the World War. The only event of importance affecting Nejd during this period was the signing of a treaty of friendship between Great Britain and Ibn Sa'ud in Dec. 1916.

Meanwhile the centre of Arabian gravity shifted to the Hejaz, where Husain ibn 'Ali, Emir of Mecca, raised the standard of revolt against the Turks. Husain's assumption of the title of "King of the Arab Countries" was not viewed with favour by Ibn Sa'ud and created between the two rulers an ever-growing coolness, which was prevented from breaking out in open hostilities only by the constant efforts of the British Government. At the end of 1917 a further cause of estrangement arose out of a dispute over the oasis of Khurma on the Hejaz-Nejd border. The people of the oasis, being of the Wahibi persuasion, and their chief, Sharif Khalid ibn Luwai, declared for and demanded protection of Ibn Sa'ud. The latter accepted their allegiance, and a serious crisis arose in the summer of 1918, when King Husain made two vigorous but unsuccessful efforts to capture the "rebel" oasis. His failure made it unnecessary for Ibn Sa'ud to take action and at the end of the War Khurma still formed part of Nejd.

War with Ibn Sa'ud.—King Husain, unwilling to accept such a situation, appealed for British intervention and in March 1919, a committee presided over by Lord Curzon decided in his favour. He was authorised to occupy the oasis, and Ibn Sa'ud was warned to relinquish it on pain of incurring the displeasure of the British Govt. and of losing his subsidy of £60,000 a year. The Hejaz forces under the King's second son 'Abdullah, advanced to Turaba, 80 m. from Khurma in May, and Ibn Sa'ud, disregarding the British Govt.'s warning, sent a force to meet him. In the dead of night the Wahibis surprised 'Abdullah's sleeping camp, and annihilated the whole of his army, some 4,000 strong. 'Abdullah and a small following escaped, and the town of Taif was evacuated by its inhabitants in fear of a Wahibi advance. Even Mecca and Jidda were thrown into a state of consternation. But Ibn Sa'ud, content with the capture of Turaba, withdrew to Riyadh. His first objective was naturally the Emirate of Jabal Shammar but, apart from occasional raids, he was unable during 1919 and 1920 to gain any substantial success. Meanwhile he sent an expedition against 'Asir, the mountainous country south of Hejaz, and captured its capital, Ibha, in the summer of 1920. Having consolidated his position there and among the neighbouring tribes down to Wadi Bisha, he again turned to Hail where an accident now favoured him, Sa'ud ibn Rashid being shot dead by a relative during a picnic. The vacant Emirate passed to 'Abdullah ibn Mit'ab, who was unable to cope with the heavy task thus thrust upon him and, fearing treachery, took refuge with Ibn Sa'ud during the summer of 1921. Muhammed ibn Talal, his successor, fared no better and in Aug. 1921 Hail surrendered to Ibn Sa'ud.

In July 1922, the Wahibis occupied Jauf, which had long owed allegiance alternately to Ibn Rashid and to the Ruwalla chief, Nuri ibn Sha'lan, and extended their activities up Wadi Sirhan. They even raided Transjordan in Aug., but were driven back by the Royal Air Force detachment at 'Amman. About the same time they occupied Khaibar and Taima on the Hejaz border and the Red Sea (Hejaz) port of Qunfida. By the summer of 1923 Ibn Sa'ud seemed to have reached the zenith of his power, and in Nov. the British Govt. invited him and the various Sharifian states (Hejaz, 'Iraq and Transjordan) to a conference at Kuwait, which dragged on till April 1924 without result. Meanwhile the Ikhwan (particularly during the winter of 1923–4) had carried out a number of raids on the tribes of the 'Iraq frontier, and the failure of the Kuwait conference resulted in a second raid (in Aug. 1924) on several villages near 'Amman. This was repulsed by the Royal Air Force, but resulted in the extension of Wahibi influence to the "Salt Villages" of Wadi Sirhan. The Wahibi monarch (who had been recognised by Great Britain in 1921 as Sultan of Nejd, and had ceased to enjoy a British subsidy as from March 1924) now played his trump card with results which far exceeded his expectations. A Wahibi army launched against Hejaz captured Taif without opposition in Sept. 1924, and, owing to the absence of its commander, committed excesses which were immediately disowned by Ibn Sa'ud. After a battle at Hadda in the Taif mountains, Mecca was occupied in Oct. and by the end of 1925 the whole of the Hejaz was in Ibn Sa'ud's possession.

III. DIVISIONS OF ARABIA

Oman.—This roughly comprises the extensive and mountainous promontory which forms the eastern extremity of Arabia, extending from Ras Musandam on the Gulf of Oman to the eastern limits of Hadhramaut at Ras Sajar (lat. 16° 8′ N.) on the Indian Ocean. Its capital, Muscat (*see* 20.99 and 19.43), was before the War an important centre of the traffic in arms, which was in 1912 subjected to control by the establishment of a warehouse at the instance of the British Government. The present Sultan of Muscat, Saiyid Taimur, who succeeded his father, Saiyid Faisal ibn Turki, in 1913, enjoys a nominal authority over the whole of Oman, but his rule is effective only on the coast. The tribes of the interior are practically independent under the loose control of an Imam of the 'Ibadi sect, whose centre is at Rustaq.

A rising of the 'Ibadis in 1913–4 against the Sultan resulted in the occupation of Bait al Falj near Muscat by a British Indian force, which remained there throughout the War, defeating the rebels in 1915. Since the War the Sultan's administration has given rise to much dissatisfaction and in 1920–1 the British Govt. intervened to patch up an understanding between him and

the 'Ibadi Imam. Shortly afterwards the Sultan had to agree to the creation of a sort of Council of Regency for the administration of the state and since then he has taken no active part in the government of his dominions, residing partly in India and partly on his personal estates. For all practical purposes the administration is controlled by the government of India.

Kuwait (*see* 15.956).—Of the various states along the Arabian coast of the Persian Gulf, Kuwait alone has had its frontier with Nejd defined. Its chief, Mubarak Ibn Subah, always a staunch friend of Great Britain, died in 1916, and was succeeded by his son, Jabir, who died the following year, to be succeeded by his brother, Salim, an inveterate foe of Ibn Sa'ud. Salim died in 1921 and was succeeded by Jabir's son, Ahmad, who still rules. The importance of Kuwait lay in the fact that before the War it was the chief *entrepôt* of Central Arabian trade, but recently owing to a dispute regarding the Sheikh's right to collect customs dues on goods in transit, Ibn Sa'ud has developed the three Hasa ports of Jubail, Qatif and 'Oqair and deflected trade in that direction. Kuwait trade has consequently to some extent declined.

Qatar.—The small peninsular state of Qatar has since 1914, when it ceased to be under Turkish rule, maintained a sort of independence under its Sheikh, 'Abdullah ibn Thani, whose authority does not extend beyond a few settlements on the coast and who is on good terms with his powerful neighbour, the Wahhabi Sultan.

Trucial Oman.—Between Qatar and Oman proper lie the petty states of Abu Thabi, Dibai, Sharja, 'Ajman and Umm al Qaiwan, each under its own semi-independent Sheikh and all controlled and protected by Great Britain, whose representative resides at Sharja, in virtue of an agreement made in 1892. The authority of these states is confined to the sea-coast and their boundaries with Nejd have not been defined.

Hadhramaut.—This comprises a considerable and prosperous territory marching with Oman on the east and the Aden protectorate on the west. Its boundaries northward towards the Great Desert are undefined. The greater part of this territory is ruled by Sultan Ghalib ibn 'Awadh of the Qa'aiti dynasty, which is closely linked with the Indian state of Haidarabad. His capital is at Makalla on the coast and the actual work of administration is carried on in the Sultan's name by a Wazir, Saiyid Husain ibn Mihdar. Apart from Makalla, Shihr on the coast and Shibam inland are the main centres of the Qa'aiti allegiance, while Tarim and Saiyun (both inland) are the headquarters of two co-equal Sultans of Kathiri stock, whose affinities are with Java and the East Indies. These Sultans are Mansur and Muhsin, both sons of Ghalib ibn Ahmad, and the effective government of their dependencies is in the hands of a Wazir, Salim ibn 'Abud. During the War the Qa'aiti influence was exercised on the side of Great Britain, while the Kathiris were intensely anti-British and were suspected of supplying the Turks in Yemen with goods imported via Shihr and Shibam. The Qa'aiti-Kathiri feud was temporarily composed in 1918 by a treaty, but the prosperity of the Hadhramaut and the development of its great agricultural resources—it is an important tobacco-growing centre—can only be secured by the elimination of the Kathiri element whose rule is as oppressive as that of the Qa'aiti dynasty is mild. The whole area falls within the sphere of British influence and protection.

Yemen and 'Asir.—These form geographically a single unit extending northward between the Red Sea and the western (undefined) border of the Great Desert from the frontier of the Aden protectorate to a line running northeast from Hali point to Wadi Bisha. Before the War this area formed the Turkish provinces of Yemen (south) and 'Asir (north), and during the War they were held to the end by Turkish troops whose hold on 'Asir was always somewhat precarious. Here the authority of Turkey had since 1910 been disputed by Saiyid Muhammed at Idrisi, who maintained his independence in the coastal lowlands (Tihama) with his capital at Sabia and in the ports of Maidi and Jizan. A Turkish expedition against him proved ineffective, and with Italian assistance in 1911–2 he consolidated his position. In 1915 he entered into an agreement with the British Resident at Aden, but was unable to assist the Allied cause in any substantial manner. After the Armistice he continued hostile to the Imam of Yemen, and cultivated friendly relations with King Husain. In 1921 he occupied Hodeida, relying on his treaty with Great Britain. Meanwhile in 1920 Ibn Sa'ud had occupied the uplands of 'Asir and their chief town, Ibha, and in 1922 the Idrisi himself died. His son and successor Saiyid 'Ali, maintained his position somewhat precariously till 1925 when the Imam Yahya of Yemen occupied Hodeida. Since then the Idrisi, confined to Sabia and the ports of Jizan and Maidi, has practically ceased to count as an Arabian potentate.

The Imam Yahya ibn Muhammad, religious head of the Zaidi sect and temporal ruler of the Yemen, has on the other hand greatly consolidated his position. Coming into power in 1904 he was soon involved in a serious rising against the Turks which was with difficulty subdued in 1905 (*see* 2.270). An arrangement was then arrived at, but was broken in 1910, when the Imam besieged San'a. The city was relieved, and in 1913, by an imperial farman, a mediatised status was conferred on the Yemen, the Imam being recognised as the religious and social chief of the Zaidi elements. At the outbreak of the World War he declined to negotiate with Aden, and sided with the Turks, using his influence to stir up strife against the British among the tribes of the Hadhramaut and the Aden protectorate. The Turks left the Yemen at the end of 1918 and a British garrison occupied Hodeida. In Aug. 1919 a British mission under Col. H. F. Jacob proceeded inland from Hodeida to visit the Imam, but was captured by Quhra tribesmen and detained at Bajil till December. In the early part of 1921 the Imam's troops, commanded by the former Turkish Wali, Mahmud Nadhim Pasha, became active in the Tihama around Hodeida but were anticipated by the Idrisi who occupied that port in February. Since then the Imam has from time to time threatened and actually violated the Aden protectorate frontier and eventually ejected the Idrisi from Hodeida (see above). At the end of 1925 he was in a stronger position than ever before, and ranked second only to Ibn Sa'ud among the rulers of Arabia. The World War seriously affected the prosperity of Hodeida and other Yemen ports, but during 1925 Italian commercial enterprise seemed to be actively engaged in restoring their pre-War importance, while late in the same year a British mission set out to visit the Imam.

IV. TRADE AND COMMUNICATIONS

Communications.—At the beginning of 1926 the Hejaz line from Ma'an to Medina was the only railway within Arabian territory. Motor transport was still in a backward stage—a few cars have used the Jidda-Mecca, Rabigh-Mecca and 'Oqair-Hufuf route for some years past—but there is likely soon to be a great expansion in this direction. There are no made roads except the one from Hodeida to San'a but, except in the mountainous and drift-sand regions, communications are easy by camel and the tracks are generally possible for motor traffic. The Hejaz has a telegraph line from Mecca to Jidda which is connected by cable with Port Sudan. The Hejaz has also some nine wireless stations and there are similar installations at Ibha Hodeida and San'a. Both the Red Sea and Persian Gulf ports and Makalla have adequate regular steamer services. Generally speaking the last few years have witnessed a considerable improvement in communications and the near future should see this improvement greatly extended.

Imports.—Arabia is essentially an importing country and imports piece-goods and foodstuffs (rice, flour, sugar, tea and spices), which it pays for by a considerable sale of camels (to Egypt, Syria, etc.), by a modest export of hides, dates, coffee, pearls, etc., and by supplies of all kinds to the annual pilgrims to the Hejaz (averaging 100,000). The chief ports are Jidda, Hodeida, Yenbo', Wejh, Rabigh and Mocha on the Red Sea, Makalla and Shihr on the Indian Ocean, and Muscat, Bahrein, 'Oqair, Qatif, Jubail and Kuwait on the Persian Gulf. Customs duty at Jidda is said to amount to £500,000 (at a general rate of

10% with exceptions in the case of silk, tobacco, etc.) in an ordinary year, but it is impossible to give an estimate of the total value of the export and import trade of all Arabia.

Production.—Camel-, sheep- and horse-breeding are carried on on a considerable scale by the Bedouin but the market for Arab horses is no longer what it was before the War, while the conditions of modern civilisation have made horses a luxury for the rich rather than a necessity for all. The Persian Gulf has a flourishing pearling industry, and in the Red Sea pearls are found in small quantities and there is a flourishing trade in black-coral (made into rosaries for pilgrims). The fishing (and salting of fish) industry has a great future but needs proper organisation. At Salif and other places there is good rock salt, while the west coast of Arabia is suspected, but not proved, to be rich in minerals. In the Hasa *abas* (cloaks) of good quality are made and in the Yemen there is a small industry of decorative gold and silver work (scabbards, sheaths, etc.). (*See* HEJAZ.)

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ARABIC LITERATURE (*see* 2.271).—A vast number of writings have appeared since 1910 in various parts of the East—*e.g.*, Egypt, North Africa, India. Among recent publications, a book written by Sheikh Ali Abdel Razek of Cairo on *Islam and the Bases of Government* (1925) is particularly noteworthy for its political and cultural significance. The author, who has been punished for heretical teaching by deprivation of his judgeship, as well as his professorship in El-Azhar University, Cairo, seeks to prove that in the Koran and in the Traditions (*Hadîth*) about Mahomet there is nothing to indicate that the Prophet cherished ambitions of earthly kingship, or that he proclaimed anything concerning matters other than those affecting faith and practice. It would follow from this that there is nothing to prevent Mahommedans from learning from unbelievers, or from keeping pace with modern European progress.

Great progress has been made in the work of editing and translating classical or standard Arabic texts. Rhuvon Guest has edited and published (1912) the Arabic text of the work on *The Governors and Judges of Egypt* by El Kindî (897–961 A.D.; 283–350 A.H.). C. H. H. Macartney has done the same (1919) for *The Dîwân of Ghailân ibn 'Uqbah, known as Dhu'r-Rummah*. Verses by Dhu'r-Rummah are quoted frequently in the works of lexicographers, but before the publication of the Dîwân only one of his longer poems had been made easily accessible. D. S. Margoliouth has made available, by publishing the text with a translation, a work which has been pronounced to be the best on life in the palaces of the Caliphs and generally one of the most instructive in the Arabic language, the *Experiences of Nations* (*Tajârib al-Uman*) by Ahmad ben Mohammed Miskawaihi[1] (d. 1030 A.D.; ?330–421 A.H.). A continuation of the *Experiences of Nations* was written by Abu Shuja 'Rudhrawari (d. 1095 A.D.; 488 A.H.). It appears to be in the main an abridgment of the Chronicle of Hilal ben Muhassin ben Ibrahim (359–448 A.H.). This text also has been published, with a translation, by Margoliouth.[2]

Chemistry came to Europe by way of the Moslems of Spain; but of the vast chemical literature in Arabic very little has been made accessible to European students. Some importance attaches, therefore, to the publication, from three manuscripts, of the text, with a translation, of the *Book of Knowledge acquired concerning the Cultivation of Gold* by Abu'l-Qâsim Muḥammad ibn Ahmad al-'Irâqî, who seems to have flourished in the 13th century A.D. (7th century A.H.).[3]

In 1921 Sir Charles J. Lyall published a complete text, with translation, of the *Mufaḍḍalîyât*,[4] the famous anthology put together by al-Mufaḍḍal, who was head of the school of al-Kûfah. Al-Kûfah and al-Baṣrah had become the headquarters of schools of grammatical and linguistic research which drew upon the national stores of poetry preserved in the memory of the tribal traditionists or Râwîs. Lyall holds that the anthology is a collection of genuine pre-Islamic poems. D. S. Margoliouth, on the other hand, maintains that the ostensibly pre-Islamic poetry is suspect on both external and internal grounds.[5]

In 1914 Dr. Alphonse Mingana published some leaves from three ancient Korâns.[6] The manuscript from which these leaves were taken is a palimpsest, the upper script being a series of closely written homilies in Arabic by early Christian Fathers, such as Theodosius, Chrysostom, and Mar Jacob. The traditional view is that the text of the Korân, as it now stands, was fixed by command of the Caliph 'Othmân; but these leaves seem to belong to a time before the text was fixed. That the traditional view may not be correct is suggested by the contents of a manuscript brought from the East by Dr. Mingana and published in 1925.[7] The manuscript incorporates a discourse (chap. 25–30) which consists entirely of quotations of the Korân translated into Syriac. These quotations seem often to represent a version which is not always in harmony with the *textus receptus* of the Korân, but exhibits whole verses which are not found in it at all. There are grounds for thinking that the version made its appearance some time between 684 and 704 A.D. This supports a suggestion made by Mingana in 1916, that the text of the Korân was standardised, not under the Caliph 'Othmân, but under the much later Umayyad Caliph 'Abd al-Malik b. Marwân.[8]

In 1922 A. Mingana published a translation of *The Book of Religion and Empire*, a semi-official Defence and Exposition of Islam written by order at the court and with the assistance of the Caliph Mutawakkil (847–61 A.D.), by 'Ali Ṭabari, who seems to have died about 854 A.D. This is the first work by 'Ali Ṭabari to be published. More recently Mingana has published a charter granted by the early Caliph Muktafi II. (1136–60 A.D.) to the Nestorian Patriarch, Abdisho III. (1138–47 A.D.). This charter has survived only as a model of good Arabic composition in an Arabic anthology. It is written in rhymed prose and in a very florid style. It shows that the early caliphs treated their subjects with great toleration.

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ARABI PASHA (*c.* 1839–1911), Egyptian soldier and revolutionary leader (*see* 2.283), died at Cairo Sept. 21 1911.

ARBER, EDWARD (1836–1912), British man of letters (*see* 2.323), was killed in a taxicab accident in London Nov. 23 1912.

ARBITRATION, INDUSTRIAL: *see* INDUSTRIAL RELATIONS.

[1] *The Eclipse of the 'Abbasid Caliphate, Original Chronicles of the Fourth Islamic Century* (1920–1).

[2] Included in the work mentioned above.

[3] The Arabic Text edited with a Translation and Introduction by E. J. Holmyard, M.A. (1923).

[4] *The Mufaḍḍalîyât.* An Anthology of Ancient Arabian Odes compiled by al-Mufaḍḍal, son of Muhammad, according to the recension and with the commentary of Abû Muḥammad al-Qâsim ibn Muḥammad al-Anbârî. Edited for the first time by Sir Chas. James Lyall. Two volumes (1921), volume 3 (1924). The dates of Mufaḍḍal's birth and death are uncertain. The years mentioned for his death vary from 164 to 168 and 170.

[5] "The Origins of Arabic Poetry" in *The Journal of the Royal Asiatic Society* (July 1925), pp. 417–49.

[6] *Leaves from three Ancient Qurâns, Possibly Pre-'Othmanic*, edited by Alphonse Mingana and Agnes Smith Lewis (1914).

[7] *An Ancient Syriac Translation of the Kur'ân exhibiting New Verses and Variants* (1925).

[8] *Journal of the Manchester Egyptian and Oriental Society* (1916), see further Hastings *Encyclopaedia of Religion and Ethics* (1918).

ARBITRATION, INTERNATIONAL (*see* 2.327).—Until 1911 progress in arbitration had been confined within certain limits, questions involving national honour or vital interests being excluded from its operation. In 1911, however, an effort was made to widen its scope. The credit for the innovation is probably due to the United States, as the new idea was first embodied in treaties between that Power and France and Great Britain respectively. The change consisted in an attempt to include within the scope of arbitration treaties all cases of international difficulty or dispute, without exception, a procedure being provided which varied according to the gravity of the matter at issue. The two treaties specifically referred to above have never been submitted to the test of an actual case and it is perhaps idle to speculate on their merits.

Arbitration Treaties before the War.—As between other Powers, various arbitration treaties embodying to a greater or less extent the idea of an all-embracing agreement were made; and it is regrettable to record that those which were put to a severe test failed entirely to prevent a resort to force of arms, thus apparently demonstrating the truth of the argument that arbitration on questions involving national honour or vital interest was foredoomed to failure. In July 1914, arbitration on the disputed points in Austria-Hungary's ultimatum was proposed by Serbia, and Britain proposed mediation. But this conciliatory procedure was unsuccessful.

In the Italo-Turkish War no time was given for any possible pacific intervention, and in the Austro-Hungarian conflict with Serbia the same method of excluding pacific intervention was adopted. In the Italian conflict with Greece over the Albania murders it was the same again, in spite of the parties being pledged to arbitration. These instances showed that arbitration must be of immediate and automatic application if it is to prevent a disaster.

Some account of the leading provisions of the arbitration treaties of 1911 between Great Britain and the United States and between France and the United States must be given. Apart from the provision that the treaties were to embrace all manner of disputes and differences, various preliminary stages of procedure were provided, which may be summarised as follows:—

1. Request by either party to submit any difference between them to a joint high commission of inquiry.
2. Power to either party to postpone the reference to the high commission for one year from the date of the request, in order to afford an opportunity for diplomatic discussion and adjustment of the questions in controversy.
3. Appointment by each party of three of their nationals, these to form the joint high commission.
4. Holding of the inquiry by the joint high commission, the inquiry to be followed by a report upon the particular question or matters referred to it, for the purpose of facilitating the solution of the disputes by elucidating the facts and defining the issues, the report to include also such recommendations and conclusions as may be appropriate.
5. If the difference persist, the case becomes the subject of an agreement to refer the matter to arbitration, such agreement to provide for the organisation of the tribunal, which will arbitrate, and to determine the question or questions at issue. The object of the treaties, however, was not only to provide automatic application, but also to divert attention from the issue to the method of settlement, and thus to enable diplomacy to gain time, while providing the means of obtaining a calm examinations of the points involved.

Arbitration under the Covenant.—Since the World War a new era for arbitration has begun. Arbitration had been regarded as having attained a sufficiently high status in international relations in being promoted by permanent treaties to the position of a recognised adjunct of diplomacy. The Covenant of the League of Nations gave it a much higher rank, and the activities with which it was sought to invest the League would practically displace diplomacy in its present representative form. Arbitration tended to replace direct negotations between the ministers whose departments were concerned, suppressing, or at any rate relegating to a secondary position, the employment of the diplomatic channel.

Under the Covenant the members of the League agree that if there should arise between them any dispute likely to lead to a rupture, they will submit the matter either to arbitration or to inquiry by the Council of the League, and they bind themselves in no case to resort to war until three months after the award by the arbitrators or the report by the Council.

The members of the League agree that whenever any dispute shall arise between them which they recognise to be suitable for submission to arbitration and which cannot be satisfactorily settled by diplomacy, they will submit the whole subject-matter to arbitration.

The members of the League also agree that they will carry out in full good faith any award that may be rendered and that they will not resort to war against a member of the League which complies therewith. In the event of any failure to carry out such an award, the Council shall propose what steps should be taken to give effect thereto.

It is seen that these provisions do not pretend to include all difficulties, but are confined to such matters as all parties may regard as arbitrable. Another clause, however, provides that "disputes as to the interpretation of a treaty, as to any question of international law, as to the existence of any fact which if established would constitute a breach of any international obligation, or as to the extent and nature of the reparation to be made for any such breach, are declared to be among those which are generally suitable for submission to arbitration."

The attitude of the British Govt. in respect of these provisions of the Covenant was expressed in a speech made by Lord Balfour on July 6 1925, in which he stated:—

Arbitration is the thing; there is no question which can arise which will not be submitted to arbitration. If arbitration be really observed, war will be impossible. If either party to a dispute refuses to arbitrate or to carry out a decision of arbitration, our obligation and that of the other parties would be to throw in our whole strength to defend the aggrieved party.

On the continent of Europe this confidence in the future of arbitration is equally strong. Before the World War, arbitration was regarded as a permissive method and though the term "compulsion" was used, it was merely in the sense that contracting parties had bound themselves to submit the cases specified in their engagement to arbitration. Under the Covenant, as Lord Balfour interprets it, compulsion is given a much more effective sense.

Geneva Protocol.—To secure further the inclusion of all differences between nations, and to apply compulsory arbitration as a substitute for war, the Geneva Protocol, adopted on Oct. 2 1924, but never ratified by the Powers, provided a systematic procedure of conciliation, arbitration, and forced compliance with the League's decisions, for the prevention of war. This took the form of an exhaustive amplification of the above-cited articles of the Covenant.

Its provisions were as follows:—

1. If the dispute submitted to the Council is not settled by it, . . . the Council shall endeavour to persuade the parties to submit the dispute to judicial settlement by arbitration.
2. (*a*) If the parties cannot agree to do so, there shall, at the request of at least one of the parties, be constituted a committee of arbitrators. The committee shall so far as possible be constituted by agreement between the parties.

(*b*) If within the period fixed by the Council, the parties have failed to agree, in whole or in part, upon the number, the names, and the powers of the arbitrators and upon the procedure, the Council shall settle the points remaining in suspense. It shall, with the utmost possible despatch, in consultation with the parties, select arbitrators and their president from among persons who, by their nationality, their personal character, and their experience, appear to it to furnish the highest guarantees of competence and impartiality.

(*c*) After the claims of the parties have been formulated, the committee of arbitrators, on the request of any party, shall through the medium of the Council request an advisory opinion upon any points of law in dispute from the Permanent Court of International Justice (*q.v.*), which in such case shall meet with the utmost possible despatch.

3. If none of the parties asks for arbitration the Council shall again take the dispute under consideration. If the Council reaches a report which is unanimously agreed to by the members thereof, other than the representatives of any of the parties to the dispute, the signatory states agree to comply with the recommendations therein.

The Protocol unfortunately amplified also the coercive clauses, military and economic, in case either party to a dispute failed to comply with the pacific solution proposed or arrived at by

the League. Owing more particularly to these coercive provisions Great Britain repudiated the Protocol. The United States, which had been foremost in promoting arbitration, has never adopted the Covenant owing mainly to these very coercive provisions which the Protocol made the mistake of amplifying. Great Britain's repudiation of the Protocol has prevented for the time being its general application. It is nevertheless important, as showing the length to which European statesmen are prepared to go in the enforcement of arbitration awards.

As regards economic coercion against a power which declines to accept arbitration, it is not a principle much more feasible than coercion by force. Suspension of trade between any two industrial countries may be as much a loss to the one as to the other. Feeling in Great Britain and the United States seems practically unanimous in distrusting the application of any coercive method whether or not a domestic interest is involved. Until some new method is found of accentuating moral force which will not have the defects of the sanctions provided by the Covenant, the moral force of universal public opinion seems destined to be the only guarantee of respect for arbitration and its award.

Meanwhile Germany, Sweden, Finland and Switzerland have concluded treaties of arbitration. In these a new element has been added to the system of compulsory treaties, in the form of a standing committee of competent persons appointed by the two contracting states, to which all difficulties can be referred for examination and counsel. Considered in relation to the treaties of 1911, this development seems to constitute another step toward the solution of the problem of extending the scope of arbitration treaties so as to include questions of national honour and vital interest.

At the sixth meeting of the Assembly of the League of Nations the failure of the Protocol of 1924 was dealt with in a report containing the following paragraph:—

> At the moment when the declarations of certain governments have shown that an early entry into force of the Protocol for the pacific settlement of international disputes is not to be expected, several delegations have been anxious to affirm the fidelity and unanimity with which the members of the League remain attached to the triple object underlying that draft treaty, namely, arbitration, security, and disarmament, and to indicate methods or measures by which an approach might be made to this object, pending the achievement of a general settlement which many consider indispensable.

The government most particularly concerned in the wrecking of the Protocol was that of Great Britain. Its attitude produced among the other members of the League of Nations the impression that Great Britain, in spite of her active championship of arbitration, was not prepared to accept the obligations resulting from strict compliance with the provisions of the Covenant. This impression was shared by many Englishmen, but Lord Balfour's statement made it clear that it was erroneous; and it was not surprising that, later on, the Foreign Secretary, Sir Austen Chamberlain, should take the lead in calling a special conference to deal with the problems existing in Central Europe, under the auspices of the Covenant itself. Great Britain thus showed that while observing her traditional attitude of distrust towards international generalities, she was genuinely attached to the principle of arbitration and was ready to give it the widest feasible scope.

Locarno Pact.—The result of the conference called by the British Govt. at Locarno in Oct. 1925 was a pact under which the Powers, between whom difficulties are most likely to arise, undertake in no circumstances whatever to resort to war. They pledge themselves to submit disputes of every kind to some form of peaceful procedure. This agreement must be taken in conjunction with Article 16 of the Covenant, which provides that disputes as to the interpretation of a treaty, as to any question of international law, as to the existence of any fact which, if established, would constitute a breach of international obligation, or as to the extent and nature of the reparation to be made for any such breach, are declared to be among those generally suitable for submission to arbitration or judicial settlement.

Both the Geneva Protocol and the Pact of Locarno adopted the same principle as that which underlay the abortive Anglo-American Treaty of 1897; though that treaty was called a treaty of arbitration it was at the same time a treaty of conciliation. It is interesting to note that Lord Salisbury, who acted, it is believed, on the advice of the late Lord Chief Justice, Lord Alverstone, initiated the negotiations for the treaty in question in a draft, the first proposition of which was as follows:

> Her Britannic Majesty and the President of the United States, shall each appoint two or more permanent judicial officers for the purposes of this treaty and on the appearance of any difference between the two Powers which, in the judgment of either of them, cannot be settled by negotiation, each of them shall designate one of the said officers as arbitrator; and the two arbitrators shall hear and determine any matter referred to them in accordance with this treaty.

This principle, though it was not adopted in the treaty of 1897, has been adopted in practically all the new treaties of arbitration entered into since the conclusion of the World War.

The important object of International Arbitration is further dealt with in a number of articles of which the following may be mentioned: EUROPE: HISTORY; LEAGUE OF NATIONS; LOCARNO, PACT OF; SANCTIONS AND GUARANTEES; TACNA-ARICA; WORLD COURT.

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ARCH, JOSEPH (1826–1919), British labour leader (*see* 2.342), died at Barford, Warwickshire, Feb. 12 1919.

ARCHAEOLOGY (*see* 2.344).—The articles which follow summarise the main features of the remarkable advance made since 1910 in the scientific knowledge of ancient life. As the handmaid of history, archaeology establishes correlations with the record of the climatic variations since the main outline of the world was shaped in the early Pliocene age. The antiquity of man has been proved for Europe to the lowest limits of the Pleistocene age.

I. INTRODUCTION

Evidence is accumulating to warrant the belief that eoliths mark the existence of a tool-using, tool-selecting, intelligent species which can be none other than the forerunner of *Homo sapiens* in the upper Pliocene, if not of *Homo sapiens* himself. Great stresses, shakings, compressions and earth movements have taken place since then, so that the wonder is that we have any evidence of this nature left. Only stone could survive these processes. Stone was the prime material from which permanent tools were fashioned, and is still employed for that purpose by the Australian aborigines, who use at the present day a practically complete series of stone implements, representing all the various stages of culture known in prehistoric Europe. It persisted long in Africa, in Oceania and in America. Communities like the Andamanese can exist without stone implements by fashioning all they need from shells and from the products of the jungle. Of the culture of such groups but little proof would survive.

Continuity of Settlement.—The science of archaeology discloses a feature of significance, the continuity of settlement. Localities have definite site-values which persist from age to age. Cities are built, are destroyed, are rebuilt in turn to perish, but the site-values ensure continuity of occupation. It is, therefore, possible to examine the sequence of strata, of deposits, to test this stratification and to lay down a chronological order by the sequence method of dating, based primarily on pottery. The tale it tells, in spite of its fragility, is of incalculable importance to the student of civilisation, because the use of pottery indicates a permanency of settlement, and historical variations in the population of localities are indicated by the introduction of new designs (*Cambridge Ancient History*, vol. i., p. 71). We can thus form, as never before, an estimate of life in ancient days and

realise how full it was, how vivid, how touched with the problems of life and death, of love and hate, of war with man, with beast and with nature. These records yield proof of the influence of religion on the arts and crafts, of the potency of magic to stimulate and provide sanction for the economic activities. They show how law and order have grown up, how peace and stabilised conditions must be postulated for the development of the high specialisation, which produces the wonderful flint work of the Badarian culture, or the jewellery of the new Indo-Sumerian civilisation, or the statuary of the later dynasties of the older kingdom in Egypt. The great empires of Babylonia, Sumeria, Egypt, Crete extend their influence, each deriving somewhat from the other.

The change from savagery to civilisation comes, as it were, suddenly. Agriculture is the necessary basis of all settled civilisations, but the time and place of its origin are not yet clear. Knowledge there was in abundance of the processes of nature; how far that knowledge was checked and controlled by experiment, how far it was sustained and conserved by the traditional forces of magic and religion, we cannot yet know.

All ideas are changing, not least the belief that maritime activity is of recent origin. How much early Egypt owed to maritime contacts is not known, but the development of maritime intercourse in the Mediterranean, focused on the Cyclades and on Crete, has certainly been a potent factor at a later period in disseminating culture east and west, tying up the lore of Chaldea with Crete. On the other side, the Persian Gulf and the Red Sea have certainly served as links with India and, at a later date in the 4th century B.C., intercourse was active from India, both from the north up to Patna on the Ganges, the capital of the Mauryan Empire, and from the south, the home of that great, mysterious Dravidian civilisation, to the still more mysterious East, even perhaps to China. Indian maritime activities may have to be correlated in due time with the culture developed in Oceania, where in distant New Zealand traditions survive of a migration from Hawaiki, identified with India, where there are still current modes of speech related to the Austric family of which Polynesia is a member.

From East and West comes evidence of the rise and fall of empires. From China, where early man is now known to have existed, comes a glimpse of early greatness. In the north of India there was certainly established a vast commercialised kingdom with cities almost modern in their architecture, planning and sanitation, and traces of this culture can be found, as we now know, in Baluchistan, as the sign-posts on the road to—or is it from?—Sumeria. Here at one stroke is revealed the secret of the change which transformed the simple society of the pastoral nomad, depicted in the Vedas, into the organised, stabilised, hierarchically ordered society of the period of the Brahmanas. Aryandom is seen to be coloured throughout by elements derived from this prehistoric culture. We now realise that the splendour of the Periclean age in Greece has a long past behind it, that Egypt was then, as Herodotus learnt, old Egypt, that art had flourished on independent lines elsewhere before.

Science is concerned with the measurement of time and in the establishment in Egypt of the Sothic cycle (*Cambridge Ancient History*, vol. i., p. 248) and in the astronomical lore of Babylon is evidence of observation, record and knowledge, profound and valuable. There must have been record and observation over long periods to permit the formulation of these systems of calendars: so too with the Maya systems, based on the vigesimal system and on stellar as well as solar and lunar observations. The independent invention by the Mayas of the Zero is notable in itself and as a mathematical device of first-rate importance and value almost comparable in scientific utility to the invention of fire, and it is due, so far as western civilisation is concerned, to India.

There are yet vast tracts unexplored; there is still need for extensive survey to form the framework of our picture, the details of which can only be corrected by and compiled from intensive studies. New scripts are discovered and, like the Minoan and Easter I. scripts, remain as yet undeciphered; other scripts give up their secrets and disclose sometimes new languages, sometimes variants of familiar stocks of speech. Ample as is the material, it is still lacking in many respects. It is still inadequate for the testing of extensive theories, but Homer has been vindicated, Herodotus no longer labours under the stigma of credulity and, as Tylor bade us remember, " What the poet relates may be fiction, what he mentions is apt to be history."

The old meets the new in many ways and in strange matters. We use steel and concrete as permanent constructional materials, and we seek, as man has always sought, to relieve the severity imposed by our materials by ornament and decoration. It is modern practice now to use solid plaster moulds into which figures may be cast for decorative purposes. This device was used in Central Asia and to it we owe the survival of Hellenistic types in Asiatic art so long as the moulds were available for use, till replaced by the ideals of Chinese art.

Though the methods and discipline of modern anthropology differ necessarily from those essential to archaeology, the two sciences are complementary to one another and, while archaeology helps us in some degree to realise the setting of ancient life, it is to anthropology that we look for the revival of the spirit by which alone we can picture the fullness of life as it was in the ancient world. There are left to us traces of religious rites for the safety and welfare of the dead, for which modern anthropology finds many analogies in current practice.

If we dare assume a continuity and persistence in belief, such that the mentalities of the lower culture of to-day represent in large measure the spiritual conditions of the ancient world, we can recreate much of the stirring past. We know that they distinguished the successful hunter on his death by special rites, we have evidence of the use of magical means to ensure success in the chase, for the promotion of fertility, for the welfare of the community, and of the utilisation of means identical with those employed by ruder folk to-day. Thus, these surveys of archaeological progress throughout the world permit in varying degree a realisation of the conditions in which civilisation, law and order, the arts of life and the beginnings of science made their appearance in the history of the world. (X)

II. A GENERAL SURVEY

The word " archaeology " is commonly used in several senses. To some, it is the general study of antiquity as a whole; of life, that is, *as it was*, within selected limits of time, in a selected region. In this sense, we speak, for example, of Greek or Roman or mediaeval European archaeology. But in this wide significance it is not easy to distinguish archaeology from history, or at all events from that wide and vague penumbra of political history, which is concerned with the background, circumstances and accessories of those ".great events " which preoccupy the political school of historians.

To others, interpreting archaeology more strictly, it is the study of the material remains of antiquity, as technology is the study of the material achievements of the present day, and the processes by which they are brought into being; of the ways, that is, in which man satisfies material needs by material means. In this sense, archaeology is the comparative study and interpretation of craftsmanship in bygone times.

But this conception of archaeology as " technology in the past tense, " though fundamentally justified, concentrates attention on materials and processes, to the neglect of the needs which they subserve, and the satisfaction which they are devised to ensure. In particular, current usage accepts, as an integral and important aspect of archaeology, the study of the ways in which man has in the past satisfied his aesthetic and other ideal needs by some material device such as sculpture or painting, either as self-sufficient arts or as enhancements of some other aspect of the craftsman's work than its sheer utility—as means to a material end.

Distribution of Interest.—In this aspect, archaeology is, or at least includes, the " past tense " of art-criticism; and this aesthetic consideration has in fact determined the distribution of archaeological interest and enquiry among periods and regions of culture. To apply a crude practical test, it is usually easy to raise

funds for archaeological research, when there is prospect of recovering ancient works of art; usually difficult, on the other hand, when the questions to be answered are primarily technological, or even historical. Examples are the relative popularity of Egyptian and of Babylonian archaeology; of the Minoan and mature Hellenic periods in comparison with the austere and almost artless Early Iron Age which separates them in Greek lands.

Such study of bygone schools of representative or even decorative art is obviously concerned not only with descriptions of the objects themselves, and their manufacture, but with the interpretation of them as expressions of aesthetic ideals, and also as aids to the comprehension of religious or political conceptions which stimulated or dominated the creative imagination of their makers; the symbolic art of Egypt, India and Mexico, the ideal types of Greek deities and Christian iconography, the great schools of portraiture, athletic sculpture and genre painting, with their political and social implications, are illustrations of this.

Relations with Epigraphy, etc.—Very special cases of such ulterior significance are the archaeological study of documentary objects, inscribed monuments, papyri and other classes of written records, and (in their historical aspect) of coins and medals. In so far as they are concerned with the materials, craftsmanship, circumstances of preservation and discovery, as evidence for date and significance, epigraphy, palaeography and numismatics are to be reckoned as archaeological studies, however closely the application of the facts which they reveal, is related to the work of the historian. When a writer like Rostovtzeff[1] speaks of "writing history with the aid of archaeology," he has however in mind, not documentary evidence acquired through archaeological research, but historical conclusions circumstantially established by archaeological considerations; the distribution, sequence and characteristics of certain kinds of human handiwork.

Relations with the "Humanities."—Apart from curio-hunting the formation of decorative "galleries" of old masterpieces, and such occasional freaks of zeal as the excavations of Assurbanipal or Nabonidus, archaeology is a recent offshot of the humanities. Though the Renaissance scholars were no less interested in ancient art (and especially architecture) than in literature, material relics were rarer and less manageable than texts; the first systematic publication of antiquities in J. Gruter's *Thesaurus* dates only from 1603; and J. Selden's *Marmora Oxoniensia* from 1628. Deliberate travel in search of such relics begins with the mission of the Marquis de Nointel to the Grand Turk in 1673 and the travels of Spon and Wheler in Greece in 1676; organisation of scholars for such research with the foundation of the Society of Dilettanti in 1733 and the travels of Stuart and Revett (1751–3), Pococke (1751) and Chandler (1764–6); and in France, of Choiseul-Gouffier and Pouqueville.

Other landmarks are the *Doctrina numorum veterum* of J. H. v. Eckhel (1792–8) and A. F. Mionnet's *Description de Medailles antiques* (1806–13) which laid the foundation for the scientific study of coins; Leake's pioneer work in Greek topography from his arrival in Constantinople in 1793; and above all, the scientific work of Napoleon's Egyptian expedition in the same year, of which the best known incident is the discovery of the "Rosetta Stone" which gave Champollion the clue for the decipherment of hieroglyphic texts. Tomb-robbing had been habitual in the Near East, as in Italy, especially in Etruria and Campania, since ancient times, but the notion of recording the finds as they were made hardly goes back beyond the days of Sir Richard Colt Hoare (1812–9). Systematic excavation of an ancient site was first attempted on a large scale at Herculaneum in 1738 and at Pompeii in 1763; but these were essentially sites of a single period and layer of deposit, and gave no scope for stratigraphical research, even if the historical perspective of the excavators had been sufficiently developed to allow this.

Type Sequences.—For another century, indeed, and more, the sole available method of investigation was the comparison of types and styles, with occasional aids to a fixed chronology from inscriptions on monuments and coins. Consequently it was long before archaeology could be regarded as more than an illustrative "handmaid to history." In certain departments of fine art, and especially in painting, the comparison of dated examples of successive phases of style made generalisations possible as to certain characteristics of "primitive" or "archaic," "mature" and "decadent" work within the same school; and in the early 19th century the same method gave brilliant results in the study of what had hitherto been merely "Gothic" architecture.

It was not until some progress had been made in the kindred subject of geological "fossils," with the aid of the "systematic" zoology of Linnaeus and Cuvier, and the evolutionary conceptions of Lamarck, that a beginning was made by C. J. Thomsen in the morphological classification of the prehistoric antiquities of the National Museum founded in Copenhagen by Nyrup in 1806. Thomsen, forming continuous series of implements, of less and more specialised types, and observing the resemblance (for example) of the most mature types made from stone, to the least-developed types in bronze, had established before 1830 the sequence of distinct "ages" of stone-, bronze- and iron-using culture within the same region. The same conclusion was reached independently by F. Lisch in the ducal museum of Mecklenburg-Schwerin in 1836; and Thomsen's pupil, J. J. A. Worsaae clinched these results by the discovery that in Danish peat-bogs, stone implements were found mainly in the lowest layers, characterised by the presence of remains of Scotch firs; bronze mainly in layers above these, with oak; and iron in the uppermost layers, where beech alone occurred: thus proving not only sequence of the three "ages," but periods of sufficient duration to allow considerable changes of climate. Keller's demonstration of similar superposition of types on the floors of Swiss lakes, in 1854, attracted even wider attention—the word *Kultur-schicht* for such layers of remains of handiwork, first occurring in 1855; and in 1859 the same stratigraphical argument, in the hands of Prestwich and Evans, confirmed the brilliant anticipation of Boucher de Perthes, of the glacial antiquity of the "palaeoliths" in the terrace-gravels of the Somme.

Thomsen's morphological argument, reformulated on a wider basis, and applied to human handiwork generally by G. Klemm,[2] was interpreted afresh on the new Darwinian principle of "survival of the fittest" by Sir J. Lubbock, *Prehistoric Times* (1865), and A. H. L-F Pitt Rivers, "Principles of Classification," *Jour. Anth. Inst.*, vol. 4 (1874); E. Kapp's *Grundlinien einer Philosophie der Technik* (1877), G. Semper's *Der Stil* (1878), and M. Hoernes, *Urgeschichte des Menschen* (1892), marking important extensions and refinements. And meanwhile the work of Keller and Troyon among the Swiss "lake dwellings" stimulated the copious well-directed explorations of Gastaldi (1860), Ströbel (1861), Pigorini (1863), Chierici (1864) and their pupils, in the far more accessible *terramare* settlements of Lombardy. It was indeed in this exceptionally favourable material that the technique of scientific excavation was mainly developed; to be applied, less than 10 years later, by Schliemann, on the traditional site of the Homeric Troy, to the first dissection of an exclusively dry-land site, on which the deposits had been accumulated in the open, without water-action.

Use of Photography.—By this time, the new art of photography had immensely increased the rapidity and accuracy with which discoveries could be recorded; H. Schliemann's *Atlas Trojanischer Alterthümer* (1874) is the first important use of it for purposes of publication. By way of contrast, the epoch-making tomb-records of von Sacken and Ramsauer, in the great early-iron-age cemetery at Hallstatt (1862) remained almost unutilised for a generation, because they consisted only of a single set of water-colour-drawings.

Photography had indeed been employed rather earlier to record architectural monuments, as in the Roman excavations of J. H. Parker, published in 1874; but for field work it was not till gelatine began to supersede collodion as the sensitised film, about 1875, that modern photographic registration became possible. Even the *British Barrows* of W. Greenwell and G. Rolleston

[1] *Iranians and Greeks in South Russia.* Preface.

[2] *Allgemeine Kulturgeschichte der Menschheit* (1843–52).

(1877), a model of scientific research and description, is but scantily illustrated by wood-blocks of single objects.

Organised Excavations.—With experience gained in Schliemann's Trojan excavations, in the Roman Forum, and on less important sites elsewhere, the new Imperial Govt. of Germany initiated at Olympia in 1874 the first large-scale excavation of an untouched classical site. The far earlier excavations of Newton (1856–66) at Halicarnassus and Cnidus, and those of Wood at Ephesus (1863–74) had at best surveyed and despoiled important sites which the barbarous Ottoman administration made it impossible to conserve. At Olympia and similarly later on the Acropolis of Athens, in the French excavations of Delphi and Delos and elsewhere, a civilised government undertook in advance to protect and maintain what was found, either on the spot, or in national collections, even more effectually than had been assured by the French inspectorate of antiquities in Egypt organised by Mariette in 1858. Obviously it is only on some such guarantee for the conservation of results that it is justifiable to leave exposed the foundations and other immovable monuments which excavation exposes to the risk of vandalism.

Preservation of Monuments.—Such public guardianship of ancient monuments other than buildings in habitual use, begins with a French statute of 1810, the official inspectorate of French monuments in 1830, and Guizot's *Commission des Monuments Historiques* in 1837; and with the farsighted legislation of the newly founded Greek Kingdom in 1834. The first British "Ancient Monuments Act "comes much later, in 1882, with the Hungarian Act of 1881 and the Turkish Antiquity Law of 1884, which was the first to provide for equitable division of portable objects between the state, the landowner and the excavator. Public custody of ancient monuments appears in the Greek, Italian and most of the continental enactments compulsorily; in the British Act of 1882, only in the event of voluntary transfer of a monument by its owner to the public Commission of Works. In addition the "National Trust for Places of Historic Interest or Natural Beauty" was recognised by the second British Act as a legal custodian, and has rendered many valuable services in this way. Systematic registration, somewhat on the French model, is contemplated under the Historical Monuments Commission of 1908, and some degree of conservation at public expense by the Irish Act of 1892 and the third British Act of 1913.

Records and Surveys.—Monuments, if sufficiently conspicuous or notable, have at all times found record in ordinary topographical maps; but the notion of a deliberately archaeological survey is comparatively modern. The first large scale map of the antiquities and ancient sites of a district is the magnificent *Karten von Attika* of F. Curtius and J. A. Kaupert (1884); rather earlier, but necessarily on a smaller scale, is the *Survey of Western Palestine*, with seven volumes of memoirs, executed for the Palestine Exploration Fund and published in 1881. A fine later example of such work is the *Archaeological Survey of Nubia*, necessitated by the imminent submergence of large numbers of sites and monuments by irrigation works. Local archaeological surveys in Britain, for the most part organised by private enterprise since 1890, are now supplemented and co-ordinated by the appointment of an archaeological officer to the Ordnance Survey. Outside Europe and Egypt an Archaeological Survey of India, revived and developed during Lord Curzon's vice-royalty, is the only attempt to plot the antiquities of a considerable region on a coherent plan, though the French *Mémoires de la Délégation Archaeologique en Perse* contain valuable pioneer surveys and also records of excavation.

Air Survey.—The employment of aircraft as an aid to archaeological discovery hardly occurs before the World War and is still rare and experimental. Remarkable results, however, have already been obtained in Great Britain, by the co-operation of training-units of the British R.A.F. with the archaeological department of the Ordnance Survey, and elsewhere, by British, French and Italian airmen in regions such as North Africa, Syria and Mesopotamia, where distances are great, surface travel arduous and exposure and visibility on the other hand unusually good. The peculiar value of such air-surveys results from the revelation (under favourable conditions of light, at dawn or sunset) of surface features due to denuded earthworks, hut-circles and other disturbances of the natural soil, of which the actual elevation is too slight and gradual to be plotted or even detected by an observer on the ground level (*see* section XIX. AIR SURVEY).

Value of Maps.—In a quite different direction, the employment of mapping as a means of interpreting the significance, not only of sites and monuments, but even of casual finds, is only recently becoming appreciated, now that a sufficient quantity of data have been accumulated and classified, and the significance of the mere find-spot of an object is more clearly appreciated. Such distribution-maps represent the analysis of the miscellaneous information incorporated in the regional survey, into appropriate categories, and the correlation of these with one another, and with natural features or resources cognate to their production or use.

Distribution of Amber.—For example, the distribution of objects of amber (the sources of which are known to be geographically limited) is already sufficiently well known to give valuable information as to the routes along which it was transmitted toward the most distant find-spots; and seeing that a commodity so widely prized was also highly valued, the distributions of other commodities, sometimes of unknown origins, along the same routes, throws fresh light on each other, as elements in a return-traffic, and on the significance of other resemblances between the cultures of the regions which these trade-routes interconnect.

Similarly, the growth and spread either of this or that type of culture as a whole, such as the Hallstatt or La Tène civilisation of the Early Iron Age in Europe, or of particular devices or practices such as the safety-pin or the leaf-shaped sword, or zoomorphic ornament or the custom of cremation, are demonstrated by comparing the distributions of early and of late phases of each type of object concerned; or conversely, the place of an anomalous variant in the series of development may be shown by the relative geographical extent of its distribution. Instructive examples of recent research in these directions are the work of Åberg on the Frankish types of brooches, of Peake on the leaf-shaped sword, and of Rostovtzeff on the polychrome jewellery and schools of animal-decoration in late classical and early mediæval times.

Sequence-Dating.—Though archaeology is seldom concerned, as history usually is, with individual (and, to that extent, unique) events, and consequently reckons far more often in terms of relative antiquity than of precise chronological data, some advance has been made—especially by Sir W. Flinders Petrie, working on the very large masses of cognate material derived from the predynastic cemeteries of the Nile Valley, and by Sir Arthur Evans on the copious contents of the palace-sites at Knossos, and other deposits of the Aegean bronze age—toward a method of "sequence-dating" capable of considerable refinement, especially wherever the series of development in different classes of craftsmanship support each other's indications. Unitary modifications in the general complexion of a culture, or of a single art or craft in it, appear under such circumstances to be closely related to the careers of individual craftsmen, leading to a rough reckoning by human generations.

Synchronisms.—Occasionally, such "sequence-datings" and the approximate coincidence of corresponding phases in distinct regions are even found to be confirmed and correlated with the "absolute" chronology of a country such as Egypt, of which there is documentary evidence for its history, by the occurrence of what are known as "datemarks."

The argument from such "datemarks," formulated first in essentials by Flinders Petrie and generally accepted as valid about 1890, is as follows. An object belonging to a particular phase (*c*) of a changing culture (*A*), and found in the same layer of deposit—a rubbish heap, ruined house or tomb—with a particular phase (*d*) of another culture (*B*) in the region of that culture, cannot be of later date than the objects with which it is found, while it may (obviously) have been itself more or less old already when it became associated with them. With such

unilateral association only, no further conclusion may be drawn. If, however, with objects of phase (*c*) in the region of culture (*A*), there be found even a single object belonging to phase (*d*) of culture (*B*), then it follows similarly that the intruded object (*d*), though it may have been older, cannot be of later date than the objects (*c*) with which it is found. But it has been already established that phase (*c*) cannot be later than phase (*d*); and phases, neither of which can be later than the other, are necessarily contemporary.

In this way it has been possible, for example, to synchronise phases of the Early Minoan culture of the south Aegean with the V. and VI. Dynasties of Egypt; phases of the Middle Minoan, with the XII.; and the Palace-Style of the Second Late Minoan period with the middle reigns of the XVIII. Dynasty.

Such synchronisms are rare as yet; but they become more numerous as the material becomes more copious and is more accurately recorded; and they illustrate the stages by which the purely morphological comparisons of the archaeology of the early 19th century are re-interpreted in the light of stratigraphical exploration into a closely reasoned construction which is difficult to distinguish from historical knowledge. (J. L. M.)

III. CONTINENTAL EUROPE AND GREAT BRITAIN

Eoliths.—The existence of tertiary man or of a tool-making animal, first mooted in 1867 at the congress of Paris, was only recently proved near Ipswich, thanks to Mr. Reid Moir's researches. Tertiary deposits in East Anglia were laid down, for the most part, in a shallow sea, and must have formed low sandbanks, sometimes carrying a sparse vegetation, not unsuitable to the existence of primitive man living mainly on shellfish. The argument for the existence of a tool-making animal is that certain flints have been found, chipped in several directions in a manner practically inconceivable had natural forces been the only agency at work. Further in the case of some of the East Anglian finds, it is difficult to see what natural forces could be involved.

At Thorington Hall, near Ipswich, a bi-valve shell was found in the gravels with the hinge still intact, thus indicating no differential movements in the gravels which could have set up shearing actions. Nor could the flints have been naturally chipped elsewhere and introduced later into the deposits, because tiny chips as well as larger chipped implements are found in definite layers associated together. This would not be the case if the objects had been washed in from a distance. Naturally the chipped flints are exceedingly primitive, the usual types being scrapers and beak-shaped tools. In the light of these new East Anglian discoveries a number of classical tertiary sites are being reconsidered, such as Boncelles (Belgium) and Puy de Courny (Auvergne, France).

Palaeolithic Cultures[1]

A considerable advance has been made in our knowledge of Palaeolithic man. Work has been done on the Archaeological Sequence both relative and absolute, though the exact correlation of the various cultures with the geological record still remains rather obscure. The French sequence of cultures has become standardised as follows, the names being taken from typical find-stations:—

Upper Palaeolithic	Magdalenian from La Madeleine, Tursac, Dordogne. Solutrean from Solutré, Seine et Loire. Aurignacian from Aurignac, Hte. Garonne.
Middle Palaeolithic	Mousterian from Le Moustier, Dordogne.
Lower Palaeolithic	Acheulean from St. Acheul (Amiens), Somme. Chellean from Chelles, Seine et Marne. Pre-Chellean.

These cultures have been separated on stratigraphical grounds supplemented by a typological study of the tools. Layers containing definite industries (*i.e.*, assemblages of contemporary artifacts) are often found in super-position one above the other in cave deposits. These typical industries are exclusively made of stone in Lower and Middle Palaeolithic times, but also of bone, horn, ivory and antler in Upper Palaeolithic times. Doubtless wooden tools were always manufactured, but this material of course readily disappears. It has been possible further to subdivide each culture, according to its special tool or series of tools. Thus, the Magdalenian shows no less than six sub-divisions, Sclutrean three, Aurignacian five, Mousterian three, Acheulean three and the Chellean two. Naturally these sub-divisions are of less general importance, but none the less they can be recognised over large parts of Western Europe.

It has been increasingly realised that the French sequence is not of universal application and that in other districts outside the immediate influence of Prehistoric France, conditions were not exactly similar; thus in Moravia, second only to France in importance from a Palaeolithic point of view, nothing earlier than Mousterian is found, while Upper Palaeolithic cultures, starting apparently from a similar Aurignacian stock develop on their own, only slightly influenced from other areas. The Prehistorian, even in these early times, has to deal with areas of cultural development in Europe, connected with, and influenced by, each other to a greater or less extent, but by no means necessarily similar.

Chronology.—The correlation of the archaeological and geological records remains a thorny question. On Penck's hypothesis Quaternary times, coinciding with the great Ice Age, can be sub-divided into four Glacial Maxima with warm inter-Glacial periods between. These are called from earliest to latest: Günz, Mindel, Riss and Würm, after four tributaries to the Danube basin from the German Alps, the inter-Glacial periods being called respectively Günz-Mindel, Mindel-Riss and Riss-Würm. Connected with the Glacial Maxima was the laying down over large parts of Europe of wind-borne deposits of loess, due to the cold, dry Steppe-like conditions prevailing. The early loesses and much of the evidence for earlier glaciations have been necessarily destroyed by the later ice advances, but the Würmian glaciation being of less intensity than the Riss, its terminal moraine has not reached out as far into the plains as that of its predecessor, which has thus been preserved. Other investigators have denied a fourfold glaciation system, and consider there were only three or even two Glacial Maxima. Correlation between the archaeological and geological record is obtained by finding industries typical of a culture in or on a datable deposit such as a loess, river terrace or known moraine. An absolute chronology in time is a very difficult matter. Attempts have been made to determine when the retreat of the Würmian ice began, but these have not been very successful. However, 20,000 years ago as an approximate date for the dawn of the Upper Palaeolithic has the support of many authorities and is probably not far wrong.

Home Art and Cave Art.—This consists of sculptured and engraved (rarely painted) objects found in home sites associated with datable tools. Lately a number of important examples including two good human figures, an ivory one from the Pyrenees (see fig. 7 on plate), and a dried clay one from Moravia have been found, as well as other statuettes and engravings of horse, mammoth, bear, etc. The Solutrean folk, except under the immediate influence of Magdalenians nearby, were not an artistic people, but there is both an Aurignacian and a Magdalenian art.

The old theory that sculpture necessarily preceded silhouette, which in turn preceded line engraving, no longer holds good. We find line engraving from the earliest times and sculpture of course continues to the end. It is true, however, that the proportion of engraving to sculpture increases with the development of the art.

Although the "Venuses" are Aurignacian, the Magdalenian art is by far the richest and comprises naturalistic figures of animals, patterns and conventionalisations, these latter increasing towards the end of the period. Some of the patterns seem to correspond

[1] A culture is perhaps definable as the sum of the activities of a people as shown by their industries and other deducible characteristics.

with our fashions of to-day, having a very limited existence in time, but a wide distribution in space, *e.g.*, a broken zigzag pattern is found at the same period in such widely separated areas as Cantabria and the Jura, while certain early Magdalenian motives are found as far east as Moravia. Attempts are being made to classify the Magdalenian home art of France according to technique and types of designs into six sub-divisions corresponding to those made with regard to the tools.

Cave art consists of paintings and engravings on the walls of caves and rock-shelters; they seem generally to have been made for ceremonial purposes. Two distinct groups are known of which the first, of Upper Palaeolithic date, occurs in the caves of the limestone districts of Dordogne, Lot, the Pyrenees and Cantabria and includes two anomalous areas, in southwest Spain and the heel of Italy (one cave only). Figures of contemporary animals, many of them now extinct, such as the mammoth, cave bear and woolly rhinoceros (see fig. 6 on plate), are wonderfully portrayed. The materials used were natural oxides and carbonates of iron, oxide of manganese and charcoal; these were ground up and mixed with fat, the colours obtained being light red, dark red, chocolate or light yellow, orange, blue black or coal black.

The authenticity of this art can be shown from the fact (*a*) that certain engravings have been found covered by undisturbed Palaeolithic deposits, which must therefore be later in date than the engravings themselves; (*b*) that figures of extinct animals occur sometimes covered with layers of stalactite. The drawings, with rare exceptions, bear no relationship to one another and are made one upon another. From such palimpsests studied in conjunction with the different techniques present here and in the home art, it has been possible to determine four distinct chronological phases, characterised by certain styles or techniques. Thus phase 1 is Aurignacian, phase 2 early Magdalenian, phase 3 middle Magdalenian and phase 4 late Magdalenian. The engravings of phase 1 show a deep, continuous line; both they and the paintings have no idea of perspective till right at the end of the period, and generally only two legs are indicated. A number of representations of the human hand occur as well as series of engraved parallel wavy lines. Phase 2 shows a very considerable advance. The engravings are no longer made with one continuous line, and sculptures in high and low relief have been found. Natural bosses of rock or stalactite somewhat resembling an animal are often utilised and improved, and the paintings show stump drawing or fine punctuated outlines. This perhaps was the most vigorous moment in the career of palaeolithic art.

In phase 3 the engravings become finer, but the paintings show considerable falling off. Their vigour is lost, the stump drawing becomes flat wash and the fine, punctuated lines degenerate into coarse, continuous ones. In phase 4 the engravings become exceedingly fine—mere scratchings—but are beautifully made. In one or two cases something of the nature of impressionism is present. For example, a little hairy mammoth is represented with his feet appearing from under his woolly coat, but on careful observation it will be seen that the feet have no linear connection with the body, yet the general appearance is perfect. The paintings regain somewhat the vigour of phase 2 by the use of polychrome, but although the beauty and skill of the later frescoes on the ceiling at Altamira (Spain) is astounding, the pristine freshness and vigour of the art of early Magdalenian times is perhaps somewhat lacking.

Magic.—Possible motives for this art involve the concept of sympathetic magic. Decoration or desire for expression are not explanations that satisfy the circumstances. They were certainly made for magic purposes connected with a desire for food. The fact that the phases change at the same time over wide areas indicates a continuity of intercourse between the artists-medicinemen-priests, involving something like schools of tradition. At the Trois Frères cave near St. Girons (Ariège, France) there is a little chamber at the end of a long cave, the walls of which are covered with beautiful engravings, the whole being dominated by the figure of a man masked, with antlers, as a stag and with a long tail (see fig. 1). Close by this figure and equally dominating the chamber below, is a sort of natural pulpit accessible from behind, whence no doubt the sorcerer himself officiated. The darkness and the weird silence of the cave must have been very conducive to a readily influenced state of mind, and among a hunting people an induced self-confidence is half the battle for success.

The second group occurs in rock shelters in eastern Spain and comprises paintings (and in one instance an engraving) in a totally different style from those in the caves. Scenes are common and, unlike the first group, so are representations of the human form. From the fact that a number of animals no longer living in Spain are painted, such as the rhinoceros, elk and bison, a late Palaeolithic age for this group is considered probable.

FIG. 1.—The "Sorcerer" at the cave of Trois Frères (after Breuil). (*Cambridge University Press.*)

Motives are unknown, but since they are quite clearly unconnected with "homes" they may possibly have been decorations at some sacred place.

MESOLITHIC CULTURES

At the end of Palaeolithic times, the climate rapidly changed to a more genial one (why is still uncertain) and the old arctic fauna disappeared. New cultures appear, some doubtless evolved from late Palaeolithic originals. Of these so-called "transitional" cultures, four main ones have been recognised: (1) Azilian named after Mas d'Azil, Ariège, France. (2) Tardenoisean named after Tardenois, Aisne, France. (3) Asturiense or Asturian named after Asturias, Spain. (4) Maglemosean named after the Maglemose or Great Bog, Zealand, Denmark.

The Azilian seems to have been a comparatively small culture, mainly focused round south France. It is found, however, in north Spain, east France and, in one instance, in Belgium; and anomalous finds have been discovered in western Yorkshire and in Scotland at Oban. No domestic animals with the exception, once, of the dog, occur. The industry shows tremendous falling off from the Magdalenian standard, though a new type of bone harpoon and painted pebbles (river pebbles with red dots, lines, circles, etc., on them) appear. Art disappears.

The Tardenoisean culture is mainly characterised by pygmy industries, these little tools being doubtless hafted as knives, teeth for saws, etc. Pygmy industries indicate the idea of a composite tool, and this idea could quite well develop at different times and in different parts of the world, so that the existence of pygmy industries in various continents does not indicate connection with European Tardenoisean cultures. The Asturian is a small culture found in Asturias (Spain) stratigraphically post-Azilian, but without domestic animals or pottery. Its origin and distribution are not yet fully known.

The Maglemosean culture with its flint and stag-antler industry, is centered round the Baltic where it is the first post-Glacial arrival, unless we are to separate some rare finds made of reindeer antler. It has been recognised as far south as Boulogne and as far west as eastern England. The typical tool is a special kind of harpoon.

FIGS. 1 and 5. Impressions of signets from Mycenae (see text). FIG. 2. Head of terra-cotta statuette; Thessaly. FIG. 3. Octopus Vase; Mycenae. Fig. 4. Marble statuette; Thessaly. FIG. 6. Reindeer on stone, Laugerie Basse, France. FIG. 7. Ivory figure from Lespugue, Pyrenees. FIG. 8. Piers of the Middle Minoan Viaduct, Knossos.

(Figs. 2 and 4. Fitzwilliam Mus, Cambridge. Fig. 3. Copyright A. G. B. Wace. Fig. 7. Courtesy of Comte A. St. Périer. Fig. 8. Sir A. Evans.)

Neolithic Civilisation

The Neolithic civilisation first introduced (*a*) agriculture, (*b*) domestic animals, (*c*) the making of pottery and (*d*) the making of stone tools by grinding and polishing. The effect of these four discoveries on human progress was enormous; (*a*) and (*b*) permitted a great increase of population, and also concentrated this population into definite communities. Specialisation was thus possible and practical knowledge increased; (*c*) refined the home and provided an excellent medium to be decorated for its own sake; (*d*) could produce an edge on stone thereby tough as well as sharp) a great addition to the sharp but brittle chipped flint edge. This was especially useful for carpentry. Where these new developments had their sources is uncertain but (*a*) and (*b*) were probably introduced from central Asia.

The Neolithic civilisation in Europe can be divided into three areas or circles, an eastern, a northern and a western, and in each circle there is possible a chronological sequence, generally threefold. Until the end of Neolithic times, the whole of central Europe was occupied by a primeval forest and, except for the loess lands which were free from trees, there was little intercourse between the various circles. In late Neolithic times, however, a dryness set in, the forest disappeared, the three circles coalesced and there developed a bewildering series of hybrids, closely followed by the introduction of the use of metal, the dawn of the Copper age, and then that of the early Bronze age.

Eastern Circle.—The early Neolithic folk of eastern Europe seem to have arrived from central Asia, probably driven thence westwards by increasing dryness due to the slow disappearance of the great sea area of late Quaternary times, that had made all those regions so suitable for human development. The culture is at first characterised by the so-called band pottery decorated with spirals, meanders and the like. This early linear pottery is succeeded by decoration by means of punctuated lines (*Stich Band*). A little later, an anomalous group of painted pottery appears as well, but the exact relationships of this latter are not clearly known. Its distribution extends from south Russia to Moravia and southwards as far as northern Thessaly.

The Western Circle.—In the Western Circle which extends from south Holland round to Italy, occur the well-known polished stone axes, and in lakes throughout the lower slopes of the Alps, pile dwellings. Megalithic buildings abound comprising dolmens, passage graves, stone kists, etc. The exact cradle of this Megalithic Tomb cult is still uncertain. In south Spain where they are especially varied, they coincide with a flourishing Copper age, early developed in that country, owing to the abundance of suitable ores.

The Northern Circle.—The Northern Circle includes Scandinavia and the Baltic area. Here is seen development from the Maglemose culture (see *ante*) to that of the Kitchen Middens where pottery occurs, although domestic animals, with the exception of the dog, are absent. This, in turn, influenced by the Megalithic culture from the southwest, gives rise to the well-known Megalithic cultures of Scandinavia. The earlier industries continue, however, to exist in the hinterland under the name of Arctic culture. But the Northern Circle suffered further influences from outside, for the so-called comb pottery culture coming from northern Asia seems to have arrived here at an early period, and rather later the introducers of the "single grave" and "battle axe" arrived from the east, originally probably cradled in south Russia.

The hybrids which developed at the end of Neolithic times cannot here be described; sufficient to say that strong northern influences are observable as far south as southern Germany, while the pile dwelling culture spread along the Alps till we find it in Slovenia. Finally the so-called Beaker folk, who were cradled in south Spain, arrived with their characteristic bell-shaped pottery vessels in central Europe, possibly via Belfort, and spread as far east as Budapest, reaching our own coasts by way of the Rhine valley. They had some knowledge of copper and it seems to be they who first introduced this metal into Great Britain.

Neolithic Art.—A very conventionalised art in rock-shelters in Spain of late Neolithic or Copper age is known; also a semi-naturalistic art engraved on rocks in western Norway which must be referred to the Arctic culture. Late figurines occur in the Eastern Circle but otherwise, with the exception of a good engraving of a fish on a cork float from Lake Wauwil and decorated pottery, home art is rare.

England.—Except from the point of view of chronology and its tertiary deposits, England is not specially important from the prehistorian's point of view. It lies far to the north and was long under the influence of the great Scandinavian ice-field. Rich Lower Palaeolithic deposits occur, specially in the basins of the Ouse and Thames. Mousterian industries, both with warm and cold fauna, have been found in the Thames basin and presumed Mousterian industries occur in caves in the southwest as well as in Derbyshire. Upper Palaeolithic industries are rare, some being found in a few caves. These show Aurignacian development with only a little influence from the Solutrean and Magdalenian cultures farther south. Pygmy industries are being discovered, specially round Sheffield, and include the pygmy Burin typical of Tardenoisean times. In northern England, an Azilian harpoon has been found to the west of the Pennines, Tardenoisean industries on the hills themselves and a Maglemosean harpoon to the east.[1] Little progress has been made in systematising the British Neolithic industries, although much has been done in docketing the Megalithic constructions, and Neolithic home sites with pottery, etc., have been excavated near Peterborough. Distribution maps for eastern England show that the forest lands were not peopled by Neolithic folk, who preferred the dry, sandy areas of Norfolk and Suffolk overlooking the Fens, with an open hinterland behind for their small flocks and herds. The absence of sickles points to but little agriculture. The Fen islands were only occupied at the end of the time, probably on account of pressure from the oncoming Beaker folk.

The Bronze Age

The outstanding Bronze age discoveries since 1910 are, of course, those of Crete, the Aegean and Mesopotamia. Elsewhere systematic work has continued following largely typological grounds. One of the earliest sites seems to be Aunjetitz in Bohemia, but exactly how metal was introduced into northern Europe is still a moot point; certain it is, however, that the Beaker folk knew of the use of copper.

The Early Iron Age

Similar systematic work and excavation continue in Early Iron age sites. The dryness of late Neolithic and Bronze age times was replaced by increasing dampness, and possibly the big folk-movements of the early Iron age were due to deteriorating climatic conditions. The main discovery in England of importance, is the find of this "Hallstadt" culture, hitherto believed absent. Typical pottery was first recognised near Devizes and is now probable from a number of sites in East Anglia and elsewhere.

Bibliography.—M. Hoernes, *Urgeschichte der Bildenden Kunst in Europa* (1915); E. A. Parkyn, *Prehistoric Art* (1915); H. F. Osborn, *Men of the Old Stone Age* (1918); R. A. S. Macalister, *A Text Book of European Archaeology* (1921); Marcellin Boule, *Les Hommes Fossiles* (1923); C. Fox, *The Archaeology of the Cambridge Region* (1923); G. G. MacCurdy, *Human Origins* (1924); H. Obermaier, *Fossil Man in Spain* (1924); W. J. Sollas, *Ancient Hunters* (1924); M. C. Burkitt, *Prehistory* (1925); V. G. Childe, *The Dawn of European Civilisation* (1925); O. G. S. Crawford, *The Long Barrows of the Cotswolds* (1925); Sir A. Keith, *The Antiquity of Man* (1925). (M. C. B.)

IV. ITALY AND THE WESTERN MEDITERRANEAN

Italy.—Despite wars and the resulting poverty in Italy, excavations continue. Archaeological reports since 1910 in the standard publications (the *Notizie degli Scavi*, the *Monumenti Antichi* and the two *Bulletini*) cover more than 20,000 packed pages. In the prehistoric field the harvest is still of great importance. The Picene region has yielded hundreds of well-

[1] It is possible that some of the small industries found on the surface in East Anglia may belong to this latter culture.

stored inhumation tombs which form a series of links between the neolithic and historic times. The finds are well placed in the Ancona Museum (Dall' Osso, *Museo di Ancona*). They explain fully why the rich Adriatic littoral was not disturbed by the Terramara invaders: the neolithic folk lived on in Picenum and barred the way. Unfortunately, some recent archaeologists, obsessed by the new "Picene hypothesis," have forgotten linguistic evidence to the point of substituting the word *Picene* for *Sabellic* throughout eastern Italy.

North of the Po, at and near Este in the Euganian region, valuable excavations have been carried on for over 10 years (*Bull. Paletn. Ital.* 1911; *Not. d. Sc.*, 1916–22). The "Atestines" were evidently a strong and wealthy people from the 8th till the 5th century, with a civilisation akin to that of the Villanova folk and in their later days strongly influenced by the Etruscans. From the great Terramara people we have had but little fresh material. The Golaseccans of the Italian Lake region are still a riddle. A few new discoveries seem to indicate that they were a tribe distinct from the Terramaricoli, and some scholars incline to the view that they represent the first Celtic invaders of Italy, though a very early group. Nothing decisive has been found in the Ligurian country. The few cremation tombs recently unearthed there may possibly belong to a wedge of Terramara folk. They certainly do not prove the Ligurians Indo-European.

Villanova sites throughout Etruria and neighbouring regions are still yielding rich rewards that confirm previous discoveries. Randall-MacIver's[1] assignment of the early Iron Age settlements of Rome and the Alban Hills to this people will probably carry conviction. The most fruitful discoveries have been made near Bologna, at Vulci, Veii (still unpublished), the Faliscan region (Holland, *The Faliscans in Prehistoric Times*), Terni (*Not. d. Sc.*, 1914, p. 3), the Alban Hills (*Bull. Paletn. Ital.*, 1924) and Antium (9th century cremation tombs found on landing the Italo-American cable in 1925). Clearly the Sabellic tribes brought inhumation into the eastern border towns of the Villanovans (from Falerii to Latium) a century or more before the Etruscans reached those places. For the excavations of many important nuraghi in Sardinia one may consult Taramelli's new catalogue of the museum of Cagliari. For the whole field of prehistoric archaeology in Italy down to the 7th century we have now a nearly complete *corpus* of the material in F. von Duhn's *Italische Gräberkunde* (1924), a book of profound erudition.

Of Etruscan sites, Caere has yielded exceedingly fine Greek vases besides valuable funerary objects and inscriptions, which will aid in restoring the history of Etruscan culture from the earliest day till Roman times. Unfortunately very few of these tombs have been published. Veii has proved unexpectedly fruitful. The foundations of a three-cella temple were found, and near it considerable fragments of a 6th-century terra-cotta group representing a contest between Apollo and Hercules, probably an acroterion of the temple. The Apollo, now in the Villa Giulia, is a masterpiece of its century (*Not. d. Sc.*, 1919). Many of the terra-cotta antefixes (*Not. d. Sc.*, 1922, 206) are also of rare beauty. On the acropolis of the city have been found parts of the old city wall, foundations of several Etruscan dwellings and two public buildings, and a large elliptical basement, which is supposed to be the foundation for a straw-thatched town hall of very early date. Farther north were discovered the stone walls of a 7th-century dwelling-house of five rooms—the oldest structure of its kind in Italy (*Not. d. Sc.*, 1913 and 1922, 206–380). The tombs have proved that Veii was once a Villanova city which fell into the hands of Etruscan rulers sometime before Rome's foundation.

Populonia, which prospered on the manufacture of the iron-ore of Elba, has yielded many important finds. During the recent War numerous shiploads of iron slag from the ancient Etruscan furnaces were removed for re-smelting, and in the process an old cemetery was uncovered. These graves and others near by were found to be well-stored with urns, arms and ornaments which A. Minto has recently published in a volume entitled *Populonia* (Firenze, 1922). A similar series on excavations at Marsiliana has also been published by the same scholar. At Orvieto a 4th-century Etruscan temple with excellent pedimental terra-cottas has been found, important especially because of the tendencies of contemporary Greek art which they reflect. Good illustrations of these finds have just been published in *Dedalo* (1925, p. 136). Vignanello has yielded good Greek vases as well as much Etruscan ware. A grave at Todi has been found to contain numerous red-figured vases and some good Etruscan armour. Finally, at Rome, on Monte Mario behind the Vatican, casual building operations revealed a very interesting 7th-century Etruscan village built over the site of an early Bronze-Age settlement. The *corpus* of Etruscan inscriptions has also advanced by several fascicles with many new inscriptions, but no real advance has yet been made toward their interpretation. A convenient summary of Etruscan art in Rome is to be found in R. A. L. Fell, *Etruria and Rome* (1924).[2]

Rome.—The city of Rome still yields a constant stream of ancient works of art. The terms of the recent treaty restored the whole of the Capitoline hill to Italy, and the government with characteristic zeal at once ordered the excavation of the site of Rome's chief temple. The massive foundations of Tarquin's structure were laid bare and found to agree with the dimensions recorded by ancient authorities (*Not. d. Sc.*, vol. 18, 1921). Unfortunately none of the decorative terra-cottas of the old temple have as yet come to light. In the Forum little has been done because of the long illness of Senator Boni, whose recent death ended a remarkable career as an excavator. On the Palatine the rear of the Imperial palace was cleared in 1915 and some excellent wall paintings and mosaics of the Claudian and Neronian periods brought to light in abandoned rooms beneath. In similar rooms found under the front of the palace were discovered wall decorations of great historical interest dating from the Ciceronian period. These are briefly described in G. Lugli's recent guide to the *Zona Archeologica di Roma* (1924). The most valuable treasure yielded by the Palatine in recent years is the exquisite but still unpublished Nike, which will probably find a worthy position in the National Museum.

The city government has excavated a large part of the Augustan Forum. The numerous architectural fragments found from the Temple of Mars Ultor, the portico near by and the marble covering of the enclosing wall are of great beauty and precision, and several inscriptions of historical importance have also come to light.

Several rooms of Nero's "Golden House" were cleared. The debris had been searched long ago for works of art, but the walls, protected by the superimposition of Hadrian's buildings, were found to be decorated in a style resembling that of the "Claudian" rooms of the Palatine. The small and richly coloured panels set in embroidered stucco are excellently executed but overloaded in design, as are the Renaissance loggia arabesques which they inspired. In many places on the walls were found the signatures of Renaissance artists who had crawled over the debris to study the ceiling decorations (partial report in *Jahrb. des Kaiser-Deutschen. Arch. Inst.*, 1913, p. 217). Among statues recently found, there should be mentioned, besides the Nike, an excellent portrait of Augustus (*Not. d. Sc.*, 1910, 223), an "Artemis" from Aricia (*Jahrb. des Kaiser-Deutschen. Arch. Inst.* 1922, 112), an excellent bronze representing a youth of the Julio-Claudian house, now in New York (*Am. Jour. Arch.*, 1915). Furthermore, some forgotten fragments of great importance, which have long been lying and awaiting study in the basement of the Vatican, include a fine head from a Parthenon metope and a good copy of one of the "Tyrannicides" (unpubl.).

In 1917 there was discovered under the railway outside of Porta Maggiore a mysterious underground "Basilica" in almost perfect preservation, probably of the 1st century A.D. It had been built by sinking shafts in which the concrete walls and the piers of the nave were moulded. After a concrete vault had been cast over the walls, the enclosed earth had been removed and the

[1] *Villanovans and Early Etruscans* (Oxford, 1925), a reliable survey and a penetrating analysis of the material.

[2] See also Randall-MacIver, and von Duhn, *op. cit.*, who will both treat Etruscan archaeology more fully in their forthcoming volumes.

walls and ceiling plastered and very richly stuccoed in low relief with mythological and genre scenes. It is, perhaps, the best preserved monumental structure of the Roman world, and the lavish stucco work, though not quite as delicate as that of the Farnesina, shows an ease and freedom of execution which gives it high rank. Whether the themes were merely decorative or were meant to be symbolic, is not known. Indeed, the purpose of the structure is still under discussion. Scholars incline to the belief that it was the meeting-place of a group devoted to some mystical cult (Mrs. E. Strong, *Jour. Hellenic Stud.*, Part I, 1924). The tomb of the Aurelii found on the Viale Manzoni (*Mon. Ant.*, 1922) has awakened much comment because of its excellent figures in fresco and the Christian symbolism that some of the paintings seem to contain. There is a seated figure before a flock that seems to symbolise Christ as Judge. Eleven excellent standing figures have with less certainty been identified with the Apostles. The new excavations of Imperial Rome constantly disclose the evidence of oriental cults. Another tomb well decorated with interesting wall paintings is that of Octavia north of the Vatican (*Not. d. Sc.*, 1922). The two largest Mithraea known have also come to light in this period, one under S. Clemente, the other under the baths of Caracalla (*Not. d. Sc.*, 1912).

Under the church of San Sebastian were found a number of columbaria of the 1st century made for pagan cremation and decorated with excellent paintings and stucco which in the 2nd century were converted into burial places. The area was then levelled off and a room for funeral banquets constructed. The walls of this room contained a great number of invocations to Peter and Paul rudely scratched. These finds will have an important place in early Christian history (*Not. d. Sc.*, 1923). Recent restorations of the churches of Santa Sabina, S. Quattro Coronati and S. Giorgio in Velabro have also revealed earlier structures of value to church history. In the rapid expansion of Rome since 1918 a very large number of tombs with sarcophagi, hundreds of important inscriptions, and three new series of catacombs have been found. These have been reported with commendable speed in the *Notizie degli Scavi*.

In the vicinity of Rome the more important excavations have disclosed Horace's villa on his Sabine farm (soon to be published in *Not. d. Sc.*), details of Domitian's palace at Albano, of Hadrian's villa near Tivoli, a splendid and very old temple with fine terra-cottas at Lanuvio (*Mon. Ant.*, vol. 27, 1921), valuable fragments of a pre-Julian calendar at Anzio (*Not. d. Sc.*, vol. 18, 1921), and a very important part of the seaport town of Ostia. At Ostia the finds are so numerous that a mere enumeration would require pages. The walls and gates of the oldest settlement (4th cent.?), which Virgil seems to describe in his seventh book, have been disclosed; the more extensive wall of the 1st century B.C. has been traced throughout and two of its excellently constructed gates cleared; the Forum of the late republic has been excavated, a temple of Rome and Augustus found at one end, and beneath the pavement of the Forum a series of barrack-rooms and offices of the oldest town. Many new temples, the offices of the city guard, the offices of the foreign shippers, the large cistern of the city, numerous state granaries, the foundations of what seems to be the earliest Temple of Jupiter, the municipal Senate house, a very interesting safety storage house, and much else can now be studied. Of particular interest in revealing the plan of city dwellings are the extensive ruins of the "Casa di Diana" which, rising to three or four storeys, contained many suites of independent apartments which received their light through windows opening to the streets. This rather than the Pompeian type of dwelling we must now assume for the city of Rome.[1]

The excavations at Pompeii in 1925 yielded a magnificent Greek bronze Ephebus, perhaps the best work of art that the buried city has disclosed. It is now in the Naples Museum. (See *Bull. d Arté*, 1926, p. 341.) The work of clearing the western part of the city has progressed uninterruptedly. A large number of houses of moderate size with fair wall paintings have been found, among them several of religious import—a Cybele group, a Pompeian Venus, a group of the twelve gods. Of particular interest are several with picturesque balconies, and an office decorated with representations of armour, supposed by some to be the headquarters of the *juvenes*, the ancient "boy scouts." The newly found structures have been carefully restored and the paintings well protected from weathering and decay, but publication has not kept pace with the excavations.

Finally, very important excavations have been diligently and carefully conducted on the Greek sites of lower Italy and Sicily. E. Gabrici published in two sumptuous volumes the discoveries made before the War at Cumae (*Mon. Ant.*, vol. 22). Since Cumae was for centuries the Greek tutor of Italian barbarians these volumes are indispensable to students of Greek and Italian studies. Unfortunately the excavations of the Temple of Apollo, the home of the sibyl whose oracles brought so many Greek rites to Rome, were stopped by the War and left incomplete. In southern Italy P. Orsi has excavated Locri, Caulonia, Medma and other sites, with striking finds of Greek vases, remarkably fine architectural decorations in terra-cotta, early Greek entablatures of great beauty, and large numbers of terra-cotta votive figures of no mean artistic value. ("Caulonia," *Mon. Ant.*, vol. 23 [1914–6]; W. A. Oldfather, "Locri" in Pauly-Wissowa; *Not. d. Sc.*, 1917 for Medma.) At Ciro in Calabria he has found a remarkable head of an acrolithic Apollo of about 460 B.C. (*Atene e Roma*, 1925). He has also published the finds from an important archaic Temple of Megara Hyblaea in *Mon. Ant.*, p. 110, (1921). But the most important work of the kind has been Orsi's extensive excavations in Syracuse, especially of the site and ruins of the great Temple of Athena. Here were found a rich store of objects from pre-Greek huts, of early Greek edifices and especially many exquisitely executed fragments of the 5th-century temple (*Not. d. Sc.*, 1910, and *Mon. Ant.*, 1918, pp. 354–762). The state has also begun a thorough-going archaeological survey of Italy, the first fascicle of which has been published by Prof. Lugli.

Spain.—Spanish archaeologists have in recent years done their most vigorous and fruitful work in the Palaeolithic sites, where discoveries of capital importance have been made. It is now clear that Spanish culture of the late Lower and the Upper Palaeolithic periods is closely connected with the Capsian art of Tunis. Because of a greater readiness to use human figures in their paintings, in hunting, ritualistic and battle scenes, than the contemporary Aurignacian-Magdalenian art of southern France has revealed, this art of Spain promises especially to attract the students of early anthropology. Obermaier has made a careful summary of results in his *Fossil Man in Spain* (1924).[2]

For the beginnings of Protohistoric art we have many valuable bronze objects from a sunken cargo of about the 10th century B.C., found outside of Huelva, apparently destined for, or coming from, the then important city of Tartessus (*C. R. Acad. Insc.*, 1923, p. 203). The city itself is being searched for near the mouth of the Guadalquivir by A. Schulten (*Arch. Anzeiger*, 1924). Of the numerous minor objects found in Carthaginian and Iberian sites a full account may be read in Bosch-Gimpera's recent report (*Arch. Anzeiger*, 1924, col. 172). The Greek colony of Emporion has yielded little but walls and an Aesculapius statue which, though heavy in execution, is pronounced by Carpenter a 5th-century Athenian work (*The Greeks in Spain* [1925]; P. Paris, *Promenades Arch. en Espagne*, 1921). Carpenter (*ibid.*) seems also to have discovered the site of the important Greek city of Hemeroskopeion. On Roman sites excavations are continuing at Mérida, especially in the imposing theatre constructed by Agrippa, where a good seated Ceres was found; at Italica, the first Roman colony of Spain; and at the Roman camps around

[1] Prof. Calza, the director of excavations at Ostia, has issued a convenient guidebook with references to the publication of the various finds (Calza, *Guida di Ostia*, 1925).

[2] The detailed reports of the more striking of recent finds are: for northwestern Spain: H. Breuil, *La Pasiega* (1913); H. Obermaier, *Com. Inv. Pal. Pre* (1918); E. Hernández-Pacheco, *ibid.* (1919); for the east and south: H. Obermaier, *Com. Inv. Pal. Pre.* (1919); H. Breuil, *L'Anthr.* (1912, 1920, 1921); and *La Pileta* (Monaco, 1915). G. G. MacCurdy, *Human Origins* (1924), records the most important finds.

Numantia constructed during the famous siege of that Celt-Iberic city (*cf.* P. Paris, *Prom. Arch. en Espagne*, 1921; J. R. Mélida, *El teatro romano de Mérida*, 1915; A. Schulten, *Numantia*, 1905; Bosch-Gimpera in *Arch. Anzeiger*, 1924).

France.—Here also the striking discoveries have been made in the caves of the Palaeolithic period. In 1923 Casteret found in the caverns of Montespan over a score of animal figures modelled in clay, in relief and in the round (*Rev. Anthr.*, 1923). Many of the bodies were significantly covered with dart thrusts. Of almost equal importance is the " Cavern of David " with its many paintings and especially its engraved figures of men and women, relatively few of which have hitherto come to light north of the Pyrenees (*Illust. Lond. News*, 1923, Oct. 20). Other important discoveries of the period are reported from Dordogne (G. Lalanne, *L'Anthr.*, 1912; Dr. L. Capitan, *C. R. Acad.*, 1913) and from Ariège (Comte H. Begouen, *Congr. Int. Anthr. Geneva*, 1912, and *C. R. Acad*, 1920, p. 303). Many scattered finds of the Hallstatt and La Tène periods have been recorded in French reports, but none of striking importance. For the Roman period excavations have cleared large areas at and about Alesia, disclosing, particularly, parts of the fortifications of Caesar and Vercingetorix (*C. R. Acad.*, 1912 and 1924), at the Roman citadel of Lyons (*Ibid.*, 1925) and at the sites of the public buildings of Vienne and Orangé (*Rev. Arch.*, 1924). (T. Fr.)

V. NORTH AFRICA

Cyrene.—The outstanding archaeological event of the period under review in North Africa is the exploration of Cyrene. Since the expedition of Lieut. Murdock Smith, R. E., and Comm. Porcher, R.N., in 1860, this important site had not been approached until a party from an American yacht reached it in 1904. As a result of their visit, a permit to excavate was obtained from the Turkish Govt. and an expedition under the late Richard Norton was sent out by the Archaeological Institute of America in 1910.

Work was at first impeded by the fears and ignorance of local Arabs, and, when these obstacles had been overcome, one member of the staff was shot by assassins. But the excavators were not deterred, and considerable results were obtained in the first season (*Bulletin of the Arch. Inst. of America*, vol. 2, 1910–1). A beginning was made in the clearance of buildings on the Acropolis, cultivated land near the Fountain of Apollo was tested, and some of the conspicuous chamber-tombs were examined. Several pieces of sculpture were found, the best being a head of Athena. From the cultivated land thousands of terra-cotta votive statuettes of archaic Greek style were recovered. All the tombs had been robbed in antiquity. In 1911 Tripoli and Cyrenaica were occupied by Italian military forces, and the American expedition was not allowed to resume its work. The excavation was continued in the following years by the Italian Colonial Service of Antiquities. Several buildings were cleared and identified, and extensive finds of marble sculpture were made.

The most highly appreciated piece is a headless statue of a nude Aphrodite, thought to be Greek work of the 4th century B.C. This was taken to Rome where it is now exhibited in the Museo delle Terme. The rest of the material from Cyrene has been placed in the museum of Benghazi. The Aphrodite was brought to light by the collapse of a wall supporting the platform of the Temple of Apollo. Excavation in this place laid bare the Baths from which 20 Hellenistic or Greco-Roman statues were recovered. The central niche in the Great Hall was occupied by a colossal portrait-statue of Alexander the Great. A colossal figure of Zeus *Aigiochos* was found in a temple, in front of a large inscribed base, which may have supported cult-statues of the Capitoline triad. Besides the official publication of these finds in the *Notiziario Archeologico* of the Italian Colonial office, many of the statues have been illustrated and discussed elsewhere.[1] More recent excavations have cleared the Temple of Zeus (or the Capitoline deities) and the *Tabularium*, and have revealed an earlier Greek structure beneath the Temple of Apollo. Two marble torsos of archaic *korai* and votive terra-cotta statuettes are the only material known that belongs to the time of the city's greatness. The early cemetery has not been located. An account of the work done at Cyrene from 1919 to 1922, was published in *Aegyptus*, 1923.

Tripolitania.—Much has been done on other sites in Tripolitania, and in the archaeological organisation of the new province. Museums have been established at Tripoli, Benghazi and Homs: the last is the repository for finds made in the excavation of Leptis Magna.[2] This particularly splendid Roman city has been found marvellously well preserved beneath sand dunes.[3] The triumphal arch of Marcus Aurelius at Tripoli has been cleared. A torso of Apollo, discovered in the demolition of the fortifications, is said to be the finest piece of Greek sculpture in marble yet found in Africa, and a Roman villa at Zliten contained the finest mosaics.[4]

Another prolific source of Hellenistic sculpture, which alone would have brought North Africa to the first place among classical lands, is a sunken ship which was located off Mahedia, near Thapsus in 1907.[5,6] A valuable document in the history of art is a bronze herm inscribed with the name of its sculptor, Boëthos of Chalchedon. Later salvage includes small decorative bronzes belonging to furniture, parts of large marble vases and candelabra in Neo-Attic style, and a painted Campanian plate of the 2nd century B.C. The ship has been closely examined. Its hold was divided into three compartments, in which the statuary was stowed, and it carried a deck-load of 65 unfluted marble columns. It seems to have brought its last cargo from Athens. The surviving pieces are in the Museum of the Bardo (Musée Alaoui) at Tunis. Two large bronze statuettes of the same kind, a standing boy and a seated girl, came from the harbour of Hippo Regius in 1912, and another of earlier style, perhaps a Greek original of the 5th century, representing a young horseman, was found at Volubilis in 1918.[7]

Morocco.—The excavation of Volubilis (Qsar-Farun), the centre of Roman domination in Morocco, was begun by direction of Marshal Lyautey in 1915, the labour being supplied by German prisoners of war. A triumphal arch and the ruins of a basilica were the visible monuments of the site. The excavations, which are still in progress, have revealed the general plan of the city, the forum with its tribune, baths and other public buildings, shops and private houses. In the latter are some good mosaics, one showing a rider sitting backwards on his horse and holding out a cup, presumably a winning jockey with his prize. Numerous inscriptions throw light on the date and status of the city; curiosities among them are dedications to Mithras and Commodus by one Aurelius Nectorega, a centurion in command of British cavalry stationed there.

Tunisia.—New cities added to the imposing series of Tunisia are Bulla Regia and Thuburbo Majus; Sufetula has been further excavated, and the three temples of the capitol, the gate of the forum, the triumphal arch and other monuments have been repaired with their original stones. This is one of the finest Roman cities of North Africa.[8] A complete set of bronze cult-vessels was found in a vault of the Capitolium at Pupput.

Algeria.—No new work of importance has been begun in Algeria, but in this province, as in Tunisia, the clearance and reconstitution of cities such as Timgad and Lambaesis goes on with constant accumulation of new material. Thubursicum can show a particularly well-preserved theatre, and Madaurus has baths with latrines. Inscriptions and mosaics are the peculiar riches of North Africa. Among the latter there is now a portrait of Xenophon at Sufetula to match the Virgil of Hadrumetum; favourite subjects are ships, buildings, landscapes and animals. The

[1] Bullettino d'Arte, *Cronaca* (June, 1914; Nov. 1915; May to Aug. 1918); *Journal of Hellenic Studies* (1920, 1921).

[2] *Notizario Arch.* 3 (1922).

[3] *Dedalo* (April 1925).

[4] *Dedalo* (Nov. 1923).

[5] *Comptes Rendus, Académie des Inscriptions* (1908–11, 1913).

[6] The finest of the bronzes recovered up to 1910 were published in *Monuments et Mémoires: Fondation Piot*, 17, 18 (1909–10), and the marbles in *Rev. Arch.* 18 (1911).

[7] *C. R. Acad. des Ins.* (1919); *Gazette des Beaux Arts* (Jan. 1921).

[8] A. Merlin in *Notes et Documents*, Tunis, Direction des Antiquités et Arts 5 (1912).

mosaic floor of a tomb at Lambiridi bears extraordinary figures which are said to illustrate hermetism.[1]

Carthage.—New interest has recently been shown in the site of Carthage, although it is too late to save much of it from damage done by building-contractors and irresponsible excavators. In 1924–5 an American university expedition has begun operations there. Dr. L. Carton has done valuable work on the topography of the Punic city, identifying the commercial and war-harbours, the admiralty island, lines of sea-walls and quays and other features.[2] Three cemeteries, covering in succession the period from the 7th to the 3rd century B.C., have been located, and a sanctuary of Tanit has been explored. The latter was full of votive offerings, each consisting of a monumental stone or altar and a buried jar which contained the relics of burnt sacrifice, charred wood and bones of infants. Punic graves have also been explored in the neighbourhood of Thapsus.

Libyan Elements.—Beside the intrusive Semitic, Greek and Latin cultures, the native Libyan elements are being more closely studied. Remains of the ancient language have been connected with modern Berber dialects, prehistoric rock-paintings have been compared with those of French and Spanish caves, and a special study has been made of dolmens and megalithic structures in the district south of Constantine. Other Iberian connections are indicated in Libyan place-names, and on the eastern side of the Mediterranean region research has detected strong Libyan influence in the Minoan civilisation of prehistoric Greece.

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(E. J. F.)

VI. SOUTH AND CENTRAL AFRICA

The boundary between Africa and Egypt and the northern and northwestern portions of the continent must be both conventional and provisional. The explorations during the last 20 years of Reisner at Kerma in Nubia (between the 3rd and 4th cataracts) and of Garstang at Meroe, have carried Egyptian influence so far south in the Nile Valley that these sites, although inhabited by peoples of mixed culture, must from the archaeological standpoint be referred rather to Egypt than to the Sudan.

No such line of division exists in the west between the North African cultures and those of negro-land; indeed Gautier[3] has shown that there is good reason to suppose that the latter has advanced perhaps as much as 1,000 km. at the expense of the former, during the last two or three thousand years. Moreover, Meroe itself does not accurately represent the southern limits of the mixed civilisation to which it has given its name; some 12 m. south of Khartum on the right bank of the Blue Nile are the remains of Soba, a Meroitic site, later the capital of the Christian kingdom of 'Alwa (the Alut of the hieroglyphs) while, as will be seen later, Meroitic remains have been recently discovered 200 m. south of Khartum.

Yet Meroe, which lies in the neighbourhood of the 17th parallel of north latitude, and which as far as our present knowledge goes was the most southern city of importance in classical times, may well stand as the main southern bastion of Egyptian influence, and the area with which this article will deal is that part of Africa lying south of 16° north, which will be divided into three provinces, eastern, western and southern.

The Nile-Congo watershed, a natural feature of geographical and ethnic importance, constitutes part of the dividing line between the eastern and western areas, which continues northwards along the broad ridge of relatively high land that roughly divides the territories of the Anglo-Egyptian Sudan from those administered by France. Thus the boundary line somewhat closely follows the western confines of Darfur, while south of the Nile-Congo watershed it coincides with the boundary between the Belgian Congo and British territories to the east, both eastern and western provinces being limited to the south by a line roughly following the 10th parallel of south latitude.

The Eastern Province

Palaeolithic Artifacts.—Here discoveries have so far been limited to the Sudan, Uganda, Somaliland, Kenya Colony and Abyssinia, while surprisingly little is yet known of the early prehistory of even these territories. Except possibly in the extreme north, within a few miles of Halfa, no implement of River-drift type is known to have been found in the Sudan. This fact may be due to incomplete exploration, but is of some significance considering the abundance of specimens which have been found on the surface in Egypt and Libya, in Somaliland (where Mr. H. W. Seton-Karr has collected countless specimens of River-drift and Mousterian types), South Africa, and recently, in deposits, by Mr. Wayland in Uganda, though the majority of the implements he discovered are perhaps to be associated with the Le Moustier *facies* rather than that of the River-drift. Be this as it may, Mr. Wayland has collected Chellean hand-axes in gravels, considered of pleistocene date, capping quartzite hill tops some 300 ft. above the present level of the lake, and also implements of a well-developed Mousterian type, including "points, side-scrapers, flake knives, tortoise cores and tortoise points," as well as two typical side-scrapers in a cave under some five ft. of cave earth.[4]

No typical Mousterian specimens have yet been found in the Sudan; certain specimens were collected from two sites, namely, Jebel Katul in northwest Kordofan, and Jebel Gule in Dar Fung. At the former site were found near the foot of the hill, a number of roughly worked stones, considered by the Abbé Breuil to belong to the Mousterian period, to which he also referred a number of thick fluted and engrailed scrapers from Jebel Gule, which somewhat closely resemble palaeolithic discs from Suffolk and other localities, while one implement was regarded as a true but much worn coup-de-poing of Mousterian age. So far as is known no implements attributable to the latter part of the Old Stone Age have been found anywhere in the Eastern Province, certain pygmy implements which will be mentioned later being regarded as neolithic.[5]

Neolithic Age.—Evidence concerning the New Stone Age is furnished by a number of finds made on widely scattered sites in the Sudan, Uganda and Kenya Colony, but there are hints that in parts of negro-Africa, which nowhere had a Copper or Bronze Age, stone implements may have persisted to within the last few centuries and the use of iron be quite recent.

Stone Axes.—The distribution of the most typical of neolithic implements, the ground stone axe, makes it necessary to refer to the conditions prevailing north of latitude 16 degrees. Unknown in predynastic Egypt polished axe heads are common in Nubia, where a number have been found in predynastic and early dynastic tombs. Many examples have come from Meroe, and specimens probably occur on every site of neolithic date in the Sudan; they have been found, *e.g.*, at Jebel Geili, 90 m. east of Khartum, at Jebel Gule, between the White and Blue Niles, and at Faragab in Northern Kordofan; moreover, the grooves in the rock faces on which they were ground exist both at Jebel Gule and Jebel Geili, while stone axes of a peculiar type have been found in western Darfur by Mr. D. Newbold. These facts all seem to support the idea put forward (*Rep. Brit. Assn.*, Pres. Address, Section H. 1915) that the ground stone axes of the Nile Valley are of negro origin, a view consistent with their occurrence

[1] *Rev. Arch.* (May to June 1922).

[2] *C. R. Acad. des Ins.* (1912; 1918–20); *Rev. Arch.* (Sept. to Oct. 1911; May to June 1919; May to June 1923).

[3] Gautier, E. F., "Études d'ethnographie saharienne," *L'Anthropologie* (1907).

[4] A. A. Smith and E. J. Wayland, *Some Primitive Stone Implements from Uganda* (Uganda Protectorate, Geological Survey Dept., 1923), and verbal information.

[5] For an account of the Jebel Gule site and the different types of implements found, see C. G. Seligman, "A Neolithic Site in the Anglo-Egyptian Sudan," *Jour. Roy. Anth. Inst.*, vol. 40 (1910).

in the Congo, and, in relatively enormous numbers, in the Gold Coast. Perforated disks or rings, and hollow conical and spherical stones, all ground in the usual neolithic style, have been found at Meroe, on Jebel Haraza (Kordofan) and at Jebel Geili, where stone disks and axe heads can be definitely associated together and with Meroitic potsherds.

Besides the types already alluded to, Jebel Gule yielded a large number of pygmy implements of quartz, carnelian and hornstone (similar to those found in South Africa and attributed to Bushmen), and there is reason to believe that this industry also existed at Faragab, where these " points " were used to bore the innumerable disk heads of ostrich egg-shell which cover the ground. Of these pygmy implements from Gule one was a well-marked lunate of Tardenoisian form, and this specimen may lead to the consideration of the distribution of the Tardenoisian type in the eastern Province. The British Museum has a number of beautifully worked *dos abattu* specimens of obsidian from the neighbourhood of Njoro in Kenya Colony; typical lunates, of jasper and of carnelian respectively, have been found in Uganda (Wayland), while to pass northwards of latitude 16°, Dr. G. A. Reisner (*Sudan Notes and Records*, vol. 2, No. 4, 1919) has found in tombs dating to the Egyptian XXV. Dynasty in Upper Nubia, perfect lunates of carnelian, in such numbers that there can be no question of their inclusion in the tombs being accidental. The handiwork of man is evident.

This may close the account of stone implements which may be assigned to the Stone Age cultures, so long as it is realised that the Neolithic certainly comes down to a period vastly more recent than the Neolithic of even northern Europe, and that in the Sudan, at least, it is overlapped by the Meroitic civilisation, numerous outliers of which have been found, including those of Jebel Geili, another in the neighbourhood of the Makwardam on the Blue Nile, notable for its Greco-Roman bronze vessels, and at Abu Sofian in western Kordofan. Although there is no evidence to show that they are Meroitic it will be convenient here to refer to the discoveries made by Mr. H. S. Wellcome at Jebel Moya near the Blue Nile, and by Seligman in the mounds near Faragab, a village of sedentary Arabs some 20 m. east of Bara in northern Kordofan. Though made about 1910 only the most meagre descriptions of the Jebel Moya discoveries have been published, although they are of prime importance to the history of the Sudan.

Besides stone implements, were found beads and amulets, a number of scarabs and small plaques bearing Ethiopian and Egyptian cartouches, ranging from about 700 B.C. or perhaps going back to an even earlier date (*Brit. Assn. Reports*, 1912), while a paper by Prof. D. E. Derry[1] giving anatomical details of skeletons from graves at this site indicates that the inhabitants were tall negroes resembling in height and cephalic index some of the present day negroes of the hills of southern Kordofan.[2] At Faragab the mounds extend over acres and their surface and the areas between them are literally covered with disk beads of ostrich egg, fragments of bone débris and other foreign objects, including fragments of imported rocks. Two types of potsherds are of special interest, one consisting of a fabric bearing the impression of the string mat on which it was made (such mats are still used in the hills of northern Kordofan), and in this resembling the coarser wares found by Garstang in the graves of Meroe, the other oblong-oval in shape and rather shallow, often decorated with geometrical designs and produced at each end into a solid mass (handle?), its general appearance recalling that of many Melanesian wooden food bowls. This type seems to be hitherto unknown anywhere in Africa. The beads are of ivory, dolomite and scolecite; the single dolomite bead is definitely not of a type hitherto regarded as negro, while a single carnelian bead, if Egyptian, as no doubt it is, is regarded by Sir Flinders Petrie as certainly not later than XVIII. Dynasty.[3] The presence of many pieces of worked ivory is noteworthy. Of Meroitic monuments of any size, apart from those found at Soba, *e.g.*, the " lamb " now in the Palace Gardens at Khartum, the rock drawings discovered by Mr. Crowfoot at Jebel Geili, representing a king wearing the uraeus crown worshipping a rayed solar divinity, which may be taken to be of late Meroitic date, is of special interest.

Rock Pictures.—The only other rock pictures described in the Sudan are in Kordofan and Darfur. Generally they are outlined in red or blackish pigment, but examples roughly graved on masses of granite also occur in the Jebel Haraza *massif*. Drawings with pigmented outlines are found on Jebel Haraza and Jebel el 'Afarit, and seem to form two groups. To the first belong rough but spirited sketches of men on horseback, camels and giraffes. The workmanship of the second group is rougher and much less vigorous; it includes representations of camels, men on horseback and men marching or dancing, carrying the small round Hamitic shield. This, together with their general resemblance to the " Libyo-Berber " rock pictures of the southern Sahara, indicates a comparatively recent date. Moreover, Mac-Michael notes that the work is faint and indeterminate, and that there is no trace of graving; in other words the neolithic tradition has not persisted. Probably they are more recent than the stone disks and hollow conical and spherical stones found on Jebel Haraza, already mentioned.

Megalithic Monuments.—Megalithic stone monuments occur in the Sudan, some of the present day, others certainly recent, a few apparently of some antiquity, though as to these our knowledge is of the slightest. In the northern Sudan the Beja tribes surround the graves of their dead with a circle of upright stones; round some of the older graves individual stones were occasionally taller than a man, and it is probably the persistence of such stones after their smaller neighbours have disappeared that has given rise to monoliths such as that some two metres high, to which the Prophet, according to the accepted tradition, tied his horse, overlooking the Khor Arab near the Sinkat-Erkowit road in the Red Sea Province.

Another monolith of much the same dimensions has been described and figured by J. W. Crowfoot from 'Isa Darheib, inland from 'Aqiq (*Geog. Jour.*, May 1911), and in this instance there seems nothing to suggest its origin in a Beja grave. Further south megalithic monuments have been reported from the Madi, while stone circles are made by the Lotuko-speaking tribes wherever stone is abundant, as squatting places for the men, though in no case could evidence be obtained of stones large enough for this use being carried even a few miles.

Again, although megalithic structures are said to occur among the Bari-speaking tribes of Mongalla Province, it is certain that at least some of these are recent erections over graves. Although megalithic neither in structure nor form there is a type of stone monument some 80 ft. long and about 5 ft. high occurring in some number in the neighbourhood of Erkowit. These (*Jour. Egypt. Archaeology*, vol. 2, 1915) are constructed without any cement or mortar; the face consists of a limiting wall of more or less flat slabs of local rock, while the spaces between the containing walls are filled in with smaller fragments.

Each of these monuments may be considered as consisting of three main elements, viz.: (1) an oblong rectangular portion, (2) two oval masses, to each of which is attached an expansion shaped somewhat like a fish's tail and (3) the curved walls uniting the other elements. Their orientation seems to have been toward the rising sun, while each oval element is interrupted at a constant point in its circumference by the interposition of from two to four upright slabs. There is no chamber or space behind these stones, but from their constant presence and the uniformity of their position it is obvious that they must have had a perfectly definite significance to the builders, indeed they recall the false doors of Egyptian monuments. Mr. J. W. Crowfoot found human bones under the filling of the rectangular portion but no objects with them. They may provisionally be regarded as

[1] This will be found in *Proc. 17th Internat. Congress of Medicine*, Sec. 1, Pt. 2 (London, 1913).

[2] For figures of Nuba resembling the Jebel Moya burials see C. G. Seligman, *Jour. Roy. Anth. Inst.*, vol. 40, 1910, especially Plate XXXV., figs. 8 and 9.

[3] C. G. Seligman, " Prehistoric Site in Northern Kordofan," *Annals of Archaeology and Anthropology*, vol. 7 (Liverpool, 1915).

mediaeval, but as antedating the spread of Mahommedan influence which was becoming dominant towards the middle of the 15th century.

It is as yet too early to estimate the significance of the objects found by Mr. D. Newbold (*Sudan Notes and Records*, vol. 7, 1924) on his recent journey from Bara in Kordofan to the international boundary (long. 24° E.) between the Sudan and French Equatorial Africa. Evidence of former occupation of the country, now desert or the poorest steppe, was abundant, including cairns, pottery (some Meroitic), a small brick pyramid at Abu Sofian (16° N., 28° E.), and five ground axes of glauconite of hitherto unknown type from the Wadi Hawa. Drawings roughly incised on boulders, *e.g.*, at Sobat el Hammad, showed tailed and phallic men, elephants, giraffes, ostriches, oryx, cattle and several other animals which could not be identified. At Umm Tersawen there were also a number of human figures, some tailed, some armed with bows. "At Abu Sofian two groups of pictures, obviously of the same date and 'school,' were within a day's march of one another. Here the drawings were incised on rough boulders, and were very numerous. Camels are shown literally in hundreds; giraffes and ostriches still appear; but the cattle dwindle in numbers, while the elephant is not represented, and the bowmen give place to men armed with spears and carrying shields." The latter armament appears to bring these drawings into the Libyco-Berber class.

Abyssinia.—Discoveries relating to the prehistoric periods are as yet lacking in Abyssinia, where interest centres in the monuments dating from the 4th century A.D. discovered at Aksum by Theodore Bent (*The Sacred City of the Ethiopians*, 1896).

Littman, the leader of the German expedition to Aksum, holds that the carved and decorated monuments generally termed "obelisks" are in fact stelae (of huge dimensions it is true, *e.g.*, from 15 to 33 metres) and therefore each to be regarded as part of a tomb, a point of view rendered the more probable by the presence at their base of stone slabs, often carved, which have every appearance of being altars. All this seems to imply a cult of the dead, but, apart from this, inscriptions dating from the 1st and 4th centuries record the names of the gods of the Semitic conquerors of northern Abyssinia. A Greek inscription of Adulis, no longer in existence but copied in the 6th century by Cosmas Indicopleustes, states that the King of Aksum of the 1st century, who caused this record to be cut, worshipped Zeus, Ares and Poseidon. A later document of King Aizanas (about A.D. 350) is in Greek, Sabaean and old Ethiopic. An analysis by Littman of this inscription, together with one dating from about a century later, indicates that worship was rendered to Heaven, Sea and Earth, together with Mahren "who begat the King," the latter being identified with Ares. Other monuments include rude monoliths, some ornamented with bands, and a most spirited rock-carving of a lioness in low relief.

The Western Province

Palaeolithic Remains.—It is only recently that stone implements of River-drift type, and therefore to be regarded provisionally as of palaeolithic age, have been discovered in West Africa. In the British Museum there is a series of massive implements of Chellean type, consisting of quartz porphyry, which on the surface have weathered to the softness of chalk. These come from the alluvial deposits of the Bauchi plateau, as do a smaller number of implements of Mousterian type of the same mineral, and one very steep end-scraper of a more homogeneous stone showing no surface weathering.[1] There is also in the national collection a number of short stumpy implements of Drift type of a reddish quartzite, for the most part with unworked butt, found on the golf links of Accra (Gold Coast). Similar specimens have been found in the local gravels, the actual specimens in the museum having apparently been washed up from the beach.

Neolithic Age.—Polished axe-heads of ordinary neolithic type are by no means uncommon in West Africa and the Congo Valley. They are found in Northern Nigeria, especially in the Bauchi Plateau gravels, where it is said that they overlap to some extent the Drift types. They are, however, of a different stone, for the most part of dolerite. In the Gold Coast Colony they are found in large numbers, as are perforated quartz discs, while a few bossed spheres about two inches in diameter, of anomalous appearance and unknown use, have been recovered. A collection of neolithic implements from Calabar includes stone axes, unusual in that they possess a definite tang for hafting.

Under the title "Tumbakultur" Oswald Menghin (*Anthropos*, 20, 1925) has recently described a culture characterised by series of implements, widespread in the Lower Congo area, which he tends to approximate, though with difficulty, to the Campignian of Europe. Be this as it may, Menghin finds a long series of artifacts passing insensibly from implements of coup-de-poing type, Campignian *pics*, flattened ovates of almost laurel-leaf type, to notched and roughly cruciform spear or arrowheads, some, though larger and coarser, irresistibly recalling the "freak" forms from Breonio in Italy. Apart from these, many ground stone axes have been found in the Congo area.

Megalithic Monuments.—Megalithic monuments are distributed widely in West Africa in the form of stone circles and standing stones. In Gambia both classes of monuments have been carefully described by the late Henry Parker in a paper published after his death (*Jour. Roy. Anth. Inst.*, vol. 53, 1923):—

> The circles themselves are generally found in groups or clusters comprising from two to nine, but single circles are met with. With one possible exception there are no uncompleted circles, except those formed by concentric outer pillars standing round an inner circle. . . . The groups of circles are arranged in single straight lines; in nearly parallel lines consisting of two, three or four circles; or in pairs; but never in triangles or pentagons. Many stones are prostrate and . . . almost invariably these fallen pillars . . . are at least partly buried by the soil. . . . Some have their upper face almost level with the ground, and as a rule the others are half or three-quarters covered by the earth. . . . Superficially considered this is the only indication of the age of these structures, and . . . it would be of great value if we knew the rate of elevation of the soil. Without such knowledge it is only possible to draw the conclusion from this evidence that both the circles and the menhirs must have been erected many centuries ago.
>
> In addition to the concentric outer pillars, there are several instances where the outer pillars are arranged on the eastern side of the circle in a straight line, or even in two parallel lines, in a north and south direction. Such lines are invariably to the east of the circle. . . .

The circles are considered sacred to the Earth Spirit, and ceremonies are performed in them to propitiate the latter, as also for the protection of the crops. It does not, however, appear that Mr. Parker excavated in them, and their date and purpose must be left for future exploration, though in the light of information received on the spot the contents of the circle (human remains, spearheads, copper armlets) dug by Messrs. J. L. Todd and G. B. Wolbach (*Man*, No. 96, 1911) suggest that in recent times these monuments were the sites of sacrifice for success in warfare.

In some of the northern villages of the Cross River Division of Nigeria, *i.e.*, in the villages of the Akayu, Indem and Atam districts (on the left bank of the Aweyong river) there are stone circles, the stones often more or less conical and carved to represent the human body from the waist upwards. These have been described and figured by Mr. C. Partridge (*Cross River Natives*, 1905, pp. 268–599); the navel is specially prominent, and cicatrices seem to be reproduced. At Agba village the circle surrounds an old tree, and the grove of the great chief who erected the circle. The tree is sacred, and of the stones it was said by the ancestors "these stones are your forefathers, your very great chiefs; every year you must sacrifice to them" (p. 271).

Beads.—In the past, claims of high antiquity have been made on behalf of the so-called "aggry" beads that have been found in West Africa. Yet as stated by Sir Hercules Read, with the single exception of the necklace to be discussed immediately, none of these beads show features not to be found in mediaeval or later beads from the factories of Venice. The necklace, presented to the British Museum by Mr. L. P. Davies, was obtained from the grave of "a renowned chief" at Mansu, a town on the

[1] Since this was written the Geological Survey of Nigeria has published an *Occasional Paper* (No. 4), by Mr. H. J. Braunholtz, describing and figuring the implements of the Bauchi plateau.

route from Elmina to Kumasi. It is described in detail in *Man*, No. 1 (1905-).

For present purposes interest centres in some 20 beads of crystalline glass, irregular-facetted, and especially one bead of crystalline glass moulded like a mulberry. Sir Hercules Read writes of these as being in a state of iridescent decay, the surfaces being in many cases deeply pitted and presenting exactly the same appearance as beads of the same kind from the Mediterranean area. He points out that the crystalline glass in this necklace is identical in appearance with those from the tombs at Kameiros in Rhodes, dating from the 6th century, and goes on to suggest, but " without insisting too strongly on this point," that here are " glass beads of classical style found for the first time in West Africa, and presenting features that in point of date may justifiably be associated with the name and time of the Carthaginian Hanno, a name often invoked when objects of indeterminate age are found on the African coast."

Though probably not of any great age, reference must be made to the soap-stone carvings of human heads or figures (occasionally animal figures) found in the ground, sometimes apparently in pits, in certain districts of Sierra Leone, where they are used as agricultural charms. These figures are for the most part roughly carved, the work being well within the scope of present-day Africans, and Joyce, who has figured and described them (*Man*, No. 57, 1905, and No. 40, 1909), points out that there is really no reason to see in them—as has been proposed—evidence of foreign, *i.e.*, Egyptian or Carthaginian influence. The objects described by Frobenius from Old Ife (*The Voice of Africa*, 1913, vol. 1, chap. 14; " The Archaeological Finds "; and *Das Unbekannte Africa*, Munich, 1923), the ancient capital of the Yoruba, are also probably of no great age; there do not seem to be any which the 16th century Benin civilisation might not have produced.

Possibly of about the same date are a number of bronze and silver objects, now on deposit in the British Museum, from a sandy mound (no doubt a grave) at Tumuni in the Sokoto Province of Northern Nigeria. Sir Hercules Read holds that they exhibit features and analogies which are unusual in negro African metal work, pointing to artistic or commercial relationship with the culture of the Mediterranean area, doubtless at a period remote from the date of the manufacture of the relics themselves.

The most important pieces are a bucket with incurved sides and lugs, and a barrel-shaped armlet (?) for wear on the bicepital region. The lines and casting of both, and the geometrical patterns tooled on their surfaces, are good and careful work. While the find, as a tomb-group, may date to 1480 A.D. as suggested by Mr. H. R. Palmer, yet, as stated by Sir Hercules Read, they are of unusual interest from the analogies they present with the early Mediterranean cultures, and we may have here a distant echo of the early art of the Bronze Age. At the same time there is no reason to think that the actual objects are anything but local productions, though they may differ from those of more recent date.

The Southern Province

Palaeolithic Implements.—Artifacts of rude Chellean type, often larger than the corresponding implements of Western Europe, are found over the greater portion of South Africa, nor does there seem to be any reason why these should not be regarded as true palaeoliths of an age comparable to those of Europe. One of the most satisfactory finds of this order is constituted by a considerable number of implements of chalcedony, quartzite, etc., exactly similar to types characteristic of the River-drift Period of Western Europe and Great Britain, associated with and evidently forming part of ancient terrace gravels deposited as drifts by the Zambesi (in the neighbourhood of Victoria Falls) at a remote period. The position of these terrace gravels and surface drifts in regard to the Batoka Gorge indicates their real antiquity, since they must have been deposited by the river when the latter was covering the old valley floor more than 400 ft. above its present level. Here Mr. Henry Balfour excavated several implements from undisturbed gravel deposits at depths varying from 6 in. to 2 ft., some greatly waterworn and heavily patinated. Leaving this particular site, it will be remembered that Peringuèy distinguished an axe or cleaver type of coup-de-poing. Dr. K. M. Barnard has informed the writer that an important find at Montagu (Cape Colony) demonstrates that this " type " is but a stage in the preparation of an ovate.

A curious point was the total absence of chips. The bouchers occurred in layers of black and white earth, indicating clearly the presence of fires. . . . Three separate occupational layers were found, separated by deposits of sand due to natural causes which may indicate lengthy periods of time. No skeletal remains or bone implements or rubbing stones of any kind were found. The whole deposit was capped by a thin layer containing small chert flakes of the type usually ascribed to the Bushmen.

Implements of Mousterian type, though less common than those of the River Drift certainly occur and are widely distributed. With regard to stone implements of more advanced types than Mousterian, there has been a tendency to describe these as " Solutric " (*e.g.*, in the publications of the late J. P. Johnson), an unfortunate and inaccurate term carrying entirely premature implications. Indeed since the generality of advanced types of South African stone implements should be regarded as Neolithic or later, reference should be made to the typical Tardenoisian lunates of late Nubian tombs, as well as to the admitted use of pygmy points by the Bushmen.[1]

Pottery.—It is not clear that examples of pottery of any considerable age exist. These figured by Peringuèy—provisionally assigned to Bushmen, Strandloopers and Hottentots—are of the rudest type, predominantly ovoid with conical bottoms, sometimes ornamented, the kneading and baking being very poor.

The Bushmen.—No apology seems necessary for considering the " archaeology " of the Bushmen with that of the kindred Strandloopers (no longer to be regarded as a distinct race, the name describing a mode of life and not implying a constant physical difference), for even though the former are not utterly extinct, the few survivors no longer pursue their characteristic arts of painting and graving on rock. It is generally admitted that the Bushmen stock came into South Africa from the north, and Stow was of the opinion that there were two great divisions, each with its characteristic mode of life and art, viz.: (1) cave-dwellers (painters), and (2) kopje-dwellers (sculptors), the latter producing their works by " pecking " the rock face on which they worked. This view does not seem to be generally accepted, perhaps it only emphasises differences in technique due preponderantly to environment.

The paintings of the Bushmen, naturalistic polychrome studies of high artistic merit, for the most part record the animals which they hunted and upon which they subsisted. But paintings of the carnivora are not absent, and cattle raids, dances and magico-religious (?) scenes are also portrayed. Belonging no doubt to the latter class are the fairly numerous examples of animal-headed human figures, not to be confused with the wearing of animal skins as a hunting ruse to admit approach to the game, as in the famous picture in the Hershel district of Cape Colony of a Bushman wearing an ostrich skin while stalking a flock of these birds.

The character of Bushman paintings has been well summed up by Mr. Henry Balfour:—

They are " remarkable not only for the realism exhibited by so many, but also for a freedom from the limitation to delineation in profile which characterises for the most part the drawings of primitive peoples, especially where animals are concerned. Attitudes of a kind difficult to render were ventured upon without hesitation, and appreciation even of the rudiments of perspective is occasionally to be noted, though only in a crude and uncertain form. The practice of endeavouring to represent more than could be seen at one time . . . is far less noticeable in Bushmen art than might have been expected from the rudimentary general culture of these peoples, and one does not see instances of *both* eyes being indicated upon a profile face, or a mouth in profile on a full face. . . . The colours were usually laid on uniformly over the surface which they

[1] For figures of typical Tardenoisian lunates, as well as many other stone implements of unusual form or special interest, a paper by Mr. John Hewitt, printed in *The South African Journal of Science*, vol. 18 (1922), should be consulted.

individually covered, but a shading off is sometimes exhibited." (*Bushmen Paintings*, 1909, p. 9.)[1]

Dr. K. M. Barnard points out that examples similar in execution to those described by L. Péringuey (*Trans. S. Afr. Philos. Soc.*, 16, 1906, and 18, 1909) have been discovered at various places in Southwest Africa, the farthest north being in the Grootfontein district. In addition to the usual animals there are representations of the human foot, and the spoor of various bucks, while from the position in which these latter occur the explanation that they are "sign-posts" to water cannot be maintained.

Quite recently Maj. F. J. Bagshawe (*Man*, No. 92, 123) has discovered in Tanganyika Territory rock-paintings of Bushmen type of so high an artistic quality that their origin can only be referred to this race, an extension northwards which goes well with the distribution of the Bushmen *kwe* (digging-stick weight), of which specimens, known in Tanganyika, have been discovered in Uganda (Wayland) and even among the Bari of the Southern Sudan (Seligman). The Tanganyika rock-paintings include an eland, cow, ostriches, giraffe and antelope.

Strandloopers.—The Strandloopers are a people of whom, apart from their skeletal characters, we know little, though concerning these there is a fair volume of reliable if not always consistent data. Their cultural attainments may be judged, *e.g.*, from the remains found in the caves and rock-shelters of T'zitzikama cliffs, about 100 m. to the west of Port Elizabeth. One of these shelters explored by Mr. F. W. Fitzsimons (described by Sir Arthur Keith, *The Antiquity of Man*, I, 1925), contained deposits some 30 ft. deep. The lower 5 ft. and the upper 6 ft. were sterile; below this latter layer was a stratum some 7 in thickness in which numerous Strandlooper burials were encountered amidst remains of fireplaces, broken pottery, implements and ornaments in stone and bone.

Then came the third stratum, over 6 ft. in thickness. While removing this stratum and working at a depth of 15 ft. below the original floor of the shelter, Mr. Fitzsimons found graves containing remains which differed from those he had met with in the stratum above. Unfortunately the bones in the lower stratum were imperfectly preserved. The graves had been partly protected by slabs of stone some of which had been rudely engraved with human figures. There were lumps of red ochre, necklaces of shell and bone and tools of stone and bone. In a still deeper stratum, also about 6 ft. in thickness, there were traces of burials and hearths, the human remains being fragmentary, but considered to belong to individuals of the Boskop types. As to the Zimbabwe and similar ruins in Rhodesia, the conclusions of D. Randall-MacIver (*Mediaeval Rhodesia*, 1906) (*see* 28.980) have not proved generally acceptable in South Africa. While there is no inherent improbability in the early Semitic origin of these ruins, it seems unnecessary to seek a foreign colonisation where the facts in no way contradict a local origin. No authentic inscriptions have been found, and no objects discovered in the Great Zimbabwe, around which the controversy has chiefly centred, need be more than a few centuries old, while those that are not foreign imports (porcelain, etc.) are of African type. Moreover a re-examination of the evidence, including unpublished material in the library at Lisbon, has led Father Schebesta (*Mitt. der Anthrop. Ges. in Wien*, 1922–3) to the conclusion that not only is the Zimbabwe a product of the indigenous Kingdom of Monomotapa described by the Portuguese, but that its builders culturally resembled the Baganda, and probably certain other of the more advanced peoples of Central Africa. For bibliography, see the references in the text. (C. G. S.)

VII. EGYPT

Since 1910 excavation in Egypt has progressed, if we except the four years of war, at a much faster rate than ever before. The methods of excavators have improved, and there has arisen a tendency to undertake specific pieces of work designed to clear up definite archaeological problems. A chronological arrangement will best show the contributions of the more important excavations of the period under review toward the pure archaeology of each successive period.

The Predynastic Period

In predynastic archaeology the outstanding discoveries are those made near Badari, 30 km. southeast of Asyut, and in the Faiyum. The full reports of these excavations have not yet been made public, but it would seem from what has already transpired that the finds take back our knowledge of the predynastic Egyptian stage beyond what was previously considered to be the beginning of the predynastic period, namely, the moment known in Petrie's Sequence Dating as S.D. 30. At Badari itself a stratified settlement has been found, the upper layers of which contain material of the usual predynastic kind. The lower strata, however, yield finds of a type hitherto unknown in Egypt. Among these are very finely worked flints (see fig. 2), including arrowheads of two shapes, and pottery which would seem to be the precursor of the predynastic red-polished and black-topped wares; this pottery, like some of later date already known from Nubia is frequently ripple-marked on the surface. In the lower strata, along with this ware, rough pottery of a type quite new to Egypt makes its appearance. Remains of huts were also found.

Fig. 2.—Flint implement from the Faiyum.

If the evidence of the stratification is sound—and there seems no reason whatever to doubt it—these finds take us a stage back beyond the earliest predynastic previously found in Egypt. Any attempt to put a date either to the beginning or to the end of the period would, on present knowledge, be folly. Not far from the settlement was found a cemetery whose contents show it to be contemporary with the lower levels of the settlement. Many tombs yielded glazed beads, and two contained objects of copper, in one case beads of copper ribbon and in the other a borer. The new civilisation, to which the name Badarian has been given, must therefore be considered not as purely neolithic but as belonging in part at least to the copper age.

Probably quite distinct from this culture is that revealed by recent discoveries in the Faiyum. Flints picked up on the surface in this area have long been known, and settlements in which the makers of these flints lived have now been found. A few rough pottery vases were recovered, but in such poor condition that it is difficult to appraise their original appearance and technique. Numbers of polished stone axes, bone borers and harpoons were picked up, and there is evidence, though not as yet quite conclusive, that they too belong to the settlements.

The archaeological position and date of this Faiyum culture remained undecided in 1925, and all that can be said pending further excavations is that it must in no way be confused with that of Badari.

Predynastic Civilisation.—The predynastic civilisation in the old sense of the word continues to receive illustration from every part of Upper Egypt, though we are still without evidence for its existence in the Delta. At Abydos were excavated two settlements, the main lesson of which is that in a settlement there will always be found types of rough flint and

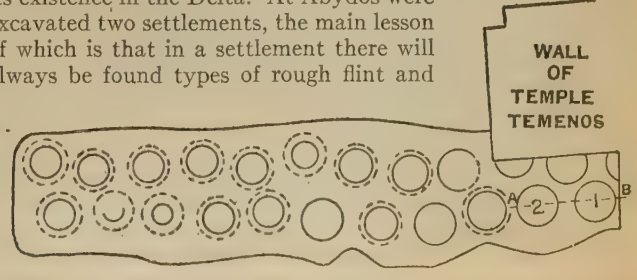


Fig. 3.—Plan of grain kiln, showing two lines of jars, and roughly rectangular form of kiln.

(*From Cemeteries of Abydos. T. E. Peet.*)

[1] This is the standard work on Bushmen paintings; for rock-gravings reference should be made to J. V. Želisko, *Felsgravierungen der Südafrikanischen Buschmänner* (Leipzig, 1925), which contains much of the unpublished material collected by Emil Holub in his journeys in the seventies and eighties of last century.

bone objects and pottery destined for every-day use which are virtually unrepresented in the cemeteries of the same period, and which would, at first sight, from their very roughness, be put down as earlier in date than the finer objects of the contemporary tombs. In each of these settlements was found a "grain-kiln" consisting of a group of large jars set in the sand and surrounded by wood fuel enclosed by a brick wall, so as to form a sort of closed kiln with the mouths of the jars free. These structures were undoubtedly used for parching grain, and throw an interesting light on predynastic agricultural science (see figs. 3 and 4).

Discovery of Copper and Iron.—The discovery of copper in Badarian tombs seems to settle in the negative the question

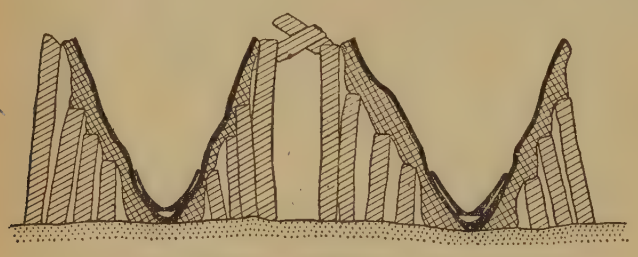


FIG. 4.—Section through AB (fig. 3). Inside each jar, at the bottom, is a small basin of rough clay, intended perhaps to prevent grain from lodging in the pointed bottom of the jar. Each jar is heavily coated with clay on the outside and supported by four rows of fire-bricks of different sizes; the fuel was placed among and between these.

(*From "Cemeteries of Abydos"—T. E. Peet.*)

whether any part of the predynastic period previously known is rightly to be considered neolithic. The finding of beads of hammered iron in two tombs of the Middle Predynastic period at Maidum takes back the knowledge of this metal in Egypt to a much earlier date than had been imagined, though the stringing of these beads along with others of gold seems to show that iron was a great rarity. There is still no evidence for the general use of iron in Egypt before about 1200 B.C.

Gebel-el-'Araq Knife.—The most striking single predynastic find during the 10 years 1915–25 is undoubtedly the flint knife with carved ivory handle from Gebel-el-'Araq. The delicacy of the work in the battle and hunting scenes on this handle is such as to give us a much higher idea than we had before of the skill of the predynastic craftsman. Some see Elamite affinities in the work and therefore postulate a period when Egyptians and Elamites were subject to the same cultural influences. It may be said here that this and some suggestions on similar lines are the only contributions made of late years to the problem of the origin of the early Egyptians, which, so far at least as archaeological evidence is concerned, remains very much where it was 10 or even 20 years ago.

The Archaic Period and Old Kingdom

The archaeology of the I. Dynasty has been very considerably illustrated by excavations of that period at Tarkhan and Tura. At both sites it is noticeable that the passage from the predynastic to the dynastic period is marked by no violent change visible in the cemeteries. At Tarkhan the main novelty is the custom of burial on beds, of much the same structure as in later Egypt, with wooden legs and side-posts, and leather straps on rush matting stretched across. In several tombs were found planks which had evidently been derived from portable houses formed of boards fastened together by rope or twisted gut, holes for which still remained. These houses probably served the same purpose as the maize-stalk huts of to-day, in which the peasants often dwell in their own fields during the busy agricultural season.

Physical Anthropology.—In some respects, however, the most important results of the excavation of Tarkhan are the measurements taken of the long bones of the skeletons, which, according to the discoverer, indicate the gradual infiltration of a new people into Egypt just before and during the I. Dynasty. In the lack of similar material from other sites it is perhaps too soon to say whether these figures prove all that is claimed for them.

Early Architecture.—The early history of architecture in Egypt seems likely to be revolutionised by recent discoveries at Saqqara. Against the north side of the Step Pyramid of King Zoser of the III. Dynasty has been found the shrine containing the royal statue. It is a small and simple but very finished construction in limestone, and the statue, in the same material, painted, which was visible from outside through two small "squint holes," while recalling the still earlier figure of Khasekhem, anticipates in the moulding of its features the fine style of the IV. and V. Dynasties.

Mastabas.—Two mastabas within the boundary wall of the pyramid have been excavated. In each case the south façade shows fine limestone masonry of a type only equalled at this early date by that of the north face of the boundary wall of the Step Pyramid. Each façade was decorated by four engaged fluted columns terminated by fluted leaf capitals. The dimensions of the column drums suggest that the façade was two-storied and that the whole building in its original state represented a house or palace with a forecourt. The side walls of the court which lay in front of the façade were ornamented with smaller engaged columns each exactly imitating a single papyrus stem and flower.

In the centre of each façade a door surmounted by a *kheker*-frieze leads to a small L-shaped offering-place containing no fewer than five niches. The roof of this chamber is formed of limestone slabs set on edge in such a way as to imitate the rafters of a wooden roof.

The pit of one of the mastabas yielded a vase inscribed with an unknown king-name Nubnefer.

The significance of these finds is clear. Here, as the excavators themselves state, we have at a very early date a type of architecture in stone which is not only quite new to us but which represents the final development of a style the earlier stages of which are totally lost.

Pyramid Architecture.—One of the chief contributions to our knowledge of Egyptian architecture has been the clearing up of the structure and lay-out of the pyramid. The pyramid of Chephren at Giza shows the following features. Against its east side lay the temple which formed the offering-place for the king buried under the pyramid. This temple was approached by a covered inclined way from a smaller introductory or "valley" temple which lay down on the edge of the cultivated land, the pyramid itself being on the plateau. The introductory temple of the Chephren pyramid is that long known as the Sphinx Temple, and the Sphinx itself forms a part of the pyramid-complex and is therefore a portrait of King Chephren.

Similar arrangements can be observed in the case of all pyramids which are not too badly destroyed. They have been worked out both for the Mycerinus pyramid at Giza and for those of the V. Dynasty Kings at Abu Sir. The vexed question whether the pyramid grew out of the mastaba form by the addition of a series of coats of stone and an apex may be said to be still in dispute.

The mastaba cemeteries of the royal families and nobles which adjoin the pyramids are found to have been regularly laid out, forming veritable cities of the dead. The substitution of a mere limestone head or heads for the funerary statues usual in the tombs is a not rare feature of this period. The deep and as yet, unexcavated shaft-tomb, containing objects bearing the name of Sneferu should add largely to our knowledge of the tomb and perhaps house-furniture of the Old Kingdom, which is at present very small.

Temple Architecture.—The excavations at Abu Sir have also revealed much that is new in connection with the temple-architecture of the Old Kingdom. The sun-temple built by King Neuserrē' resembles in its general design a pyramid, having a valley-temple and inclined approach. The temple itself has been restored by its finders as resting against the east wall of a truncated pyramid surmounted by a huge obelisk. In the offering-court was found an alabaster altar with a slightly raised circular

By permission from "Portraits of Queen Nofert-Ete" by Borchardt; publisher J. C. Hinrichs, Leipzig.

QUEEN NEFERTETE ("The beautiful one has come"), WIFE OF "THE HERETIC KING"

From the bust recently excavated, and now in the Neues Museum, Berlin.

centre surrounded by four blocks each in the form of a *hotep*-sign, thus taking back to the Old Kingdom a form previously known only from the New Empire. South of the temple was a brick structure in the form of a boat, doubtless representing the barque of the "Morning Sun." Similar boats have been found in connection with other pyramids.

The Earlier Intermediate Period

The lacuna between the end of the Old Kingdom and the beginning of the Middle has been largely filled up on the literary and historical side by the publication of the two new Petrograd papyri. Archaeologically the results indicated by these have been borne out by excavation, more particularly at Qau el Kebîr and at Sidmant. It is now clear, for instance, that the button-seals with their rather crude geometric and naturalistic designs are to be attributed to the end of the VI. Dynasty and just later, and they are regarded by some authorities as a product of the Syrian peoples who invaded the Delta at this moment. The Herakleopolitan Period, IX. and X. Dynasties, represented by cemeteries at Sidmant, has yielded material which completes the link between the Old and the Middle Kingdoms (see fig. 5).

Scarabs.—In the Sidmant tombs simple scarabs are found which determine the types for this period, and the scarab can now be traced back almost, if not actually, into the VI. Dynasty. The supposed examples of the IV. and V. Dynasties are still highly suspect. The Sidmant cemeteries also show the development of the wooden models of servants, cattle, granaries, etc., which reached their highest perfection under the XI. Dynasty.

Models in Tombs.—To this later date belongs the wonderful find of such models made in the tomb of Mehenkwetrē in the hill behind Sheikh 'Abd el Qurna at Thebes. They include gardens with pools, scenes of cattle-inspection, slaughter-houses, carpenters' shops, breweries, bakeries and weavers' yards. They infinitely surpass in delicacy of technique and attention to detail—as well as in preservation—any of the models hitherto known to us, and will be of real service in reconstructing the methods of Egyptian craftsmen, more particularly spinners and weavers.

The Middle Kingdom

The XII. Dynasty continues, in the matter of large monuments, to maintain its reputation for secrecy, and we are still without a single even tolerably preserved temple of ordinary type, though the design of the pyramid offering-temple, a normal development of that of the Old Kingdom, is now known from Lisht and Dahshur. In respect to smaller antiquities a great increase in our knowledge has taken place. In connection with the XII. Dynasty tomb of Senebtisi at Lisht it has been shown that much of the tomb-furniture previously held to be of this dynasty, notably the brightly painted coffins with texts inscribed within, and the wooden models of servants, farm scenes, etc., is earlier, and must be pushed back into the XI. Dynasty, if not in some cases even farther. To the XI. probably belong, for example, the pit-graves which lie in front of the great rock-tombs at Beni Hasan. The typical XII. Dynasty coffin is almost plain, often with a single band of inscription down the centre, and the more elaborately painted examples, though they do in some parts of Egypt survive into this dynasty, are perhaps to be associated with the hegemony of Herakleopolis in the IX. and X. Dynasties, a hegemony which, historically as well as archaeologically, is just beginning to come to its own.

Jewellery.—Among the smaller archaeological material of the Middle Kingdom none has received of late more ample illustration than jewellery. In the shaft and chamber tomb of a princess Sithathoriunut, near the pyramid of Senusret II. at El Lahun, was found a mass of jewellery which can be only compared for quantity and quality with the early finds from Dahshur. The finest pieces are a superb gold diadem, and two pectorals of the Dahshur type. All three pieces are inlaid with semi-precious stones, lapis lazuli, turquoise, carhelian and garnet. Similar work was found in jewels from a tomb at Riqa, and we may now take it that this form of *cloisonnée* work was a product of the Egyptian jewellers of the Middle Kingdom, if not earlier; at any rate there is no longer any reason for seeking its origin abroad. The two ebony caskets with inlay of ivory and other material in which the El Lahun jewels had originally lain take back this type of box, now so well known from the tombs of Yuia and Tuyu and Tutankhamun, into the XII. Dynasty.

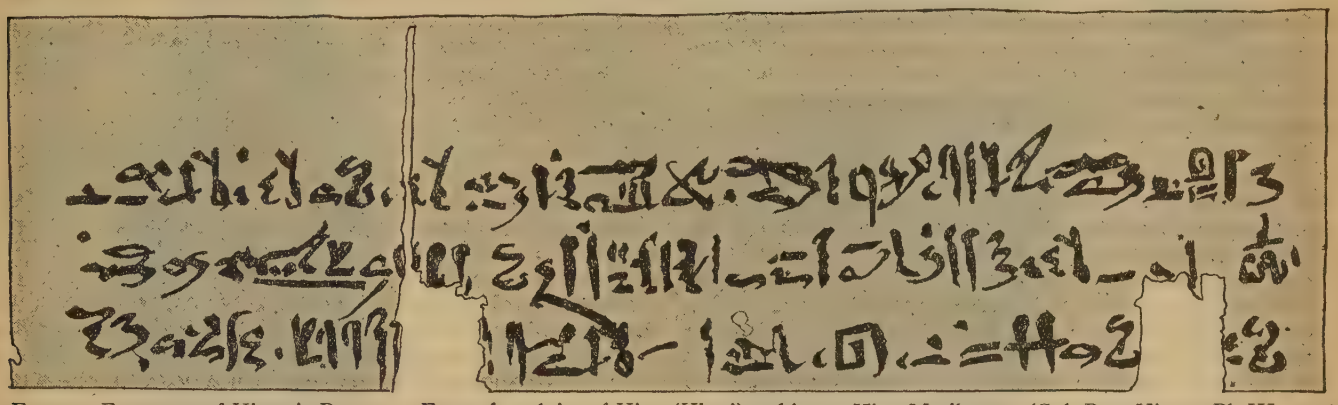


Fig. 5.—Fragment of Hieratic Papyrus. From the advice of King (Kheti) to his son King Merikerēc. (Gol. Pap. Hierat. Pl. XI. 1116A. recto. 11.70–72.) "(Egypt fights) 70 in the necropolis. Injure not the tombs with deeds of injury (?); for even so I did and even so it did occur, even as should be (??) done to 71 one who has transgressed in this way (?) with (?) the God. Deal not evilly with the Southern land, for thou knowest the prophecy of the Residence concerning it. 72 That (?) shall (?) happen even as this did happen. They did not transgress, according as they said . . . . I speak of (?) Thinis . . . . . 73." (Translation by Dr. Alan Gardiner in *Journal of Egyptian Archaeology*, I, 22 ff.)

The Later Intermediate Period

New discoveries affecting this dark epoch have chiefly been made in two types of tomb, both of which are in a sense exotic, the so-called "pan-graves" and the Hyksos tombs. Many years ago shallow tombs scooped in the desert sand were found at Hu which contained crouched burials accompanied partly by normal Egyptian objects typical of the end of the XII. Dynasty and later, partly by black-topped vases not unlike those of predynastic date, skulls of animals, often painted with black and red spots, and bracelets made of rectangular slips of mother-of-pearl. Similar tombs are now known from Rifa's Balabish and elsewhere. The contents of these tombs show close affinities with those of the later period of the C-group in Nubia (see below) though at the same time there are disturbing points of difference These latter are not, however, so serious as to invalidate the conclusion that at about the end of the Middle Kingdom there was a considerable infiltration of people from Nubia into Upper Egypt. One grave at Rifa'a contains a scarab of the Hyksos king Sheshy, but the "pan-grave" civilisation would appear to have died out in Egypt at or before the rise of the New Kingdom.

Type of Grave.—In this same connection must be noticed a

type of grave occurring not in groups but only sporadically in Egypt (*e.g.*, El Qurna, Abydos) at about the same period. These tombs all contain specimens of the very thin beautiful red polished pottery with black top of which the most frequent shape is the cup or bowl with flared rim found in such quantities at Kerma in Nubia and clearly typical of some southern civilisation, allied to but not identical with the Nubian C-group and the Egyptian pan-graves (see below). Such burials must be those of isolated immigrants from the south.

The other type of burial typical in Egypt of the dark age which followed the Middle Kingdom is that of which examples were found at Tell el Yahudiya. Here there exists an enormous fort with earthen walls, which is doubtless rightly assigned to the Hyksos invaders, and beside it lies the cemetery of its inhabitants. The bodies are crouched, and the more remarkable finds in the tombs, which contain a certain amount of normal Egyptian material, are scarabs with names of Hyksos kings, and a type of black pottery, mostly tall jugs with handles, with white-filled incisions. The home of this pottery, which occurs sporadically in tombs throughout Egypt and even as far south as the Sudan, is still uncertain, though many place it in Syria. A clever attempt to assign a Nubian origin to this ware has lately been made, but has not yet met with general acceptance.

Cretan Pottery.—With regard to foreign pottery in general it may be recorded here that most of the foreign painted ware found many years ago at El Lahun is now recognised as being Cretan of Middle Minoan date. An almost complete vase of this style was found in a tomb at Abydos together with cylinder-seals of Amenemhet III. and Senusret III.

The New Empire

Our archaeological knowledge of the New Empire (XVIII. Dynasty onward) has been increased mainly by three facts, the systematic excavation of Tell el 'Amarna, the discovery of the tomb of Tutankhamun and the clearance of the royal cemeteries of the Ethiopian Period in the district of Napata.

Domestic Architecture.—The importance of the Tell el 'Amarna excavations, apart from the artistic value of many of the objects found, lies in the fact that here for the first time we learn the details of Egyptian town-planning and domestic architecture. A considerable portion of the city of Akheťaten built by King Akheńaten about 1375 B.C. has now been laid bare. The design of the town is simple and regular. Two main streets, one of them more than 50 yd. broad in places, traverse it from north to south, but both are completely unpaved. The houses were all built of mud brick, occasionally with details, such as door-posts, lintels and column bases, in limestone. The nucleus of each house was the central hall, the walls of which were carried up higher than those of the surrounding rooms and provided with windows towards the top. This hall was roofed with wood and mud-plaster supported on wooden columns from one to four in number. Round it were grouped two long rooms, one on the north and the other on the west, both perhaps partly open to the weather on the outer side, bedrooms, workrooms, bathroom with limestone bath and lavatory. A staircase led up from the central hall on to the roof. In one instance at least there seems to be evidence for the existence of a second storey. The walls of the rooms were in many cases painted with bright designs in colours on the plain mud-plaster background. The larger houses were enclosed in a garden with trees, flower-beds and possibly in some cases an artificial pond. In a part of the enclosure were granaries, kitchen, a well and servants' quarters (see fig. 6).

Fig. 6.—Plan of the house of the Vizier Nekht.
(*From City of Akhenaton, Peet and Woolley.*)

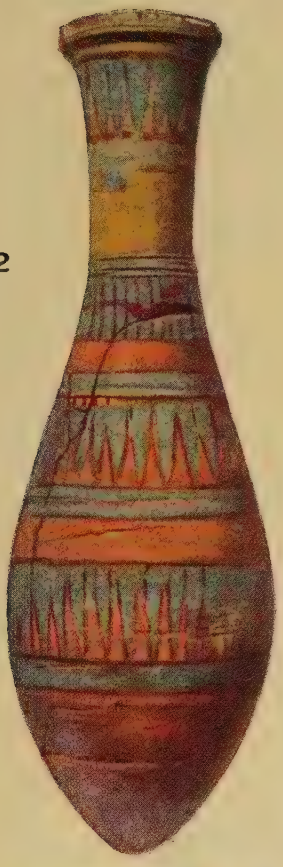
Palaces.—In addition to houses two other buildings have been excavated. The one, called Maruaten, seems to be a combination of a palace with religious buildings, the other, the North Palace, may have served a purely secular purpose. Both are destroyed almost to floor level, but in our nearly complete lack of information with regard to such buildings, they are of high value. With them may be included the palace of Amenophis III. on the west side of Thebes and that of Merenptah recently excavated at Memphis. All testify to the extensive use of fresco paintings both for the walls and the pavements of buildings of this period (see fig. 5 on plate).

Religious Architecture.—In the matter of religious architecture there is little new to record save the clearance of the so-called Osireion, at Abydos, behind the Seti temple. This is unique insomuch as it is the only subterranean building as yet known in Egypt. Its massive columns and roof-blocks, necessary to support 30 ft. of superincumbent sand, are a new feature in Egyptian architecture. It was finished as a cenotaph of Merenptah, though the burial-chamber itself was inscribed with funerary texts in the name of Seti I. The identification with Strabo's Well seems very probable.

King Tutankhamun's Tomb.—From the archaeological point of view the main value of the discovery of the tomb of King Tutankhamun lies in the almost numberless specimens which it has produced and is still producing of the arts and crafts of the Egyptians at this period. It will be many years before all its contents can be thoroughly studied and the skill of their makers properly appraised. In the meantime it may be said that, though the artistic value of the objects is somewhat variable, their technique is uniformly good. Taking the finds of this tomb in connection with those from the tomb of Yuia and Tuyu it will be possible to write a detailed treatise on Egyptian furniture of this period: the forms of beds, couches, chairs, stools and cabinets seem to have been very definitely fixed by tradition, but there is infinite variety in the manner in which decoration of carving, inlay, *appliqué* and painting on stucco was applied to them. From these same tombs and that of Tuthmosis IV. we have now evidence which enables us to reconstruct in its smallest detail the Egyptian war-chariot, with its broad stout axle and flimsy body, usually of leather framed in wood.

The Jewellery.—Tutankhamun's jewellery bids fair to rival in quantity all that previously found in Egypt; it is not as yet published, but it shows us the logical continuation and development in the New Empire of the openwork, the granular and the inlaid techniques of the Middle Kingdom. Specimens of garments seem to show true needlework embroidery as contrasted with the embroidered tapestry hitherto known on Egyptian materials: the use of applied golden sequins as a decoration is a new feature. A great contribution is made to the much discussed question of Egyptian lighting by the discovery of wicks of twisted linen suspended in oil cups. In connection with this same subject it may be added that De Garis Davies has recognised in certain tomb-pictures representations of candles consisting of large conical masses of fat consumed by means of a small wick at the apex.

The Shrines.—From the funerary point of view the chief addition so far made to our knowledge by the tomb is the verification of the purpose and arrangement of the so-called shrines of wood



1 4 by permission of the British Museum; 5 by permission of the Egypt Exploration Society

SPECIMENS OF EGYPTIAN ART

1 String of beads and pendants in glazed faience (modern stringing)—from Tell el-'Amarnah. c. 1370 B.C. 2. Painted pottery vase of rare design—from Tell el-'Amarnah. c. 1370 B.C. 3. Variegated glass vessel in shape of a fish—from Tell el-'Amarnah. c. 1370 B.C. 4. Cup of XII Dynasty Black-top ware—from Nubia. c. 2000 B.C. 5. Fragment of wall fresco (with restoration) from a house at Tell el-'Amarnah.

with gilt decoration which, one within another, conceal and protect the coffins. Such a canopy was found in fragments in the tomb of Queen Tyi, and the use then conjectured for it is fully confirmed by the finding of Tutankhamun's canopies in position.

Egyptian Archaeology in Nubia and Syria

No account of Egyptian archaeology can afford to omit the discoveries of the period 1910–25 in Nubia. In the predynastic period the civilisation of Egypt and Nubia was one and the same. From the I. Dynasty onward Nubia fell behind and produced for many centuries mere modifications of this early culture. These are known as the A-group, parallel to the Early Dynastic in Egypt, the B-group, parallel to the Old Kingdon, and the C-group, roughly parallel to the Middle Kingdom. During the Middle Kingdom the Egyptian governors of Nubia lived at Kerma, near the Third Cataract, where a curious new civilisation seems to have been built up by Egyptian craftsmen on the C-group basis. The most remarkable product of this culture is the beautiful thin red-polished pottery with black top referred to above (*see* fig. 4 on plate). The Egyptian governors at Kerma were buried on their beds surrounded by large numbers of native victims slaughtered at their funeral, apparently in imitation of a local custom observed, though less fully, in the tombs of contemporary Nubian chiefs. The New Kingdom brought the whole flood of Egyptian civilisation into Nubia, and the local industries hardly survived this inruption except for certain of the old types of pottery.

Revival of Nubian Culture.—Some centuries later this Nubian culture underwent an astonishing revival, the centre of which lay farther south in the Sudan, where Dr. Reisner has laid open an entirely new field of research. Historically he would divide his finds into two periods, the Napatan Kingdom of Ethiopia, about 900 to 300 B.C., and a Meroitic Kingdom of Ethiopia from 300 B.C. to 500 A.D. The archaeological importance of his work lies in the fact that he has discovered the tombs of the whole of the rulers of the Ethiopian Kingdoms throughout these periods, together with objects typical of the civilisation which they enjoyed. The earliest tombs of the Napatan kingdom at El-Kurru are mere mounds or tumuli, but with Piankhi, the conqueror of Egypt and founder of the XXV. Egyptian Dynasty, the pyramid once again becomes the correct form for a royal tomb, after a lapse of about 1,000 years. The finds in the tumuli include numerous arrow-points of flint and chalcedony of Libyan forms, and these, combined with certain inscriptional evidence, indicate that the ancestors of Piankhi were not Ethiopians but immigrants from Libya. Graves of horses were in some cases found close beside those of their royal owners. The finds in general show that Ethiopia formed a stronghold of Egyptian arts and crafts during the period of decadence in Egypt itself, and possibly prepared the way for the renaissance of the XXVI. Dynasty.

The Meroitic Kingdom.—The Meroitic Kingdom is almost without interest archaeologically. The local pottery seems, however, to make one last effort, and side by side with a survival of the ancient Nubian black and brown ware with white-filled incision, produces an elegant thin yellow ware painted with geometrical—more rarely naturalistic—designs or ornamented in the barbotine style. All else is decadent Egyptian or still more decadent Graeco-Roman.

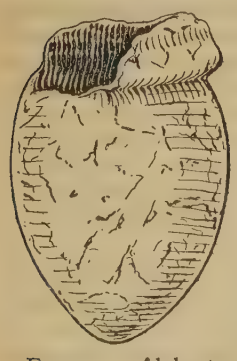


Fig. 7. — Alabaster vase from Byblos. V. or VI. Dynasty. (British Museum.)

Relations with Syria and Palestine.—In conclusion a short reference is necessary to the new field of Egyptian archaeology which appears to be opening up in Syria-Palestine. The interest of the discoveries of Beisan (the biblical Beth-Shan) are in the main historical, but the excavation of a XIX. Dynasty Egyptian fortress and of an Egyptian temple of Ashtaroth of similar date, with still earlier temple beneath it, is a matter of very new archaeological interest. At Byblos, too, where the Egyptians from very early times, appear to have made offerings in a temple, among which are vases inscribed with names of V. and VI. Dynasty kings and a cylinder which can hardly be later than the Thinite period (I. and II. Dynasties), there appears a likelihood that important archaeological material from a remote period but poorly represented in Egypt itself may be recovered. The occurrence in the tombs of certain chieftains of Byblos of Egyptian objects of XII. Dynasty date, in conjunction with local pottery and silver vases possibly of Aegean origin, is also noteworthy (*see* section X., Western Asia).

(T. E. P.)

VIII. CRETE

Later archaeological discovery has hardly altered any of the results stated by Sir Arthur Evans, the most experienced and most active of Cretan explorers, in 1910, but the very considerable accumulation of new material confirmed and extended his conclusions. It is only at Knossos that architectural novelties have since come to light, but two more palaces have been found, at Tylissos and Mallia, and several towns, some containing large and almost palatial houses, have been partially or completely cleared in the islands of Pseira and Mokhlos, at Nirou Khani on the north coast of Crete, and at Arkhanes and Plati in the interior.

Further work in the great palaces revealed new details of their plan and structure, and at Knossos much has also been done toward replacing the upper floors. The sanctuary cave of Kamares has been re-examined, and other mountain shrines were investigated at Arkalokhori and on Juktas. The most extensive finds, however, are sepulchral. Few cemeteries were known before 1910, and they belonged mostly to the end of the Late Minoan age (Zapher Papoura, Liliana, Kourtes); since then the earlier periods are represented on numerous sites, the most notable of which are in the Mesara plain (beehive-tombs), in Mokhlos, near Gournia (Sphoungaras and Pakhyammos), and again at Knossos (Isopata). The latest transitional phase was illustrated by remarkable finds at Vrokastro. Several works of sculpture of great distinction appeared during the period under review, having been found in some instances in their proper context by scientific excavation, and duly received into the Museum of Candia; in other instances accidentally or illicitly unearthed, and passed through the hands of dealers into foreign collections.

The first volume of Sir Arthur Evans' book, *The Palace of Minos at Knossos*, includes all the significant material that had been found on every Cretan site up to the time of its publication (1921). The varieties of hieroglyphic and linear scripts find their latest discussion in its pages, and an isolated document so remote from Knossos as the Phaistos Disk is fully examined there. No further progress had been made toward the determination of the Minoan language, but Sir Arthur Evans stated that the painted inscriptions on certain Mycenean vases found at Thebes in Boeotia agree both in form and grouping with the script in use at Knossos in the latest Palace period (L.M.II.), a coincidence which argues identity of language as of religion and general culture in the mainland (Mycenean) in the Phaistos Disk and Cretan (Minoan) civilisations. He is inclined to recognise in the Phaistos Disk a section of a pictographic metrical composition celebrating a sea-raid, a religious song of victory, conveyed to Crete from a Lycian or kindred Anatolian country. The book includes the results of supplementary excavations in Knossos undertaken in 1912 for the purpose of clearing up some obscure points in the plan and history of the palace. An instructive but difficult feature was the existence of superimposed pavements and floor levels, which showed successive chronological phases often involving complete change of function and design. It became evident in the course of these probings that the site was still productive, and excavation was accordingly resumed in 1922 and continued in the following years.[1]

At the southeast angle of the palace several huge blocks of masonry were found 20 ft. out of place, having been hurled to

[1] A. J. (Oct. 1922), J. H. S., Part II. (1924).

that distance by an earthquake shock, and having demolished a house in their fall. The pottery and other objects abandoned in the house give an accurate date for the catastrophe at the end of the Middle Minoan period (1600 B.C.). It seems that the widespread destruction and the general set-back which was long observed at the end of this period must now find its explanation in this physical cause. Some parts of the palace structure were not rebuilt after their collapse, and this house and another that shared its ruin were methodically filled in after a religious sacrifice had been performed on the spot, presumably to propitiate the earth-shaking power. Relics of the rite were found in two skulls of long-horned bulls and fragments of portable tripod altars. Rich stores of polychrome pottery of the finest (M. M. II.) style, were recovered from structures underlying these houses. A subsidence at this angle of the palace wall was shown by further exploration to have been a subterranean quarry with vaults and galleries from which potters and plasterers of the Early Minoan epoch had derived a certain kind of red earth.

In regard to the structure of the palace particular attention was given to the entrances. By the north gate the foundations of an outer bastion were traced, and the discovery of an early magazine for oil-jars points to its use as a depôt for stores arriving by the sea-gate from the harbour town of Knossos. The state entrance of the palace was the west porch. Here the removal of large fallen blocks revealed for the first time its true inner lines. Opening out of a reception area there was found a warder's lodge, a feature which recurs elsewhere in Cretan palaces. The processional corridor leading south from this entrance turned left to a Southern propylon which, in its original form, contained a large sacristy cist. From this propylon a broad flight of steps led through a spacious upper porch to the principal hall of the West Wing. Beyond this, unexpected evidence come to light of a staircase leading from the stepped porch on the Central Court to an upper storey. These structures have been replaced in their original positions and the Great Hall and its approaches covered with floors of reinforced concrete supporting the original column bases and door joints. This makes at once a monumental feature of the site, a protection for the lower rooms, and a permanent conservation of the existing elements.

But the most remarkable discoveries were made in connection with the south gate, where excavation revealed a monumental portico with inclined steps climbing up the slope. In connection with this on the farther bank of the stream that fed the Kairatos, there came to light, beneath an indurated natural deposit of gypsum, the most colossal piece of Minoan architecture that has been found in Crete, the piers of a massive viaduct by which the southern road was led across the torrent (see fig. 8 on plate). The stepped intervals between the piers, through which the flood-waters were released, are precisely like the spillways of a modern dam. Further sections of the road were traced at intervals across the island, over the low watershed of the central sea. Its track is visible in the ancient cuttings, in some surviving sections of its heavily built retaining walls, and in guard-houses, residences and shrines along its route. Its terminal port was at Komo near Phaistos and H. Triada, which it also linked with the dominating power at Knossos, but it doubtless served as the general line of traffic to Knossos from the Libyan sea and Egypt.

At the Knossian road-head, in front of the viaduct, Evans found a caravanserai of unique character. Its remains show a front yard backed with stone stables and storerooms, which served as the basement of upper storeys, partly brick-built. There was a refectory in the form of a stepped pavilion, adorned with a painted frieze of partridges and hoopoes. Attached to the pavilion is a smaller porch containing a sunk basin for foot-washing, and fragments of clay bath-tubs in an adjoining room indicate that more extensive ablutions were performed in greater privacy. There are even traces of a piped hot-water system. A small spring chamber was heavily choked with gypsum incrustation; but when this was hewn away the water at once rose in its ancient place, and the system here and elsewhere is now in working order. After the choking of the spring at the end of the Palace period, the well house was used as a shrine, and was filled with votive offerings belonging to the latest Mycenean and the earliest Geometric periods, which show the same continuity of culture on an inhabited site as is seen in graves at Vrokastro and elsewhere. The lowest date that can be provisionally assigned to the Proto-Geometric material is 1000 B.C. The date of the main structure of the inn, as of the great viaduct and portico beyond it, is L. M. I.*a* (1550 B.C.), to which period the painted frieze belongs. The viaduct in its original form and the stepped portico belonged to M. M. I.*a* and were therefore contemporary with the original foundation of the palace.

Some other frescoes came to light in the palace itself, where a lower level of the processional corridor (to which the well-known

FIG. 8.—Minoan Officer leading negro soldiers: part of painted frieze from the House of the Frescoes, Knossos.

"cup-bearer" belonged) yielded fragments of figures of the same early style as the "Ladies in Blue." Many very important paintings were obtained in an area west of the palace, in a house since named the House of the Frescoes. These pictures, which are not yet fully pieced together, are remarkable both for style and subject. They represent rich landscapes, with great variety of rocks, shrubs and flowers, done in the free naturalistic manner of L.M. I.*a*. Among the plants are birds and animals, including a monkey that can be identified as a Sudanese species. One piece shows a jet of water rising from an artificial fountain. Another bears the figure of a *Minoan officer accompanied by two negro soldiers* (see fig. 8). The intimate African relations which are illustrated by these paintings became increasingly apparent in Minoan remains. One of the late discoveries at Knossos may throw light upon the beginning of this influence. In the south-west part of the central court, where paving slabs had been removed, wall foundations were discovered, and were thoroughly investigated in 1923 and 1924. Two main strata could be distinguished, though both belonged to the concluding phase of the Upper Neolithic, and in these the ground-plans of two rectangular houses were made out. The accompanying pottery showed some anticipations of E.M.I. forms, such as stemmed goblets, which seem to have had metallic prototypes.

A find was a copper axe on a house floor in a pure neolithic context, probably imported, like the models for the vase-shapes, from protodynastic Egypt. In the same house was the base of a mottled limestone cylindrical pot of late predynastic type, and other fragments show that the local fabric of variegated stone vessels, which culminated in the magnificent specimens of Mokhlos, had already begun before the end of the Stone Age. The

house-plans are an agglomeration of rooms like the later palace itself, but an entirely new and unexpected feature in them is the fixed hearth, of which two examples were discovered. These are the only instances in Crete before the latest Minoan period, when the fixed hearth reappears in conjunction with the Mycenean *megaron* as an importation from the Greek mainland. The fact that throughout the long interval of the Minoan age only portable tripod hearths and chafing-pans are found must be referred to an influence coming from the milder climate of North Africa. The fixed hearth must now be regarded as part of the original Anatolian inheritance of Crete, which persisted until the end of the Stone Age, and was then displaced by a new movement.

The African influence, which had previously been noted in many physical and personal characteristics of the Minoan race, has had further confirmation on the sepulchral side. Between 1904 and 1917 a series of beehive tombs (*tholoi*) were located in the Mesara, and their contents proved to be objects of the same early class as the H. Onuphrios deposit, the Egyptian and possibly Libyan affinities of which were pointed out by Sir Arthur Evans in 1895. Two of the present series were found at H. Triada; most of the remainder were published by their excavator, the Cretan Ephor, S. Xanthoudides, in 1924. The vaults have megalithic doorways and in some cases rectangular antechambers. They were used for communal burial during the whole of the Early Minoan age, and some contained remains of several hundred interments. The associated material consisted mostly of pottery, notably of rare E.M. types, stone vessels, carved ivory seals, copper and silver weapons. One of the most significant foreign elements is a Babylonian cylinder of about 2000 B.C. (=M.M. I.) The beehive vault and the square entrance enclosure occur, as Sir Arthur Evans has pointed out, in certain tombs of North Africa, where an origin for the form is indicated in the huts of Libyan nomads. On the other side these early Cretan *tholoi* may supply the ancestry of the stately Mycenean tombs, which first appeared in mainland Greece after the Cretan occupation at the end of M.M. III. During the Middle Minoan age such vaults seem to have gone out of use for sepulchral purposes in Crete, but their design and method of building are exemplified in a circular well-house discovered by Evans at Arkhanes near Knossos in 1922, which is contemporary with the earliest mainland tombs.

The strange variety in Minoan methods of burial has been amply demonstrated by recent work. Besides the *tholoi*, which may have been peculiar to Mesara with its close Libyan outlook, Early Minoan communal interments have been found in a cave at Pyrgos[1] and in rectangular enclosures or rock-shelters at Mokhlos. Cist graves of the same period have been found at Mokhlos, Pseira and Sphoungaras. This Cycladic mode of burial was practised also in the Middle Minoan age, but burial in jars then came into use beside it, and is represented on the same three sites and at Pakhyammos. Jar-burial was usual in L.M. I., when the great square chamber tombs began (Isopata); the latter persisted with beehive tombs as the typical Late Minoan and Mycenean method. Shaft-graves and pit-caves were frequent in L.M. II. and after (Zapher Papoura), and in L.M. III. the custom arose of using clay chests and bathtubs for coffins, the unearthing of which in classical times doubtless gave rise to the stories that Minos and Agamemnon had been killed in their baths. Rich finds of coloured stone vases and unique gold jewels came from the E.M. tombs of Mokhlos. The same cemetery and those of Sphoungaras and Pakhyammos produced fine examples of painted burial jars, particularly of L.M. I. date. The Knossian chamber tombs opened in 1910 belong to a group situated on the plateau of Isopata.[2] Their earliest elements go back to the end of M.M. III. The Tomb of the Polychrome Vases (L.M. I.) contained two goblets brightly painted in unfixed colours which illustrate the survival of an obsolete technique for sepulchral use. The cult of the dead is more impressively displayed in the neighbouring Tomb of the Double-Axes (L.M. II.), the singular form of which, with central buttress bearing a carved half-column, is a symbolical reproduction of a Minoan columnar sanctuary with its supporting pillar-crypt. There are benches along the walls as in a living-room, and a cist grave cut in a platform on the stone floor has the plan of a double-axe. The tomb, like most of its kind, had been rifled in antiquity, but among the few pieces of jewellery remaining were some amber beads and disks, and several fine specimens of Palace style vases were made up from fragments. Smaller vases were a bull's-head "filler" and a jar of the same shape as the ritual polychrome vases, and there were two bronze double-axes.

Similar cult objects were found in the large house west of the palace known as the Little Palace, which is connected by a paved way with the theatral area. In this building a room with sunken balustraded floor approached by steps (such as were once thought to be baths, and are now recognised as sacred chambers) was already known. Further exploration revealed other architectural features which seem universally to have been connected with the Minoan cult. These are basements with heavy square pillars supporting the roof at points where columns above carried the ceiling of an upper hall. Between the pillars in this instance were vats for receiving libations; in other Knossian houses cups have been found holding remains of offerings and the stepped socket of a double-axe. Here, in the well of a staircase giving access to one of the columnar upper rooms, were found a similar axe-socket, clay vases in the shape of a bull's head, and other ritual forms, and a magnificent bull's-head vase carved in black steatite, half natural size. Its nostrils were inlaid with white shell, its eyes painted behind crystal inlay, and the horns were gilt wood.[3] Very curious finds of cult objects were also made in a large house at Nirou Khani by Xanthoudides in 1919.[4] In one room were four colossal double-axe blades of bronze, of which the biggest was nearly 4 ft. long and more than 2 ft. wide. In two other rooms 40 or 50 tripod-altars made of unbaked clay had been stacked in rows along the walls. It must be supposed that these sacred implements were manufactured here, and that one of the privileges of the priest-kings who lived in the palaces was the sale of such furniture to their subjects. The pottery from this building is mostly of L.M. I. style.

Another palatial house of the same date was excavated by J. Khatzidakis, at Tylissos.[5] It had been destroyed by fire about the same time as the palace of Knossos. Remarkable objects were found: four gigantic basins, from 4½ ft. to 2½ ft. in diameter, an obsidian libation-vase ("filler") 9 in. high, fragments of painted plaster, one with a picture of a large ceremonial fan, and a bronze statuette of a praying man. This last figure was the means of identifying a very fine example of the type which had lain in the British Museum for many years.[6] Another bronze statuette, perhaps representing a flute-player, which is said to have been found near Phaistos, was acquired by the Rijksmuseum of Leyden.[7] A quite extraordinary piece of Minoan sculpture is a small bronze group representing a man somersaulting backwards over a charging bull. This belongs to an English collector.[8] Sculpture in ivory is also illustrated by two exquisite pieces. One, which is now in the Museum of Fine Arts at Boston, is a figure of the Minoan goddess or her votary wearing a flounced robe enriched with gold and holding two golden snakes.[9] The other,[10] obtained by Sir Arthur Evans, represents a boy with arms upraised in adoration, and was apparently the companion figure of the Boston ivory in a group of the goddess and her son-consort. A marble statuette bought by the Fitzwilliam Museum at Cambridge (1926) represents the goddess holding her breasts. It reproduces in detail the costume of the Snake Goddess of Knossos.

Another palace has been located at Mallia, on the north coast

[1] Ἀρχ. Δελτ. (1918).
[2] A. J. Evans, "Tomb of the Double-Axes," etc., *Archaeologia* (1914).
[3] *Ibid.*
[4] Ἀρχ. Ἐφ (1922).
[5] Ἀρχ. Ἐφ (1912).
[6] *J.H.S.* (1921).
[7] Jahrb. d. deutsch. arch. Inst. (1915).
[8] *J.H.S.* (1921).
[9] *A.J.A.* (1915).
[10] This will be published in vol. 2 of *The Palace of Minos at Knossos.*

of Crete, and is now being excavated by the French school at Athens. It was destroyed at the very beginning of the Middle Minoan age, and consequently supplies much valuable chronological information, as, for instance, that the hieroglyphic script of Knossos was fully developed in M.M. I.*a*. To the same early period belongs the largest bronze sword that has been found in Europe, a splendid weapon with inlaid hilt and faceted crystal pommel. It comes from what may have been a royal tomb on this site. The excavation of the palaces of Phaistos and H. Triada is regarded by the Italian Mission as finished. A final plan and description of Phaistos were published by L. Pernier in 1914.[1] A street of houses, described as an *agora*, of the Late Minoan period was uncovered at H. Triada in 1910, and in 1912 an L.M. III. shrine was found there, containing the customary stacks of cups for offerings. Such domestic shrines or the more intimate pillar-cult of houses are represented in every considerable Minoan building. Public places of worship are less common and of different kind. A built sanctuary was found by Sir A. Evans on Mount Juktas,[2] but other mountain-shrines, sacred to the powers of nature, seem to have been left in their natural state. The Kamares Cave, situated on Mount Ida, in which the first finds of M.M. polychrome pottery ("Kamares ware") were made about 1894, was fully explored by the British school at Athens in 1913. This cave is a great hollow in the limestone, nearly 6,000 ft. above the sea, running about 100 yards into the mountain at a downward slope of 30 degrees. At its bottom is a smaller cave with a very narrow entrance. No trace of habitation was found. The place was evidently a sanctuary dominating Phaistos and the Mesara, and the offerings found in it were made "by people coming as far down into the cave as they could, or perhaps as far as they dared, and laying their vases among the great boulders."[3] Little was found besides pottery, and that belonged almost exclusively to M.M. I. and II. Most of it was plain ware, but painted shards were numerous, and among the recovered vases are some of the most decorative in Minoan art. The absence of the kinds of votive offerings, particularly bronzes, which have been found in other Cretan sanctuaries, must probably be explained as a fashion of the time. In the same year Khatzidakis cleared a very small cave which was nowhere more than three feet high or six feet wide, at Arkalokhori near Lyttos. The predominant offerings were copper dagger-blades and double-axes of Early Minoan date. The first examples of E.M. I. stemmed goblets in black pottery with burnished patterns were also found here.[4]

The end of the Minoan age is still obscure in detail. Universal destruction is apparent at the close of L.M. II., and in the island towns of Pseira and Mokhlos there was no subsequent recovery. The Cretan sites, however, were reoccupied at once, and although the palaces were not fully rebuilt their partial inhabitation and the continuous use of towns and cemeteries indicate no cultural or racial change in the last period (L.M. III.). But Late Mycenean (Myc. III.) elements were brought from the mainland at this time to Crete, as they were carried to Cyprus, Rhodes and elsewhere in the Aegean, and the last phase of prehellenic culture in Crete seems to have been the same as in the rest of Greece. The following age of transition, which was represented by the offerings in the well-house at Knossos, is best seen at Vrokastro. There, on a series of high hills and ridges near Gournia, has been found an extensive settlement with attached cemeteries of the latest Bronze and earliest Iron Ages. Two distinct funeral rites are recorded: inhumation in chamber tombs, and cremation in the same tombs or in bone enclosures. The style of the pottery in the chamber tombs is Sub-Mycenean or Proto-Geometric; that in the bone enclosures is early and mature Geometric. The pottery in the town is of the latest Mycenean class (Myc. III.*b*). Different types of fibulae were associated with the three kinds of pottery, iron weapons were found with both kinds of burial, and in one chamber tomb there was a bronze tripod of the kind that had been previously found with Transitional material at Knossos, in Cyprus, at Athens, and most recently at Tiryns. Six Egyptian faïence seals were found with the tripod, which had not been precisely dated. But it is clear that the Vrokastro finds cover the period between 1200 and 800 B.C., and display the stages by which Hellenic (Geometric) art displaced Minoan, without, however, offering an historical explanation of that phenomenon. Crete evidently felt the full activity of these momentous changes. Discoveries made by an Italian Mission at Afrati, the ancient Arcadia, in 1924[5] revealed a remarkable series of vases in the early Orientalising style, which tend to show that the island was prominently concerned with the revival of art in the Archaic Greek period, partly by maintaining the Minoan tradition, partly by resuming its old position of intermediary between Europe and the Middle East.

The period was also marked by the publication of many important books. Some of these are final records of excavations made before 1910, but previously known only from provisional reports in periodical publications: such are the late Richard Seager's accounts of his valuable explorations in Pseira and Mokhlos, the first part of the publication of objects found by the British school of Athens at Palaikastro, and the first volume of Sir Arthur Evans' great work. Books reviewing the Cretan material in its Aegean or wider Mediterranean relations were written by Dussaud, Fimmer, Glotz, Hall and Mosso; and two useful pictorial surveys were produced by Maraghiannis and Bossert.

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(E. J. F.)

IX. GREECE AND EASTERN MEDITERRANEAN

Greece.—In Greece since 1910 the increase in our archaeological knowledge has been great in spite of the cessation of work during the War. It is best to divide the field into two sections—the prehistoric and the historic. The gain to knowledge seems greater in the former than in the latter, because practically every discovery in the prehistoric sphere, where we know so little, adds considerably to our knowledge. On the other hand the historic period is already so well explored that only important discoveries make really serious additions.

The Prehistoric Period

The Greek and British researches in Phocis and Thessaly in 1912 and 1910 show that a Neolithic and Bronze Age culture flourished all over Northern Greece between 3000 B.C. and the close of the Mycenaean period about 1150 B.C. Its development shows four periods, of which the first and second are Neolithic. The culture of the first is well advanced and indicates that man had progressed far beyond the palaeolithic stage. The second has connections with similar cultures that centre in the upper Balkans round the Carpathians. The third period is the early Bronze Age and it also is related to the early cultures of Macedonia and Serbia. The fourth period is the Later Bronze Age and a

[1] *Ann. Scuola Ital.*, i. (1914).
[2] *Palace of Minos*, i., p. 154.
[3] R. M. Dawkins in *B.S.A.*, 19 (1912–3).
[4] *B.S.A.*, 19 (1912–3).
[5] *J.H.S.* (1924).

time of decline until in the 15th century B.C. Mycenaean civilisation invaded the country. Recent American researches in Corinthia, Argolis and Arcadia have shown that in Neolithic times a similar culture covered Southern Greece. In both north and south brightly painted hand-made and polished pottery is characteristic of the Neolithic periods, and as it is technically good, is in strong contrast to the coarse, incised Neolithic pottery of Crete and the islands. This suggests a racial difference between the islands and the mainland at that time, and since the polychrome pottery of the second period is related to that of the Carpathian area, this might point to the coming of people from East Central Europe into the Peloponnese before the close of the third millennium. During this second Neolithic period a bronze-using folk akin to the population of the islands and Crete entered Southern Greece, and overran the Peloponnese and all Central Greece, as far north as Mount Othrys. This probably occurred about the middle of the third millennium.

The Bronze Age.—The remains of the Early Bronze Age in Southern Greece (Early Helladic Period) are well illustrated by the American excavations in Corinthia and by the Swedish at Asine, by the German at Tiryns, by the Greek in Boeotia and Euboea and by the British at Mycenae. The same series of excavations with more recent work by the Americans in Boeotia and the discovery of the "House of Cadmus" at Thebes by the Greeks have immeasurably increased our knowledge of the Middle Bronze Age and Late Bronze Age (Middle and Late Helladic Periods) in continental Greece. The Middle Bronze Age is marked by the intrusion of people characterised by the use of pottery known as Minyan Ware. The origin of this is not yet known and though it is common on the Greek mainland and occurs also in the islands, none had been found in Crete up to 1925. It would appear that in the Middle Bronze Age, owing to this intrusion, relations between Crete and the mainland were broken. Before the beginning of the Late Bronze Age about 1650 B.C., the Cretan civilisation established itself on the mainland partly by trade and partly by colonisation. The receptivity of the people of the mainland for the more advanced civilisation is exemplified by the rapid rise of places such as Thebes or Mycenae to first-class importance. Then with the Late Bronze Age begins the Mycenaean Age *par excellence* and the history of this has been completely rewritten as a result of the excavations just referred to at Mycenae, Tiryns and Thebes. During the 16th and 15th centuries B.C. Crete was culturally dominant on the mainland and was possibly politically dominant as well. But before the close of the 15th century B.C. the character of the mainland asserted itself so strongly that when, about the beginning of the 14th century B.C., the Palace of Knossos was destroyed Mycenae succeeded to the artistic and political inheritance of Crete.

Mycenaean Culture.—Mycenae in the 16th century B.C. was ruled by a dynasty of kings who were buried in the Shaft Graves discovered by Schliemann. They were succeeded by a second dynasty about 1500 B.C. and the monarchs of this were buried in the nine beehive tombs which are one of the marvels of Mycenae. Brilliant remains have also been found of the frescoes which decorated the palaces of Tiryns and Thebes. About 1400 B.C. when Mycenae took the place of Knossos as the centre of power and culture, there arose a great king who extended and refortified its citadel, built the Lion Gate and the Grave Circle, and reconstructed the palace on the summit of the acropolis. To him may also be assigned the Treasury of Atreus which dates from the same period. To the same century belong the citadel and palace of Tiryns and the latest phase of the "House of Cadmus" at Thebes. At both sites a quantity of vases bearing painted inscriptions in the still undeciphered Minoan script have been discovered. Well-furnished tombs excavated at Mycenae, Thebes, Chalcis and Asine have yielded a rich series of objects illustrating the art, customs and religion of the people. The latest Bronze Age stratum at Mycenae seems to indicate that, although Mycenae itself perished by fire during the 12th century B.C., there was no sudden break in civilisation at the beginning of the Iron Age. The seals, *a*, *b*, *c*, *d*, (see figs. 1 and 5 on plate) are of the 15th, 14th, 13th and 12th centuries B.C., respectively.

The Historic Period

Excavations by the Americans at Vrokastro in Crete and on Mount Hymettus, by the British at Halos, by the Swedes at Asine and by the French at Delos have thrown further light on the early Iron Age and it is becoming clearer that its culture, from which classical Greek art is descended directly, was an age of transition when the art of the Bronze Age absorbed new elements and so commenced a fresh evolutionary process. The finds on Hymettus hint that the employment of the Greek alphabet may perhaps have to be put back even earlier than the 7th century B.C. This need cause no surprise, for the comparatively high stage of development which it had reached in the 6th century B.C. indicates that it had been used for some time, and we know the art of writing was well known in the Bronze Age.

The evidence concerning the rise of archaic art has been enriched by the German and Greek work at Corfu and Thermos in Aetolia. The important discovery of a pedimental group in high relief at Corfu has much enlarged our knowledge of early temple sculptures. In the centre is a great Gorgon being slain by a small Perseus and on either side of her is a large lion. Other small figures occupy the interspaces and the angles. The primitive composition of this group shows that early temple sculpture followed the types of the heraldic groups of the Bronze Age like the Lion Gate of Mycenae. A similar composition of a goddess between two lions has been reconstructed from fragments found in the Artemision at Delos. The French researches in the Heraion at Delos, the Greek in the temple of Zeus Thaulios at Pherae, the Italian at Arcadia in Crete, by their richness in pottery and other small objects, well illustrate the gradual development of Greek art from the geometric to the late archaic period.

Classical Period.—In the classical period the principal progress that has been made lies in the attempts to read the early history of famous buildings such as the Parthenon, the Olympieion and the Nike Temple at Athens, the Heraion at Olympia and the Temple of Apollo at Thermos. When these temples were first excavated they were regarded as units of one period only. Now the early altar of Nike has been found; also two earlier temples below the Heraion and at least one earlier temple below the Parthenon and below the Olympieion. The first temple at Thermos was surrounded by a colonnade curved at one end and probably dates as far back as the 8th if not the 9th century B.C. It is thus the earliest Greek temple.

On the sites of great cities such as Argos, Elis and Corinth work has been continued by the Dutch, Austrians and Americans, but in proportion to the expense involved and the fame of the cities the results are disappointing except for some interesting classical inscriptions from Argos and a few imperial statues of the 1st century A.D. from Corinth. Similarly the new British excavations at Sparta, apart from one good archaic marble statue, a few small bronzes and a crop of Hadrianic inscriptions, have not been encouraging. On the other hand experimental work by the Americans on the smaller sites of Phlious and Nemea has proved very promising. Fresh work has been undertaken by the French at Delphi which has revealed a shrine of Hermes to the west of the sanctuary. Buildings previously excavated, such as the Athenian and Sicyonian Treasuries and the Temple of Athena Pronoia have been re-examined with valuable results as to their history, plans and decoration. In Delos the Sanctuary of the Foreign Gods was found and cleared and other work done in and around the sanctuaries of Apollo and Artemis and in particular the position of the tombs of the Hyperborean maidens mentioned by Herodotus is believed to have been identified. A Greek excavation has found a sanctuary of Herakles on Mount Oeta where, according to legend, was the hero's funeral pyre. At Koroneia interesting inscriptions of Roman date have been found which refer to the maintenance of the dikes of Lake Kopais.

Study of the Hellenistic remains of Asine and of Mycenae by the Swedes and the British has provided interesting information about the life of small townships. The Greeks have begun work on the important Byzantine ruins at Nicopolis.

Balkan Area.—In Balkan lands, owing to the disturbances of war, not so much has been done as might have been hoped.

Albania and southern Serbia are still more or less virgin fields, though the Byzantine monuments of the latter region have been carefully studied by the French. Still, the results achieved are worthy of enumeration.

Macedonia.—A distinct advance has been made in Greek Macedonia, where French and British explorers have been at work on the prehistoric mounds. The results are only provisional, but we can estimate the character and connections of its culture in the Bronze Age. Though, as might be expected, there was contact with Serbia to the north, with Thessaly in the south and with Thrace in the east, Macedonia had distinct individuality. Finally in the period just before the beginning of the Iron Age it was subjected to fairly strong Mycenaean influence, especially along the littoral. The Greek and French have begun at Pella, Dium, Thessalonica and Philippi the exploration of the remains of the succeeding Hellenic and Roman periods. At Thessalonica it has been shown that the Arch of Galerius was originally double and built in connection with the round domed building later converted into the church of St. George. At Philippi the shrines of Silvanus and of the Egyptian gods have been identified, and illustrate the variety of cults practised in a city of Greek Macedonia in Roman times.

Aegean Islands.—In the Aegean Is. much work has been done. A sign of the times is the beginning of operations in Samothrace by a Czechoslovak expedition. The Greeks have started the exploration of Mitylene and Chios. The French have been at work in Thasos since 1910 though with several intervals due to the War. The city walls, which have been almost completely traced, have several gates marked by the presence of interesting reliefs of the early 5th century B.C. Many other sculptures have been found, including an archaic Apollo Kriophoros over 10 ft. high and the remains of a group of statues representing Dionysus with Comedy, Tragedy and other figures. The foundations of a temple nearly as large as the Parthenon have been cleared, the market place and surrounding buildings explored and the theatre carefully studied. The crop of inscriptions has been large and apart from the art treasures found it is to be hoped that the correlation of the results will provide us with new material for the history of Greek culture in the Thracian archipelago. In Samos the Germans have completed the excavation of the Temple of Hera. This was a very large temple with a double colonnade all round and had 24 columns on the long sides with eight at one end and nine at the other. The existing ruins are those of a temple which was begun in the first half of the 5th century B.C., but was never finished. To a considerable extent it imitated a still earlier building which was destroyed by the Persians when they raided Samos about 517 B.C. after the death of Polycrates. Near the altar a statue base with the name of Cicero has been found and others erected in honour of the Julio-Claudian imperial family for their help to the temple after it had suffered in the piratical war of the time.

The Dodecanese.—The Italians have begun a survey of the Dodecanese and a Museum has been established in Rhodes. Excavations have taken place at several sites, mostly in Rhodes, where perhaps the most interesting results have been obtained at Ialysus. Here many more tombs were opened in the cemetery whence came the Mycenaean vases now in the British Museum. In Cyprus a Swedish expedition has done valuable work. Hitherto most of the evidence for the early history of the island was provided by tombs, too often carelessly excavated. The Swedes have been scientifically investigating the stratification of early inhabited sites and have determined a chronological sequence by which the previously excavated tombs can be classified. Thus a satisfactory basis is obtained for the classification of the earlier civilisation of the island, which shows, with native elements, connections with Syria, Egypt, Mycenae and, if the signs are rightly interpreted, with Cilicia. The character of the Mycenaean pottery mentioned from Cyprus, Rhodes and Macedonia reflects the culture of Mycenae and the mainland rather than of Crete. The great expansion of the Aegean civilisation would thus have taken place after the fall of Knossos, when Mycenae was the centre of power. (A. J. B. W.)

X. WESTERN ASIA[1]

Palestine.—In Palestine the most important discoveries of the years 1910–25 have been made in the American excavations at Beisan, the site of the ancient Bethshean or Bethshan. The work has been carried on for the University Museum, Philadelphia, by Mr. Clarence S. Fisher, assisted by various helpers, and is now being continued by Mr. A. Rowe, an Australian archaeologist.[1] Bethshan was an important place as commanding the fords of the Jordan eastward from Galilee into Syria south of Lake Tiberias.

In very early times a route ran past it from the Vale of Esdraelon, which the road from Egypt through Philistia reached at Megiddo, across the Jordan and so northward past the Hauran to the district of Damascus. It was occupied by the invading Scyths in the 7th century B.C., and from them derived its classical name Skythopolis. Seven centuries earlier, under the XVIII.–XIX. Dynasties of Egypt, it was an important Egyptian fortress, with which the Egyptians held central Palestine before the Philistine invasion, and after that event ended the Egyptian control, it was one of the chief fortresses of the Philistines till their defeat by the Israelites.

The hope that important discoveries of Philistine remains would be made during the excavations has not been fulfilled. Instead, however, very important discoveries of the Egyptian period have been made, including two stelae of Seti I. and one of Rameses II., and a locally-made statue of Rameses III., the art of which is very curious. One of the two stelae of Seti I. has been said to mention the Tuirsha (Mediterranean sea-rovers who invaded and took service in Palestine in the 14th and 13th centuries B.C.) and the 'Aperiu or 'Apuri, a people who have often, and probably rightly, been identified with the 'Ibhrīm or Hebrews. The statement that Semitic prisoners are mentioned also on the stela of Rameses II. as working on buildings in the city of Rameses (Pelusium) in the Delta, which has naturally been taken as confirmation of the Biblical tradition of the Hebrews working under the Egyptian taskmasters at "Pithom and Rameses" is now known to be erroneous.[2] Were it correct, it need not have been supposed therefore that his son Meneptah was the Pharaoh of the Exodus, as has often been thought. The Exodus probably took place much earlier than his time, if, as was supposed by Josephus, it is identical with the Expulsion of the Hyksos. In that case Iahmase or Amasis I. will have been the Pharaoh of the Exodus. There may have been, however, a Ramesside oppression, the tradition of which has been transferred to the period before the Exodus, whereas it really refers to three centuries later,[3] so that Rameses II. may have been the Pharaoh of an oppression, though the Pharaoh of the Exodus lived long before then. But no confirmation of this view can be derived from the stelae of Bethshan.

Another important excavation in Palestine has been that of Ophel, the site of the most ancient Jerusalem, for the Palestine Exploration Fund, carried out by Prof. R. A. S. Macalister, assisted and succeeded by the Rev. J. Garrow Duncan.[4] Not much that is interesting in the way of antiquities has been discovered, but the architectural and topographical finds have been notable, including the Jebusite Wall with its additions of Solomonic and Nehemian times, and what Prof. Macalister considers to be the remains of the Millo bastion, with the breach made by David when he stormed the city. The oldest Jerusalem probably did not occupy any part of the present city. It lay on the tongue-like hill spur of Ophel between the Tyropoeion Valley and the Vale of Hinnom, overlooking Siloam and the Virgin's Well immediately south of the Haram or sacred enclosure of the Moslem mosques which occupy the site of the Temple of Zion. The hill has now no buildings, but a house here and there on it. It was here that the ancient city of Urusalim stood which is mentioned in the Tell el-Amarna letters of the 14th century B.C. A tiny place it must have been, according to modern ideas; but very ancient cities occupied very small sites with extraordinarily narrow streets and closely packed houses, as we see from the remains of the contemporary and earlier towns of Gournia and

[1]The figures appearing throughout the text of this section, "Western Asia," refer to the bibliography at the end of the section.

Pseira in Crete, where the streets often hardly allowed of two persons passing one another. The Palestine Exploration Fund's work lies astride the shoulder of the hill towards the northern end or root. At its southern end or butt, M. Raymond Weill has carried out excavations for Baron Edmond de Rothschild, which have yielded results of interest,[5] such as the Greek inscription recording the building of the synagogue of Theodotos, besides some archaeological evidence with regard to the walls, water-supply, necropoles, etc., of the most ancient Jerusalem on Ophel, and a good deal with regard to the antiquity of the quarrymen of Roman times, who probably destroyed tombs and other evidence as to the earliest epoch which we would give our ears to possess now. Other explorations at Jerusalem have been essayed by Mr. Nathan Slousch.

Petra and Transjordan.—In the south Petra has been investigated again by Sir Alexander Kennedy,[6] and Mr. St. J. Philby has noted archaeological remains in Transjordan, where the Roman ruins at 'Amman, which had been reported to be in some danger of vandalic interference, are now more carefully supervised. Further north Dr. Hrozný, of Vienna, has been digging near Mzerib,[7] at Sheikh Sa'ud, where he discovered near the inscribed monolith of Rameses II. an interesting Canaanite inscription dating before 1000 B.C., as well as buildings of the Hittite period. In spite of the fact that Angora had given him full permission to do so, he was not permitted by the local Turkish authority to excavate at Kül Tepe, near Kaisariyeh, the spot whence have come the " Cappodocian " tablets of early Semitic immigrants into Anatolia that are in our museums. In the north the most important excavations have been those of M. Montet at Jebeil,[8] the site of the ancient Byblos or Gebal, on the Phoenician coast. It has of late years become increasingly evident that Byblos had a specially close connection with Egypt.

The well-known legend about the stranding of the body of Osiris at Byblos and the journey of Isis to collect his scattered members in a box or coffin has always shown that the foreign town of Byblos had very early a special connection with Egyptian myth and legend. And in ancient texts it is always mentioned as if it has some special importance for Egypt. M. Montet has now shown by his excavations that not only was Byblos quite Egyptianised as early as the time of the XII. Dynasty (*c.* 2000 B.C.), but that even so early as the time of the III.–IV. Dynasties 1,000 years before, in the time of King Sneferu, it possessed a purely Egyptian temple. We are at once reminded of the record that Sneferu sent ships to the Phoenician coast to bring back the great beams of pine and cedar that he needed for his buildings. In fact much earlier than his time in all probability wood was brought by sea from the Lebanon to Egypt, and the legendary connection of Osiris with Byblos, the enclosure of his body in a wooden coffin there, and the fact that his emblem, the *Ded* or *Ṭaṭ* (usually called " the emblem of stability "), is nothing but a conventional representation of a coniferous tree with horizontal branches,[9] probably refer to the fact that the Egyptians very early obtained from Byblos the wood for the making of the coffins of the dead. Byblos was a holy place in connection with Khentamenti and Osiris, the gods of the dead (afterwards united), and before the time of Sneferu became practically an Egyptian colony, as we see from M. Montet's results. From them too we see the effect of the Egyptian connection on the local culture, especially under the XII. Dynasty, when the dead Phoenician princes were buried in sarcophagi of half-Egyptian form, with many of the ordinary Egyptian accompaniments of the dead at the time, in the shape of stone vases, etc., imported from Egypt.

We see too how it was that Egyptian influence was always so strong in Phoenicia, from the earliest to the latest times; how it was that under the XVIII. Dynasty the conquering Pharaohs so easily established their rule there after the expulsion of the Hyksos, and that the native princes continued faithful to Egypt, even when deserted by the pacificist King Akhenaten and abandoned to the attacks of the Amorites and Hittites; how it was that under the XXVI. Dynasty Egypt could always find some support against Babylon in Phoenicia; and how it was that even to the end Phoenician art always exhibited a strong Egyptian impress, stronger than that of the rival art of Mesopotamia. A very important discovery made by M. Montet is that of an Aramaic or rather Phoenician inscription of the time of Rameses II. (*c.* 1250 B.C.), the epitaph of a local prince, Ahiram, of that time. This shows that the Phoenician or Aramaic alphabet already existed as early as the 13th century B.C., whereas previously it had not been supposed that it dated very much earlier than the 9th to which the famous inscription of the Moabite Stone belongs.[10] In the north M. Contenau has continued his excavation at Sidon.[11] Other articles on Syrian and Palestinian archaeology which need not be specified here have appeared in *Syria* and in the *Quarterly Statement* of the Palestine Exploration Fund, such as the exploration of Tell Nebi Minduh (Kadesh on the Orontes) by M. Pézard (*Syria*, 1922), for instance, as well as articles on Philistine pottery by Saussey, and so on.

An important find was made in the Beirut Museum by Mr. C. L. Woolley in 1921 of sub-Mycenaean pottery that had been found in burials in North Syria.[12] It can hardly be doubted that these are remains of the Philistine invading horde that made its way about 1200 B.C. from southeast Asia Minor through Anatolia, overthrowing the Hittites, so that " no land stood before them," into Central Syria (Amor), where the horde abode for some time, before continuing its advance through Palestine to the borders of Egypt. There it was defeated by Rameses III., afterwards settling down in the Shephelah as the historic people of the Philistines, to whom we must ascribe the sub-Mycenaean, ceramic from various excavations in Palestine. They themselves, though not properly speaking Minoan or Mycenaean Aegeans had been very closely affected by Mycenaean culture, as were no doubt all other " Peoples of the Sea."

Speculations as to the influence of Minoan culture on that of Phoenicia, such as those of Woolley, who would ascribe the Phoenician seafaring possibly to the influence of Aegean dynasts in the Phoenician cities,[13] are hardly borne out by the facts, as we have no proof of any such foreign princes having ever existed, and in the Amarna letters all the names of Phoenician princes are Semitic. Still less probable is the fantastic hypothesis of Autran,[14] who would establish Minoan culture on the Phoenician coast, a theory for which there is no archaeological warrant whatever, as Woolley himself shows.

Anatolia.—In Anatolia the revived Turkish régime has not been favourable to archaeological exploration until very recently, when the veteran Prof. Ramsay and certain American scholars have once more got to work on the antiquities of the classical period. Hrozný was not allowed to dig at Kül Tepe, as has been mentioned above. As regards the earlier period, work has been confined to the further elucidation of the Hittite documents found at Boghàz-Kyöi, work which has been carried out chiefly by Drs. Hrozný, Forrer and Sommer. Forrer[15] has identified eight different languages as spoken in Bronze-Age Anatolia, of which the royal or official Hattic or Hittite (" Kanisian ") of the Boghàz Kyöi tablets is, he agrees with Hrozný, Indo-European: while " Protohattic," the original language of the Hittites, is Asianic, and non-Aryan, as are also other Asia Minor languages. " Luvian," according to Forrer, was a more distant relation of the original speech of the " Wiros " (as Dr. Peter Giles and others call the original Indo-Europeans) than " Kanisian " Hittite, and has occasional resemblances to Greek, which in the case of Greek are to be assigned to the Aryan Greeks borrowing from their " Luvian " predecessors in Greece. For Forrer, apparently, the Aegeans, and so probably the Minoan Cretans, talked Luvian. (Here is an opening for would-be decipherers of the Minoan script.)

But whether this be so or not, the only epigraphic relics that we possess of Eteokretan appear to be entirely non-Aryan, like " Protohattic " or Lycian. Forrer has followed up his discovery of these different tongues in cuneiform, a discovery which is beyond cavil by a supposed discovery to which serious objections may provisionally be taken.[16] He thinks he has found in Hittite documents actual mention of Achaian princes of the 14th and 13th centuries B.C., and these specifically the Andreus and Eteokles mentioned by Pausanias as early rulers of the Boeotian

Orchomenos and (no less) the famous Atreus of Mycenae. Nobody doubts, of course, nowadays that the heroic princes of Greek legend had their originals in fact, and Atreus may very well have been an historic personage. But when we find him and others discovered so "pat" in Hittite documents we may well pause. It is like discovering a mention of King Arthur in a Saxon chronicle, and about as probable. The ultimate authority for the identifications rests on the correctness of Dr. Forrer's identifications of place-names. Now the *Ahhiawa* which he so confidently identifies as Achaia is identified by Prof. Garstang, a rival identifier of Hittite place-names, as the classical Anchiale, the Ingirā of the Assyrians, in Cilicia.[17] And so on. We are not on firm ground yet. As for the names themselves, *Antaravas* might do quite well for Andreus—it is just how a Cyprian would have translated Ἀνδρεύς into his syllabic script—but though *Attarissiyas* is an interesting equivalent for Atreus (=A-tresyas, "untrembling"?) it has yet to be shown to be a probable one philologically: it is by no means certain that Atreus does=†A-tresyas, and mean "untrembling." *Tavagalavas*=Eteokles (Ἐτεοκλῆς) is open to grave suspicion.

However, in the cuneiform equivalents of Greek names, in the list of Cypriote princes who submitted to Sargon of Assyria in 673 B.C., Eteandros (Ἐτεϝάνδρος) is reproduced as *Ituwandar*. The digamma is given its full force. We should have expected to have seen Eteokles reproduced as "Ituvukalavas." Where is the initial? There are archaeological difficulties in the way of acceptance of the theory too. Forrer does not take sufficient account of them, and until further discovery has confirmed his identifications it would be as well to be chary of accepting them at their face value. Dr. Kretschmer has identified Alakshandu, another prince mentioned in these tablets as king of Uilusa, as an Alexandros, of the Pamphylian coast, who, since there were Κιλικες in the Troad as well as in Cilicia, was the original of Alexandros of Ilios, otherwise Paris himself![18] His memory had merely migrated from Pamphylia to the Troad. All this seems rather wild. Uilusa has also been identified with Ialysos in Rhodes by Prof. Garstang.[19] Dr. Forrer will implicitly have none of all this: for him Uilusa was Elaioussa in Cilicia and Alakshandu was a Cilician. It must be said against Dr. Kretschmer's view that we should expect to find Alexandros transliterated in cuneiform by Alakshandar, not Alakshandu, as Eteandros was by Ituwandar, and as in fact the name of Alexander the Great *was* actually transliterated into cuneiform in the 4th century B.C. The ρ was an indispensable element in the word. Generally speaking, all these attempts of identifications of names,[20] whether of persons or places, in the Hittite tablets, do not yet seem to have yielded much positive knowledge.[21] But that is not to say that they will not do so in the future.

We cannot make more than a passing reference here to the very interesting discovery at Es-Salahiye (Bithnanaia) on the Euphrates, in what is now French mandated territory, by British officers in 1920 of frescoes of late-Roman time which have been published by Prof. J. H. Breasted and M. Franz Cumont,[22] as they are later in date than most of the archaeological discoveries with which we deal.

Mesopotamia.—In Mesopotamia, active archaeological work is in progress. The pre-War work of the Germans at Qala 'a Shargat (Asshur) and Babylon has not been resumed, but that of the French (de Genouillac) at Tell Oheimir, the site of the ancient Kish, has been taken up by a joint expedition of the University of Oxford and the Field Museum, Chicago, largely financed by a British Maecenas, Mr. Weld, and directed by Prof. Stephen Langdon, with the assistance of Mr. Philip Mackay in the field. Very interesting results have been obtained in the first two years' investigation of this vast site, including one of the oldest monuments of Babylonian writing, a stone tablet with incised inscriptions in linear hieroglyphics, the original signs from which later on the cuneiform script was developed. This can hardly date any later than 3500 B.C., and is probably older. Fragments of figures of men in mother-of-pearl inlay were found, that are also among the most ancient relics of Sumerian art, and probably belong to the same period. They are of extremely curious type and archaic aspect, giving the impression of being distinctly older than the oldest relics of historic art from Ur and Lagash. The first volume recording this work has already been published by Prof. Langdon.[23]

At Kish, however, hardly any relics of older prehistoric age have as yet been discovered than have come to light at Tell el 'Obeid and Abu Shahrein, and to a less extent at Ur. These relics in the shape of painted pottery and flint implements, etc., were first found by Mr. Campbell Thompson at Abu Shahrein (the ancient Eridu)[24] and by Mr. H. R. Hall at Tell el 'Obeid and Ur,[25] both excavating for the British Museum in 1918–9. In 1922–3 this work was taken up again by a joint expedition of the British Museum and the University Museum, Philadelphia, under the direction of Mr. C. L. Woolley, accompanied by the late Mr. F. G. Newton as architect, Mr. Sidney Smith of the British Museum and Mr. A. W. Laurence in the first year, in 1923–4 by Mr. F. G. Newton and by Mr. C. J. Gadd of the British Museum and Mr. Fitzgerald; and in 1924–5 by the Rev. L. Legrain and Mr. Linnell.[26] Continuing the work begun by Mr. Hall at Ur, Mr. Woolley has there discovered and planned with the help of Mr. Newton a most interesting series of temple-buildings and has traced the temenos-wall of the temple of the moon-god. The ziggurat or temple-tower has also been cleared by him and planned by Mr. Newton. He has also completed the work begun by Mr. Hall at Tell el 'Obeid, and has found there more relics of the sculpture and toreutic art of the early Sumerian period, first discovered by Hall. The copper Lion's head (*see* fig. 10 on plate) is now published for the first time.

The newly found antiquities include an inscribed tablet of the very early king A-annipadda, of the I. Dynasty of Ur, who is to be dated about 3200 B.C., shortly before the time of Ur-Ninâ of Lagash, whose sculptured tablets, etc., were formerly the most ancient known relics of Sumerian art. A very fine example of the same art of copper plating over a bitumen or clay ore, or an *âme* of wood covered with bitumen or clay, as exemplified in Mr. Hall's Lions, is the bull discovered by Mr. Woolley (*see* fig. 11 on plate) in the British Museum. Mr. Woolley has discovered and explored the prehistoric necropolis from which came the painted pottery and stone implements found on the surface by Hall, and so has added to our knowledge of this earlier culture, which was probably Sumerian, and is certainly now to be dated well before 3500 B.C. It was apparently chalcolithic in character, and so the introduction of metal into Babylonia is probably to be placed before 4000 B.C., perhaps roughly contemporaneously with its introduction into Egypt in the pre-Dynastic period, which also was largely chalcolithic. The question whether Egypt or Babylonia was first in the field with copper is still unsolved, but the possibility that both countries received it from the north at about the same time seems increasingly probable.

The prehistoric Sumerian pottery is paralleled by a somewhat similar ware found at Samarra, north of Baghdad, by Sarre and Herzfeld,[27] before the War, and by the identical ware discovered by Pézard at Bandar Bushir.[28] All these wares present analogies to those found by the French expedition of de Morgan some years ago at Susa and at Tepe Musyan in Persia, as also to that found by Pumpelly at Anau in Turkistan. And further connections eastward with the neolithic ware from Muhammedabad in Eastern Persia have been adumbrated,[29] while wares have been discovered in China that have been compared with the Mesopotamian and with that of Tripolje in Bosnia.[30] Whether this is going too far or not remains to be seen. The whole question of the interrelationships of these primitive wares of Asia is treated by Mr. H. Frankfort, in an occasional paper published by the Anthropological Institute of Great Britain, No. 6.[31] Mr. Frankfort finds that the Babylonian pottery is most closely connected with the oldest ware of Susa I., which probably dates from *c.* 4000 B.C. or perhaps somewhat later. The late M. de Morgan also contributed an article on the neolithic age in the Near East to *Syria*[32] before his regretted death.

Connections with India.—A very interesting parallel with Sumerian art has recently been discovered by Sir John Marshall in excavations at Mohenjo Daro in Sindh and at Harappa in the

FIG. 9. Figure of Priest or Official; early Sumerian: c. 3200 B.C. From Tell el 'Obeid. FIG. 10. Lion's head, of bitumen covered with copper. From Tell el 'Obeid. FIG. 11. Copper bull; early Sumerian: c. 3200 B.C. From Tell el 'Obeid. FIG. 12. Steatite seals from Harappa, Punjab (British Museum).

(Fig. 9 and Fig. 10. Brit. Mus. Excavations, 1919. Fig. 11. Joint excavations of Brit. Mus. & Univ. of Pa. Mus., Philadelphia.)

Punjab, in the shape of seals (*see* fig. 12 on plate) with intagli of bulls in, as Prof. Sayce and Messrs. Sidney Smith and Gadd have pointed out, distinctly Sumerian style, and with signs somewhat resembling the oldest forms of Sumerian writing.[33] They certainly seem to show some art-connection between Babylonia and India in the early third millennium B.C., but whether they are to be taken as confirmation of the hypothesis of racial connection between Sumerians and Dravidians, bringing the Sumerians from India, put forward by Hall in 1913,[34] or are rather to be taken as proof of connection the other way, the Indians having borrowed elements of art from Babylonia, remains to be seen. The connection is rendered the more certain by the discovery at Kish in 1925 of a seal identical in character with those of Mohenjo Daro and Harappa,[35] a find of phenomenal importance. (*See* Section XIII. INDIA.) Since then two other seals of the same type from Babylonia have been identified; one is in the Louvre. An impression of a similar seal has recently been published by Père Scheil.[35a]

In 1923 two distinguished French Assyriologists, M. Thureau-Dangin and the Rev. Père Dhorme, carried out excavations for a short time in the Tell of Asharah on the Euphrates, which yielded interesting results.[36]

Recent Publications.—One of the most important recent publications of cuneiform inscriptions has been that by Mr. C. J. Gadd, of the British Museum, of a tablet containing Babylonian annals relating to the period of the final attack on Nineveh by the Medes and Babylonians, which fixes the date of the Fall of Nineveh as 612 B.C., whereas hitherto 606 has generally been regarded as the date.[37] There is no doubt however now that 612 is the correct year. Many new and unexpected details of the final war are given, showing that for a year or two after the catastrophe an Assyrian king named Ashur-uballit maintained himself at Harran, and that the Egyptians, then ruled by Psammetichus I., so far from being inimical to Assyria, as had previously been supposed, in reality supported her, and that in 616 Psammetichus had sent an army to Mesopotamia to her help.[38] Pharaoh Necho also apparently marched to Carchemish in order to help Ashur-uballit in the first place, but after the fall of Harran attempted to hold Assyria's western provinces as his own share of the spoil, till he was defeated and expelled by Nabopolassar.[39] Mr. Sidney Smith has pursued his publication of the Cappadocian tablets in the British Museum, and has published new material dating from of the time of the Persians and the Diadochi.[40]

Chronology.—A great deal has been written on Babylonian chronology in the light of new discoveries of king-lists by Legrain, Gadd, Leroy Waterman, Langdon, Weidner, Schroeder, Lehmann-Haupt, Albright, del Negro, Schnabel, Fotheringham and E. Meyer;[41] but certainty cannot be said to have been reached in the matter except the fact of the uselessness of the lists (as in Egypt) for definite chronological purposes. The volumes of the *Cambridge Ancient History* hitherto published have contained interesting contributions by Prof. S. Langdon and Dr. R. C. Thompson on early Babylonian history, and a new American history of Assyria has been published by Prof. A. T. Olmstead,[42] with the help of new material deciphered from ancient Assyrian letters by Dr. Leroy Waterman. M. Delaporte has brought out an English edition of his book on Mesopotamia in the "Evolution de l'Humanité" series,[43] and Dr. Meissner an illustrated work in two volumes on "Babylonien und Assyrien" in the *Kulturgeschichtliche Bibliotek*.[44] Finally Sir Ernest Budge has lately published a new edition of his *Babylonian Life and History*,[45] which contains summaries of the most recent discoveries and a work largely devoted to making clear the overwhelmingly British character of Assyriological science which it has maintained since the days of Rawlinson and Hincks, entitled *The Rise and Progress of Assyriology*.[46]

In Western Persia the French Mission has continued its work at Susa, and some recent results have been published by M. Mecquenem in the *Revue Assyriologique*.[47] A word of homage is due to the memory of the great French archaeologist, M. Clermont-Ganneau, who passed away, full of years and honours, in 1923, of M. Jacques de Morgan and of Mr. F. G. Newton, the architect who assisted Mr. Woolley at Ur, and with the plans and restoration of the temple-tower.[48]

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XI. CENTRAL ASIA

In Eastern Iran, *i.e.*, Soghdiana, Bactria (including Gandhāra, or the northwest corner of the Punjab), in Chorasmia, Merev and Seistan, lie the keys to the problems of early Iranian culture and its influence on the culture of India and China. Again, southern Siberia, in its *qurghans* or *tumuli*, preserves antiquities, which will, undoubtedly, reveal some day the still obscure relations between its nomad "Scythian" inhabitants, the Pontus and China. But excepting the work done in Gandhāra, the only scientific excavations on a larger scale have been made in Eastern or Chinese Turkistan, a bowl-shaped depression hemmed in on all sides except the east by enormous mountain-chains with difficult passes, and in the east approached through the Gobi Desert. The only safe trade routes between China and the Hellenistic Orient passed through the rich oases along the northern and the southern margin of the bowl. By them the silks of China reached the West and the products of the Hellenistic Orient, of Iran, of India and the Buddhist religion, the most powerful propagator of Indian religious thought and of modified Hellenistic art, reached China and the Far East.

These routes were of the highest importance to China, and whenever a vigorous dynasty ruled that country, they were regularly protected by military garrisons.

But, while the Eastern Iranian sites contain relics possibly dating back to early Iranian history, the ruined cities and

monasteries of Eastern Turkistan (and of Gandhāra, which is culturally indissolubly connected with Eastern Turkistan) offer only remains of the period between the last century before Christ, in the West, and the 10th to 11th centuries of our era.

However, the archaeological work done in these comparatively late sites, by Russian, English, German, French and Japanese explorers, has proved that the ultimate basis of Buddhist art in China, as in all other eastern Buddhist lands, is the Hellenistic Antique as developed in Gandhāra.

The Tokharians.—The name Eastern Turkistan does not apply to this area in the early period, for until the Uighur Turks began their conquest, from the northeast, in the 8th century, the many oasis-states were occupied by Iranians (Sacae and Soghdians) in the west, southwest and north, and by Indians in the extreme southwest. From the oasis of Kucha in the north, to that of Turfan in the northeast, the ruling race appears to have been a tribe speaking a language of the European (*centum*) group. They are called Tokharians in the Middle Turkish texts dug out from temple ruins near Turfan, and the energetic heads, on the wall-paintings from these temples, of blue-eyed, red-haired men with European features, differing entirely in everything but dress from pictures of Iranian or Eastern Asiatic donors, may well be portraits of men of this remarkable race.

MSS. Discoveries.—The numerous MSS. finds are written on wood, leather, palm-leaf, birch-bark and paper in Tokharian (till then unknown), the lost languages of the Sacae and Soghdians, in Sanscrit, Pehlevi and at least two Iranian dialects, Middle-Turkish in two dialects, Tangutan, Tibetan, Syriac, a few lines of Greek, in Chinese and Mongol, with yet undeciphered MSS. fragments of the lost language of the Hephthalites or White Huns, and small fragments in two other unknown alphabets. All this literature is strictly religious, excepting fragments of a Middle-Turkish translation of the fables of Aesopus and remains of two MSS. of the legend of Barlaam and Josaphat, also in Turkish, found in the Turfan oasis, close to the borders of China proper.

The religions represented are Buddhism, Christianity, Zoroastrianism (one fragmentary leaf) and Manichaeism, which, introduced by way of China and accepted by the Uighur kings in the 8th century, is represented by many MSS., sometimes beautifully illuminated, in the Soghdian, Middle-Persian and Middle-Turkish languages. These remains are written in no fewer than 24 scripts. Islam is not associated with this culture. When this religion began to encroach upon it in the 10th century, the decline of the mainly Buddhist states of East Turkistan had begun.

Art Problems.—In sculpture and painting the basis of all this art is the Hellenistic Antique, as developed in Gandhāra and in Bactria under Indian and Iranian influences. The Buddhist religion, and with it the modified Graeco-Buddhist art of Gandhāra, entered Central-Asia by the Royal Road through the the Khyber Pass and Bactria, through Udyana and, later by the trade-routes through Kashmir.

Architecture.—The architecture is purely ecclesiastical—domestic buildings probably did not differ materially from similar erections in the present day. Iranian or Indian models are strictly followed. All traces of Chinese influence are absent and, of antique elements, only the beautiful *caisson* ceilings occur occasionally. Two groups are found, (*a*) rock-cut temples and cells, (*b*) temples, *stūpas*, and monasteries built with sun-dried bricks (*adobe*).

Cave Temples.—The cave-temple settlements follow Bactrian rather than Indian prototypes in their general plan. They are mostly crowded together, often in hundreds, on the perpendicular faces of steep cliffs, in glens of difficult access, near running water and in wild and romantic scenery. The cells of the monks are simple, small, vaulted rooms, with a fire-place, and often a bench cut out of the stone. The walls are plain white-washed, without any ornament. There are very few such cells in even extensive temple groups.

Settlements.—The cave-buildings in the older settlements were connected by extensive stone-cut galleries, provided with few windows for the admission of air. Light in the temples and cells must have been mainly artificial, as proved by great masses of remains of wicker-lanterns.

The commonest type of cave-temple is of Indian origin. It consists of a square, vaulted anteroom, opening on a cella of the same description. The back-wall of the cella has a recess, in which the cult-statue was placed. To the right and left of the statue, two short, low, vaulted corridors were cut into the rock opening into a third corridor, at right angles to them, and parallel to the back-wall of the cella.

The square or rectangular block of stone thus resulting often contained, in a hidden receptacle, relics, manuscripts, coins and other valuables. These receptacles had always been opened and despoiled. This block stands for the *stūpa*. The corridors were used for processional circumambulation. On the walls of the cella were painted the effigies of the donors, the life-story of the Buddha in a number of pictures separated by decorative borders, or rows of paintings representing certain Buddhist legends.

The vaulted roof is decorated with tiers of conventionalised representations of mountain landscapes, each containing some birth-story (*jātaka*). The middle line between the two topmost tiers contained representations of flights of ducks, constellations, the sun and the moon, wind goddesses and the effigies of the sun- and moon-gods in their chariots, most of these representations following Hellenistic prototypes. In later temples (after 700 A.D.) the mountains are replaced by rows of Buddhas.

Iranian Types.—Two other common types are Iranian. The first consists of a square room covered by a cupola rising from profiled mouldings at the upper edge of the walls. The second is similar but covered by a *lantern roof*, such as exists to this day in wooden houses from Armenia through Bactria to Kashmir and Western Tibet, as described by Moorcroft.[1] In later cave-temples further east (Turfan), this roof was often painted only on the vaulted temple roof. These two Iranian types are used by the Chinese and Koreans as models in their cave-temples (*e.g.*, Tunhwang). Another type is a long, narrow, tun-vaulted apartment, with, or without, a socle for the cult-figure.

Brick Temples.—The temples built with sun-dried bricks are erected on the same lines as the cave-temples. The "lantern-roof," however, never occurs in these buildings, as this construction is impossible with bricks, but the middle of the ceiling vault in the eastern oases (7th–9th centuries) often bore a painted representation of such a roof. These painted lantern-roofs were commonly used to decorate ceilings in Chinese cave-temples.

The Stūpa.—The *stūpa* is either (1) a (massive) building of pyramidal shape, plain on the outside, with a receptacle for relics, coins, MSS., etc., or (2) a dome-shaped erection on a quadrangular base, or (3) in the eastern oases, a pyramid with rows of niches for Buddha-statues, or (4) as a remarkable quadrangular building in several tiers, diminishing in size upwards, like a gigantic staircase. A number of large, vaulted niches for Buddha-statues are carved on the four faces of each tier. These erections are often of great size, one face having as much as 20 metres length. Another rarer Indian type, of much smaller size generally, is a beautifully proportioned building of polygonal cross-section.

Monasteries.—The monastery is usually a square or rectangle surrounded by a strong wall with towers; with one or more temples and rows of cells arranged along the inner course of the walls, built of sunburnt bricks of most excellent quality, evidently made on the spot in the required shape and size.

Paintings.—In most temples the walls and vaulted ceilings of the rooms were richly decorated with mural paintings in tempera-colours. The colours vary in the different settlements, the most ancient ones being distinguished by a lavish use of true ultramarine. In some temples the floor was of stucco, often with most artistic paintings in *al fresco*.

The walls were found in all stages of preparation. Some were

[1] M. Trebeck, *Travels in the Himalayan Provinces, etc.* (London, 1841, vol. 2, 390) who found it in cave-temples at Bāmiān; "the roof was carved so as to represent tiers of beams crossing each other at angles and diminishing their distance as they ascended, until they left an octangular space of about 20 inches only, imitating the roof of a log-house in Tibet and Kashmir."

simply roughened, awaiting the application of a layer of smoothed stamped clay, in others this finish had been applied, after which the smooth surface was covered with a very thin layer of stucco. On this smoothened surface the painters drew a " net " of rectangles, one within the other, into which the patterns for the pictures were fitted.

Designs.—These patterns were larger or smaller pieces of paper, on which the artist drew his pictures with India ink. The lines were then perforated, the pattern fixed to the wall and beaten with a bag containing powdered charcoal. The contours thus obtained were then traced in India ink and the colours filled in. Sometimes, in young settlements, an ancient pattern may have been used, so that critical analysis of style, in paintings and still more in sculpture, is not a safe guide to the age of the work.

Art Influence and Sources.—All paintings are intensely influenced by late-antique schools of painting, originating in Gandhāra, the Punjab and Bactria. According to the province whence the painters came, or drew their inspiration, the paintings of Turkistan show Hellenistic elements modified in an Indian, or in an Iranian sense. Purely antique and purely Sassanian elements also occur, especially in friezes.

Chinese elements are wanting absolutely in the older, western oases. But China accepted the syncretistic art, painting and sculpture produced in these regions, and, misunderstanding and modifying the forms received from the West in a Chinese sense, created the splendid art of Thang times on the basis of modified Hellenistic Buddhist art.

After Buddhism declined in India, China became the leading Buddhist power, and this new syncretistic Chinese art gained influence only in the eastern settlements (Turfan), and never farther west than the oasis of Kutchā.

Main Styles.—Five principal well-marked styles of painting, were first observed by A. Grünwedel. (1) Several styles, directly containing late antique elements, such as are found in the Gandhāra-Sculptures; are united under the name Gandhāra. In certain temples antique elements preponderate, while others show these elements modified in Iranian or Indian sense (presumably 5th–6th century A.D.). (2) The style of the " Knights with the long swords " (Tokharians), is presumably a local continuation of Style No. 1 (probably 6th–7th century A.D.). (3) The Older Turkish style, has a pronounced syncretistic character; the forms of style 1 and 2 are incorporated, but Chinese elements begin to occur. The decorative borders of the wall-paintings and the ceilings show a remarkable and charming flower-ornamentation. The costume of the donors differs completely from that of the donors in the older styles. The inscriptions are in Chinese and Central-Asian Brāhmī (presumably 7th–9th century A.D.). (4) The Younger Turkish Style, more properly the Uighur style, shows a further syncretistic development of style 3 in a Chinese sense—it is only found in the Turfan oasis and is the final development of the older elements into Chinese forms (8th–11th century A.D.). (5) The Lamaistic Style has evident relations to Tibetan art.

Sculpture.—All sculpture in Eastern Turkistan derives from the late antique school of Gandhāra and pure Hellenistic types appear even in late times in the Eastern settlements, where the paintings had assumed an essentially Chinese character.

Use of Moulds.—The perseverance, in sculpture, of Hellenistic forms is simply explained by the fact that, Turkistan being a loess-country, without stone fit for the sculptor, the art-craftsmen were forced to use stucco-moulds, of which quantities were found, mostly for the production of half-relievo figures. The larger kinds were moulded in pieces and afterwards put together, often very roughly, with straw-ropes, twigs, coarse pegs, etc. The statue was prepared in the rough, its surface was remodelled, finished off with a fine layer of stucco and richly painted and gilded.

In the older western oases the material for the statues was often stucco; in the later (eastern) settlements the common clay of the country, mixed with chopped straw, vegetable fibres and animal hair. In spite of the crudeness of this material, the effect resulting is frequently imposing.

The moulds were probably imported from Gandhāra and replaced, when broken, by exact duplicates, produced, mechanically, from their own former products. Thus antique forms persisted long after paintings had begun to undergo Eastern-Asiatic modifications. When the Sassanians cut the road to the West, no new Western influences could penetrate, while communications with China continued to be easy and frequent.

Change of Type.—In consequence, the ideal type of beauty began to change and gradually the craftsmen deliberately changed their moulds to suit the Eastern-Asiatic type of beauty. The nose became shorter, the brows were made slanting, the eyes more prominent, etc., while the late antique hairdresses, utterly incomprehensible to the Easterns, were changed according to their own notions and taste.

Thus the evolution of a late antique head can be followed, through many stages, until a typically Chinese head results.

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XII. PERSIA

Pre-Achaemenian Period.—Rock-sculptures of remote antiquity have been discovered or more accurately studied. They prove that the influence of the higher developed civilisations of Elam and Babylonia stretched much farther into the interior than was supposed. A gold treasure discovered in the Asterābād region (frontier of Russian Turkistān) is Sumerian in character (3000–2500 B.C.); engraved shells of proto-Elamite type are found at Isfahān; and an elaborate early Sumerian rock-sculpture was discovered near Talaspid in Fars. The conclusions drawn from those single objects are supported by the main archaeological material: pottery. The rich harvest of proto-Elamite pottery at Susa belongs to *c* 3000 B.C. Very similar pottery has been found all over Iran.

At this remote period, relations with India are attested:—among the fresh discoveries of prehistoric remains at Harappa and Mohenjo Daro are typical seals, which may all be derived from types preceding the later cylindrical shape and in common use in Elam and Sumer during the fourth millennium B.C.

The second millennium marks a period of cultural depression in Iran. Painted pottery continued in the whole of Iran down to the Achaemenian and Seleucid periods, *i.e.*, to the beginning of our era, and a great number of bronzes belong to a group known from Asia Minor, which cannot be dated exactly. A great change happened suddenly: a new population, the Arians, who later founded the Median and the Achaemenian empires, settled in Iran. In harmony with the historical indications in the Assyrian annals, we find the first monuments of this population in north-west Iran, around the lake Urmia and Hamadan-Ekbatana, a region belonging at that time to the Khaldian or Urartaean empire of Van. There remains a group of large tombs, cut into rock, in the shape of the Median house which survives in west Iran to the present day. All the tombs are found in ancient Media, and architectural features and religious emblems prove them to be pre-Achaemenian, hence Median. But whether the inhabitants were already Zoroastrians or followers of a pre-Zoroastrian faith, remains unanswered.

Achaemenian Period.—The discovery of another royal tomb in Khak-i-Rustam, Mamassani region in Fars, connects the Median tombs with those of the Achaemenians at Persepolis and Naqsh-i-Rustam. It must be attributed to a predecessor of Cyrus, one of the kings of Anshan, his ancestors. It has columns with proto-Ionic capitals. Hence, Achaemenian architecture derives its origin from the Median type, of which the rock-cut tombs are the only remains as yet discovered. The art of Arian Iran was at first created in northwest Persia, influenced by the art of the Khaldian or Urartaean empire of Van, itself depending upon the older, Hittite, art of Asia Minor. From Media this art spread into south Iran. Rock-cutting freestone masonry, wooden columns and a highly developed metallurgy are its characteristics.

The similarity to the early Ionic architecture of the west coast of Asia Minor is explained, not by Greek co-operation, but by the fact that both are the extreme branches of a style of architecture that once spread over Asia Minor, Armenia and west Iran. On the other hand, during the whole reign of the Achaemenids, three provinces of India, called Hindu, Gandhara and Thatagu, formed integral parts of their empire. The first surviving monuments of India, although post-Achaemenian, show evidence of Iranian influence in architecture and sculpture—columns, capitals, ornaments. The plan of the palace of Pataliputra is believed to be made in imitation of Persepolis. The transition to rock-sculpture, freestone masonry, stone sculpture from older woodwork, is due to immediate Iranian influence. China adopted the same methods, as proved by the oldest Chinese monuments discovered in Szechwan.

Post-Achaemenian Period.—The least known period of Iranian history is the Parthian, which is of special importance for the development of the Zoroastrian religion and the national epics. The most promising sites are a Greek temple (of Dionysos?) at Khurheh in Mahallat, the capital Hecatompylos near Damghan, and the huge temple of Anâhît at Kangāvar. During the Arsacid period, the great empire of the Saka or Indo-Scythians, extending from the modern province of Seistān in Persia to Muttra and Bombay in India, was connected, more or less loosely, with Iran. Among its rulers, known from their coins, appear some members of the Sûrên family, one of the highest feudal houses of Parthia. When the Arsacid Dynasty was replaced by the Sasanians, the reconquest or the extension of their rule over those eastern parts of Iran was among their first accomplishments. According to Pahlavi inscriptions and Bactrian coins, from 230–350 A.D., ancient Soghd and Bactria, *i.e.*, Samarqand and Balkh, were ruled by Sasanian prince-governors, and, in the same way, at least from 280–350 A.D., the entire former Scythian empire was an integral part of their realm. These new facts, proved by inscriptions and coins, explain the Iranian influence exercised during this period on the civilisation of India.

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(E. HE.*)

XIII. INDIA

Archaeological exploration was first started officially in northern India in 1862 and was strengthened by Lord Curzon, when Viceroy. India was divided into circles, each with its own superintendent and staff. Epigraphists were appointed, and, later, an archaeological chemist was added to the department. Annual progress reports are published, and an Imperial Series of Monographs and Memoirs on particular subjects is maintained. Epigraphical results are chiefly published in the *Epigraphia Indica*, the *Epigraphia Moslemica* and the *Epigraphia Birmanica*. In addition to the exploration of architectural monuments above ground, and the excavation of those below, a great deal of work has been accomplished in the conservation and repair of these. Antiquarian museums have been established all over the country, and several of the native states have taken up archaeological work within their own areas.

Prehistoric Antiquities.—"Eoliths" have been found in India which, as elsewhere, are provisionally accepted as artifacts. Palaeolithic implements of the Chellean type are widely spread in India. Neolithic implements exhibit a remarkable variety and in general conform to similar objects from western Asia and Europe. The most noteworthy exception is the chisel-shaped, high shouldered celt found in Burma, Assam and Chotā Nāgpur, as in Indo-China and the Malay Peninsula.

Pottery.—Pottery, both plain and decorated, is found in association with neolithic sites. The plain forms are either rough, smooth, polished or painted while the decorated forms are impressed or moulded or, less commonly, incised. Some of the geometrical painted designs are considered to recall the typical features of Anau and Elam pottery. In southern India incised designs and cognate marks have been described as owners' marks, potters' marks, hieroglyphics, some being regarded as resembling Minoan script.

Cave Drawings.—In caves in the offshoots of the Vindhyas, associated with pygmy flints, are found rude drawings in ruddle or haematite, which have been ascribed to neolithic culture, though possibly the product of relatively recent inhabitants. At Singanpur the cave paintings of hunting scenes, groups of figures, picture writing and drawings of animals, reptiles, etc., have been thought to show the same methods as were used at Cogul in Spain—an Aurignacian product. The argument is far from convincing and the theory of an Australian connection cannot be regarded as proved.

Megaliths, etc.—Special problems are raised by the megalithic monuments found in many parts of India. Examination of cairns in Hyderābād state and southern India has yielded pottery of an interesting type: lapis lazuli beads which, being foreign to India, indicate commercial intercourse, possibly with Kashmīr or Persia; some gold, silver and copper and iron, due perhaps to an early use of iron for local purposes. It is suggested that resemblances to Egyptian material indicate contact with a common source.

Recent Excavations.—The results of the survey of the rock-cut temples of India carried out before Lord Curzon's time have been published. Much miscellaneous work has also been accomplished amongst the structural temples. Ampler funds have enabled the department to take up excavation work on a more extensive scale, and some of the more ancient sites, especially in the north of India, have been opened up. Amongst these are the mounds covering the ruins of the old city of Taxila in the Punjab—a place mentioned by early Greek and Chinese historians as a great centre of trade and learning centuries before the Christian era. Much of the three sites that the city occupied as it passed successively under the domination of Persia in the 5th century B.C., the Greeks, the Mauryas, the Bactrian Greeks, the Scythians in the 1st century B.C. and the Kushans, has been laid bare and has revealed much of its story. The walls of the houses, monasteries, chapels, *stupas*, and the palace of the kings have been unearthed. One of the *stupas*, containing a portion of the relics of the Buddha, yielded with it a very interesting inscribed silver scroll. Besides much semi-classical sculpture, the ruins have given up a great abundance of minor antiquities in pottery, stone, copper, bronze, silver and gold together with quantities of coins—the accumulation of centuries. Prof. Herzfeld has lately discovered inscriptions in Persia which, he considers, go to prove that the Punjab was under Persian rule in the 3rd century A.D. In the 5th century the White Huns overran the country leaving ruin in their wake (*see* Section XII. PERSIA).

Buddhist Relics.—The great *stupa* built by the Kushan king, Kanishka, over a relic of the Buddha, which had been mentioned by the Chinese pilgrims, has been identified and opened. The mound lay at a short distance to the west of Peshāwar. It yielded the relics and the reliquary, the latter bearing the name and an effigy of the king. The *stupa* appears to have been the largest and most magnificent monument of its kind known in India. The recovered relics were presented, with great ceremony, to the Burmese Buddhists in 1910. Other relics of the Master, from the Piprahwa *stupa*, had been previously presented to the King of Siam, and, later, others from Taxila were conveyed to the Buddhists of Ceylon, who had in 1882 received those from the *stupa* opened up at Supara (? Ophir) near Bombay.

The Maurya Palace at Patna.—On the site of the old Maurya capital of Pataliputra (Patna) remains of the palace of the emperors have been brought to light, once a vast pillared hall of about the 3rd century B.C., containing eight rows of monolithic columns, of 10 columns each, of polished sandstone. It presents, in many respects, a marked likeness to the Hall of a Hundred Columns at Persepolis, indicating a close intercourse between Persia and India. The rest of the building, which appears to have been burnt, was probably of wood.

From the remains of the old Buddhist monasteries at Nalanda, once famous as a Buddhist seat of learning, four miles from Rajagriha, a large number of antiquities was collected.

Greco-Buddhist Art.—Greco-Buddhist sculptures, of the best period of Gandhāra art, have been reclaimed at Takht-i-Bahi, and investigations have been carried out along the Peshāwar-Swat border. From Sahri-Bahlol excavation has yielded quantities of sculptures in stone and stucco. At Mathurā (Muttra) inscribed images of the emperor Kanishka and other Kushan princes have been found; and at Isapur, near by, an inscribed sacrificial pillar whose inscription was considered the earliest in pure Sanskrit then found. Further excavations were carried out at Kasia (Kusinagara) the place where the Buddha died. At Basarh and Bhita excavations were continued which produced great numbers of seals at the former place.

Buddhist Monuments.—Buddhism, following the valley of the Indus, advanced through the Punjab into Sind leaving a trail of Buddhist monuments in its wake. The remains of several *stupas* have been uncovered especially that at Mirpur-Khas which contained its relics. The great site of Brahmanabad has been examined, and in the light of the recent Sumerian-like finds at Mohen-jo-dharo, it requires further and deeper excavation.

In central India, extensive clearances were made around the Great *Stupa* at Sanchi, and the fragments of the old railing which adorned the berm and the top being found, the latter was restored, together with the crowning umbrella, while the basements of monasteries and chapels were reclaimed from the debris and jungle. Near by, at Besnagar, the site of Vidisa, a flourishing city when the Greek kings were ruling at Taxila, the base of a Garuda pillar was cleared revealing an inscription recording its erection by a Greek, Heliodorus, an ambassador from the Taxilan court.

Excavations were continued at Sarnath, near Benares, where objects of the Gupta and mediaeval periods and Kushan coins were recovered; other places visited and explored included Suratgadh (Bīkaner), Salihundam in south India, the Jamalgarhi *stupa*, the caves of Bagh with their interesting frescoes, Maheth and Saheth the site of Sravasti, and many other spots in south India and Burma.

Sumerian Discoveries.—The most startling and unexpected discovery made in the archaeological field is that of the presence, in the Punjab and in Sind, of objects which bear a striking likeness to Sumerian remains of 3000 B.C., and the character of the few letters found upon some of these distinctly points to a common origin. In Sir John Marshall's view "this Indus civilisation extended over an immense area including Sind, much of the Punjab, Baluchistān and probably Rājputāna and countries even further to the east. The existence of roomy and well-built houses and the relatively high degree of luxury as well as the character of many of the smaller antiquities (seals, gold jewellery, copper vessels) betoken a social condition much in advance of what was then prevailing in Mesopotamia or Egypt."[1]

Kashmir.—Remarkable buildings and richly moulded reliefs were discovered at Harwan in Kashmir by the state Archaeological Dept. comprising the triple basement of a *stupa;* a set of chapels; two smaller *stupas*, and a large apsidal temple, in the courtyard of which is a curious tile pavement, on which are Kharoshthi numerals which indicate a date of 400 to 500 A.D. at the latest. Amongst the moulded decorations occurs a representation of a cock fight which recalls to mind one of a bull fight in the oldest of the Bhaja caves, surrounded with Persepolitan details.

Ajanta Cave Paintings.—The famous wall paintings at the Ajanta Caves, of about the 7th century A.D., which were in a very bad state, and were peeling from the walls in places, were taken in hand by an expert from Italy, who has put them into a more permanent state of preservation.

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INDONESIA

Sumatra.—Sumatra still awaits investigation. It may be surmised that it escaped colonisation from India because the maritime movements of that country from the East started from points in India and under conditions which made Java rather than Sumatra their main objective. The set of local currents and the weather conditions played a decisive part in determining the lines of early navigation, especially in this difficult region.

Java.—The settlement of Indian colonists in Java dates from the 5th century A.D. and was mainly influenced by the south, whence radiated the main forces of colonisation, although in the 4th century B.C. commercial enterprise from Bengal was active. No detailed description of the monuments at Borobodur is necessary, but the presence of Saivaite elements, as well as of Buddhistic material, afford clues to the admixture of religious motives in the decoration of what is justly termed the Ninth Wonder of the World. Modern analysis of the reliefs of the great temple is held to reveal ignorance of Indian structure. The employment of Javanese conventions indicates that the fundamental elements must be looked for in local architectural principles, the inspiration being afforded by Hindu rulers and priests who were devoid of technical knowledge. Java marks the limit of Hindu influence which still indeed persists there.

Other Islands.—In the remainder of the islands which compose Indonesia two strains of influence may be discerned—Chinese and Malay—which have both combined and also been influenced by contact with Islamic culture of Arabian origin. In Celebes Stone Age culture persisted till recent times; in Borneo only the coastal fringe shows any traces of contact with superior cultures, the interior, which is largely unexplored, being occupied by peoples of a low stage of culture, including pygmy groups. In the Philippines, however, three distinct zones of cultural settlements may be discerned, *i.e.*, the coastal, the plain and the mountainous, the rudest being that associated with the mountainous area. Much that is essential in the culture of the sub-tropical areas is perishable in the humidity and temperature conditions which there prevail. It is possible, however, that in the future systematic investigation may disclose evidence of the extension, both of early Chinese and early Indian influence over a greater zone in Indonesia than is at present suspected.

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[1] *Illustrated London News*, Feb. 27 1926, p. 346.

XIV. CHINA AND SOUTHEASTERN ASIA

Although the progress which has been made in the study of the prehistoric archaeology of the Far East has been very great, it is not possible at present to put forward a sequence dating which can in any way compare with that of Europe. The precise significance of many of the finds is at present imperfectly understood, but material is being collected, which should in the near future enable the archaeologist to trace the prehistory of much of this vast area.

Palaeolithic Remains.—Up to the present no true palaeolithic implements have been discovered, either in China proper or in southeastern Asia. Matsumoto believes that a human sacrum found in the province of Honan in central China must be considered to belong to Neanderthal man, but precise data are lacking and the definite association of the bone with those of elephants is uncertain; nor can the early implements from Indo-China be considered definitely palaeolithic because, although of rude form, they are associated with a modern fauna. Numerous surface finds in China, which have sometimes been considered to be palaeolithic, are equally doubtful. North of the Great Wall in the region, however, where the Hwang Ho penetrates Gobi with a great northerly bend usually known as the " Ordos bend," Teilhard and Licent found definite palaeolithic remains in at least five localities. The types from one site (Ning Hsia) in the northerly part of Kansu, the province which separates Mongolia from Tibet, are said to be Mousterian. The second site, a fluviatile deposit, at Sjara Osso Gol, contemporary with the loess of central China, contained similar implements associated with quaternary deposits containing forms similar to Elephas primigenius and Rhinoceros tichorhinus of Europe. Deposits at a third site in the same region contained implements which are probably older. Implementiferous deposits were also found elsewhere in loess gravels and in the desert region close to the Hwang Ho itself. The sites extend over a long belt of country nearly 600 m. long enclosed by the great bend of the Hwang Ho. While most of the implements appear to be Mousterian, some are closer to the Aurignacian type, but all are small, possibly, as the explorers suggest, owing to paucity of material. The forms are not quite identical with those from Europe, and until the gaps are filled, exact comparison is impossible.

Neolithic Remains.—The neolithic deposits, essentially a vague term in this region, are widespread over the Far East and at least two separate culture areas exist, though further investigation may either link up the two or discover new areas. Provisionally these may be termed the northern and southern areas.

Northern Area.—The northern includes much of Mongolia, northeastern China, Manchuria and certain parts of Japan. Its relation to the Siberian early cultures has not yet been fully explored. Much of this area is extremely rich in remains. In certain regions on the Mongolian plateau this culture has been established stratigraphically, and is nearly always found in a bed of black sands superimposed on the quaternary sands, which in Mongolia replace the loess of the Chinese plain. The neolithic succeeds the palaeolithic without any transition, as far as is known at present. One of the most important sites is at Linn Hsi north of Sira Mouren Gol (116° east and 44° north). Most of the implements discovered are somewhat rude and might at first sight be considered to be palaeolithic, but other delicate instruments occur, including triangular arrow-heads. They are associated with rude pottery, which is made without a wheel.

The most important implements which have been found both on the plateau and within the Wall at Kalgan, north of Peking, are comparatively fragile laurel-leaf-shaped implements slightly polished. Both Andersson and Teilhard are unanimous in thinking these implements to be ploughshares. Their importance lies in the fact that similar implements are associated with the neolithic culture of North America, and there is every reason to associate the two. At present the authors of this culture are not clearly known. The kitchen middens of Japan show a similar culture, which can there be divided into periods stratigraphically. In Japan human skeletons have been discovered in association with the pottery. The types are similar to those of the present day Ainu (*see* RACES OF MANKIND) but it is difficult to associate the two groups of peoples, as the Ainu have no indigenous pottery. Numerous rude stone monuments have been found in Manchuria and Korea, which probably belong to this culture but they have not as yet been adequately studied.

Pottery.—The rude pottery of this culture survived through the succeeding periods, and indeed is in use to-day, which makes some of the dating difficult. It forms an integral part of the finds in the succeeding culture, which has been carefully studied by Andersson in various parts of China, including the most westerly and the central provinces and Manchuria. This culture is definitely of a chalcolithic type; with it are associated not only the coarse ware already noted but polished celts and fine painted ware, which can be divided into brick-red small, thin-walled monochrome vessels and others which are painted. Wheel-made vessels occur, but most are hand-made. The polychrome vessels are mostly bowls and are often beautifully worked. This type of pottery belongs to the same class of painted ware which has been found at Anau near 'Ashqābād in Russian Turkistān and Tripolje and has a wide distribution in western Asia (*see* Section X. WESTERN ASIA, note 30). There are also some local forms, notably the tripod pot, which has developed into the *li* of ancient and modern China. This culture, with its close parallels with the west and indigenous forms, has a very wide distribution over northern China, and is associated with the bones of people who do not differ essentially from the modern Chinese. No traces of metal have been discovered in spite of careful and extensive excavations, but apart from the introduction of metal and the substitution of metal for ceramic or lithic material, many of the forms associated with this culture survive in China to-day, with the exception of the remarkable polychrome ware. Up to the present this culture does not appear to have been reported from Japan.

No exact dating can be given; probably in Manchuria the culture was at its height about 1500 B.C., but as it extended over a vast area its floruit was probably very different in different localities. Pig, the typical domestic animal of China since Chinese culture began, was found in immense quantities, but in some places Andersson found remains of recent animals now locally extinct. Considerable surface changes have taken place in some sites since their deposition. In a loess country, however, denudation sometimes takes place at a rapid rate.

Southern Area.—The southern extent of both this culture and the preceding one is not yet known, and the rude neolithic is not at present clearly established in central China. Southeastern Asia seems to constitute a separate archaeological province, separate certainly from the Mediterranean region and on the whole from the countries to the immediate west. Although the brothers Sarasin seem to have linked up the archaeology of Ceylon both with that of India and some parts of the Malay Archipelago, suggesting a culture which in Europe would be considered late palaeolithic, elsewhere such evidence is lacking. In the Malay Peninsula numerous polished stone implements have been discovered and there is evidence to suggest that at least some were in use contemporaneously with metals, some authorities suggesting both bronze and iron. Earlier or stratified deposits, which probably exist, remain as yet to be discovered. Special attention has been directed to this region, owing to the discovery of pithecanthropus erectus and other primitive skulls in Java, but in spite of considerable researches in that island the history of palaeolithic culture in that region has yet to be written.

Indo-China.—Indo-China has been more thoroughly explored. A careful examination of a number of caves has not led to the discovery of any ancient animal remains comparable either to those of Mongolia, India or Europe. The fauna of the caves is essentially recent, terrestrial molluscs being especially prominent, all belonging to species which still survive in the same region. The industry associated with the early caves is of rude technique, although pottery is found. The implements have not the finish which is characteristic of some of those belonging to the earlier neolithic of Manchuria, and have been considered by some to be actually palaeolithic. The fauna, however, contra-

dicts this and they must be definitely considered to be neolithic. Certain cranial fragments have been discovered associated with the industry, and their reconstruction has revealed a type of man akin to the modern Melanesians (*see* RACES OF MANKIND). This industry closes very abruptly and there is no transitional period between this and the succeeding or " classical neolithic " period of Indo-China. This culture has a wide distribution and extends as far as and probably beyond the southern frontiers of modern China and westwards into India. But its full extension has not yet been explored and it is not possible to express its exact limits. It is certainly a recent neolithic, but the attempts which have been made to date it, especially by estimating the effects of annual increase of fluviatile deposits, by which means a date several centuries anterior to our era has been arrived at, have not received any general acceptance.

We have a well-marked culture which is characteristic of an archaeological province, which must be, in the present state of our knowledge, considered entirely separate from the other cultures so far considered. The technique shows a very considerable experience in the art of stone working, especially in the form of the axes which have a characteristic shape. They are rectangular in form and in many specimens are worked with a shoulder, the part farthest from the blade thus forming a tongue for hafting. The bracelets made of shell also show considerable skill in the handling of materials.

The origin of this highly developed culture is at present unknown. Recent workers are inclined to regard it as not being indigenous to the area in which it is at present known, but as being introduced suddenly by some great ethnic movement which drove out the former Melanesian makers of the rude earlier neolithic culture. The local transition is too great, as at present explored, to permit any suggestion of the peaceful penetration of an alien culture, but further excavations in neighbouring regions may throw light on the transition. It does not seem possible at present to link up the various neolithic periods of south-eastern Asia with those of the northern part of the continent, but it would appear that there must be a line of contact between the chalcolithic of northern and central China and the neolithic of Indo-China somewhere in southern China. Sites have, however, at present not been reported. (*See* MONGOLIA.)

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(L. H. D. B.)

XV. OCEANIA AND EASTER ISLAND

Introduction and General.—In the latter part of the 18th century permanent contact with European settlers was established and induced a rapid transition from the stone to the steel age. Previously writing was unknown in the area, if we except the pictographic " script," as yet imperfectly explained, of Easter I., and in spite of the astonishingly high development of oral tradition in Polynesia and of the occasional accounts of earlier European navigators from the 16th century onward, the pre-European period must be regarded as, in the main, prehistoric.

Imperfection of Record.—Although it is improbable that any of the more important monuments have entirely escaped observation and record, the greater part of the area has never been properly surveyed in an archaeological sense, and the published records available for many islands are meagre and of too unequal value to allow of any final correlation. The only islands of which detailed surveys have been published are Easter, the Australs, the Marquesas, Hawaii (some islands), the Carolines (Ponape and Kusaie) and, in part, New Zealand and the Chathams. Surveys of Tonga, Rapa-iti and some smaller islands (Fanning, Malden, Christmas, etc.) are now (1926) in preparation by the Bishop Museum, Honolulu.

Absence of Palaeolithic Culture.—Owing to the character of the climate, and the complete absence of pottery in Polynesia, the materials for archaeological study are practically limited to stone tools and monuments. No evidence of a palaeolithic culture has been found in any part of Oceania. The prevailing tools are everywhere axes or adzes of stone (occasionally also shell), polished wholly or in part, although flaked obsidian was also used in certain islands where it occurred (*e.g.*, Easter, New Zealand, New Britain), and roughly flaked quarrying tools bearing a superficial resemblance to palaeolithic hand-axes are found in Easter Island. Judged by its tools, the prehistoric culture of the area belongs entirely to the neolithic period.

Divisions.—The ethnographical division into Melanesia and Polynesia holds good, in the main, for archaeology. In the former region adzes are of the " celt " type and rounded or sublenticular in section; in the latter they are predominantly straight-edged and angular in section, and further subdivided into a tanged and tangless type, characteristic of east and west Polynesia respectively. The distribution of monuments is in substantial agreement with that of the tools, and the elaborate structures of masonry characteristic of Polynesia scarcely occur west of Fiji, where rude heterogeneous megaliths are the rule. Exceptions in the Solomon and Banks Is. may be regarded as relics of Polynesian migrations eastwards, or as due to later reflex movements.

Absence of Stratified Sites.—No stratified sites showing culture sequence, except in a minor degree in New Zealand, have been found. The habit of making permanent funerary offerings seems to have been little developed, and grave-goods, where discovered, do not differ markedly from artifacts of recent date. Only in parts of Melanesia has the occurrence of deposits distinct in character from the products of the historic inhabitants been observed.

POLYNESIA

In Polynesia there is little evidence of a succession of cultures; monuments and implements represent at most an earlier and higher phase of the culture that continued into historic times. Exceptions do occur, however; adzes of distinctively Melanesian type, found in Tahiti and Easter I., and the carvings of bird-headed men in the latter, suggest the possibility of a pre-Polynesian occupation of parts of eastern Oceania by the negroid race. The presence of a strong negroid strain in the inhabitants of eastern Polynesia is doubtful evidence in the same direction, since it may quite probably be due to racial intermixture during the Polynesian migrations through Melanesia and not to fusion in the islands in which it is found.

Eastern Polynesia.—In all the island groups east of Tonga and Samoa, without a single important exception, occur the remains, now more or less ruined, of megalithic structures, the sacred places or *marae* of the Polynesians. These consist typically of paved rectangular enclosures, surrounded by stone walls, and containing one or more rectangular stone platforms, sometimes, as in Tahiti, of stepped pyramidal form. These elements were variously combined and differ in details of construction, contour and size. Thus in the Marquesas the walls are low or absent, in the Australs the platforms are generally lacking, while in Tahiti and Hawaii all features are generally present. The platforms were faced with large boulders or hewn blocks of stone or coral, sometimes weighing many tons, and often neatly fitted in regular courses, although mortar was never employed. The core consisted of earth or rubble, and sometimes contained burial pits or vaults. Platforms served also as substructures for sacred houses of perishable material, for the exposure of the dead, as sacrificial altars, etc. Many of them were originally surmounted by large figures of wood or stone in conventionalised human form. The stone figures, some still *in situ*, are found in Hawaii (Necker), Easter I., Pitcairn, Tahiti, the Australs (Raivavai) and in the Marquesas, where they exactly resemble those carved in wood.

In the Marquesas, platforms, which always had vertical sides, were also much used for secular purposes, both in public assembly

places (*tohua*) as seats for the spectators of dances, and as foundations for the ordinary dwelling-houses. The extreme development of terraces and platforms in the latter islands is undoubtedly due to the scarcity of level ground in the steep and narrow valleys, and to the abundance of suitable boulders and easily worked volcanic stone. The largest recorded platform, that of Oborea, in Tahiti, now almost destroyed, measured 90 x 24 yd. at the base, and rose in 10 or 11 steps to a height of about 50 ft.; but in general these structures did not exceed 12 ft. in height. The antiquity of particular structures cannot be determined from internal evidence, but they were presumably built by ancestors of the historical Polynesians, who on traditional evidence did not reach the area earlier than the 7th century A.D. The fact that they occur in similar form in all groups, including Tahiti and Hawaii, which remained without intercommunication after the great voyages of the 13th and 14th centuries, as well as on intermediate islands, afterwards uninhabited, like Malden and Fanning, shows that the type must have been fully developed by the time of these voyages. Many were still in use when discovered, and some were even constructed in the historic period.

Easter Island.—In Easter I., where large trees were absent, stone construction attained its maximum development. The coast is almost surrounded by stone terraces (*ahu*), associated with burial vaults, the largest being some 300 ft. long and 15 ft. high; on these platforms, and scattered about the island, stood hundreds of monolithic statues, now overthrown, ranging from 6 to upwards of 30 ft. in height, and crowned originally with "hats" of red tuff. Some of these were still standing and apparently worshipped when discovered in 1722. Stone houses with partially corbelled roofs are found here only in Oceania, and the numerous carvings of bird-headed men on rocks and statues are unique in Polynesia. The *maraes* and stone figures of Pitcairn, uninhabited when found, bear some resemblance to those of Easter Island. Pitcairn I. has traces of a former Polynesian settlement in *maraes* and figures somewhat resembling those of Easter Island. Large stone axes of exceptional type have been dug up in the soil. Other small islands, found uninhabited, but bearing evidence of former Polynesian settlement, include Palmerston, Flint, Malden, Christmas, Fanning, Necker (Hawaii).

Samoa and Tonga.—In Samoa and Tonga typical walled *maraes* are not found, but the occurrence of stone temple and burial platforms in the former, and sepulchral mounds containing stone cists in the latter have been recorded. In the mountainous interior of Upolu (Samoa) is a group of upright basalt slabs on a paved floor (*O Le Fale-o-le-Fe 'e*), evidently the supports of a former house or temple, while in Savaii there are remains of roads and raised causeways elaborately engineered, but long disused and partly destroyed by an overflow of lava.

The most striking examples of true megaliths are the two trilithons on Tongatábu (Tonga), 15 and 30 ft. high respectively, the lintel stone being mortised into the two uprights in one case, and surmounted by a stone bowl in the other. A tradition ascribes the erection of the former to a chief of the 14th century in connection with a kava feast. Equally remarkable are the terraced "tombs of the kings" (*langi*), which are faced with hewn coral blocks measuring up to 22 ft. in length.

Stone Fortifications and Petroglyphs.—Stone fortifications occur on many islands, and reach their highest development in the terraced entrenchments and solid stone towers on the mountains of Rapaiti. Of the petroglyphs, representing conventional human and animal figures, concentric circles, etc., which are found abundantly in Hawaii and the Marquesas, some by their situation seem to have had religious significance, while others are "travellers' marks"; but many are of recent date.

New Zealand.—The final settlement of New Zealand by Polynesian immigrants from Rarotonga in the 14th century was preceded by an earlier branch of the same race, possibly also by people of Melanesian affinities. Archaeology throws little light on this question. The earthwork and stone fortifications belong for the most part to Maori culture, as do probably the pit dwellings and terraces of the Pelorus and Auckland districts and the artificial caves and figures carved in the soft tuff of Rotorua. Excavations in Otago have shown that the culture of the early moa hunters, which includes flake implements of quartzite and obsidian and rock paintings, did not differ essentially from that of the historical Maori. Curious figures incised in a sandstone pit in Auckland and rock-carvings in the Kaingaroa plains representing canoes of Maori type are among the more interesting recent discoveries. The stone implements of the extinct Moriori resemble Maori types, with the exception of tanged obsidian blades; tree-carvings and much weathered bird figures incised on cliffs have been reported.

Micronesia

The most important monuments of Micronesia are found in the Caroline Is., where both on Ponape and Kusaie extensive groups of buildings intersected by canals were constructed on artificially enlarged reefs protected by sea walls. They take the form of rectangular paved courtyards, frequently in contiguous clusters, surrounded by massive walls, constructed by laying long columnar blocks of basalt lengthwise and crosswise in alternate layers. These walls rise in places to a height of more than 20 ft., but were not roofed. The enclosures formerly contained houses of perishable material, traces of which remain; also platforms, terraced or pyramidal, in which were sepulchral vaults roofed with coral or basalt slabs. The most striking and best preserved of these structures is the royal cemetery of Nan Tauach at Matolenim (Ponape), which stands in a double enclosure and contains four burial chambers. Enclosed burial platforms of a somewhat similar type occur farther west in Yap and the Bunaj Islands. They have certain points in common with the *marae* of Polynesia, to which they are possibly related. Although the date at which these "sacred cities" of the Carolines were begun is not clear, they were still inhabited at the time of their discovery, and the tradition of how they were constructed by means of inclined planes of tree trunks survives. The stone pounders, and shell and other objects found in the tombs, do not suggest a high antiquity.

In the Marianne Is. occur groups of conical pillars, built of cemented coral slabs, and surmounted by hemispherical capitals. These are always arranged in two parallel rows, and presumably served as house supports; a burial has, however, been reported in one of the capitals. The largest, in Tinian, are 15 ft. in height with capitals six or seven ft. in diameter.

Melanesia

In various parts of Melanesia are found relics of a prehistoric culture or cultures, which it is as yet impossible to date or correlate satisfactorily. An important region covers the east end of New Guinea, New Britain and the adjacent archipelago, where the remains found include ornamented pottery (somewhat similar to that of prehistoric Japan), engraved shells, obsidian implements and stone pestles and mortars, some of which occur at a considerable depth in river gravels and all of which are quite distinct from the products of recent inhabitants. In the same region, but within a more limited area, are low stone circles, lines and heaps of stones, now used as squatting places and, in part at least, of recent origin. Rock paintings and engravings are numerous in the district behind Port Moresby, some of them coated with a film of calcium carbonate, indicating a certain antiquity. Megaliths are widely distributed and irrigation terraces are found throughout Melanesia. In the Solomon Is. (Bougainville and San Cristoval) upright stones occur singly and in groups; in San Cristoval some villages are bordered with stone walls or platforms, and numerous stone-faced and earth mounds—containing shafts leading to burial chambers, and sometimes surmounted by stone statues, small dolmens, or upright stones—are still in use. They may be related to Polynesian burial platforms. Their form and the mortuary customs associated with them have led to a comparison with early Egyptian mastabas; but the supposed resemblance of the pig-tail figures to Egyptian royal statues seems too remote to justify the emphasis laid upon it. In the New Hebrides the antiquities include menhirs, stone sacrificial "tables" or dolmens, walls and high platforms, and

an obsolete type of pottery. There is an exceptional development of stone walls and buildings in the Banks Is., but some of these are of recent construction. In New Caledonia stone statues (in caves in Lifu) and a few "dolmens or trilithons" have been reported. Petroglyphs are common to all these groups, and particularly numerous in New Caledonia, where they take the form of human and animal figures, spirals and other patterns. Some of the better structures may be attributed to reflex Polynesian influence which has affected many of these islands in comparatively recent times; the *nanga* of Fiji so closely resemble Polynesian *marae* as to leave no doubt of their common origin.

Migrations—Negrito and negroid races were undoubtedly the first to arrive in the Pacific and occupy the Melanesian area, and may possibly have spread as far as Easter Island.

Oral traditions, supported by botanical and linguistic evidence, indicate that the ancestors of the mixed Polynesian race set out from the Asiatic continent (probably India) in the latter part of the 1st millenium B.C., and after a period of settlement in the Indonesian archipelago proceeded in at least two main streams of migration by way of Melanesia or Micronesia to Fiji, which they reached in about the 5th century A.D. Thence eastern Polynesia and New Zealand were settled in successive voyages during the 7th to 14th centuries. Hawaii seems to have been reached first by a direct migration from Indonesia, and subsequently by a branch of the main wave from southeastern Polynesia; this conclusion is supported by archaeological study which recognises two distinct types of *heiau* (*marae*), the later of which corresponds with the Taendi Purgu type.

Hypotheses—The hypothesis that Oceania served as a highway for the diffusion of an "archaic civilisation," originating in Egypt in the 3rd millenium B.C., and including the practices of sun worship, mummification and the building of megalithic structures; and that the stone monuments of Oceania are attributable to the bearers of this culture complex, has been a subject of considerable controversy. If tradition is right in asserting that Polynesian migrations did not reach the eastern Pacific before the 6th or 7th centuries A.D., and if, as appears probable, these people were the builders of the monuments in that area, it is apparent that they cannot have reached America in time to introduce civilisation to that continent. On the other hand, since they were in contact with Asia till a late period, they can hardly have escaped the influence of old-world culture or have failed to carry some of its elements with them into the Pacific. The absence of pottery has been used by others as an argument for the very early isolation of the Polynesians; but this art might easily have been lost as a result of prolonged wanderings among coral islands, where the material with which to practice it was not available. The view that Oceania was peopled by migration from America finds little support at the present time.

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XVI. NORTH AMERICA

Pueblo Area.—The greatest activity in archaeological research in northern America has been in Arizona, New Mexico, Colorado, Utah and Nevada—the territory of the ancient Pueblos—partly because its ceramic remains afford an exceptional basis for determining the succession of cultures. The excavations by A. V. Kidder of Phillips Academy at Pecos, by Neil M. Judd of the National Geographic Society, at Pueblo Bonito and Pueblo del Arroyo, and by F. W. Hodge, of the Museum of the American Indian, Heye Foundation, at Hawikuh, each of whom has devoted six years to these researches in New Mexico, had for their chief purpose a determination by stratigraphic studies of the sequences of the pottery types found at those sites.

Other studies of a generally similar nature were conducted by N. C. Nelson for the American Museum of Natural History in ruins of the Tewa, Tano and Keres Indians of the Rio Grande drainage in New Mexico, especially in Galisteo valley, which have been productive of much information on the stages of pottery development from the earliest period until the Pueblo rebellion of 1680; and by Earl H. Morris during several seasons at the great ruin near Aztec, New Mexico, the site of which has been purchased and presented to the Government as a National monument. During three years in Cañon del Muerto, Arizona, Morris recovered a remarkable series of sandals and other textiles. There has been work by Erich Schmidt at an ancient pueblo site near Miami, southern Arizona; by Fewkes in various important Pueblo culture centres, such as the Mesa Verde National Park and the Hovenweep region of Colorado, the Mimbres valley of New Mexico, the Navaho National monument and the Black Falls ruins in Arizona.

Excavations by E. L. Hewett of the School of American Research at Chettro Kettle in Chaco Cañon and elsewhere in New Mexico; by Hodge and Lothrop at Kechipauan, near Zuñi in the same state; by J. A. Jeançon and F. H. H. Roberts in southern Colorado; by Jeançon in Taos valley and the ancient Tewa country of northern New Mexico; by Wesley Bradfield of the School of American Research near the Santa Rita mines in southern New Mexico; by the Cosgroves for two years in Mimbres valley for the Peabody Museum of Harvard University; the joint researches conducted by the Bureau of American Ethnology and the School of American Research, under Hodge and Hewett respectively, in the Rito de los Frijoles, the Pajarito Park, and the Jemez valley, New Mexico (the Southwest Museum of Los Angeles joining in the Jemez work a year later), and the discoveries by Dr. Wilson for the Commercial Museum of Philadelphia in Tewa ruins of the Pajarito have all added to the sum of knowledge respecting this important archaeological field, while the systematic work by Kidder and Guernsey for Phillips Academy and the Peabody Museum of Harvard University, respectively, in caves, cliff-dwellings and other habitation sites and burial places, during several seasons, have resulted in defining the four earliest periods of southwestern culture.

Byron Cummings of the University of Utah and the University of Arizona, Judd of the National Museum, and J. L. Nusbaum of the Museum of the American Indian, have worked at the archaeology of northern Arizona and southern Utah. Walter Hough of the National Museum has explored pit-dwellings near Luna, New Mexico. Of a more or less kindred character were the observations on ancient remains near Flagstaff and in the Grand Cañon, Arizona, by S. A. Barrett and G. A. West of the Milwaukee Public Museum. The reputed finding in the Grand Cañon of ancient pictographs representing mammoths, seriously exploited by a local museum in California, has not been accepted. In 1924–6 M. R. Harrington, for the Museum of the American Indian, conducted excavations at a series of early Pueblo ruins known as Pueblo Grande de Nevada, in southeastern Nevada, of great archaeological importance because the remains pertain to the most westerly extension of the Pueblo culture area yet discovered.

Southern States.—Perhaps less spectacular in results, but of equal importance, have been the excavations conducted in the southern states by several institutions, and notably by Mr. Clarence B. Moore, whose researches in conjunction with the Academy of Natural Sciences of Philadelphia have been characterised as the most important of their kind ever undertaken by

private means within the United States. Mr. Moore devoted each field season during many years to the excavation of hundreds of mounds along the streams and the Florida coast, the results of his observations being published as the units of work were finished. The Bureau of American Ethnology also explored mounds in Alabama and Tennessee and at Weeden I. near St. Petersburg, Florida, where culture stratification was observed by Fewkes. A season was spent in a study of the historic Nacoochee mound of the Cherokee by Heye, Hodge and Pepper, in Georgia, in 1915, under the joint auspices of the Bureau of American Ethnology and the Museum of the American Indian. Of great importance to the elucidation of the culture history of the Cherokee are the results of excavations by M. R. Harrington in Tennessee for the Museum of the American Indian, which have been published, as likewise has his memoir on some important Caddo sites in Arkansas, explored under the same auspices. Of special interest to archaeologists, by reason of its great size, is the Etowah mound in Georgia, the systematic excavation of which, commenced by Moorehead for Phillips Academy, promises noteworthy results. The same institution has explored mounds also in Mississippi with a view to determining relations.

Since its establishment in 1909, the Alabama Anthropological Society has located more than 200 aboriginal sites within the State and has explored about a fourth of these. On the Alabama and Coosa rivers evidences of an advanced culture, identical with that revealed by Moore at Moundville, have been uncovered, and certain artifacts suggest Mexican influence in this area. Of more or less related interest, by reason of cultural contact with the adjacent mainland in prehistoric times, are the researches carried on in the West Indies by Fewkes for the Bureau of American Ethnology and the Museum of the American Indian, by de Booy and Huckerby for the latter museum, and especially by M. R. Harrington for the same institution in Cuba, with results of outstanding importance. Until 1918 Texas had been almost neglected as a field of archaeological research, but the Bureau of American Ethnology and the University of Texas, represented by J. E. Pearce, have done much to elucidate the problems of the early inhabitants of that state. Everywhere over the limestone region are found numerous and extensive kitchen middens which show evidence of a hunter culture only. In the timbered region of eastern Texas are evidences of an early mound-builder culture and of the relatively settled village culture of the historic period. Along the streams of central Texas are many old camp sites which reveal evidences of a culture superior to that of the kitchen middens. In the trans-Pecos region a low form of Pueblo culture has been revealed, with evidences of cave life here and there, and in the Panhandle traces of a crude form of stone buildings have been found by Moorehead, who regards them of Pueblo origin.

Cave Work.—Special efforts have long been made to trace the remains of very early man in the United States; and although various reports of such occurrence in association with fossil remains have been made from time to time, no indubitable evidence had, up to 1926, been adduced. With a view to obtaining scientific data on the subject, much cave work has been done, notably in the Ozark mountains of Arkansas-Missouri, by the Bureau of American Ethnology, by Nelson for the American Museum of Natural History, and by M. R. Harrington for the Museum of the American Indian, and also by Nelson in Kentucky caves. Loud, of the University of California, and Harrington have also conducted important excavations in an anciently inhabited cave near Lovelock, Nevada. But in none of these investigations has anything been found to indicate the former presence of people not readily identifiable as American Indians. The Delaware valley near Trenton, New Jersey, has long been the scene of researches looking to the establishment of evidence of early man in the vicinity, the latest studies there being those of Leslie Spier and Alanson Skinner for the American Museum of Natural History, who found a pre-pottery argillite culture underlying the later culture of the historic Delaware Indians, and demonstrated that arrowheads and natural pebbles were impartially deposited in sand by a stream which was probably not much later than the Glacial retreat. Anthropologists demand incontrovertible evidence of the existence of very early man in America, however, and Holmes and Hrdlička of the National Museum have been especially active in combating all suggestions of such, based on casual or superficial observation or on fortuitous associations.

Mound Region.—The Peabody Museum of Harvard University in 1911 finished the exploration of the extensive aboriginal cemetery at Madisonville, Ohio, and a new survey of the great Serpent mound in that State was made. In co-operation with the University of Illinois, Moorehead of Phillips Academy conducted investigations of the Cahokia mound group in Illinois, the largest in the United States, whose larger earthworks are now preserved as a State park. For twenty-five years the Ohio State Archaeological and Historical Society, under W. C. Mills, has conducted intensive excavations throughout the State, special attention being devoted since 1910 to the Harness mound, the Seip group and Tremper mound in the lower Scioto valley, all belonging to the Hopewell culture; the Feurt mounds and village-sites of the Fort Ancient culture; the Westenhaven mound, probably of early Hopewell culture; the Mound City group, and the celebrated Hopewell group, which in 1925 revealed, among other remarkable objects, artificial copper noses on two skeletons and a necklace of 320 pearls. Various sites in Butler county and along the Scioto were investigated, and Flint Ridge, the source of material for making arrow- and spear-points and knives, was examined.

The Milwaukee Public Museum has been remarkably active in archaeological work in Wisconsin under the guidance of S. A. Barrett. The Kratz Creek mound group in Marquette county was investigated and 53 mounds opened, with important results; the extensive old site at Aztalan was uncovered, revealing influence from the coast of the Gulf of Mexico; and mound groups in Shawano, Oconto, Green, Lake and Marquette counties, and at Shorewood, a Milwaukee suburb, were likewise explored. Investigations of old Kansa and other sites in Nebraska, and still other sites in Iowa, were carried on by the Peabody Museum of Harvard University. In South Dakota, W. W. Stirling, for the National Museum, explored four of ten village sites on the Missouri river, three of which were Arikara and one the historic village visited by Lewis and Clark in 1804. The Wisconsin Archaeological Society has located, since 1911, nearly 5,000 mounds in 21 counties, in addition to large numbers of village, camp and workshop sites, planting grounds, cemeteries, flint and pipestone quarries, lead diggings, sacred springs, petroglyphs, etc., and a number of single mounds, mound groups, burial places and other aboriginal remains have been explored. Additional mounds and mound groups have been preserved for public use and marked with tablets at various places, and a large part of the ancient Indian enclosure of Aztalan has been acquired by the society and is now the Aztalan Mound Park under State control.

Pacific Coast.—The efforts of the University of California have been devoted mainly to the archaeology of its own State. A beginning has been made on the systematic recording of the localised private collections and on the methodical comparison of all this material by areas. Actual excavating has been done in strategic points in the upper San Joaquin valley, on San Francisco bay, in the Stockton-Lodi region and on Humboldt bay. Looking toward the establishment of connections, excavation has also been conducted in the Willamette valley at Albany, and on the Columbia river, principally at Sauvies I. and The Dalles, in Oregon, and in western Nevada; and reconnaissance trips have been made into the Imperial valley, California, and into Lower California. Excavation of a site at Santa Barbara by J. P. Harrington for the Bureau of American Ethnology and the Museum of the American Indian revealed typical Chumash artifacts, together with skeletal remains which at first were thought to be of extreme age, but more deliberate scientific study shows them to have no features not characteristic of late Pacific coast Indians.

New York and New England.—On behalf of the New York State Museum, Arthur C. Parker investigated many sites. One of the late historical period at Port Jervis revealed characteristic articles of European provenience. A pre-colonial site at Richmond Mills, Ontario county, examined with the co-operation

of the L. H. Morgan Chapter of the State Archaeological Society, proved to be Seneca. A site of similar culture near Factory Hollow, in the same county, probably had been occupied by the Richmond Mills people in early colonial times. A pre-colonial site near the outlet of Owasco lake had belonged to an Algonkian tribe. A site in Brant, on the Cattaraugus reservation, had been occupied by the Seneca at the beginning of the colonial period. Other sites investigated were the Seneca village of Gannagaro, near the town of Victor, which was destroyed by the French in 1687, an Algonkian fishing village at Green Point near Catskill, a site near Vine Valley, on Canandaigua lake, with remains similar to the Ohio mound region, a quarry site and workshop south of Coxsackie, covering a hill a mile long, an Algonkian site near Four Mile Point, on Hudson river, which exhibited contact with New England. Several years were devoted to an archaeological survey of the State and the charting of sites, and much light has been shed on the chronological sequence of the early aboriginal occupancy. In 1925 the Rochester Municipal Museum, under Mr. Parker's direction, conducted an expedition on Lamoka lake, Schuyler county, where an early, pre-pottery Algonkian fishing village site was uncovered. Considerable activity was manifested by the Museum of the American Indian in archaeological researches especially in and about New York City—at Throgs Neck, Clason Point and Inwood (where Skinner conducted important excavations), on Long Island and Staten Island, and at Croton Point, as well as at several up-State localities, notably on Frontenac island, in Cayuga lake, where D. A. Cadzow uncovered a prehistoric Algonkian site.

In New England, Phillips Academy, under Moorehead, conducted many expeditions during 12 seasons, mapping upward of 1,000 shell-heaps and village sites and 50 cemeteries. About 50 sites were explored. Reports on the archaeology of Maine and other areas were published, and a correlation of cultures by means of a study of type specimens is in progress. The Peabody Museum of Harvard University has surveyed an interesting old earthwork in the Sudbury valley, Massachusetts, an Indian burial-place was explored at Dartmouth in the same State, and excavation has been conducted at old sites in Charles river valley and on Martha's Vineyard. The Peabody Museum of Natural History in Yale University has done considerable field-work in Connecticut, under the immediate direction of G. G. MacCurdy, and in 1925 Carroll G. Alton, assistant, dug out a camp-site on Thames river near Norwich, which dates from the early contact with whites.

Canada.—Although the exigencies of the World War retarded progress in archaeological research, the Victoria Memorial Museum at Ottawa has done much in field reconnaissance and in recording and publishing results since 1911. Following the first extensive exploration, conducted in 1912 at an Iroquoian site near Roebuck, Ontario, by W. J. Wintemberg, archaeological reconnaissances have been made in Manitoba by W. B. Nickerson; in Ontario by Wintemberg; in Nova Scotia, New Brunswick, Alberta, Saskatchewan, British Columbia (including Queen Charlotte Is.) by Harlan I. Smith, and on Barter I., Alaska, by D. Jenness.

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XVII. MEXICO AND CENTRAL AMERICA

Important advances have been made in our knowledge of the archaeology of Mexico and the adjacent Central America since 1910 as the result of first, the discovery of a stratification of archaeological remains in the valley of Mexico; second, the decipherment of dates inscribed on Mayan monuments in Yucatan and adjacent parts of Mexico, Guatemala and Honduras, and the reduction of these dates into days of the Gregorian calendar and years of the Christian era; third, reclassifications in language introducing new data on the origin of various tribes; fourth, demonstrations in the field of technology and art establishing time levels in industry and disclosing the extent of ancient commerce; fifth, reinterpretations in myths and legends now believed to deal in part with historical characters. The facts presented in the explanations of Tyler and Lehmann must now be posed in historical succession covering 5,000 or 6,000 years.[1]

Stratification of Remains.—The stratification was first observed at Atzcapotzalco, near Mexico City, in 1910, and later was investigated by the International School of Archaeology at Colhuacan and near-by sites. In the top soil were found objects of Aztec manufacture, and under these, to the depth of several feet, were the much finer products of the Toltecs. Finally in a deep stratum of water-worn gravels were found little clay figurines of men and women, made in a peculiar style, together with pottery strikingly different in shape and design from that of the upper layers. Similar figurines were also found on the tops of denuded hills about Lake Tezcuco and were recognised as belonging to an archaeological type called Tarascan, which has been re-named Archaic.

The discovery yielded three major horizons: Archaic, Toltec (with obvious affiliations to the Mayan of the Central American lowlands), and finally Aztec or Chichimec, corresponding to the civilisation found by Cortes. The Archaic remains belonged to a village-dwelling population acquainted with agriculture and weaving as well as with pottery-making, and it therefore became necessary to postulate a still earlier culture of pre-agricultural type, that of the first immigrants into the New World. These are believed to have entered America via the Siberia-Alaska bridge in lower Neolithic times. Remains of these first nomads are rare in Mexico and Central America, but are found elsewhere.

Archaic Culture

The Archaic culture was the outgrowth of the domestication of maize, beans, squashes and other plants indigenous to the arid lands of the American tropics. The little figurines of men and women have been interpreted as expressions of a primitive religion in which the little men stood for success in war and the chase and the much more common statuettes of women were fetishes of the fertility of mother earth. These little figurines can be traced through slight variations in style from Mexico into Colombia, thence eastward across Venezuela as well as southward to Peru. Archaic art underlies the higher expressions of civilisation in all tropical America, and the plants domesticated at this time furnish the economic explanation of growth in population and increasing complexity of social organisation. The ultimate economic values of this nuclear civilisation of ancient America are incalculably vast.

The Archaic culture lasted for several thousand years, the indications of age being, first, the thickness of deposits; second, the high degree of domestication in plants, which are carried further from their wild state than the domesticated plants of the Old World. Some botanists have insisted that American agriculture is older than that of Asia, but the archaeological evidences hardly support this conclusion. The first independent domestication of plants may be on nearly the same historical plane in the two hemispheres. New indications of age for the Archaic

[1] *See* Archaeology (5.677) and Mexico (18.329).

culture are found in sites near Mexico City, where ancient lava flows have covered villages of this period.

Mayan Chronology

The Mayas (*see* 17.931) may have established themselves in the wet lowlands of eastern Central America as early as 1000 B.C. The archaeological evidence indicates, however, that their beginnings were in the piedmontal zone adjacent to the dry region of the Archaic civilisation. In this zone transitional types of pottery are found which are lacking in the heart of the Mayan territory. The early Mayas modified the important food plants of the Archaic civilisation till these plants would grow under conditions of heavy rainfall, and they succeeded in domesticating a number of new plants, such as cacao.

The sources of Mayan history are several brief chronicles preserved in Spanish writing by educated Indians together with abundant inscriptions on early monuments. The chronicles reach back to 176 A.D. in a count of time periods called Katuns, which are really periods of 7,200 days, corresponding to the basic value of the fourth position in the place-value notation of numbers used by the Mayas. This numerical system is vigesimal instead of decimal except that in the third place we find 360 instead of 400 and the katun is 20 times 360. On the ancient monuments the dates are the number of days from a beginning day, and the terminal days of katuns are emphasised.

The German school of Americanist science led by Seler paid marked attention to Aztec sources and interpreted Mayan archaeology in the light of their Mexican studies. The American school undertook the study of Mayan sources on their own merits under the leadership of Brinton, Goodman, Bowditch and Thomas. In 1910 Morley suggested a correlation of the katuns of the chronicles with the katuns of the ancient inscriptions on the evidence of an inscription at Chichen Itza. At the same time Spinden showed that when monuments at Copan were arranged in stylistic order, the dates fell in similar order, indicating that these dates probably declared the chronological positions. The early correlation of the katuns proved to be slightly in error since the katuns had been counted as current rather than elapsed units of time. Nevertheless, the arrangement made possible relative accuracy in chronology, while the demonstration of artistic sequence permitted the placing of many abbreviated dates.

Early attempts at correlating the Mayan calendar with European time counts failed to pass all tests. In 1919 Spinden published a day-for-day correlation of Mexican and Mayan chronology with that of Europe, and in 1924 presented astronomical proof of the correctness of the arrangement and showed that many Mayan calculations deal with fixed points of the tropical year such as the solstices and equinoxes and especially with two arbitrary stations in a farmer's year of the ancient Mayas, namely, April 9 and Sept. 2, reached by sunset readings along an astronomical base line at Copan. This base line consists of two monuments set up on opposite sides of the valley and about four miles apart. An observer standing at the eastern monument sees the sun go down directly behind the western one on the two dates given above, which are also recorded on several monuments in the ancient city. It appears that an astronomical congress was held in Copan to decide formally upon these stations. References to this congress are found in the Mayan chronicles as well as in traditions of the Mexicans.

An unknown scientist, possibly deified as the god called Itzamna, seems to have invented the Mayan calendar after making a daily record of observations beginning on Aug. 6 613 B.C. This date is the real zero of Mayan history, although the perfected Mayan calendar was not inaugurated till 580 B.C. (according to inscriptions at Palenque and Copan) when the new year's day of the Mayan civil year stood exactly at the winter solstice. The unknown scientist reduced a calendar of moons to a calendar of numbers. A 365-day year was constructed of 18 months of 20 days each plus 5 days. The days were counted in numerical succession from a mundane era reached by counting seven baktuns, or units of the fifth numerical position, back into the past from Aug. 6 613 B.C. In this manner the epoch of the mundane era was established on Oct. 14 3373 B.C.

The writing out of the number of days in the Mayan calendar involved place-value numeration 1,000 years before this important arithmetical device was known to the Old World and the Mayan eral count of days preceded by 300 years the first eral count of years in the Old World (the era of the Seleucidae, Oct. 1 312 B.C.). The unknown Mayan scientist likewise invented a system of designating the days by a permutation of 13 numbers and 20 names, making a round of 260 days called the tzolkin. When this permutation of days is combined with the 365 positions in the year the result is $52 \times 365 = 18{,}980$ days, called the calendar round. The mundane era is zero, 4 Ahau 8 Cumhu, but the zero is written 13–0–0–0–0, as we transcribe Mayan numbers in this case and the historical era is 7–0–0–0–0, 10 Ahau 18 Zac. The 4 Ahau and 10 Ahau are designations of days in the permutation and they are declared to occupy, respectively, the 8th place in the month Cumhu and the 18th place in the month Zac. The Mayas had a system of hieroglyphs with pictographic, ideographic and phonetic elements by which days, months and many other things could be recorded. For numerals they generally used bars and dots, with the dot counting as one and the bar as five. Numbers with bar-and-dot numerals in several places were commonly written in columns with the lowest place-value at the bottom.

The decipherment of Mayan dates discloses a remarkable astronomical science. This ancient people had obtained by observation practically the modern values for the length of the tropical year, for intervals between possible eclipses and for the average periods of revolutions of several planets. They accomplished these results because they did not invalidate their calendar by making leap-year corrections, but permitted the months to revolve slowly around the natural year. The proper corrections were accurately known but were not interpolated. The etymologies of month names and the symbolism of month hieroglyphs are in agreement with the seasons when we put the first day of the month Pop at the winter solstice, a condition which obtained about 580 B.C. At almost the same time the Venus calendar started flush with the actual heliacal risings or first appearances of the planet as morning star. The Mayas observed that in every period of 8 calendar years there were 5 appearances of Venus as morning star, at intervals which averaged 584 days. When the 260-day tzolkin was brought into the reckoning, a grand Venus permutation of 37,960 days, or 104 calendar years, was obtained. During this time the actual positions of Venus moved a little more than 5 days out of agreement with the Mayan civil calendar and about 30 days out of agreement with the seasons. The Mayas observed the calendarial positions of Venus and they also observed the actual positions. Moreover, they held as sacred to Venus certain special days in the tropical year, one being April 12, which could be occupied by heliacal rising of Venus once in 243 or 251 years. On Stela C at Copan, this principal date is the actual one of Venus' emergence out of the sunlight, and there is a marvellous calculation covering 4,617 years which involves the moon as well as Venus.

The first Mayan monuments with contemporary dates fall about 100 B.C. The most brilliant period of the First Empire began about 400 A.D., and ended suddenly shortly after 600 A.D. At this time all the great cities, such as Copan, Tikal and Palenque, were abandoned to the enveloping forest. The sudden breakdown has been variously attributed to yellow fever, civil war, social decay, exhaustion of the soil and even climatic change. The Mayas, greatly reduced, moved into the region back of Campeche. Several fine buildings and a few dates are known from this intermediate period. The Second Empire began with the re-establishment of Chichen Itza about 960 A.D. There was a brilliant renaissance in which Uxmal, Izamal, Kabah and Labna flourished. Then a large part of northern Yucatan was subdued by the Toltecs from the highlands of Mexico. Dates are now known for some of the finest buildings of the Second Empire. A second abandonment of stone-built cities took place about 100 years before the coming of the Spaniards.

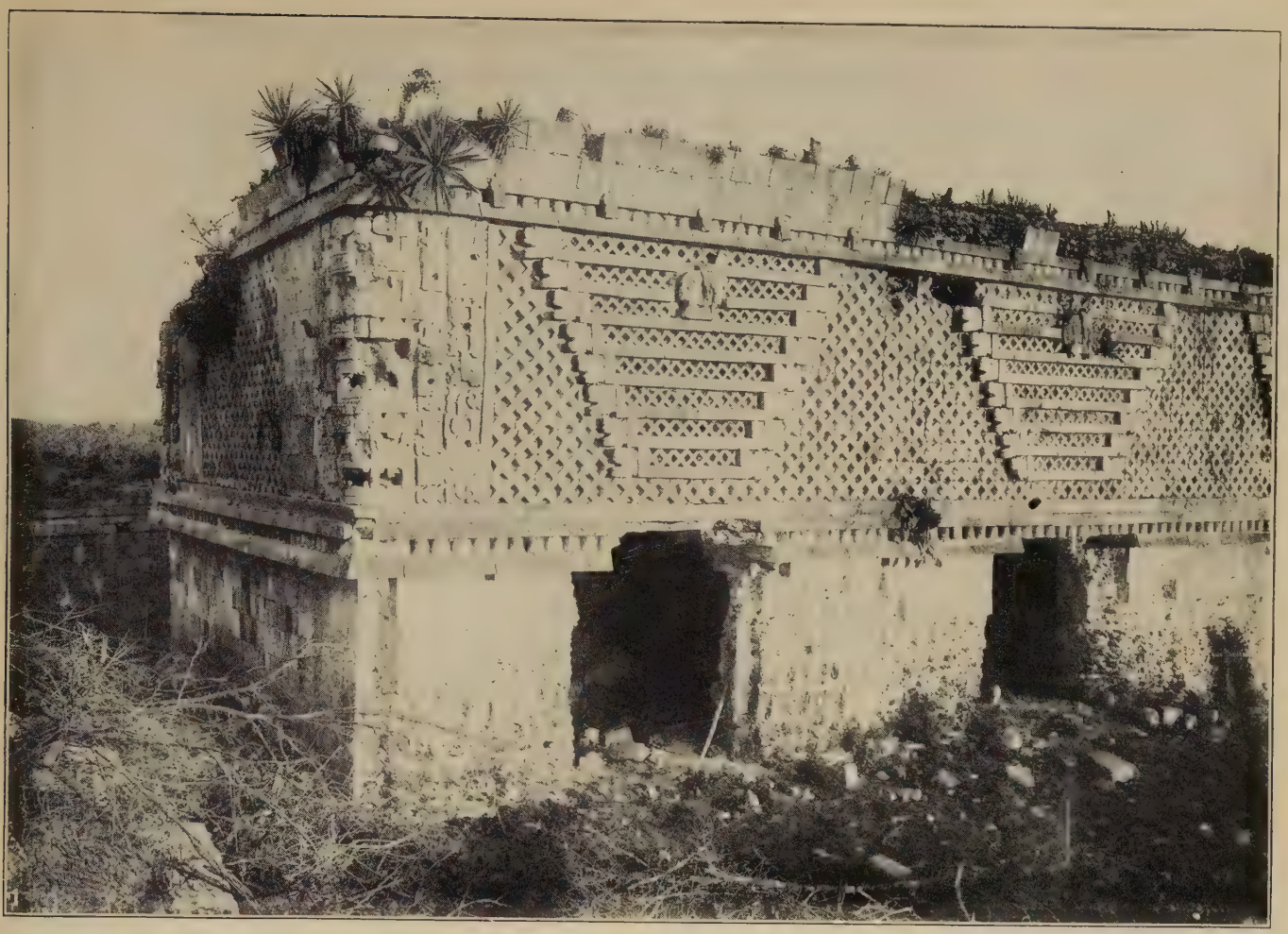

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FIG. 1. Eastern Building of the Nunnery, Uxmal, Yucatan. FIG. 2. Stela A, Copan, Honduras. FIG. 3. The great turtle sculpture, Quirigua, Guatemala. FIG. 4. Altar with inscription, Copan, Honduras. FIG. 5. Mayan inscription at Quirigua, Guatemala, in which the upper line is an introduction to two horizontal columns of faces of gods, with a final date corresponding to June 12 496 A.D.

The Toltecs

The Toltecs (*see* 26.1062) were one of several nations outside the Mayan area who enjoyed the fruits of the First Empire. Others were the Chorotegas to the south in Honduras, Nicaragua and Costa Rica, and the Ulmecs, Zapotecs, Mixtecs and Totonecs to the west and northwest in Mexico. The height of individualised culture for these secondary civilisations was between 1000 and 1200 A.D. At the end they were mostly consolidated into the extensive but short-lived Toltec Empire under Huetzin, Ihuitimal and Quetzalcoatl. The original capital of the Toltecs was Tula, doubtless to be identified with Teotihuacan. From here they extended their rule toward the northwest as far as the present states of Zacatecas and Durango and toward the southeast as far as Salvador and perhaps Nicaragua. They became a power in northern Yucatan with Chichen Itza, Mayapan and Uxmal as the chief cities under their control.

Little is known about the first two rulers mentioned above. Ihuitimal was also called Totepeuh, and is mentioned under both names in Guatemalan chronicles. The third was the great Quetzalcoatl, also called Topiltzin, "Our Prince." In the Mayan chronicles Quetzalcoatl appears as Kukulcan, "Plumed Serpent"; and as Hunac Ceel, "Great Fear." Quetzalcoatl is one of the great characters of history, a compound of warrior, priest, administrator and scientist. He seems to have received his early training in Yucatan, endearing himself to the Mayas by several scientific achievements, of which three can be recovered. He founded the Toltec era which served for later Mexican chronology and which began with a day called 1 Tecpatl, or Flint, in the first position of the Mexican month Toxcatl. This was Aug. 6 168 A.D., in exact correspondence with the first historical day of the Mayas, but 1,781 years later. He also established the era of the Sacred Fire on the day 7 Acatl in the year 2 Acatl in coincidence with the sacred fire ceremony of the Mayas. The zero day of this era was Feb. 16 1196 A.D. Finally, Quetzalcoatl was made God of the Morning Star because he predicted the appearance of Venus as morning star in the year 1 Acatl when it rose on April 12 1208 A.D., in conformity with a famous date for this planet treated in old Mayan books and on monuments at Copan.

As regards his political activities we know that Quetzalcoatl put down a rebellion of the Mayas in 1191, subduing Chichen Itza and making it the Toltec capital of Yucatan. He created orders of nobility and elaborated the coronation ceremony used in later times by most Mexican and Central American nations. Quetzalcoatl introduced into Mexico a mild religious cult of the Mayas without human sacrifice but with fasting and penance, in which the worship centred around a serpentine deity connected with the annual rains. In later times Quetzalcoatl was identified with the Mexican counterpart of this serpentine deity as Ehecatl, "God of the Storm Winds." The new religion of Quetzalcoatl brought on civil war among the Toltecs, which ultimately destroyed their power about 1220, although some of the arts and ceremonies were maintained at Cholula, Colhuacan and Atzcapotzalco.

The Age of Metals

The establishment of Mayan and Toltec chronology fixes, within relatively narrow limits, the beginning of the metal age in Central America and Mexico. No specimen of metal, not even a copper stain, was observed during excavations at Copan, Quirigua and other Mayan cities of the First Empire. Las Quebradas in Guatemala was actually built upon a placer mine, yet in the sluicing operations which have almost destroyed the site, no specimen of worked gold has been found. Nor are any ornaments of metal, such as gorgets and bells, pictured on the early monuments. We therefore conclude that the metal age did not begin till after 600 A.D., yet by 1200 A.D. metal work was highly developed in gold, silver, copper and various alloys. Many specimens found at Chichen Itza in northern Yucatan are of Costa Rican and Colombian origin, and the technique of metal-working is the same from southern Colombia to Central Mexico. The art was apparently introduced from South America about 1000 A.D., and underwent a rapid growth in the 500 years before the Spanish Conquest. Recent analyses have shown that the Mexicans were not ignorant of bronze and that they made many alloys, some containing lead. They were acquainted with the lost wax process of hollow casting and with a false filigree really moulded from a model of wax wire.

Recent publications by Saville and Rivet cover Mexican gold work, and the former has published papers on wood carving and turquoise mosaic work, the latter probably a Toltec invention. The fine ceramics of Mexico and Central America deserve greater attention for beauty of shape, design and colour. One kind of pottery is semi-glazed due to a suffusion of lead flux. Another kind resembles cloisonné but is made with heavy pigments rather than enamel. Also there is fresco pottery, moulded and carved pottery, and still another kind in which the designs are put on by a negative wax process resembling that of Javanese batiks.

The Chichimecan Period.—The Chichimecan period begins with the abandonment of the Toltec cities about 1220 A.D. and extends to the Spanish Conquest. The Chichimecs were tribes of rather low culture, speaking dialects of the Mexican language. During the civil wars that marked the end of the Toltec Empire the Chichimecs pressed into the valley of Mexico and established themselves in small groups among the Toltec survivors. Afterwards the Chichimecs boasted that they had begun their career of empire as pure nomads, but these claims need not be taken too seriously.

The best document dealing with this period, the Codex Xolotl, makes Xolotl, the founder of the dynasty of Tezcuco, enter the abandoned territory around Teotihuacan in 1224. He is pictured as a mountain brigand collecting tribute from farmers. The Acolhuas, as Xolotl's Chichimecs were called, became sedentary under Techotlala, who founded Texcuco about the same time that the Aztecs, another division of Chichimecs, founded Tenochtitlan. His son, Ixtlilxochitl, was murdered by the famous tyrant Tezozomoc of Atzcapotzalco, but Nezahualcoyotl recovered the power in 1431. Regnal years of the dynasty of Tezcuco follow:—

Xolotl	1225–1284	Ixtlilxochitl	1409–1418
Nopal	1284–1315	Interregnum	1418–1431
Tlotzin	1315–1324	Nezahualcoyotl	1431–1472
Quinatzin	1324–1357	Nezahualpilli	1472–1515
Techotlala	1357–1409	Cacama	1515–1520

The Aztecs have an unbelievable tale of a peregrination with many stops. It begins at the Toltec era, on the year 1 Tecpatl, corresponding to 1168. In 1325 the Aztecs reached the shores of Lake Tezcuco, where they lived undisturbed until 1351, when they were defeated in a sanguinary battle among the reeds by the combined forces of Colhucan, Xaltocan and Altzcapotzalco. They then became vassals of Cozcoz of Colhuacan and in 1364 moved to several small islands to construct Tenochtitlan as their capital. After the accession of Acamapichtli in 1376 the history of the Aztecs is one of conquest upon conquest and of horrible excesses in human sacrifice. Yet Montezuma held in 1519 only a small part of the territory that Quetzalcoatl had controlled in 1200 nor had the Chichimecan arts yet reached the high standard set by the Toltecs.

Linguistic Reclassifications.—The science of linguistics may give the historian his oldest facts because the demonstration of kindred speech in sundered tribes is proof presumptive of ancient contact. The number of distinct stocks of language in the New World has been greatly reduced in recent years (*see* Philology). The Shoshoni and Pima languages are connected with the Nahuan or Mexican languages. This stock stretches from Idaho to Costa Rica and embraces tribes that by test of culture run from lowly nomadic to highly civilised—witness the "Digger" Indians of Nevada and the Aztecs of Mexico. The drift has plainly been toward the south, yet it is strongly indicated that some tribes of this group have been in Mexico for several thousand years. The Otomi languages in Central Mexico are joined with the Chiapanecan group, mostly located in Nicaragua and Costa Rica, indicating a southern movement of the latter, but there is evidence that the Otomi moved northward instead. The incursion of wild South

American tribes into the Isthmus of Panama exerted a pressure which depopulated most of the Chorotegan culture area. Lehmann also joined the Subtiaba language of Nicaragua with the Yopi of southern Mexico. The Yopi, like the Otomi, were much given to the terrible cult of Xife, God of the Flayed, which likewise flourished in Nicaragua. The Subtiaba have been put into the Hokan stock, which mostly comprises the very primitive tribes of California and northern Mexico, while some North American Indian languages are possibly connected with the languages of eastern Asia. Such linguistic affiliations obviously go back long before the dawn of history.

The arguments against influences of the Old World upon the New in the matter of high civilisation are very strong. The economic bases in domesticated plants are distinct, the New World makes no use of the wheel at all and the really wonderful scientific achievements of the Mayas find no counterpart in the Eastern Hemisphere.

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XVIII. SOUTH AMERICA

The archaeology of the great continent of South America is, as yet, imperfectly known, and great areas still remain to be investigated. It follows that the northwestern part of the country must have been the first region settled, and the archaeology of Colombia and Ecuador, in the mountain region and the coast, appears to indicate two perhaps independent movements of people from middle America, profoundly influenced by the widely different environment.

It is highly probable that the vast region of Brazil and eastern Argentina was not occupied for so long a time as the Pacific coast and the inter-Andean valleys; indeed, it is reasonable to conjecture that the southern Brazilian area and portions of Argentina were the latest parts of the continent to be permanently settled, if it is considered that the logical route of early migration southward from Central America was probably along the Pacific coast, or through the Andean valleys, or both. There seems to have been, at the time of the earliest aboriginal invasion of South America, a movement eastward from Panama, along the northern coast of the continent, through Colombia, Venezuela and the Guianas, which reached the mouth of the Amazon and ascended that stream; and there may also have been a contemporaneous filtration of people southward by way of the numerous waterways which drain into the Caribbean Sea. This movement of people would naturally have taken a much longer time, considering the physical difficulties of the route, than by the less obstructed highway on the Pacific side of the continent.

Considerable archaeological work has been carried on in Ecuador, Peru and Argentina; to a lesser degree in Colombia and Chile, while the rest of the continent still remains almost virgin field for the investigator. Specifically, the great Republic of Brazil, somewhat larger in area than the United States, exclusive of Alaska, is as yet almost *terra incognita*, so far as its antiquities are concerned.

Ecuador.—Our knowledge of the archaeology of Ecuador has been greatly advanced by the researches of Saville, Jijon y Camaño, Rivet and Uhle, and it is now possible to determine something of the ancient culture of this part of South America. In this country there are three great zones, not climatic but cultural, for every variety of climate prevails. These culture zones are those of (1) the inter-Andean valleys, (2) the Pacific coast and (3) the Oriente of the Amazon basin. The antiquities from the Pacific coast indicate the former existence of two cultures differing widely from those represented by the artifacts from the highlands, where at least three major cultures may be distinguished, especially in the types of pottery found in the Andean valleys. The northern coast culture merges into the culture of the south Colombian coast region, and throughout the Ecuadorian coast there are distinct traces of influence exerted from Central America, chiefly from the field of Mayan culture (*see* Section XVII.) Some of the human effigy vessels and figures are unquestionably of Central American style, and might have been made within the area of Mayan culture. In the countless human heads and faces of pottery are found all styles of treatment, from the archaic of Mexico to the most advanced and accurate modelling. Many of the pieces are so closely allied to Mayan artifacts as to be almost indistinguishable. At the same time, these coast cultures possessed individual characteristics indicating an intense local development.

In the interior of Ecuador investigations in the province of Chimborazo have revealed stratified culture sequence (not as yet discovered on the coast), where six epochs appear to be present, before the comparatively late invasion of the Inca northward from Peru. Much remains to be done in this important field; most of the region of Colombia, especially where the continent approaches the Isthmus of Panama, still awaits examination.

Peru.—On the coast of Peru, are conditions not found elsewhere in ancient America. The entire stretch of coast, except for the narrow strips watered by streams, is a parched and rainless region, where there are numberless ancient cemeteries. In these are preserved, to a degree not found in any other part of the Western Hemisphere, everything that was buried in the graves hollowed in the nitrous sands. Owing to these unusual natural conditions little relating to the material culture of the ancient inhabitants of the Peruvian coast has been lost, and we possess greater knowledge of their arts and crafts than of any other aboriginal American people. The Inca, or more properly the Quichua, were not the originators of the complex of cultures, nor did they form the mass of the coast population. They came down from the mountains in comparatively recent times, and were the heirs of at least four cultures, or succeeding epochs or periods of civilisation, which had developed in sequence on the coast and in the great Andean valleys. Although the Inca dominated the region along the coast when the Spaniards arrived, they had made little impress on the arts and crafts of the coast people. That man has existed for a considerable period on the Peruvian coast has been demonstrated amply by the archaeological researches of Uhle, in the Chincha valley, at Ica, Pachacamac, Ancon, Moche and other places, and we now know with a degree of certainty something of the character of the different pre-Inca culture epochs.

Quipus.—Unlike the great Nahuan and Mayan civilisations of middle America, the civilised people of South America never developed a system of hieroglyphic "writing," but they invented a device of an exceedingly ingenious nature for recording numerical records. The quipu or knot record was a simple but clever primitive method of tying knots on a string. Locke has established the numerical value of the knots on the pendent strands of the quipu. A number was arranged in decimal notation, with the units or ones at the lower end of the strand. The tens were tied above the ones, and the highest order appears nearest the main or parent strand. The number in each order above the ones is usually a group of single knots, not exceeding nine, while the ones, or lowest order, is represented by a long knot. When the items listed were in groups it was customary to group the strands on the main strand, and frequently a top strand served to sum up the numbers in the pendent strands to which it was attached. A colour scheme was in use with certain colours for the different kinds of things recorded. Nordenskiöld has now followed up

this discovery by calculations based on a number of quipus, and indicates that many of them appear to have been of a calendarial nature in connection with calculations concerning the length of the year based on observations of both solar and lunar years, for astrological and divinatory purposes. If the studies of Nordenskiöld are proved to be sound, it will be possible to place the ancient Peruvians on the same intellectual plane as the ancient Mayans of Yucatan and Central America.

Chile.—To the south of Peru, it has been established that in northern Chile, there were in early times several cultures chronologically considered, the so-called Atacameno standing out as the leading people of this part of South America. This culture flourished in the desert of Atacama, reaching from the Chilean coast eastward to high altitudes, and into northwestern Argentina and southern Bolivia. It appears to have been related to the Diaguite or Calchaqui culture of Argentina. Late researches in the coastal area have revealed undoubted stratified deposits which have attracted the attention of students, and promise ultimately to yield much information pertaining to the early history of this interesting region.

Argentina.—Knowledge of the archaeology of Argentina is confined chiefly to its northwestern provinces. Here the climatic conditions are similar to those of the desert regions of Peru and Chile; hence perishable materials have been preserved to a remarkable degree. The country has been extensively explored in recent years by Argentine archaeologists, whose researches have revealed certain striking similarities in types of artifacts with those of southwestern United States. There seems to have been more than one culture in this great region, but the most generally recognised has been called Calchaqui, now more usually known as Diaguite. Of the language and affiliations of the Diaguite people nothing is known, but there is evidence of an invasion from the Andean region of Peru and Bolivia that profoundly influenced this culture, probably in relatively modern times.

(M. H. S.*)

XIX. AIR SURVEY

Long before aeroplanes were invented it was confidently hoped that vertical photographs would some day be taken, and it was felt certain that, if so, they would greatly assist archaeology. Maj. Elsdale was the pioneer of air-photography in the British Army. Between about 1880 and 1887 he carried out many experiments from free balloons; but ballooning was not much in favour then and, although some progress was made, he received little or no official support in his experiments

During several years immediately preceding the War, Mr. Henry S. Wellcome successfully used large box-kites, with specially devised automatic control cameras, for photographing his archaeological sites and excavations in the Upper Nile regions of the Anglo-Egyptian Sudan.

During the War, when aeroplane photographs first became common, it was expected that archaeological features would be observed; but in the British sector in France none were seen. The photographs were often taken at a great height, over country which is archaeologically barren, or which was too rankly overgrown to show results. Only on other fronts was time found for archaeology in the air. Colonel Beazeley observed and photographed in 'Iraq in 1917, cities whose ruins were unintelligible on the ground. On an air-photograph these ruins were seen as an orderly arrangement of streets and houses. This definitely proved that air-photography could add to knowledge, and that it would be an invaluable aid to excavation. To Col. Beazeley, therefore, is due the credit for the first actual application of aeroplane photography to archaeology.

The birth of the new study in England, however, dates from 1922 when Air Comm. Clark Hall observed certain curious marks on R.A.F. air-photos taken in Hampshire. With him must be mentioned Flight-Lieut. Haslam, who took a number of photographs near Winchester showing what turned out to be prehistoric fields. Air Comm. Clark Hall showed these photographs to Dr. Williams-Freeman and Mr. O. G. S. Crawford, Archaeology Officer of the Ordnance Survey, who saw that their expectations were fulfilled, and even surpassed, by what was revealed. It was possible from these photographs to make a map of the prehistoric field-system near Winchester.

Popular interest was first aroused by Mr. O. G. S. Crawford's discovery and publication of negatives showing, for the first time, the complete course of the Stonehenge avenue (eastern branch). The photographs were taken in the dry year of 1921 by the Old Sarum squadron; but their archaeological importance was not recognised until two years later, in 1923.

The most important archaeological air-photographs obtained are those taken during 1924 by Mr. O. G. S. Crawford and Mr. Alexander Keiller. An aeroplane was specially hired, and about 300 photographs of archaeological sites were taken.

Outside England little has been done except in 'Iraq, Palestine and Egypt. In Palestine many sites have been photographed by the Royal Air Force, at the suggestion of the Dept. of Antiquities. A photograph of Masada on the Dead Sea is to be described and published shortly in the *Journal of Roman Studies.* In Egypt valuable archaeological results were secured as a by-product of the 3rd Nile Aerial Survey (1922). Oblique photographs have been taken of Numantia in Spain but obliques are always inferior in archaeological value to verticals.

It is usually imagined that the camera, when fixed in an aeroplane, records marks on the ground which are invisible to the eye of an observer. That is not so. The observer can see these marks more plainly than the camera records them, for he sees them in colour. The most remarkable discoveries that have been made are due to plants, which are sensitive to slight differences of soil and moisture. For example, if a ditch has been dug on a chalk down and the down has afterwards been ploughed flat and sown with corn, for ever afterwards the subsoil filling (or silt) of that ditch differs from the adjacent never-disturbed soil. Nothing can ever restore chalk once dug to its former state. Archaeologists have long know this, for one of the principal needs in excavation is to distinguish between disturbed and undisturbed soil. But one cannot dig up a whole field or several fields to find a ditch which, after all, may not exist. Here it is that a vertical view helps; for the effect of this moister and more fertile silt upon a crop of corn is to promote its growth and deepen its colour. Thus from above one sees, and can photograph, a belt of darker green corn following the line of the vanished ditch. These lines are sometimes visible on the ground, from across a valley, or even at closer quarters. Sometimes (as in parts of the Stonehenge Avenue) they are quite invisible. But always, when more than a single ditch is concerned, the distant view is necessary to convert chaos into order. The reason for this necessity can best be explained by means of a comparison. If one looks through a magnifying-glass at a half-tone illustration made through a coarse screen, it ceases to be seen as a picture and becomes a meaningless maze of blurred dots. If one holds it some distance off and looks at it with the naked eye it becomes a picture again. The observer on the ground is like the user of the magnifying-glass; the observer (or camera) in the air resembles him who looks at the picture from a distance. (*See* Surveying)

The majority of prehistoric sites, and many later ones, were a maze of ditches and pits, dug for drainage, storage, habitation, defence or boundary purposes. Many still exist on the downs, undisturbed and turf covered; many more have been flattened by cultivation. All of the latter can be re-discovered by air-photography, provided only that the arable has not been allowed to revert to grass. Even then traces of the ditches are sometimes visible, especially on poor soils and in dry summers, by a belt of darker green. Air observation, however, is most fruitful when young crops are growing; then discovery is easy and rapid, and every flight is productive. Such sites may afterwards be seen to exist by an observer on the ground; but few of them could ever have been discovered except from the air. Chalk is not the only soil that produces these streak-sites; they have been observed on oolitic limestone near Bath and plateau gravel near Exbury.

Other factors enable air-photography to record ancient sites. Prehistoric cultivation-banks are revealed because they either throw slight shadows or because when ploughed they appear as belts of lighter soil, from the chalk grains mixed with them (see plate). From photographs the prehistoric field-system of a district can be accurately mapped. Again, rabbits work in the looser silt of filled-up ditches (as well as in the soil of the lynchets), and if there are many rabbits a white line, or row of white patches, is visible from the air. Daisies and poppies grow from choice above these ditches, and barrows and hill-top camps have thus been revealed by white and scarlet circles.

Lastly, the low shadows at sunrise and sunset etch the slopes of low banks in deep black. That is the time to photograph lynchets. On a June morning before breakfast the greater part of Salisbury Plain is seen to be covered with the banks of abandoned Celtic fields; but afterwards they "fade into the common light of day." The great ramparts of hill-top camps throw a shadow even at mid-day, but are best photographed when the sun is low, for then not only do the ramparts stand out best, but also the banks and pits of the habitations within.

Hambledon Hill, Dorset, England (see fig. 1 on plate), one of the finest hill-top camps, on an isolated hill about 300 ft. above the surrounding country. The entrance of the camp is protected by a hook-like prolongation of an outer rampart; from it led a pathway within the camp, passing between oblong and circular pits, the site of huts. Those, especially in the middle portion of the camp, are very clearly seen, and beside them is a Long Barrow, far older of course than the camp, which was probably made in the Early Iron Age. Across the narrow ridge connecting the hill of the camp with the next hill, was built a formidable double scarp-to-scarp rampart; and beyond this can be seen the faint outline of a probably older camp (only partially included). The hill must have been permanently inhabited.

Note. A scattered flock of sheep in the inner portion of the camp will give some idea of the scale of the photograph.

Oakley Down, Dorset, England (see fig. 2 on plate), between Salisbury and Blandford, on chalk soil, now covered with turf. The principal features are: (1)The raised causeway of the Roman road running diagonally across the picture, (2) a group of round barrows, or burial mounds of the Early Bronze Age, older than the Roman road, through two disk-barrows on either side of it, (3) a network of Celtic fields, particularly noticeable in one corner of the photograph. In the valley below is the remains of a contemporary pond (very large, but now dry), and there are signs of Celtic ploughing on both sides of the Roman road.

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(O. G. S. C.)

ARCHANGEL (*see* 2.356), Capital of the province of Archangel in the Russian Socialist Federal Soviet Republic. In 1925 its population was about 35,000. It is governed by executive committees elected by the local congress of Soviets. The principal industry is sawmilling.

The population practically doubled between 1914 and 1916. Warehouses and other buildings, an electric light and power plant, and a tramway in the main street were built. On the side of the river, where the railway station stands, some miles of wooden houses sprang up. To cope with increased traffic a start was made in 1916 with the conversion to broad gauge and the double tracking of the railway to Vologda, this work being completed in 1919. The railway terminus was enlarged and the road to Leningrad was remade to carry a military motor service. Two of the largest ice-breakers, in addition to the one already in use, and several big floating docks were installed in the port, and numerous jetties and quays were built. But facilities for the handling of guns, munitions, etc., remained inadequate; and added to this difficulty was the fact that after the closing of the Baltic and Black Sea harbours, Archangel was the only available Russian port served by a railway, and was therefore called upon to handle the whole of the wheat exports. Continuous dredging has to be carried on during the summer in the harbour, which is accessible for vessels drawing up to 21 ft., but only those of under 20 ft. draught can cross the bar and shoal in one tide.

History.—After German mine-layers had visited Archangel in 1915, a unit of six British trawlers was sent, but till 1917 they engaged only in mine-sweeping and escort work. A difficult problem arose after the Russian collapse in 1917, when vast quantities of stores and coal were lying in the port. Subsequently British and French cruisers were sent to hold the coast, and when the Germans were in Finland in May 1918 troops were sent; these occupied Archangel with little opposition on Aug. 2 1918, and advanced up the railway in conjunction with a flotilla on the Dvina. In the same year N. Tschaikovsky, a socialist who had been exiled in England, overthrew the rule of the Soviet Commissars and set up a provisional northern government in Archangel and Murmansk with himself as president. The town councils and courts of law were re-established, and in September a conference of northern co-operative associations was held to consider the economic organisation of the district. Tschaikovsky's party joined the British in operations against the Bolsheviks, and the campaign was carried on after the World War, the evacuation of Archangel not being completed till Sept. 1919, when the city was again in Bolshevik hands.

ARCHER, WILLIAM (1856–1924), British critic (*see* 2.362), became dramatic critic of *The Tribune* in 1906 and afterwards of *The Nation* and *The Star*. In 1921 his play *The Green Goddess* was produced in the United States and subsequently in London with great success. In 1923 he published *The Old Drama and the New*. An acute, rather than a sympathetic critic, he, nevertheless, must be applauded as not least amid the influences determining the renaissance of the British drama. He died Dec. 27 1924.

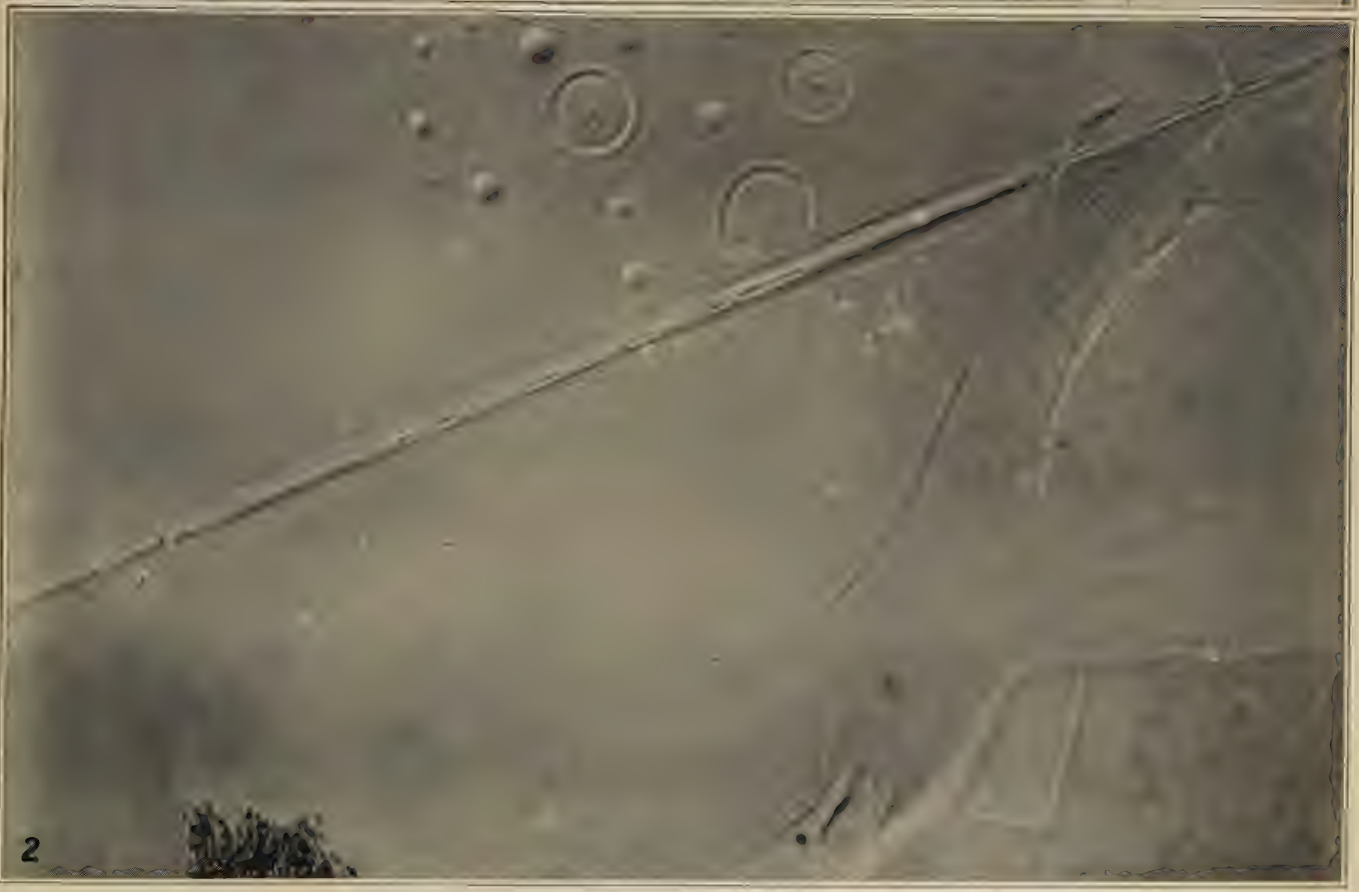
ARCHERY (*see* 2.362), a pastime which has recently enjoyed a considerable increase in popularity.

At the beginning of 1914 there were in Great Britain no less than 75 recognised archery societies and, though the standard of shooting, as compared with that of the period 1855–80, had, no doubt, deteriorated, yet slowly but surely interest in the sport was reviving. Then came the World War and archery in common with other sport was dropped or at most indulged in merely to keep the clubs going and afford the War workers some temporary relaxation. The Royal Toxophilite Society, the leading society in the kingdom, held no meetings from 1915 until 1919, and all the public meetings were abandoned.

When the War came to an end, great efforts were made by archers all over the kingdom to revive the sport; new clubs were formed, old clubs were revived and, on the whole, it may be said that there are now more votaries of archery, especially among ladies, than for many years past. Toward the close of the War, the Royal Toxophilite Society had been forced to relinquish its ground in Regent's Park, London, and to accept for a time the hospitality of the Honourable Artillery Company in Finsbury, while endeavouring to obtain a fresh ground in London. After two years, new headquarters were found in the neighbourhood of Hyde Park, the ground was laid out and a small clubhouse obtained near it. The Society was reorganised, ladies being, for the first time, admitted as members. In 1925 the Bowyers' Company once more offered two gold medals for competition among the best shots in the kingdom, on the society's ground. In this year were revived the various championship meetings, namely the Grand National, the Grand Western, the Grand Northern, the Southern Counties, the Leamington and Midland Archery Meeting and the Hereford Round Meeting.

Archery in the United States.—No international meetings have yet been held, though archery has made considerable headway in the United States, as is proved by a comparison of the scores made in the American and English championships in 1924. The American champion of that year, S. Jiles, made 889 on the double York round as against 880 made by the English champion, W. A. Inderwick; while the lady champion of America, Miss D. D. Smith, made 575 on the double national round as against 580 made by the English champion, Mrs. Shillito.

A comparison of some of the best scores, made since 1895, reveals the fact that while H. A. Ford's 1,251 for the double York round is unapproached, yet scores of over 1,000 have been made



PHOTOGRAPHS ILLUSTRATING THE VALUE OF AERIAL PHOTOGRAPHY IN ARCHAEOLOGICAL RESEARCH

FIG. 1. A fine example of a hill-top camp at Hambledon Hill, England. FIG. 2. Barrow mounds and Roman road at Oakley Down, England.

by F. A. Govett (1,004), C. E. Nesham (1,027) and H. P. Nesham (1,067), the last-named in 1912, while in 1913 C. K. Philips made 982. On the single York round an examination of club records shows that some remarkably fine scores have been made since 1910, notably 114 hits totalling 592 by C. K. Philips in Oct. 1913; 112 hits totalling 574 by H. P. Nesham in Nov. 1912; and 100 hits totalling 524 by Spencer Madan in Oct. 1912, besides many other scores of 500 and over. In 1925 the highest recorded club score for the single York round was 497 by E. H. Nelson. (E. H. P.*)

ARCHITECTURE (*see* 2.369).—To review the progress of architecture during the period 1910–26 in the world at large, and more particularly in America, Great Britain and the European continent, we should first understand the influences—social, political, industrial and educational—which lie at the root of an unprecedented construction development during this period. Strictly speaking, architecture is concerned only with those buildings which embody elements of beauty, or which at least vary from strict utilitarian necessities for the sake of better appearance. Undoubtedly the outstanding feature of the period under review has been a growing interest in, and enthusiasm for, the architectural improvement and embellishment of all types of buildings. We are, as a rule, no longer contented with purely utilitarian solutions of our problems. We demand improvement in the appearance of our surroundings, whether it be our homes, our workshops or our playhouses.

I. INTRODUCTION

Sixteen years may seem a very short time for a distinct change or even for any new tendency to develop in the field of architecture. If it took a century to modify a style in the past, how then can a decade and a half manifest any important change? The answer is simply that architectural forms change in direct ratio to the rapidity of building construction and building demolition. In the past, building was a slow, leisurely proceeding, expensive in terms of human energy; to-day power machinery furnishes most of the energy; consequently, changes in style, which are nothing more or less than period changes in the life of the people, occur more rapidly. A building which formerly would have taken five years to complete, can to-day be built in one year or perhaps less.

We can safely assume that five times the amount of building is now being done, and that therefore styles will change five times as rapidly, provided, of course, that there is a sustained demand for such quantities of building. In America this demand is enormous; old buildings give way to new, new buildings seem to rise almost over night; and in Europe, where the tendency is to retain and use what it already has, there is to be noted a marked tendency in the same direction, as, for example, the passing of Regent street and the Kingsway development in London and the Continental cutting of boulevards in Paris and in Rome. Since a nation writes its history in buildings and gives expression to its natural love of beauty through architecture, anything which so enormously increases both the size and the number of buildings must be accounted a potent factor in architectural development of all kinds.

Influence of the World War.—This demand for rapid building construction is largely the result of the influences of the World War. For a period of nearly five years, there was a complete cessation of building operations except for war purposes. The natural reaction was to make up for time lost. France has the tremendous task of reconstructing its devastated areas. In England the housing situation is an all-absorbing problem. In America, with its almost unlimited resources and wealth, better housing is a crying need, greater factories are required to supply the materials and the furnishings for these houses, and more business buildings are needed in which to conduct the commerce and trade resulting from renewed and augmented activity.

Such frenzied building activity has not always followed war. But the World War was singular in this respect: it entailed vast re-organisations of labour for the intensive production of war materials. The result was that labour in construction fields demanded and received wages out of all proportion to the scale formerly paid, and far above the rates paid to workers in other fields. These conditions in turn resulted in an expanding scale of living to which this large portion of the population would have attained under normal peace conditions only after a long period of years. The increased housing demand was a natural corollary of increased wages. The masses, more affluent than ever before, insisted on larger and better homes, more elaborate and expensive furnishings.

Rush to the Cities.—A further cause of building activity is the concentration of population in and near the larger cities. The World War is not alone responsible for this. Since about 1885 the rapidly increasing development of machinery has completely changed social relationships. Men and women who are no longer needed on the farms to produce food for the world have flocked to the cities to produce manufactured articles. The production and use of more and more articles, both necessities and luxuries, require more buildings to make them in, more buildings to sell them from, more buildings in which to transact the business arising from their manufacture and sale, and more homes to house the workers. In the words of a recent writer, " Production has played many parts in history; it has taken various forms. The form which it takes in this, the machine age, is strange and new. ' Consumption ' is a new necessity, a new science. Through the centuries, the problem has been, how to produce enough of the things men wanted; the problem now is to make men want and use more things." With the concentration of population have come the corporation, the trust and the super-trust. Great buildings, great at least in bulk and cost, are required to house vast numbers of workers. Formerly a municipal or other government was the only agency which could build large structures; to-day private enterprises, through control of capital in large amounts, builds on a greater scale and more expensively than any government will or can build. This evident and rapid change influences every walk of life and thereby affects every building, no matter what its function. (*See* URBANISATION.)

DIVISIONS OF THE SUBJECT

At first glance, a division of our subject by countries would seem to be a natural one: American architecture, British architecture, French, Japanese, etc. It is a method frequently employed in architectural surveys, but all parts of the world have been brought so closely together, and each nation's knowledge of every other nation's activities is so complete and immediate, that such division would result in unnecessary duplication. One could hardly, for example, describe the modern architecture of Japan and not explain the British and American influence. Means of communication have so reduced time and distance that national styles are no longer mutually exclusive. The possibility that any nation in the future will develop a purely indigenous architecture is remote, for it would mean that the physical, material and spiritual status of its people had not been touched by modern inventions. We shall therefore discuss our subject, not by geographical boundaries, but according to those influences, industrial, commercial, social, educational, political and religious, which are the basic causes of all building development, and common to all nations. We have placed them in the order of their importance, considered in terms of capital investment and number of people involved. If computed in terms of human happiness and well-being, then possibly the order should be reversed.

II. INDUSTRIAL ARCHITECTURE

Under this classification we include all buildings in which commodities are made and stored, from the reception of the raw material to the production of the finished article. This field, while not usually discussed in a review of architecture, has now peculiar significance, because the present period of civilisation is normally neither an age of war nor an age of art, but a scientific and industrial age. Industrial plants, through combination and absorption, have grown far beyond the wildest imaginings of the 'eighties of the last century. Such growth is an accepted

condition of our time, and the architect has a definite part in it. His problems in this field are large problems. To be sure, he is given little opportunity for the elaboration of detail, but he has great opportunity for interesting arrangements and impressive masses.

Only in the 20th century have such problems as steel plants, mining hoists, automobile works, etc., been considered in any sense architectural. Generally handled by engineers with practical considerations only in view, the architect had no essential part, but was called in, if at all, to add a bit of " dressing " to a predetermined structure. To-day, however, the large corporations have come to realise more and more that beauty in its broadest sense is a commercial asset.

Importance of the Architect.—The architect, by training and experience, has a more comprehensive sense of arrangement than the engineer or the contractor. A prominent builder in the industrial field says: " There is not much doubt that the very finest industrial buildings which have been built in the years between 1915 and 1925, the finest in general effectiveness as well as in appearance, have been produced under the direction of architects. A certain distinctive appearance, a certain completeness of design, a more perfect interior arrangement and a general suitability seem more likely to prevail when the largest industrial buildings are handled through an architect's office than when an architect is not in the picture." The architect is consulted to advantage from the outset of the problem; choice of site, plan arrangement, types of construction, fire prevention, natural lighting, welfare provisions, plumbing, heating and ventilation, and artificial illumination are all matters of consideration in the design of any building.

Reinforced concrete, a form of construction in increasing use, is peculiarly adapted to industrial plants. In the earlier examples it was used in imitation of other and more customary building materials, with forms of ornamentation such as cornices, architraves, arches, etc., borrowed from older buildings of the masonry type. Later examples show a great improvement in this respect; the concrete is used with the greatest simplicity of form, and all extraneous embellishment omitted. Effects are secured by carefully studied proportion and massing. (*See* FERRO CONCRETE.)

The City Factory.—The factory in cities is beginning to take on city dress. The open labour market commonly causes a large industrial plant, especially in such work as garment-making, to build in the heart of a city. Such a plant should not be a blot among fine buildings, but should be in harmony with its surroundings. (*See* FACTORY DESIGN.)

The plan problem is as varied as the nature of the work carried on, but industrial plants may be divided into three types, depending on the different kinds of enclosed spaces: (1) plants of large area, of only one floor, top lighted; (2) plants of large spaces for great machines, travelling cranes, etc., in conjunction with smaller spaces of the ordinary type; (3) plants of ordinary spaces, many storeyed and dependent on light from the sides. The first type furnishes simply a problem of building over large areas and with " saw tooth " skylight construction; the second involves engineering for broad spaces, but both clerestory and top lighting are possible; the third type does not differ from the ordinary many-storeyed building built for commercial work.

III. COMMERCIAL ARCHITECTURE

Commercial architecture includes all buildings in which the purchase, sale, exchange and transport of commodities is carried on, and in which the financing of business enterprises is negotiated. It covers a wide field. With industrial architecture, to which it is closely allied, it constitutes by far the most important architectural development since 1900, not alone as measured in terms of quantity, but in terms of actual progress as well. The necessities of industry and commerce have developed a striking and significantly new architecture, highly expressive of our own age. The whole trend in the commercial field is toward larger and larger units—larger office buildings, larger department stores, larger banks, larger railway stations.

The increase in the height and mass of commercial buildings (and we shall see later wherein this applies to hotels and apartment houses as well) is perhaps the most phenomenal feature of this development. Many misapprehensions exist as to its cause. One of the most persistent is the belief that in New York, where the so-called sky-scraper has received its chief development, the long, narrow shape of the island forced growth upward. This is far from the truth. There is still plenty of room for lateral expansion on Manhattan Island. The tall buildings form a narrow ridge through the center, following the general course of Broadway. Should all the buildings on the island proper be reduced to an average height, they would probably not exceed seven or eight storeys. This contention is proved by the rapid appearance of groups of tall buildings in many other cities where the special topographical conditions of New York do not exist.

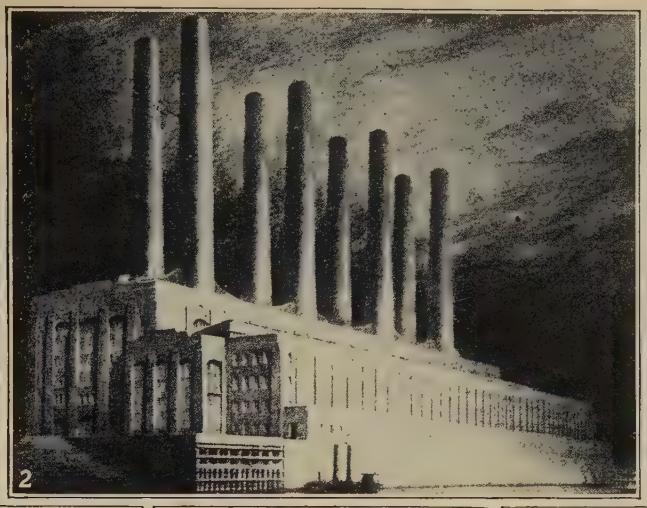
The truth is that increased concentration makes for increased efficiency in commercial operations. It is probable that the tall building originated in the desire of real-estate owners to exploit small and heavily-taxed property holdings. Increased revenue could be obtained from a small area of land by building upward. The sky-scraper has proved invaluable to efficiency in business, for, in the final analysis, all important business affairs are negotiated through personal contact, in spite of telephone, telegraph and other substitutive means of communication.

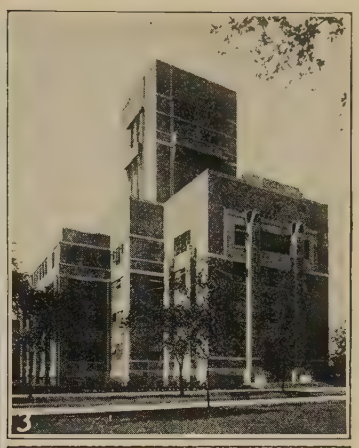
Office Planning.—Since the office building of the sky-scraper type is the most distinctive example of commercial architecture, let us consider it in detail. The usual procedure in most plan studies is to start with the ground floor and build up. But in planning office buildings (and this applies to hotels as well) the architect reverses this process and plans from the top down. That is to say, he develops a typical upper-floor plan first, because the major income is derived from these typical floors, and if some sacrifice is to be made, it can better be made on the ground floor than on the office floors. A typical office unit is first determined upon, a series of such units is arranged along both sides of a corridor, and then the line of vertical circulation (lifts or elevators) is fixed at a central point on this corridor so that no tenant is obliged to walk more than 100 ft. from his office door to an elevator. Utility spaces—toilets, cleaners' closets, vent shafts, flues, etc.—are then added and the plan is completed.

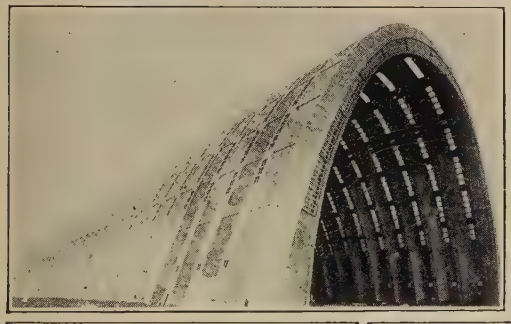
Authorities differ as to what constitutes the ideal office unit; they agree, however, that it is better to have less space (less capital investment) permanently rented at a high figure than much space partially rented at a low figure. Lighting is the important factor here. The depth, *i.e.*, distance from windows to corridor, of a well-lighted office is never more than twice the clear ceiling height. Twenty feet is better than twenty-five. The width of the unit varies with the distance between steel columns, which economical engineering consideration places at not less than 15 or more than 22 feet. The diagram shows a typical office unit with internal divisions, each of which can be subdivided into smaller rooms in a single large office unit. Although a 4-ft. corridor might serve all practical purposes, the width should increase with the length for the sake of beauty of proportion. Corridors should also increase in size as they approach the elevators.

The building lot at the architect's disposal determines, of course, the arrangement of offices. The plot plan diagram given herewith shows possible dispositions on three standard lots. It will be noted that " dark " spots, such as always occur where a wing joins the main buildings, are used as far as possible for the necessary utilities, such as elevators, stairways and smoke towers. Toilets can be artificially ventilated and lighted, but it seems better to place them on small back courts, which furnish inferior office space at best, thereby retaining some degree of natural light and full natural ventilation. The British building laws require outside toilets, always; that is, they must always have outside windows, no matter how much artificial ventilation may be provided.

Staircases and Elevators.—In American office buildings, stairways are little more than fire-escapes. As the law requires them to be entirely enclosed with fire-resisting walls and doors, they are never conspicuous and are rarely visible. In England,







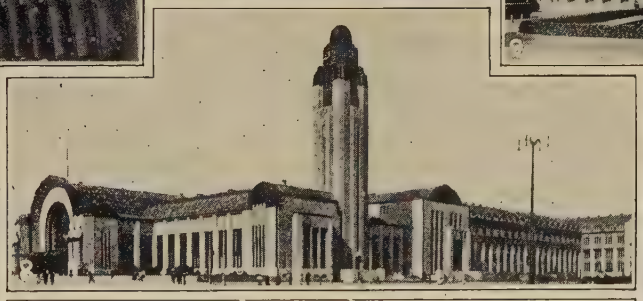


FIG. 1. Army Supply Base, Brooklyn, N. Y., Cass Gilbert, Architect. A simple but effective use of concrete.

FIG. 2. Cahokia Power Station, Illinois, U. S. A., Moran, Russell and Crowell, Architects. Study in mass, using great stacks as dominant feature.

FIG. 3. Bunte Bros. Factory, Chicago, Illinois, U. S. A., Schmidt, Garden & Martin, Architects. Effective use of brick and stone simply treated but with interest at final points.

FIG. 4. R. R. Donnelley & Sons Co. Printing Plant, Chicago, Howard Shaw, Architect. Practical conditions solved for mass interest and yet delicate detail.

FIG. 5. Fletcher Bldg., N. Y. City, Helmle & Corbett, Architects. City factory in concrete, using the structural recessing of wall as it rises, as basis of architectural treatment.

FIG. 6. Shoe Factory, Norwich, England, A. T. Scott & Sons, Architects. A good example of pleasing masses simply treated.

FIG. 7. Dirigible Hangar, Orly (S. et O.), France. Freyssinet, Engineer. Reinforced concrete in pure harmony of form and function.

FIG. 8. Railway Station, Helsingfors, Finland, Eliel Saarinen, Architect. Effective composition without use of conventional classic forms.

FIG. 9. Wireless Station, Nauen, Germany, H. Malthesias, Architect. Interesting composition in brick depending solely on mass and proportions.

FIG. 10. Britannic House, London, Sir Edwin Lutyens, Architect. A variety of different openings charmingly harmonised by careful sense of scale.

FIG. 11. Pennsylvania Station, N. Y. City, McKim, Mead & White, Architects. Classic architecture used most impressively.

FIG. 12. Adelaide House, London, Sir John Burnet & Partners, Architects. Extreme simplicity within a well defined frame.

ARCHITECTURE (Commercial)

FIG. 1. Woolworth Bldg., N. Y. City, Cass Gilbert, Architect. Highest building in the world (except Eiffel Tower). Vertical composition on vertical mass.

FIG. 2. Bush Building, N. Y. City, Helmle & Corbett, Architects. Building on a narrow lot, but architecturally treated on all sides.

FIG. 3. Tribune Tower, Chicago, Howells & Hood, Architects. Height accentuated by flying buttresses carried above height restriction for usable floors

FIG. 4. Telephone Bldg., N. Y. City, McKenzie, Voorhees & Gmelin, Architects. Striking example of the effect of height restriction with tower.

FIG. 5. Strand and Wellington Street, London, Trehearne & Norman, Architects. New simplicity in business building.

FIG. 6. Standard Oil Building, N. Y. City, Carrère & Hastings, Shreve & Lamb, Architects. Height restriction interpreted with classic feeling.

FIG. 7. Bush House, London, Helmle & Corbett, Architects. Architecturally treated with respect for importance of location at end of Kingsway.

FIG. 8. Pennsylvania Station Interior. McKim, Mead & White, Architects. Impressive space inspired by ancient Roman baths.

FIG. 9. American Radiator Building. Raymond Hood, Architect. An interesting experiment in black brick with gold trimmings

FIG. 10. Philadelphia Savings Fund, Mellor, Meigs & Howe, Architects. A simple bank expressive of security and wealth.

FIG. 11. Chile House, Hamburg, F. Hoger, Architect. Extreme modernism of questionable beauty.

FIG. 12. Bon Marché, Paris, L. H. Boileau, Architect. Interior of a large store with skylight court and balconies, example of modern French.

FIG. 13. General Motors Company, Detroit, Mich., Albert Kahn, Architect. Head Office of a very modern Trust.

where the height of buildings is limited to nine or at the most 10 storeys, there is one conspicuous open stairway and there are one or two sets of enclosed stairs.

Elevators are often the key to the plan scheme and are usually grouped together for greater service efficiency. Even small buildings have at least two (because of possible breakdown), and if more are needed on account of greater floor area or greater number of storeys, they are so placed that a tenant waiting for a car may be able to step easily to the first one that flashes a signal. A battery of six elevators, three facing three, is the ideal arrangement. Eight, four facing four, are possible. More than eight in one battery is not practical, because in such case the passenger might not reach the car before it had passed. If more than one system is installed, the systems must be separated enough for each to serve effectively an entirely new area, and the plan problem simply repeats itself, *i.e.*, two buildings side by side, but with connecting corridors.

Inasmuch as 100 ft. each way from the elevator line is the convenient limit one may go horizontally, 15 storeys is about the limit of effective service for a single battery. As the building with ground area for one group of elevators increases in height, it may require a battery of more than eight, in which case the problem becomes two buildings, one placed on top of the other, with the vertical circulation of the upper structure running through the lower as an "express" service. This general formula, however, is only partially applicable to buildings which diminish in floor area as they rise.

Lighting.—Window spacing and height is an important consideration. The usual bay between steel columns is from 15 to 20 feet. Experience seems to dictate the use of two windows in this bay. One window to a bay gives too much wall space and too little light; three windows give too little wall space and too much light. An even field of equally spaced windows is more elastic for interior division into offices. The amount of natural light is not as important as the quality of light. Windows located with regard to exterior architectural effect rather than to interior comfort and convenience sometimes extend nearly to the floor, while above is left a dark void of wall space and ceiling. Many windows of average size are preferable to a few large openings, just as several well-distributed ceiling lights in a room give better illumination than one powerful centre light. Too much glass surface causes economic waste and physical discomfort.

No general principles can be formulated for the planning of ground floors, basements and sub-basements, because conditions vary widely according to the local problem. The number of floors below the street level depends upon the height, and to some extent the location, of the building. Some very high buildings have as many as five floors below the pavement. Boilers and mechanical equipment are located on various of these lower floors according to the needs of the problem.

Zoning.—Building regulations naturally have a direct effect on city architecture. Early in the 18th century the building-height restriction in Paris produced the Mansard roof, which became such a fashion that it was widely adopted in cities and countries where no height limitation existed. Similarly, the London Building Act gave that city a distinctive character which has been preserved even in newer districts. And now the recently enacted zoning laws in New York, although their primary purpose is utilitarian, are creating a distinctly new style of architecture, one which bids fair not only to become a pattern throughout the United States, but also to influence European forms.

The ordinary sky-scraper, which was simply an elongation of the five- or six-storey commercial building made possible by the lack of height limitation, was in no sense a new form. Rather, it was a distortion of an old form. The new zoning law in New York does not prohibit the erection of sky-scrapers, but it considerably modifies their appearance. Its chief aim is to relieve street congestion, for, other things being equal, it is obvious that such congestion is directly proportionate to the bulk of the buildings flanking the street. The Paris law limits the straight vertical height to 20 metres; above that, additional storeys must remain within the arc of a circle of fixed radius. The London regulations permit of 80 ft. vertical height and two supplementary storeys which must remain behind a sloping line of 75 deg. from the horizontal.

In New York the vertical height is now determined by the width of the street, but varies according to the "zone" or district in which the given property is situated. These districts are classified as follows: "One-time" districts "one-and-one-half-time" districts, "two-time" districts and "two-and-one-half-time" districts. That is to say, the straight vertical height may be equal to the width of the street in residence zones; it may be one-and-one-half times the width of the street in certain residence and business zones; twice the width in the principal business centres and two-and-one-half times in the Wall Street financial section. For the purpose of the law, no street is considered less than 50 ft. or more than 100 ft. wide. Additional storeys above the vertical height must remain back of a line drawn from the centre of the street through a point on the top front of the vertical height.

The salient feature of New York is its towers, and it was considered wise, in framing the new zoning law, to permit the erection of a tower, which may rise to an indefinite height (limited only by structural possibilities and economic conditions), upon 25% of the total lot area. This has resulted in a very surprising and interesting form of architecture which is rapidly changing the aspect of the city, despite the fact that the law has been in force but seven years.

In Paris certain buildings of a monumental nature, either religious or governmental, may exceed the height limit. In London, towers purely for architectural embellishment but not for human occupancy, may pass the legal height. In New York, however, no restriction is made as to occupancy of the tower provided that the building remains within the given "envelope." Furthermore, the so-called "dormer" permit allows certain portions of the front of each building to rise slightly in excess of the maximum vertical height to give variety of outline. Above this the buildings are usually stepped back, forming a pyramidal series of terraces which vie with the storeyed magnificence of the hanging gardens of Babylon. The law has produced two other interesting results: first, the virtual elimination of interior light courts, these being cut in the side in order to preserve a base for the central tower; second, the tendency to assemble larger and larger plottage so that the 25% tower will be large enough to warrant construction of a great number of tower storeys.

Bank Buildings.—The plan problem of banks and financial institutions has changed little except in the space involved. Many mechanical improvements which affect lighting, ventilation and control have developed, and new inter-communicating devices to facilitate the rapid transaction of business are employed. Due in large part to exhaustive experiments made by the Federal Reserve banking system, established by Act of Dec. 23 1913, vault construction has made notable advances, certain types of vault being virtually impregnable to burglar and even mob attack. Although these practical matters are part of the architect's work, they do not materially affect the aesthetic problem. One tendency, however, which does concern the purely architectural aspect, may be noted. The main banking room, where the major part of the public transacts business, is becoming more and more the architectural feature of the interior. Even the officers of the bank, from the president down, are quartered in this space, and the various partitions necessary to separate bank employees and public take the form of screens, counters, rails, etc., which thereby become a kind of furniture rather than an architectural separation. Some of these great banking rooms are the most magnificent and richly treated spaces in modern architecture, comparable to the interior of government buildings, or even to palaces of the Old World.

Stores.—Following the trend of all commercial and industrial construction, stores are being concentrated in larger units. The small shop on the street level continues to exist, but it has produced nothing particularly new in design. On the contrary, many of the most distinctive have attained refreshing charm

and simplicity by reverting to designs of a century ago. The great department store is the principal modern solution of the retailing problem. The building often covers an entire city block (sometimes even two), and is sometimes many storeys in height. By means of quantity purchase and elaborately developed service and delivery systems, the department store supplies the public with every kind of commodity so competing with the speciality shops.

In Paris and Berlin the centrally lighted " well " type of store, with its surrounding galleries, is still the rule and gives an impressive interior which is both airy and attractive. But in London and New York every inch of floor-space is utilised, and artificial illumination takes the place of the natural light proceeding from the skylight over the central well. In fact, American building laws in most cities do not permit the open well form of store because of fire hazard. In addition to the usual lifts, the movement of shoppers is facilitated by means of mechanical devices such as escalators and ramps and lifts. Intercommunicating belt conveyers, etc., are usually installed to speed the movement of merchandise.

Transportation.—Although architecture relating to transportation is here listed in the commercial category, transportation affects every branch of human endeavour more or less directly and might well be discussed under any or all subdivisions of the subject. The railway terminus is the most important problem the architect has to deal with in this group, bridges and viaducts being considered still in the light of engineering problems not susceptible of architectural treatment.

These mammoth stations are becoming an impressive feature of the modern city and offer fine opportunities for the display of architectural genius. There are two reasons for this: the tendency to combine the termini of several railways in a central or union depot, and the increasing realisation that railway stations are the real gateways to the modern city. First impressions are likely to be lasting ones, and no better point could be chosen at which to make an effective display. Even in many small towns and villages, stations are being erected in keeping with the local environment and designed with an eye to artistic fitness.

Generally speaking, two classes of people make use of a station; those travelling daily to adjacent suburbs, who know precisely where and how to go, and desire to reach their trains with the least possible inconvenience; and strangers who must make inquiries at every turn. The architectural problem is therefore to provide an entrance of generous proportions leading directly to a central hall where information booths, booking-offices, luggage-rooms, parcel deposits, news stands, etc., are convenient, and from which gates to trains, conspicuously marked, are readily accessible. Furthermore the movement of trains, luggage and freight involves engineering complications of no mean order. These exacting requirements have been met with notable success in several imposing structures since 1910. The Pennsylvania and Grand Central Terminals in New York, the Union station in Washington, D.C., and the new Union station in Chicago are some of the most impressive examples (*see* RAILWAY STATIONS).

IV. SOCIAL ARCHITECTURE

Under this heading we shall include all buildings for human residence, recreation, entertainment and health. Not many generations ago, all these activities were provided for in the home, where our forbears lived, entertained, played and cared for the sick and the infirm. To-day all these social activities are more highly specialised, and are more and more being taken care of in specially designed buildings. The theatre, picture house, public garden, amusement park, stadium, ball park, athletic field, etc., provide for recreation. The sick and dependent are ministered to in public and private hospitals, nursing homes, orphanages and homes for the aged, infirm, feeble-minded, etc.

Present-day dwellings are of five distinct classes: (1) the free-standing country home, which is becoming less usual; (2) the more compact city house, also fast disappearing; (3) the still more compact flat, or, as it is more usually termed in America, apartment; (4) the apartment hotel, a development of quite recent years; and (5) the hotel itself.

Private Dwellings.—Before the World War, the building of country homes proceeded at a more or less normal pace. Many fine examples of very elaborate and distinctive architecture appeared, with gardens, parks, terraces, fountains and informal and rustic settings. But since the War, the construction of homes by individual owners has diminished steadily. This has been due not only to the burdens laid upon wealth, but to the difficulty of obtaining competent domestic servants. The large house is peculiarly dependent on this class of worker. But, drawn away from their usual pursuits by the War, the servant class was at its close unwilling to return to domestic duties. Even small dwellings, in which the housework was formerly done by members of the family, are now being brought into groups, and much of the domestic drudgery is provided for co-operatively. This tendency has been a fairly steady growth since 1885. The factory has usurped more and more of the work of the home: food is supplied in ready-cooked form; clothes are washed in quantity; heat and light are automatically provided. With less and less of this kind of work to do, the modern home-dweller finds that he or she wants none at all.

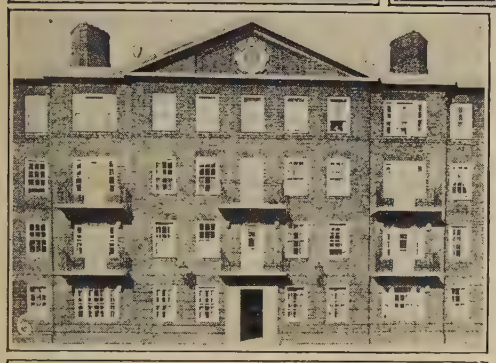
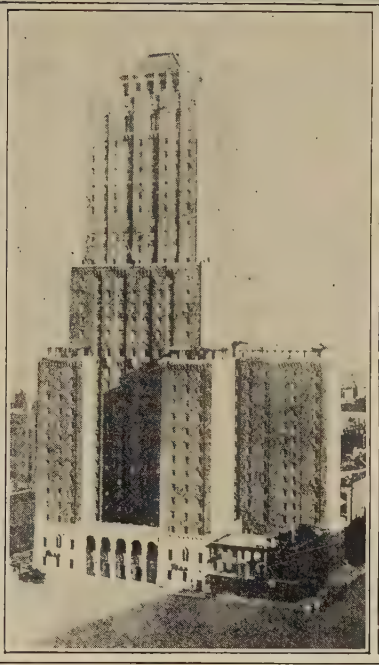
The War also gave great impetus to housing schemes. Pressing necessity forced governments, both national and local, and corporations, both large and small, to provide habitations on an extensive scale. Town-planners studied the problem, overcame the difficulties, and incidentally proved that better homes, with infinitely more healthful surroundings and better sanitary conditions, could be provided through paternalistic or benevolent direction than was possible through individual initiative.

Apartment House or Flat.—Together with these housing developments, the modern apartment or flat building is the most striking feature of social architecture. Apartments, especially in America, are not confined to cities and towns where the concentration of population might furnish an excuse; they have an increasing vogue even in the small villages.

The apartment building is simply a combination of compact homes one above the other. For many years Paris used this type of dwelling extensively, and examples exist in many other large European cities. Recent apartment houses, notably in America, exhibit many new and architecturally interesting features. The plan problem consists of making a series of compact home units, each comprising a living-room, dining-room, kitchen and one or more bedrooms and baths. These are the essentials, although a foyer or entrance hall, library and study may be added to the living-room; a breakfast-room, pantry and servants' hall may be added to the kitchen and dining-room; and a nursery and servants' rooms to the bedrooms. These, however, are merely supplementary to the basic unit.

Apartment buildings are of two distinct types: the walk-up and the elevator or lift type. Any building over five or six storeys requires a lift, and to be of practical value the lift must always work. Since no mechanical device is ever perfect, good planning practice requires that when lifts are installed there be a battery of at least two in order to ensure constant operation in case of a breakdown. It might seem that the lift would change the planning problem only in so far as it made more storeys possible. Of course when there are only one or two apartments to a floor, either the lift or the stairway occupies a central location, and the apartments are planned around this line of vertical circulation as a starting point. But as the number of apartments per floor in the walk-up type increases, additional separate lines of stairways must be added where needed. Lifts, however, being perpendicular shafts, are kept together, thereby forming a central distributing point on each floor to a much larger number of apartments. This requires special planning.

In arrangement the apartment unit is not essentially different from the old-fashioned home, except that in the apartment, which is the outgrowth of a desire to reduce the cares of housekeeping, the several rooms must be placed with a view to convenient intercommunication, and must be reduced in size to the minimum. The living-room or parlour is the largest room, and

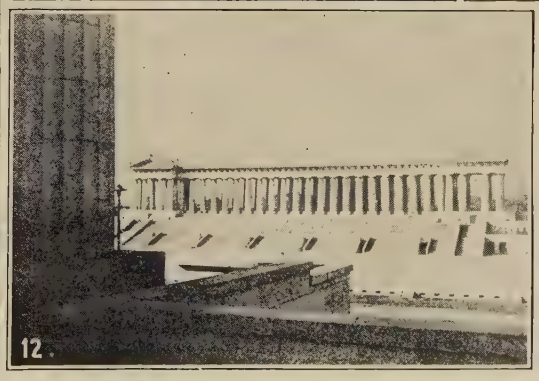


FIG. 1. House, New Canaan, Conn., U. S. A., Calvin Kiessling, Architect. Wood architecture, early American Colonial style.

FIG. 2. House, Los Angeles, Calif., Harwood Hewitt, Architect. Spanish Mission style suitable to warm climate.

FIG. 3. Garden, Burdocks, Gloucestershire, England, E. Guy Dawber, Architect. Charming combination of formal and informal.

FIG. 4. Flats, Jackson Heights, L. I., A. J. Thomas, Architect. Example of concentrated housing with generous garden space.

FIG. 5. Great Maythern, Kent, Sir Edwin Lutyens, Architect. Fine restoration.

FIG. 6. Hortensia House, Chelsea, London, Percy Tubbs, Son & Duncan, Architects. "Walk Up" apartments simply treated.

FIG. 7. Shelton Hotel, N. Y. City, Arthur Loomis Harmon, Architect. Skyscraper apartment hotel.

FIG. 8. Apartment House (Wohnhausgruppe), Karl Ehn, Architect. Vienna. Garden court view.

FIG. 9. Apartment House, Paris, Sauvage & Sarrazin, Architects. Interesting use of recessed upper storeys.

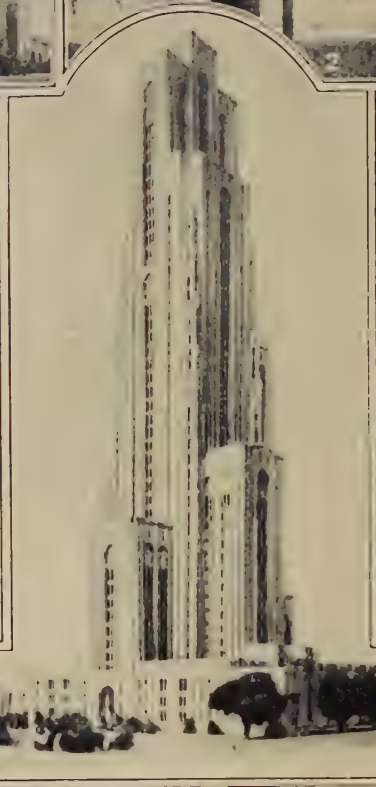
FIG. 10. Residence, Leningrad, I. Fomin, Architect. Classic influence.

FIG. 11. Théâtre des Champs Elysées, Paris, A. & G. Perret, Architects. Modern solution of theatre façade.

FIG. 12. Grant Park Stadium, Chicago, Holabird & Roche, Architects. Example of impressive civic provision for outdoor entertainment.

FIG. 13. Fifth Avenue Hospital, York & Sawyer, Architects. A city hospital planned for maximum light and air.

ARCHITECTURE (Educational)



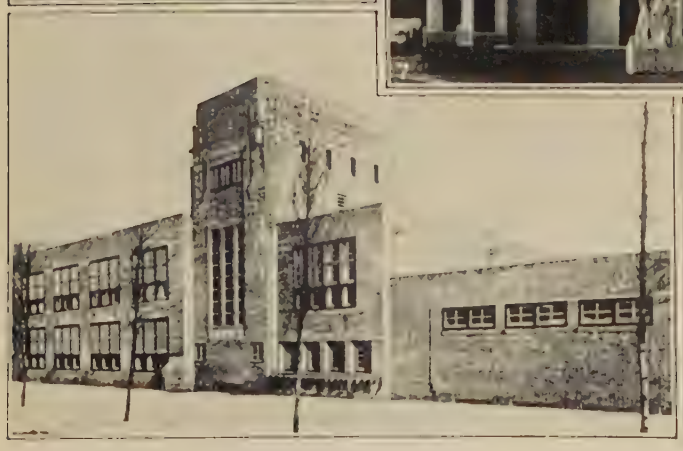


FIG. 1. High School, Rockville Center, L. I., U. S. A., H. T. Blanchard, Architect. Fairly typical of American schools.

FIG. 2. High School, Columbus, Ohio, W. B. Ittner, Architect. Impressive massing in classic manner.

FIG. 3. Clare College, Cambridge, Eng., Sir Giles Scott, Architect. Memorial architecture in spirit of school building.

FIG. 4. Projected building of the University of Pittsburgh, U. S. A., Day and Klauder, Architects. Most modern combination of school and skyscraper.

FIG. 5. Harkness Hall, Yale University, U. S. A., J. G. Rogers, Architect. Example of old-world architecture brought to modern university.

FIG. 6. Art Gallery, Zurich, Switzerland, Prof. Karl Moser, Architect. Modern architectural motifs interestingly used.

FIG. 7. Pavillon du Collectionneur, Paris, 1925, Exposition, Pierre Patout, Architect. Extreme modern exposition architecture very well done.

FIG. 8. American Academy in Rome, McKim, Mead & White, Architects. Important school of architecture and allied arts.

FIG. 9. School Building, Hilversum, Holland, Dudok, Architect. Effects secured by mass, rather than detail.

FIG. 10. Freer Art Gallery, Washington, D. C., Chas. A. Platt, Architect. Interesting handling of walls with few openings.

opening off this, usually with wide doors which permit the occasional use of the two spaces as one, is the dining-room. Adjacent to the dining-room are the pantry, if one is included in the plan, and the kitchen. Bedrooms and baths are preferably arranged in a wing of the building, so that they may be separated to some extent from the other quarters.

Modern bathrooms are small and very compactly arranged, one to each bedroom when possible. Service facilities for the kitchen are important. When the building does not exceed nine or ten floors, a hand-operated dumb-waiter is installed, running from the basement to each kitchen, by means of which the janitor of the building distributes food supplies to the various tenants. Garbage is collected by the same device, although incinerators are also widely employed. The flues of the incinerator open into all the kitchens, and garbage and waste are emptied directly into them and reduced to ashes, which can be removed from time to time at the base. This disposal system keeps the dumb-waiter car and shaft clean. A gas-stove, an all-metal kitchen cabinet, a combination porcelain sink and laundry tub, an ice-box, and in recent years an electric ice-machine are generally installed when the building is erected. In America the use of an ice-box is almost universal, not only for cooling purposes during the summer heat, but because it helps to preserve food in a safe and sanitary condition throughout the year. The dining-room has one or more electric outlets convenient for toasters and electric grills on the dining-room table. The living-room often has a practicable fireplace, not for heating but as a social amenity. (*See* HOUSEHOLD APPLIANCES.)

A central heating plant for each building or group of buildings provides the necessary warmth during the winter months, the system usually employed being steam with exposed radiators in all rooms. When the apartment building exceeds ten storeys, the hand-operated dumb-waiter is hardly practical. Electrically driven "fool-proof" dumb-waiters are sometimes used, but the initial cost is large and the upkeep expensive. In the most modern practice, an additional service lift is installed. This is preferably located near the kitchen wing, or at the rear of the apartment house, to bring in food supplies, to remove garbage and waste, and for the use of the servants.

In the beginning, the particular appeal of the "flat" was the elimination of stairs. In the old-fashioned city house, built like a narrow slab in a block of similar houses, the overburdened housewife found the stairs very tiring, especially when it meant six or seven flights from basement to attic. This advantage in the flat, however, was largely offset by the difficulty of separating living from sleeping quarters. The so-called "duplex" apartment was the first solution of this annoying problem. Here the entire apartment unit occupies two floors, the sleeping quarters above and the living-rooms below, with a small interior stair for communication.

In the effort to reduce space, since part of the care of a home is its size, a low ceiling was adopted. The New York building law at present specifies a clear height of no less than eight feet; formerly it was nine. Consequently builders anxious to get the maximum return from a given piece of property build to this minimum. The larger rooms, particularly the living-room, seemed proportionately low, and were consequently depressing. Even the largest and most expensive apartments seldom exceeded $9\frac{1}{2}$ ft., on account of the great waste of cubic contents in the minor rooms. This has resulted in the evolution of still another type of apartment, in which, by a combination of alternating "duplex" and "simplex" floors, the living-rooms are given an extra ceiling height, bringing them back again to the proportions of the old-fashioned city home, two storeys of living-rooms being placed adjacent to three storeys of minor rooms. This arrangement has the double advantage of retaining something of the atmosphere of the old-fashioned home in at least one important room, and yet economising space, while providing the advantage of modern convenience in other parts of the apartment.

Apartment Hotels.—The apartment hotel, a type of building which is becoming more and more popular, is simply an apartment house in which the kitchens and the servants' sections of all the apartments are concentrated in one place and conducted under hotel management. Meals are privately served in each apartment, as simply or as elaborately as desired, and maid service is furnished by the management. Public dining-rooms are also provided. Architecturally, the apartment hotel may be characterised as an apartment house without kitchens, or as a hotel made up of permanent private suites.

Hotels.—In the hotel proper, improvement in mechanical arrangements is more manifest than any change in basic planning principle. As in most other types of building, the tendency is toward increased size. A prominent hotel authority states that the heavy overhead expense of a modern hotel, giving as it does complete service of every kind, makes it difficult to operate successfully with less than 1,000 rooms. Some recent examples in America exceed 2,000 rooms. This means large ground area or great height, or both. Twenty storeys are now customary, and a 40-storey hotel is projected for New York. The plan problem of an hotel starts with a typical bedroom floor which is repeated many times and is the basis of income for the hotel. Steel skeleton construction, the accepted form of building in nearly all countries, makes possible a more economical bedroom floor arrangement than the older types of wall-bearing construction, with which, of course, there was also a definite limit to the possible number of storeys. The lower floors, the least in demand as bedrooms (for the public seems to have lost its fear of fire in modern structures and prefers to be high for light, air and freedom from noise), are used for the essential hotel offices, lounging spaces, parlours, dining-rooms, banquet-halls, restaurants, cafeterias, etc.

Specialised Buildings.—In the field of indoor entertainment, progress in theatre design is very marked, while the advent of the picture house adds a new problem. In the old theatres, stage and auditorium formed two nearly balancing elements. Improved mechanical equipment has somewhat reduced the size of the stage, and the different seating arrangements of the auditorium have increased proportionately the ground area of this part. The cinema requires almost no stage, and in many cases the auditorium has been enlarged beyond the reach of the human voice. In both types the cross section shows the use of but one balcony, and shows no supporting posts to interrupt the view. Architecturally most theatres of both types are problems in interior design. Being commercial enterprises, and requiring no natural light, they occupy spaces away from the street and have at most only a small street frontage. Of course the government-owned and municipal theatres are generally free standing, and have an architectural treatment in keeping with their location.

For open-air entertainment, the most significant structure that has appeared is the great stadium, rivalling in size, and in some cases in architectural embellishment, the colosseums of old. These are of three general classes: those completely elliptical in form and built on banked-up earth; those built up from the level of the ground as was the Colosseum of Rome, but open at one end; and those built only at one side of the play-field.

Care of the sick has been given particular attention. The experience of the World War gave both medicine and surgery opportunities for study and experiment that brought about great strides in both these fields, and evolved many new features in hospital design. The temporary War hospitals showed new arrangements and new dispositions in all the various activities in modern hospitals, and these new ideas became incorporated in the post-War permanent buildings. Two types of plans may be noted—the open scheme with few storeys where ample space is available, and the compact many-storeyed type required in cities. The open plans show a more orderly arrangement of building units, central administration, kitchen facilities and power plants; general orientation is a very important factor, and lines of communication unite the various elements in a direct and simple plan-scheme.

V. EDUCATIONAL ARCHITECTURE

Under this heading we shall include all buildings in which knowledge is imparted and acquired, either directly, by contact

between teacher and pupil, as in schools, colleges and universities; or indirectly, as in museums, libraries and exposition buildings. Compulsory education, especially in the elementary branches, prevails in most civilised countries, and government-directed institutions are on the increase. Schools are erected to fit many and diverse lines of study. The one-time high-school group that represented merely the finishing touches of an English education has become subdivided into many different forms. The modern development of education, that prepares the pupil for a later status in life, has resulted in vocational schools, in which the pupil may be trained in a vocation which his inclination, guided by the influence of his teachers, leads him to select, and which launches him successfully upon a career.

School Architecture.—The development of architecture in school building has been one of the most remarkable phases of architectural progress during the present century. (*See* EDUCATION.) The architect who specialises in schoolhouse construction not only must be a student of educational methods, but he must also know how to conserve the physical wellbeing of the pupil during school hours by surrounding him with every element of safety that will safeguard his health, his eyesight and his general physical condition. Specialists in various lines of schoolhouse construction have developed these matters to a point of exact science: and in the plan of the building, the arrangement of the classroom, the width of the corridors, and the heating and ventilation systems, methods have been evolved that make the schoolhouse the most perfectly functioning building that we have at present developed.

The tendency towards larger and larger units, which runs through commerce and industry, manifests itself again in educational buildings. This is deplored by many educators on the ground that it standardises educational methods and robs the student of individual attention, but the fact remains that the large institution is the only adequate means of meeting the demand for instruction.

There is, however, a definite limit to the number of students a single teacher can handle. Much study and experiment on the part of experts in this field have evolved a classroom of fairly definite size and shape. The school plan revolves around this unit classroom, just as the plan of an office building is based upon the office unit. Unilateral lighting is preferred when possible. Wide corridors adjoin all rooms, leading to the building exits, stairways, assembly hall, gymnasium and other special spaces. Ceiling heights are ample for ventilation purposes, and when there is 15 feet or more from floor to floor above, stairways can be doubled, thus securing two separate stair exits in the space formerly occupied by one.

Universities.—The most interesting feature of the newer colleges and universities is the comprehensive plan lay-out upon which they are being built, permitting of future expansion. The older universities of Europe grew through the centuries by successive accretions, and they possess, of course, the charm and interest of historical background and precedent. Certain modern universities, notably in America, have endeavoured to recapture this atmosphere by imitating the semi-monastic architecture of those older institutions—Harkness Memorial Hall at Yale and the Graduate School at Princeton, to mention only two. On the other hand, there is a growing tendency to accept frankly the changed conditions of the time and build in the modern idiom. The University of Pittsburgh plans to build its halls of learning in the form of a modern 60-storey sky-scraper.

Libraries.—Libraries are keeping step with the general increase in public education. Many large cities have a central building, extensive in scope and impressive in design, and one or more branches at convenient points in the populous districts. The general plan consists of a central public room, where books are loaned and returned, where card catalogues are convenient for consultation, and where information is given. Together with the stock rooms, this forms the hub of the plan, around which are disposed other special spaces, such as children's room, periodical rooms, reference rooms, special exhibits, etc., as the scope of the work demands.

Museums.—Public museums constantly take a more important place in modern life as a means of indirect education. The addition of many commercial, industrial, mechanical, horticultural and other museums to the traditional art museum is proof of this. Here the plan is comparatively simple, consisting of large well-lighted spaces through which visitors pass from room to room. Good modern practice provides one entrance with control, and a disposition of rooms which permits of any given space being temporarily closed for rearrangement or installation of exhibits without shutting off other rooms from public access. The growing tendency of the modern museum to combine educational courses open to the public with its more traditional activities frequently calls for the addition of lecture-rooms, reference-rooms and even auditoriums to the usual plan.

Expositions.—Expositions are generally housed in temporary buildings constructed for the purpose. The plan problem is of especial interest to the architect, because it gives him an opportunity to make experiments on a large scale which he might not care to risk in more permanent buildings designed for special purposes. The Columbian Exposition in Chicago in 1893 changed the whole tendency of architecture in America, creating a veritable renaissance of classic styles. The Paris Exposition Universelle in 1900 experimented with the flowing line and naturalistic ornament, but with no permanent effect upon architecture in general. The Wembley Exhibition near London revealed certain possibilities in the use of permanent concrete construction, but lost much effectiveness through lack of distinction in setting and approach. The French, on the other hand, made the most of their Exposition des Arts Décoratifs in Paris in 1925, and many of the temporary buildings displayed architectural forms of unusual interest: the straight line, the post and lintel, sculpture in low relief panels, strong contrasting colours; classical mouldings, capitals and cornices were conspicuous by their absence. The influence of the Paris Exposition can be seen in certain commercial buildings in America, and will doubtless have a lasting effect, because the style so readily adapts itself to modern forms of machine-made construction.

VI. STATE AND CITY ARCHITECTURE

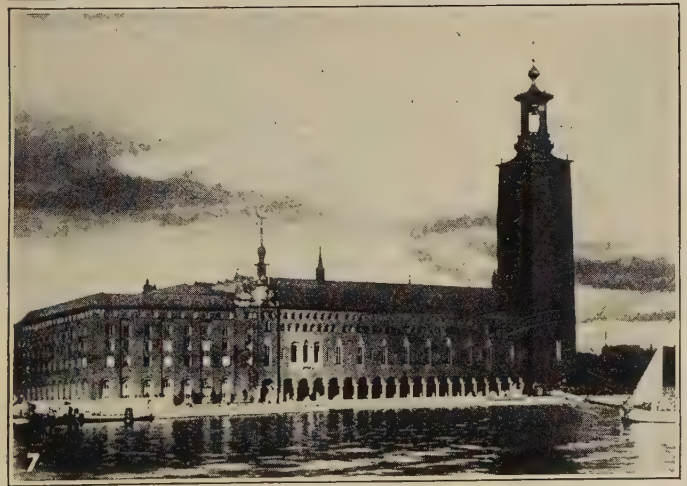
When the War broke out many municipalities in England were erecting new and imposing buildings to house local administrations. State governments in the United States had undertaken new capitols; and new, modernised post-offices, customs-houses, town-halls, etc., were partially built in many quarters. The War temporarily checked such activity, but much of the work has been completed since.

The plan problem of modern administrative buildings is somewhat similar to that of the commercial office building except for two special features. In the first place, the inclusion in the plan of certain large and specially designed rooms or spaces for the assembly of boards, councils, delegates or gatherings of representatives, which become the dominant features, surrounded by offices for government workers and permanent staffs; and secondly, the more extravagant architectural treatment of both the exterior and the interior, with liberal provisions for landscaped settings, all very properly done to impress the community with the power and authority of the state.

The architectural problem is new only in so far as the tendency for the state to assume ownership of certain public utilities has considerably increased the space needed for government work. The London County Council Hall, near the Houses of Parliament, the fine building of the Port of London Authority, the Town Hall of Stockholm and the state Capitol of Nebraska in the United States are conspicuous examples. The political changes resulting from the War will undoubtedly find expression in new governmental buildings in the countries most affected, although as yet nothing of note has appeared.

VII. ECCLESIASTICAL ARCHITECTURE

Religious architecture, which includes all buildings erected for spiritual or commemorative purposes, appears to be in a transitional stage. In the endeavour to adapt itself to changing



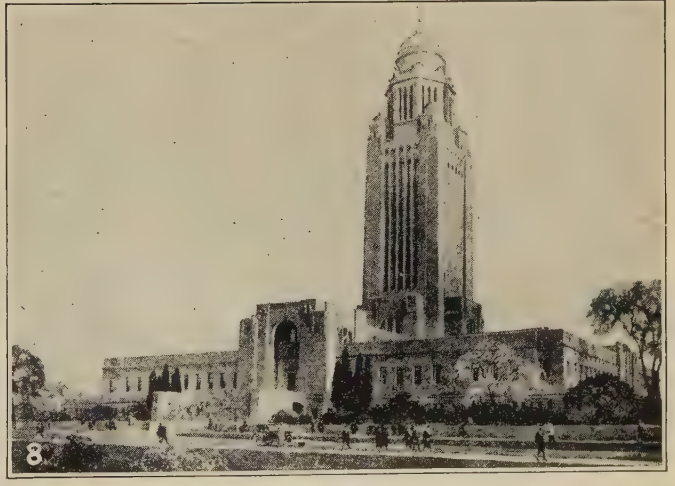


FIG. 1. Western Tower, Union Building, Pretoria, South Africa, Sir Herbert Baker, Architect. An example of dignified government architecture.

FIG. 2. New York Municipal Building, McKim, Mead & White, Architects. A city's business office in a skyscraper. A street passes through the central arch of the monumental colonnade.

FIG. 3. Port of London Authority, Sir Herbert Baker, Architect. The extreme of monumental character.

FIG. 4. Bureau des Postes, Paris, Le Cœur. Modern interior architecture of a new kind.

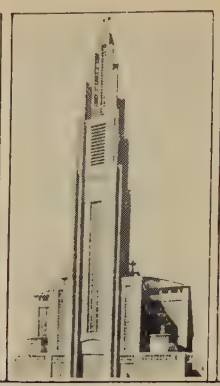
FIG. 5. County Hall, London, Ralph Knott, Architect. An imposing elevation making the most of the frontage on the Thames.

FIG. 6. Town Hall, Stockholm, Sweden, R. Ostberg, Architect. Interior: impressive scale and unusual combination of old forms with new detail.

FIG. 7. Town Hall, Stockholm, Sweden, R. Ostberg, Architect. A new and northern variation on the theme of the Doge's Palace and Campanile at Venice

FIG. 8. Nebraska State Capitol, Lincoln, Nebraska, U. S. A., Bertram G. Goodhue, Architect. A new and inspiring solution of the State Government Building.

ARCHITECTURE (Religious)



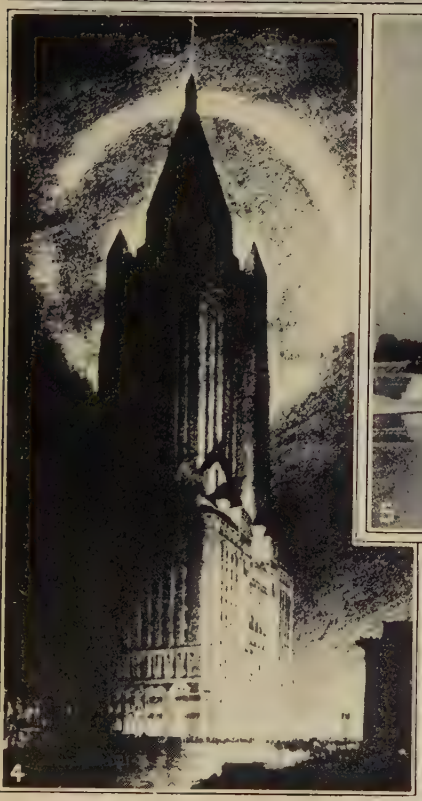


FIG. 1. Liverpool Cathedral, England, Sir Giles Scott, Architect. A great building with all the inspiration of the middle ages and yet thoroughly modern.

FIG. 2. Nôtre Dame de Rainey, Perret, Architect. Concrete in its new form. Note the external wind braces on the spire.

FIG. 3. St. John the Divine, N. Y. City, Heins & LaFarge, Architects, R. A. Cram succeeding. Extremely reminiscent of the old world.

FIG. 4. Broadway Temple, N. Y. City, Donn Barber, Architect. Most striking example of the combination of church and business.

FIG. 5. Lincoln Memorial, Washington, D. C., Henry Bacon, Architect. Most impressive example of classic dignity, in a perfect setting.

FIG. 6. Chicago Temple, Holabird & Roche, Architects. Another example of church and business.

FIG. 7. Cenotaph, Whitehall, London, Sir Edwin Lutyens, Architect. Most impressive of war memorials. Photo. W. S. Campbell, Press Studio, London.

FIG. 8. Washington Masonic Memorial, Alexandria, Va., U. S. A., Helmle & Corbett, Architects. A tower in steps inspired by the ziggurat of old, in a carefully landscaped setting.

FIG. 9. War Memorial, Paisley, Scotland, Sir Robert Lorimer, Architect, and Mrs. Meredith Williams, Sculptor. Sculpture and architecture combined in a dignified ensemble.

conditions, the Church finds itself faced on the one hand with the necessity of broadening its activities, and on the other with the problem of effecting a physical compromise with other forms of building. Architecturally this involves two distinct problems: (1) enlarging or modifying the Church to house new activities; (2) combining it with commercial structures, a course adopted to some extent in the United States.

In the past, the Church was a refuge for the poor and afflicted, a seat of learning and a centre of social life. One after another these functions began to be assumed by independent agencies. Education, except in the spiritual sense, fell chiefly under secular supervision; separate institutions began to care for the sick and the poor; the increased number of social diversions weakened this phase of the Church's hold on the people. There seems to be, however, a tendency to reassume some of these functions in the form of welfare work and community service. This has added to the necessary equipment of the Church proper such spaces as small auditoriums, Sunday-school rooms, gymnasia, committee-rooms, restaurants, etc. The modern church, excepting the ritualistic type, which has not materially changed in plan arrangement or source of design, tends more and more to assume the form of an auditorium in which the important consideration is to see and hear adequately.

The enormous growth of large cities has left many churches stranded in business or financial sections, miles from their parishes, so that their very existence as buildings is jeopardised. In both London and New York there are many such churches which are preserved only for their architectural interest or historic associations. It is not mere speculation that, with a few exceptions, these will eventually have to give way. Even in newly developed residential communities, the smaller church finds it difficult to retain a fixed or stable congregation. Localities are no longer local. The automobile, the railway, the telephone and the radio have all conspired to diffuse and diversify public attention.

New Churches.—The most startling and essentially modern feature of religious architecture is the "sky-scraper church." In order to retain a position in the crowded, highly taxed business centres, certain churches in America have combined with office buildings. This enables them to carry on their social and community service without depending entirely on voluntary contributions for maintenance. The architectural problem here is a commercial sky-scraper with an auditorium on the ground floor; two buildings of quite different character are superimposed one on the other.

Churches, from the simple village type to the great cathedral, are being built, for instance the cathedral at Washington, the great cathedral in Liverpool and the Cathedral of Saint John the Divine in New York. France tried a novel experiment in building the Church of Notre Dame at le Raincy. This structure, built of reinforced concrete, is of rigidly simple modernistic design but of dubious aesthetic value.

VIII. IN MEMORIAM ARCHITECTURE

Memorials, a form of architecture antedating any remaining evidence of permanent human habitation, have greatly increased in number and importance since the War. As a problem, memorials have a peculiar fascination for the architect, because they are usually untrammelled by the practical restrictions of ordinary buildings, and frequently offer the best opportunity for combination with the allied arts of sculpture and painting. The difficulties of the problem lie principally in this very lack of limitations, the freedom of choice making selection of the appropriate mode of expression more difficult.

War memorials, which abound in every country engaged in the conflict, frequently employ war implements and costumes as a basis of design. The most successful, however, stress abstract conceptions such as bravery rather than the paraphernalia of war. An indication of the universal trend toward democracy is apparent in numerous memorials to the Unknown Soldier. War memorials range from simple wall tablets to buildings of impressive proportions. The latter sometimes take the form of memorial hospitals, soldiers' homes, assembly halls, etc., in which case their inclusion under memorial architecture is merely nominal. Public interest in war memorials brought about a recrudescence of other commemorative monuments. The Lincoln Memorial in Washington, D.C., is one of the most impressive ever erected to one man. The George Washington Masonic National Memorial at Alexandria, Va., overlooking the Potomac river, is another example on an impressive scale.

IX. CONCLUSION

Several general matters bearing upon the development of architecture, which could not appropriately be considered in any of the foregoing categories, deserve discussion here. Architectural education, because of a change from the apprenticeship method to the school method, has made phenomenal progress. In France, of course, where the École des Beaux Arts has provided systematic instruction for over two centuries, there has never been a lack of trained men. Even after America began to establish architectural courses (at first in connection with engineering schools), England still retained the apprenticeship system. But when students of both nations began to attend the Beaux Arts in Paris the situation gradually changed. The United States is organised through the medium of the Beaux Arts Institute of Design in one vast school of architecture, with a hundred or more teachers and over a thousand students. In England, the University of Liverpool, the University of London and other well-established schools of architecture conduct their courses along lines similar to the Beaux Arts *atelier* system

The essential features of this system are as follows: Students work in groups, called *ateliers* or studios. The students of each group receive a programme of conditions for a building (or part of a building, depending upon their degree of advancement), and, after several hours of study, prepare an *esquisse* (sketch) which combines in one drawing their general solution of the problem. With this sketch as a basis, they proceed to develop a *projet*, or plan, in complete detail. The work is carried on under the supervision of a *patron*, who in most cases is a practising architect as well as a teacher. Discussion and mutual help among the students of each studio are invaluable factors in the progress of the student, the older pupils helping the younger with ideas and the technique of drafting, the younger helping the older with the mechanical work of repetition and details. Of course no student's work is complete until he has had ample office practice. The great advantage of the *atelier* method lies in the acquisition of broad ideas of plan-composition and design at a time of life when the imaginative faculties are susceptible of development and before the student has become hedged in and cramped by the endless details of actual practice.

The effect of this system upon the design of modern buildings is marked. Formerly a single genius, such as Wren or the Brothers Adam in England, or Richardson or McKim in America, could change the style of architecture of an entire nation, for it has always been true in the arts that the quantity producer, provided his work had quality as well, exerted the greatest influence upon other workers in the same field. The *atelier* method, by inculcating sound principles and directing thousands of students along definite lines, improves the standard of architecture the world over. No architect's training is now considered complete until he has had a good school and college education, a sound cultural background, a complete university course in his particular subject, and travel and study abroad. Familiarity with architectural forms in general, knowledge of modern engineering practice, and thorough sympathy with the practical building requirements of the time are the basic reasons why buildings are constantly improving both in style and in quality of workmanship, and why architects as a professional group are less and less influenced by the genius of a single master, no matter how great his skill or how large the quantity of his work.

Russian Architecture.—The plan of this survey of world architecture cannot be strictly followed in considering Russian architecture because of the fact that during the larger part of the period in question political conditions practically excluded Russia

from participation in the common cultural life of the other nations. The years that immediately preceded the World War may, however, be discussed, as they formed the most creative period in all Russian history. After the first abortive revolution of 1905 a great number of wealthy landowners began for safety's sake to move to the cities, selling their estates and investing money in industrial and commercial enterprises. A revival of building activity in the cities followed, while the increasing influence of the nobility in Russian city life left its mark on the style of the architecture, "Classicism," which reminded the nobility of the period of its political and cultural domination. In both the chief cities of Russia (St. Petersburg and Moscow) there were built palatial private residences, of 30 or 40 rooms each, artistically decorated in a "classical" style. Whole blocks were covered with newly built apartment houses, with spacious halls and picturesque interior courts decorated by fountains and statues.

The years which immediately preceded the War were characterised by the last attempt of the nobility to affirm its predominance as the governing class of Russia. At the same time it was the period of an acute struggle between the nobility and the industrial class of Russia, which at that moment had become already sufficiently strong and independent and, in its best and most progressive representatives, had attained a level of spiritual culture and artistic taste not inferior to that of the nobility. We witnessed, therefore, a similar revival of industrial buildings, on a very large scale, concrete and concrete-steel being widely used. Entire factory settlements were built anew, the largest of which are found in the rubber industry (The "Treugolnik" Co.—about 7,000,000 sq. ft.), textile industry, shipbuilding, railroad stations, warehouses, grain elevators and war industries.

The years 1914–23 were a period of stagnation for Russian architecture. Only purely theoretical and experimental work was being done in the studios of architects, bringing about the formation of two distinct artistic schools. One, represented mostly by the younger generation of revolutionary tendencies, is based on abstract philosophical theories, contrary to technical possibilities and the requirements of life itself. This is the so-called "cubism." The other school, headed by architects of mature artistic judgment and large practical experience, remains true to classical principles, but tries to simplify the classical forms and to use construction as a decorative element. In 1923 an All-Russian Agricultural Exposition building (more than 52,000,000 cu. ft.) was constructed in Moscow by the architects Shchussev and Oltargevsky. In this undertaking both of the above-mentioned schools were represented, as some parts of the building were constructed by architects of "cubistic" tendencies.

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(H. W. C.)

ARCTIC REGIONS. (*see* 21.938).—This article deals with the sovereignty, climate and resources of the area known as the polar regions. For the story of its exploration since 1910 *see* the article POLAR REGIONS.

Sovereignty Questions.—Most Arctic lands are now under the sovereignty of one or other state. The treaty transferring the Danish West Indies to the United States (1917) contained a clause recognising Denmark's right to extend her economic and political sphere over the whole of Greenland. Norway disputed this right on the ground that only Norwegian sealers and trawlers made any use of the east coast. An agreement between the two states was signed in 1924, giving Norwegians unhindered access to that shore, but leaving undecided the question of Danish sovereignty, which Norway does not admit, maintaining that Eastern Greenland is a *terra nullius*. In 1916 Russia reiterated her claim to all the Arctic islands lying north of Asia, including Wrangel Island. Attempts on the part of V. Stefansson in 1921–4 to establish a British claim to Wrangel Island met with no official support in Britain or Canada, and in Aug. 1924 Russia officially hoisted her flag on the island and reasserted her claim. Franz Josef Land is not included among Russian claims, and may be regarded as a *terra nullius*. By a treaty signed in Paris, Feb. 9 1920, the principal European Powers and the United States and Japan recognised Norway's sovereignty of Spitsbergen and Bear Island. Canada claims all islands of the American Arctic Archipelago between the meridian of 60° and 142° west of Greenwich, Greenland excepted. This carries British sovereignty to the Pole. (R. N. R. B.)

I. CLIMATIC CONDITIONS

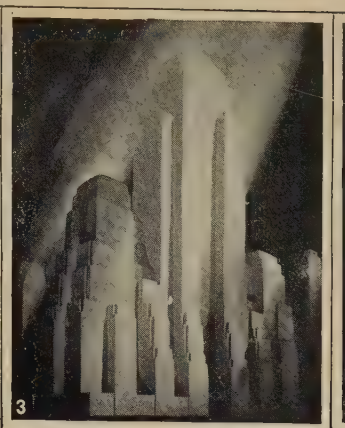
It is a commonplace of modern geography that there are two main kinds of climate, continental and insular, with the sea-coasts of continents partaking somewhat of the insular qualities. In continental climates, there are greater extremes of heat and cold than on islands. It follows that the most intense cold in the Arctic is nowhere near either the mathematical centre, called the North Pole, or the sea-ice centre, called the Pole of Inaccessibility (84° N. Lat., 160° W. Long.). In arctic Alaska, the coldest weather is, so far as we know, in the Yukon basin; in Canada it is in Yukon Territory; and in Siberia it is in the province of Yakutsk. All these places have been inhabited for a quarter of a century or more by Europeans who are not known to have been materially discouraged in their work by the mere disagreeableness of the climate, although they have been handicapped by the frozen ground and in other things that result directly from the cold.

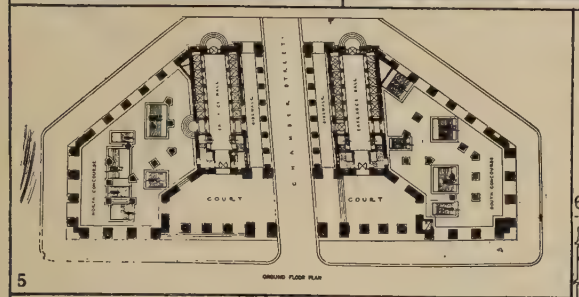
The Coldest Region.—The coldest known region of the northern hemisphere is the province of Yakutsk, in the vicinity of the arctic circle, where temperatures colder than 90° F. below zero have been reliably recorded—and that on the edge of cereal farming, for the great Russian atlas published just before the War indicates that wheat, barley, oats and rye are cultivated, if not at the very cold pole of the Northern Hemisphere, at least within a comparatively short distance from it, where the temperature frequently drops lower than 80° below zero. This is colder than any known region in arctic Alaska or arctic Canada. We may conclude, then, that winter cold does not frighten away Europeans through its mere disagreeableness nor render it impossible for them to make a living.

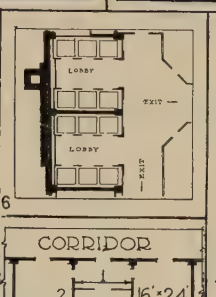
No records apparently authentic of temperatures colder than 60° F. below zero are available from any of the arctic islands, and it is almost certain that they do not occur. The coldest spells that do occur are when the wind blows from the interiors of the islands. It seems unlikely, therefore, that the temperature ever drops as low as 55° below zero at the North Pole, the Pole of Inaccessibility, or, indeed, at any point on the arctic sea.

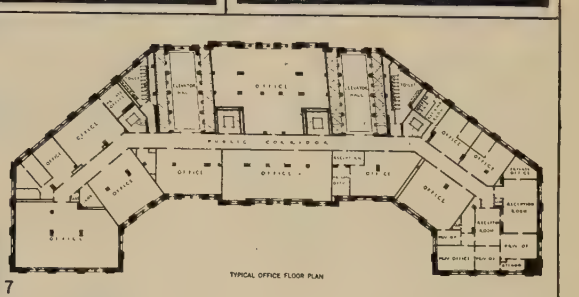
Summer Temperatures.—There is probably no spot on a lowland in the continental Arctic, whether in Asia or America, that does not occasionally have a summer temperature warmer than 80° F. in the shade. Or, if there is such a place, it must be on a peninsula, or on a narrow coastal strip between ice-covered mountains and the sea. Many places in the continental Arctic have occasional temperatures above 85° in the shade, and at least one arctic weather bureau station, that of the United States Govt. at Fort Yukon, Alaska, has a record of 100° in the shade. The slowness of the public to realise that there is such great summer heat in the Arctic is due partly to the prevalence of the ancient view that all the Arctic is always cold, and partly to the reports of travellers whose entire arctic experience has been on the ocean or on a seacoast.

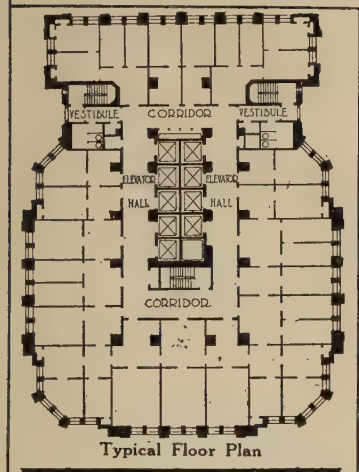
The reason for the great mid-summer heat on arctic lowlands is, of course, that the sun delivers an adequate number of heat units per day to account for it. The ordinarily accepted figures are three or four per cent more at the North Pole than at the equator for the top of the atmosphere and three or four per cent less for sea-level. This means that you would have "tropical" heat at any place in the Arctic where the sun's rays strike a dark surface and where there is no local reservoir of "cold" to neutralise it. The places, therefore, that do show a "tropical" heat are on lowlands that are sheltered from ocean breezes and from



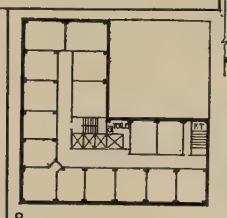




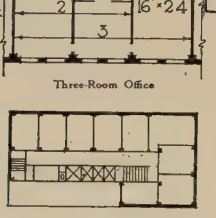




Typical Floor Plan

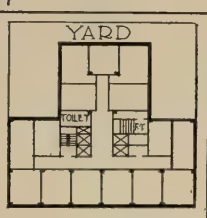


Corner Lot, 100x100

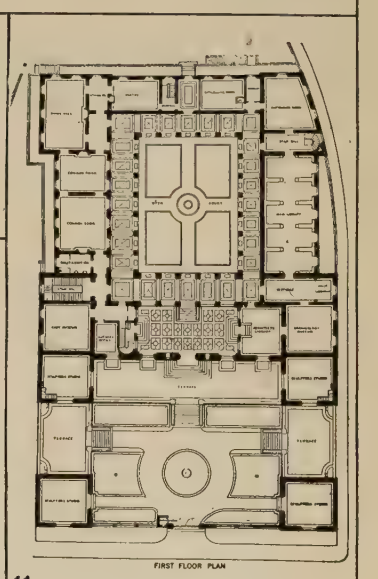


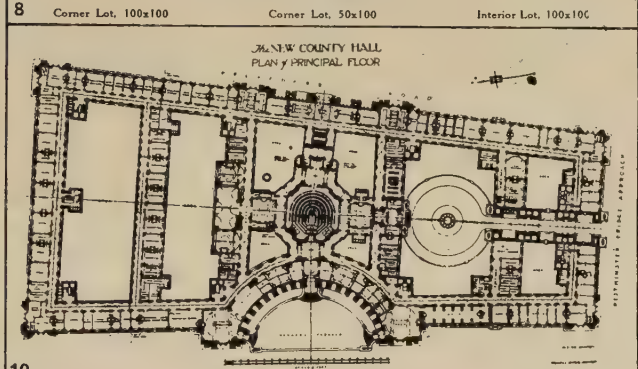
Three-Room Office

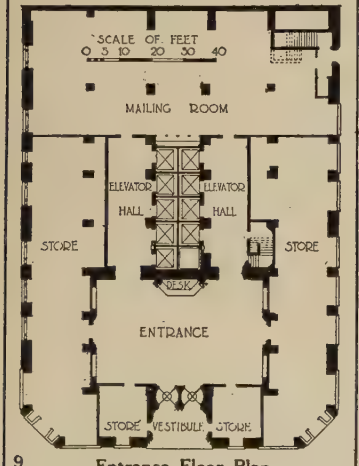
Corner Lot, 50x100



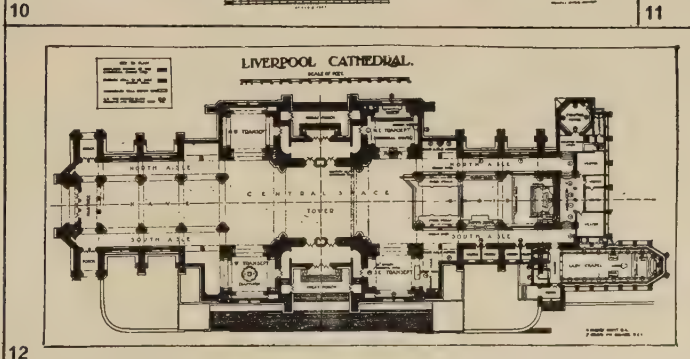
Interior Lot, 100x100







Entrance Floor Plan



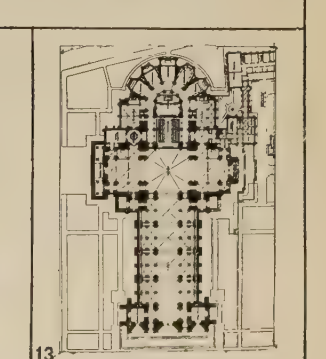


FIG. 1.—Zoning Envelope (building laws of New York City) showing the mass of building which would occur if carried to extreme limits permitted by law over square 800 x 200 ft. On 25 % of a lot area, a tower may rise to any height.

FIG. 2.—Same as 1, showing courts cut in to provide natural light in building.

FIG. 3.—Sloping surfaces changed to vertical, ready for windows—the tower reduced to a structural possibility—*i.e*, height of 1,000 ft. and offsets adjusted to steel supports.

FIG. 4.—The finished building, windows in place, architecturally embellished and ready for occupancy. These diagrams show the cause of the "style" of architecture which is becoming prevalent in America.

FIG. 5.—Plan of ground floor, Municipal Building, New York City: McKim, Mead and White, Architects. A street passes through the centre.

FIG. 6.—Economical layout for elevators in an office building.

FIG. 7.—Plan of typical office floor, Municipal Building, New York City: McKim, Mead and White, Architects. Note elevator layout.

FIG. 8.—Typical office plans on rectangular lots.

FIG. 9.—Ground floor and typical floor, Tribune Building, Chicago: Howells and Hood, Architects.

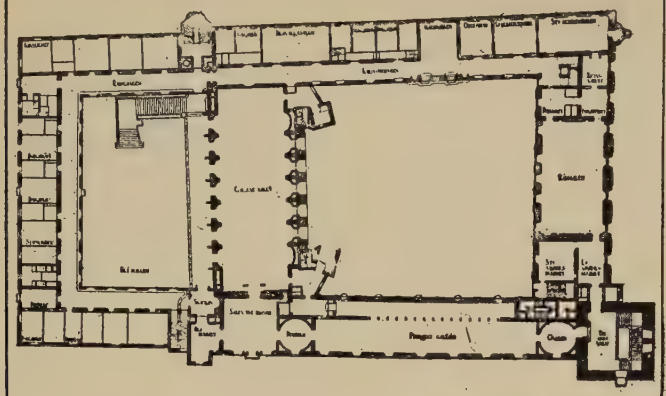
FIG. 10.—Plan of the new County Hall, London: Ralph Knott, Architect. Elements well composed, with clear circulation.

FIG. 11.—Plan of American Academy in Rome: McKim, Mead and White.

FIG. 12.—Plan of Liverpool Cathedral: Sir Giles Scott, Architect. Developed under one guiding hand.

FIG. 13—Plan of Cathedral of St. John the Divine, New York City: Heins and La Farge, Architects; R. A. Cram, succeeding. Developed under different hands, as were the old cathedrals, which were long in building.

ARCHITECTURE



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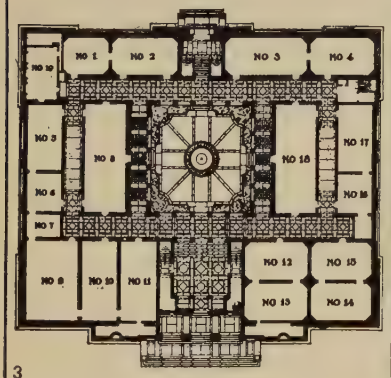

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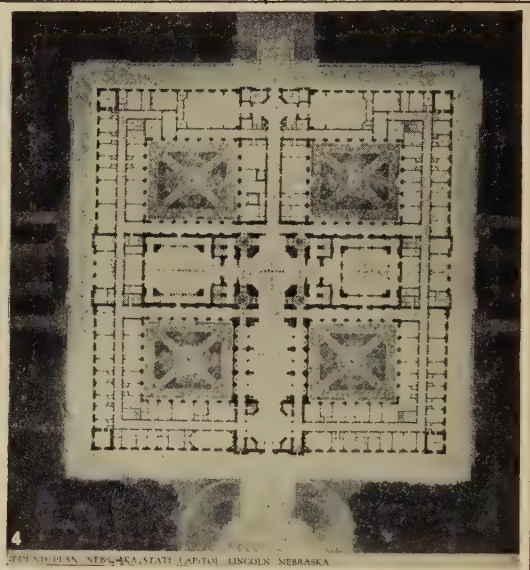

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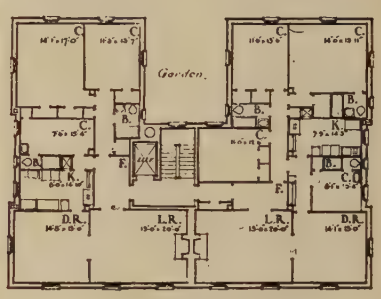

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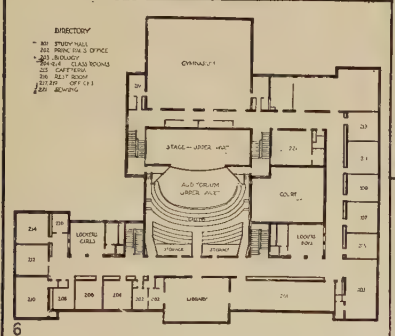

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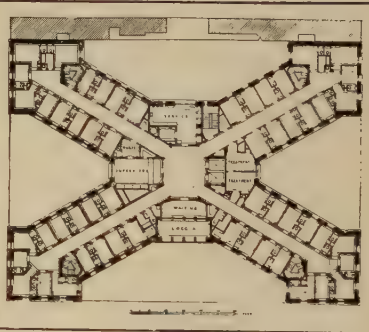

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J. E. R. Carpenter, Architect.

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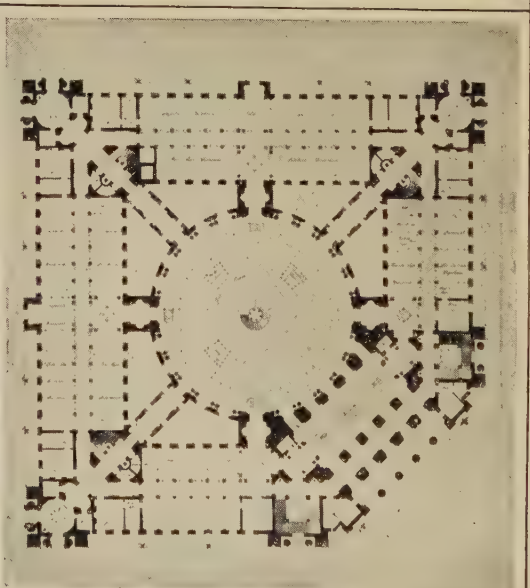

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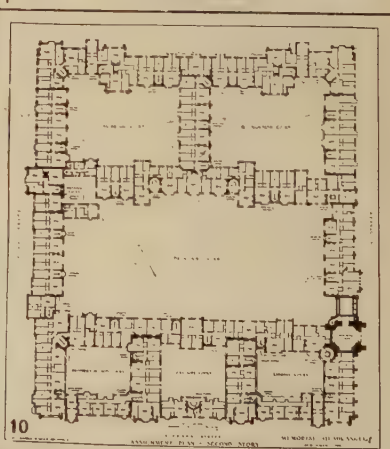

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FIG. 1.—Plan of Town Hall, Stockholm, Sweden: R. Ostberg, Architect. Modern building reminiscent of old forms.

FIG. 2.—Typical upper floor plan of Shelton Hotel, New York City: A. L. Harmon, Architect. Modern skyscraper hotel.

FIG. 3.—Plan of Freer Art Gallery, Washington: Charles Platt, Architect. Well arranged display spaces.

FIG. 4.—Plan of Nebraska State Capitol: B. G. Goodhue, Architect. A new note in state capitol planning.

FIG. 5.—A typical plan of small suburban apartment, Jackson Heights, New York City: A. J. Thomas, Architect. The better type of modern housing practice.

FIG. 6.—Fairly typical American high school plan, Rockville Center, N. Y.: H. T. Blanchard, Architect.

FIG. 7.—Typical upper floor plan, Fifth Avenue Hospital, New York City: York and Sawyer, Architects. An unusual plan for the limited space available in a city.

FIG. 8.—Example of plan of large apartments, New York City: J. E. R. Carpenter, Architect.

FIG. 9.—Plan of Port of London Authority Building. Very clear and well organised. Sir Herbert Baker, Architect.

FIG. 10.—Plan of Memorial Quadrangle, Yale University, New Haven, Conn. A reminiscence of the Old World. J. R. Rogers, Architect.

winds that come from ice-covered mountains. If the length of summer is measured by the season during which streams flow unfrozen and during which certain insects are alive and more or less active, the arctic summer would range from a maximum of about five and a half months in such places as the north shore of Great Bear Lake, to perhaps two months in places like Borden Island.

But an important thing to remember is that there is a direct dependence of animals on plant life and that plants measure their summer not by the calendar but by the number of hours of sunlight. At Fort Yukon, Alaska, for instance, on a day that varies from, let us say, 65° at the coldest to 95° at the warmest (in the shade), there would be approximately as much growing time as in two ordinary days in the humid tropics. This is why some plants grow so much more rapidly in certain parts of the Arctic than the same plants do in any part of the tropics or temperate zone. An interesting, and to most botanists an unexpected, corollary is that some plants also grow to far greater size in the Arctic than in the temperate zone or tropics, as cabbages, for instance. This may possibly be because they lose speed in the temperate zone where they have to stop and start again to conform with alternation of day and night, but can maintain a continuous and fairly uniform rate of growth in the Arctic where the daylight is continuous.

Arctic Weather.—Dr. Fridtjof Nansen announced as one of the outstanding conclusions of his great scientific expedition of 1893–6, that the Arctic is, on the average, one of the least stormy large regions of the world. Stefansson's observations as a result of 11 years spent north of the arctic circle and the studies of other observers have tended to confirm Nansen. In many parts violent gales are quite absent, or at least have not yet been observed by scientific men. Gales are common only where an open ocean is faced by high mountains or a plateau.

Snowfall.—It is difficult to measure arctic snowfall because the snow is usually very dry and fluffy and is driven about a great deal by even the lightest winds. There is no doubt that, however, on the average, arctic precipitation is very light. It is estimated that, if the snow of winter be added to the rain of summer, the result would be about eight inches of water, certainly not more than ten, on most parts of the arctic lowlands of Canada and Alaska. The Siberian lowlands may be even drier. We have, therefore, the apparent paradox that the average snowfall of the Arctic is much less than that of Scotland or of Illinois, for instance.

Glaciers.—It is now well established that there is no permanent snow or ice on any land in the Arctic unless it be mountainous. The required height of mountains varies roughly with the varying precipitation. The highest mountains of Melville I., for instance, are probably not more than 4,000 feet. This is not enough for the formation of any real glaciers. Mr. E. de K. Leffingwell, in his studies of arctic Alaska, found that in the first coast range south of Flaxman I., the altitude of 6,000 ft. was not enough for the formation of glaciers. But in the second range, a little farther south, which runs up towards 10,000 ft., there were some glaciers. So far as we yet know, there is no evidence of ancient glaciation on the great low plains of arctic Alaska. This must have been because they were then as now a region of very light snowfall.

Fogs.—Since fogs are caused by the meeting of air currents of differing humidity and temperature, it is obvious that the insular Arctic and the coast lands must be regions of frequent fogs. In summer, for instance, with a lowland steaming under a sun that creates an 80° temperature in the shade, and just in front of it an ocean the surface of which is around 30° F., any breeze blowing from the land would be suddenly cooled, producing a sea fog. Similarly, any breeze coming from the ocean would produce a fog over the superheated land. Such fogs would be thickest and most frequent where the sea and land meet. We gradually work out of the land fogs when we travel inland and out of the sea fogs when we steam away from land. From the flying point of view, it is important that these fogs have been found by experience to be very low on the average. They are often thick on the decks of whaling ships, but so thin at the masthead that the captains in the crow's-nests can see each other plainly while the men on the decks have no visual evidence that other ships are near.

Summing up, the arctic winters are longer than those of most extremely cold places now inhabited by prosperous and contented Europeans, such as Dakota and Manitoba, for instance. They are also a little colder. But they are, on the other hand, less stormy and with a lighter snowfall. The summers, although shorter, are in some places almost or quite as hot. It would seem, then, that the same sort of people might be willing to live in the Arctic who are willing to live in Dakota and Manitoba.

It will undoubtedly be difficult to get people to colonise the Arctic, but in the opinion of many this will not be any special arctic problem but rather a general frontier one. For the tendency which brings American farmers to the cities, increasing the percentage of urban population, makes it as difficult to induce Londoners who are out of work to migrate to sub-tropical Australia as to sub-arctic Canada. The weakening or dying out of the frontier spirit is one of the conspicuous social phenomena of our time.

II. NATURAL RESOURCES

Since the climate, as such, will not prevent arctic colonisation, the ascertained resources may be enumerated.

Coal.—It is now known that coal is almost, if not quite as likely to be found in the Arctic as in tropical or temperate lands. It is not surprising, therefore, that seams of coal, of varying quality, of course, have been reported by most arctic explorers. Stefansson, for instance, found coal in all but two of the islands north of Western Canada. In these, Victoria Island and Meighen Island, further exploration may show coal.

Coal of quality said to be equal to the best Welsh has been mined for several decades in Spitsbergen, some five or six hundred miles north of the arctic circle, and these mines should eventually supply a great part of northern Scandinavia and of northern Russia. In Alaska, a coal mine at Cape Lisburne, well north of the arctic circle, was worked to supply the whaling fleet even before 1885, and fell into disuse only with the abandonment of the whaling industry. The natives of the north coast of Alaska mine coal at Wainwright for their own use and to sell locally to missionaries, government schools, traders, etc. The members of Stefansson's expedition, living by hunting on Melville I., maintained two winter camps, one in Liddon Gulf and the other on the north coast near Cape Grassy. They burned bituminous shale in the southern camp, but in the northern they burned lignite of good quality, some of it saturated with oil.

Oil.—Indications of oil have been found in many parts of the Arctic. The Imperial Oil Co. of Canada, a branch of the American Standard Oil, has flowing wells on the Mackenzie river just south of the arctic circle, and the same oil-fields are known to extend beyond the circle. About 500 m. north from these wells and, therefore, about 500 m. north of the arctic circle, Stefansson found oil on northern Melville Island. The U.S. Navy has recently set aside a vast oil reserve in arctic Alaska, and both private prospectors and representatives of large oil companies have staked claims east of the government reserve. These claims are near Cape Simpson which, but for Barrow, is the most northerly cape in Alaska.

Iron and Copper.—Hardly less fundamental than oil and coal are iron and copper. No large arctic deposits of iron ore are known. There are iron "prospects," however, in many places. But the copper fields that lie between Bear Lake and the centre of Victoria I. in a district roughly 200 m. sq., give great promise —if the world's need of copper increases, or if the spread of settlements to that country make mining more feasible. There are copper prospects in other parts of the Arctic, and gold, silver, platinum and tin have been found.

Vegetation.—A more fundamental resource than even the oil and coal is the vegetation of the Arctic that makes food-production possible. The coniferous forest extends beyond the arctic circle, in Canada in certain river valleys as much as 150 m., and

even farther in Siberia. Trees 100 ft. high are found 100 m. north of the arctic circle. They make the Arctic more homelike to those who are used to forests, and they are doubtless valuable. But many consider that the same land would be more immediately valuable if the trees were absent, for then it would be covered with grass, like most of the rest of the Arctic, whether continental or insular.

It is one of the exploded beliefs that arctic vegetation is mainly mosses and lichens. Some 20 years ago, Sir Clements Markham published the statement that the Arctic possesses 28 species of ferns, 250 lichens, 332 mosses and 762 flowering plants. Many species have been discovered since then, and many others will be discovered hereafter. There will probably be little disagreement with the estimate that we have in the Arctic at least 10 times as many tons of flowering plants as of non-flowering. There are a few small portions of the Arctic where cereals can be profitably cultivated, and still others where garden vegetables will be of some value. But, so far as can be seen at present, the chief thing to do with the arctic soil is to permit that vegetation to continue growing which grows there already and to make an economic use of it by converting it into meat, hides and other animal products.

Reindeer.—There is one suitable animal, the reindeer, domestic in the Old World since prehistoric times. No one knows how many of these there may be in arctic Siberia, where single owners often have from 5,000 to 10,000 head. But there are definite figures for the entire period of reindeer domestication in Alaska. The American Govt. commenced by importing 16 head from Siberia in 1892. Up to 1902, when importation ceased because of an embargo imposed by the Tsar's Govt., 1,280 animals were brought from Siberia. These have never failed to double every three years since importation, so that by the spring of 1926 there were 500,000 head.

The U.S. Department of Agriculture estimates that the grazing resources of arctic and sub-arctic Alaska will be adequate for 3,000,000 to 4,000,000. Since the climate and vegetation of arctic Canada are, for reindeer purposes, the same as those of arctic Alaska, with an area 10 times greater, we can say, roughly, that Canada will support from 30,000,000 to 40,000,000 head. Undoubtedly the reindeer area in Asia and northern Europe is twice as large as the Alaskan and Canadian put together, which would make total world figures between 100,000,000 and 125,000,000. This estimate is probably low.

No animal now domestic can be profitable in the Arctic except the reindeer. Cattle, sheep, horses and goats can, of course, be raised in many parts, but, under present costs and prices, they would not pay. The reindeer pays handsomely because it needs no barn for shelter, no hay for feed, nor any protection from wind or weather.

Domestication of Ovibos.—There was a project under discussion in 1926 of domesticating the ovibos (musk ox) because it eats certain arctic vegetation that reindeer do not eat and because the reindeer produces only meat and hides while the ovibos produces wool in addition. Ovibos beef is indistinguishable from ordinary domestic beef in colour, flavour, taste and odour. The wool, as determined by the Textiles department of the University of Leeds (Prof. Aldred F. Barker), has good heat retaining and wearing qualities, is easy to bleach and dye, is softer than cashmere, and will not shrink—in other words, is one of the finest of known wools.

With the ovibos domesticated, the potentialities of the Arctic will be greater. But with only the reindeer, there is no doubt that the arctic grasslands (which means all lands in the Arctic not so high and mountainous as to be snow-covered) will be colonised unless, indeed, the world movement of population from the country to the cities stops further colonisation entirely. In most cases mining will develop after the ranchmen have occupied the grazing lands. But in some cases, notably with oil, the mining will precede colonisation. That gold mining will precede colonisation seems for the moment unlikely, although that is the one kind of mining that has hitherto taken people to the Arctic. But the rise in the cost of living is only another expression for a drop in the value of gold, so that the gold deposits, which paid fabulously in Alaska 20 years ago, are not paying now even where production remains uniform.

Site-value.—Finally we must point out a resource of the Arctic that has nothing to do with climate, minerals or the like, but is due entirely to position. The history of civilisation as we know it is essentially the history of the Northern Hemisphere. Generally speaking, civilisation seems to have started in the subtropics—Yucatan for the New World; Egypt, Asia Minor, etc., for the Old World. As civilisation has been spreading northward during historic time, it has really been spreading toward the centre of a circle. That centre is the Arctic.

It was an Elizabethan ideal to find a sea-way north from Europe to the Indies. No practical route was ever found, because of the floating ice in the arctic sea. So, perforce, we have gone roundabout. But now ships of the air are opening up the roads of the air which lie straight in any desired direction. As the Elizabethans knew, China is north of Europe. But Peking is also north of New York, and the wheat-fields that are spreading over central Siberia are north of the growing wheat-fields of central Canada. The cities springing up in those wheat lands will be far from each other east and west, but not half so far north and south.

Air Routes.—The world is developing an increasing speed mania, both for messages and for passengers. The flying conditions of the Arctic are probably, on the average, as good as those of any other equally large area of the world. It follows, therefore, that the centre of the circle of civilisation, which is the Arctic, will be the flying crossroads of the world. This will necessitate the establishment of way stations here and there. Of itself, that will to a small extent require colonisation. It will have a vastly greater indirect effect by spreading accurate knowledge of the Arctic throughout the world. Thereupon will follow such colonisation as the real climate and actual resources justify.

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ARDENNES, BATTLE OF THE: *see* FRONTIERS, BATTLES OF THE.

ARGENTINA (*see* 2.460).—A republic in South America, having an area of 1,153,119 sq. m., and a population, Jan. 1 1924, of 9,293,797.

I. POLITICAL HISTORY

During the period 1910–25 Argentina enjoyed an external and domestic peace such as she had never known throughout a period of similar duration in her history. She was enabled to consolidate and bring nearer perfection the institutions of the country; give effect to the democratic ideals of her statesmen; and put an end to abuses and systems which, for nearly a century, had disturbed her peace and retarded her progress. In 1910 the republic celebrated the centenary of her first bid for independence, commemorating with a successful international exhibition the events of May 25 1810, when the residents of Buenos Aires ejected from office the Spanish-controlled municipal council and deposed the viceroy Cisneros. By 1910, after 100 years of recurrent political disturbance, a new era for Argentina had opened. There was peace within her frontiers and all difficulties with her neighbours had been overcome. Boundary disputes with Brazil, Chile and Bolivia had been amicably settled, either by the arbitrament of foreign powers—as in the case of the very serious difference with Chile—or by direct negotiation.

The Pre-War Years.—Dr. Roque Sáenz Peña was installed in office as President in Oct. 1910. He gave the closest attention to reforms designed to foster and strengthen public respect for and confidence in the institutions of the country. Much of the trouble during the 20 years prior to 1910 had been due to corrupt practices possible under the old system of open voting at elections, and the methods of trickery and force employed through-

out the country by powerful "caudillos," or political "bosses." President Peña reformed the electoral law and instituted the secret ballot. This was the outstanding and most valuable of his official actions, and incidentally it is worth noting that the first effect of the reform, at the next presidential elections in 1916, was the defeat of the Conservative party to which the author of the new law belonged, and which had enjoyed political control of the country for over a quarter of a century. There was a good deal of industrial trouble in the years 1910–4, due, not to any political unrest, but to economic conditions following the collapse of the land and cattle boom of 1910. Early in 1914 Dr. Peña was too ill to fulfil his duties, and the presidential mandate was assumed by the vice-president, Dr. Victorino de la Plaza.

The War Period.—President Peña died in 1914. With conspicuous ability Dr. de la Plaza was directing the affairs of the nation through a difficult period when the outbreak of the World War occurred. In a country with such a cosmopolitan population the sudden disruption of international relations necessarily had an immediate repercussion. All important contracts involving shipping, the exportation of grain and meat and the importation of manufactures, were cancelled and something like a business panic was imminent. It was only averted by the declaration of a moratorium. The banks closed their doors for a week, and time was given for an examination of the general situation. The strict neutrality of Argentina was proclaimed. It was recognised early that the republic would play an important part in the provisioning of Europe, and out of a moment of threatened panic the country emerged in a spirit of confidence that at least it could not be adversely affected by the War.

The general outlook of the Argentine people on the causes of the War and its subsequent conduct was one largely of indifference until the events of early 1918. There was a fairly pronounced sympathy with the Allies, and particularly with Belgium and France, but Germany's preliminary successes rather impressed the people, and the vigour with which she entered upon propaganda in Argentina had its effect. A German newspaper in the Spanish language was established in Buenos Aires and was widely circulated gratis throughout the country. The Allies were very slow in countering this propaganda, and Argentine public opinion at first held that the Central Empires would prove successful. This opinion was strengthened by the news of the annihilation of Admiral Cradock's squadron off Coronel, Chile, by the German squadron commanded by Admiral von Spee, but its effect was quickly overcome by the more convincing destruction of the German fleet in the battle of the Falklands. Meanwhile Buenos Aires had had its first glimpse of the War, by the arrival of the German steamer "Elenore Woermann," bringing the survivors of the "Cap Trafalgar" and the cruiser "Ebor," the former of which—well known in the Plate trade—had been sunk by the British armed liner "Carmania." The great newspaper *La Nación* was strongly pro-Ally, and prominent poets and other writers pronounced themselves vigourously in condemnation of Germany. Officially, however, the country remained strictly neutral, though its whole resources were exclusively at the disposal of the Allied powers.

President Irigoyen's Régime.—The presidential elections in 1916 withdrew all attention from the War to domestic politics. For the first time the elections were to be "free" under the secret voting system introduced by President Peña. The Conservatives confidently nominated Señor Rojas-Seru. The Radicals who had, to use a local expression, "been in the wilderness" for 30 years, put forward Dr. Hipólito Irigoyen, and the result was a sensational victory for the latter. Dr. Irigoyen was comparatively unknown to the new generation, and came from relative obscurity to the presidency. Twenty-five years earlier he had been one of the most vigorous "caudillos" in the country, and had suffered exile for his association with Leandro N. Alem in the revolution of 1893. Buenos Aires knew little of him, but his power and prestige with his party and in the country must have been very great throughout the period when he was quietly working for a restoration to power of the Radicals. On attaining office in Oct. 1916 he followed the custom of transferring to his partisans every office and position that could possibly be given. It was widely believed that, while the neutrality of Argentina in the War would be strictly adhered to, the President was privately rather pro-German. This popular belief received no confirmation by any official act, and it is much more probable that Dr. Irigoyen entertained no feeling one way or the other, his policy being one of intense nationalism.

When in the early part of 1917 the United States entered the War and President Wilson appealed to the Latin American States to follow her lead, strong influences were brought to bear to change the official attitude of Argentina. Brazil and other countries declared war on Germany; Uruguay broke off diplomatic relations, but President Irigoyen permitted no departure from the country's proclaimed neutrality. A more severe test came when, in pursuance of her unrestricted submarine campaign, Germany sank several ships flying the Argentine flag. National feeling ran high. It was intensified by the disclosure that the German Minister in Buenos Aires, using Swedish diplomatic channels for the purpose, had advised his government in dealing with Argentine ships, either to spare them or "sink without a trace." Wild riots ensued in Buenos Aires. The German Club was sacked, and other property damaged. A clamour for war arose, but the President refused to give way. The government contented itself with demanding explanations and obtaining compensation, which was given by Germany by way of the transfer to the Argentine national transport fleet of certain ships that had lain in port since the outbreak of the War.

Post-War Years.—The conclusion of the War was as entirely unexpected in Argentina as its outbreak. The country was enjoying great prosperity, only suffering to a limited extent from shortages of coal and certain manufactures. Immediately the Armistice was signed there was some confusion, especially as regards the condition of the primary industries under war contracts, now to be cancelled. Industries that had sprung into being during the War also felt "panicky" in face of an expected early resumption of trade with Europe in manufactured goods. Trade unionism had developed strongly, particularly among the marine and dockside workers. President Irigoyen was reputed to be intensely sympathetic toward the "proletariat," and much of the energies of his cabinet had been devoted to legislation designed to ameliorate the conditions of the labouring masses. At this period strikes were rather frequent. Early in 1919 occurred the "tragic week," of which practically no report reached Europe. A prolonged strike at the works of the Argentine Iron and Steel Company culminated in a demonstration of the strikers. The police were sent for, and came into conflict with the rioting strikers, several of whom were killed. At the funeral of the victims, which was attended by thousands of workers, further shooting took place. The trouble spread throughout the city of Buenos Aires, and finally the military took charge of the situation and promptly restored order. Actually the affair had no deep political significance, though subversive elements of the cosmopolitan population certainly intruded themselves into it. Industrial troubles endured until after the end of Dr. Irigoyen's term of office. Shipping and the transport systems were most involved, and the business of handling the country's imports and exports suffered severely. In 1922 the port of Buenos Aires was completely at a standstill for over three months. From the beginning of 1923 the position began to improve, coincident with the country's return to normal conditions of industry, trade and commerce.

Argentina and the League.—The republic was one of the first of the Latin American States to give its adhesion to the League of Nations, which it joined on July 16 1919. The Foreign Minister (Dr. Honorio Pueyrredon) and a delegation attended the first Assembly in 1920, when the minister delivered a striking address and presented a formula for the inclusion of Germany and all sovereign states within the League on a basis of absolute equality, and for submitting disputes to an international judicial court. On the rejection by the Assembly of this formula, the delegation withdrew. Up to the end of 1925 the republic had taken no active part in the deliberations of the League. For a time no

dues were paid, but in 1925 Congress approved of the nation meeting its obligations in this respect.

President Alvear's Régime.—Dr. Irigoyen's term of office expired in Oct. 1922. He was succeeded as president by Dr. Marcelo T. de Alvear, whose candidature was supported by the retiring president as head of the Radical party. At the elections the people again gave the Radicals their confidence, the Conservatives and Socialists being easily defeated. In the Federal capital the Socialist party had come into prominence since 1910. In the 1922 presidential elections, the following votes in the Electoral College were secured: Union Civica Radical, 335; Concentration National (Conservative), 60; Socialist, 22; Democrata Progresista, 10. Under the Alvear régime substantial progress was made, particularly in the direction of financial reform. The floating debt was greatly reduced, economy in administration effected, the big overdraft in excess of legal authorisation at the Banco de la Nación wiped out, and a more rigid control exercised over the affairs of the nation. A more businesslike attention was paid to the exploitation of the State-owned petroleum industry and the administration of the National railways.

In 1925 President Alvear had to reorganise his Cabinet, following the resignations of the Ministers of the Interior and of Agriculture. During the first few months of his administration the President and his Cabinet were faced with rather difficult economic conditions owing to the heavy fall of cattle values, upon which so much of the prosperity of the country depends. The foreign freezing companies fixed prices according to the demand ruling in European markets, and intense dissatisfaction prevailed amongst the influential cattle breeders. It was proposed at one time to nationalise the meat export industry, or alternatively to compel the exporters to pay minimum prices. Before any of the varied schemes for rectifying the situation came to fruition, however, values for cattle began to rise, and in 1925 they reached the highest point ever recorded. Agricultural and other primary industries were in a flourishing condition in 1925, high prices ruling for most lines of produce.

Social Legislation.—The period 1910–25 was remarkable for the volume of legislation of a social character, most of it passed during the Irigoyen régime. The principal Acts passed related to employers' liability; compensation for injured workers and those incapacitated by disease contracted at their work; the early closing of shops and business establishments; restriction of Sunday labour; official control of sweated industries carried on in the home for an outside employer, and the provision of cheap homes for workers, and pensions. A National Department of Labour was established, with very wide control over every phase of employment and industry. In the immediate post-War years, a Rent Restriction Act was in operation, but it became inoperative in 1924 when the Supreme Court declared it unconstitutional. In 1923 the attempt to enforce a general Pensions Law, framed somewhat on the lines of the British legislation, proved futile owing to the opposition of both employers and employees, who refused to make the required contributions. This law practically lapsed, though it was not repealed.

British Royal Visit.—A notable event in Argentine history was the first official visit ever paid to the country by a member of the British Royal Family, the Prince of Wales journeying in H.M.S. "Repulse" to Buenos Aires at the invitation of the president and nation. The Prince reached the Federal capital on Aug. 18 1925, and received an enthusiastic welcome. After a round of ceremonies he toured the country, and crossed the Andes to Chile. On his return to Argentina he was again shown the greatest hospitality, and spent some days as the personal guest of President Alvear. In recognition of the magnificent reception given to the Prince, King George V. bestowed the Grand Cross of the Order of the Bath upon the President, and conferred high honours upon members of his cabinet and prominent officials. (L. MA.)

Defence.—The army of the Republic is a national militia, and service is compulsory for all male citizens from the age of 20 to 45 years; naturalised citizens are exempt for a period of 10 years. For the first 10 years men belong to the permanent forces, *i.e.*, the first line, for the next 10 years to the National Guard, and for the last five to the Territorial Guard: the period with the permanent forces includes one year's continuous service. The Army Regulations of Jan. 1916 laid down the establishment for 1924 as 1,501 officers, 3,160 non-commissioned officers, 1,820 volunteers and 20,000 conscripts. There is a trained reserve of 300,000 men, half in the first line and half in the special reserve, and a territorial reserve of 100,000 men. A military aviation school has been established at El Palomar: in Dec. 1924 the Air Force consisted of a fighting flight, a bombing flight, and an observation flight. The navy consists of two battleships, the "Moreno" and "Rivadavia," four armoured cruisers, one light cruiser, one cruiser, seven destroyers, five torpedo boats, two coast defence vessels and a few training and miscellaneous craft. The battleships, launched in 1917, have a displacement of 27,940 tons and a nominal speed of 22·5 knots: their principal armament consists of twelve 12-in. and twelve 6-in. guns. Under a programme introduced in 1924 for the reconditioning of the battleships and four cruisers, the "Rivadavia" and "Moreno" were brought up to the post-War standard of their class in the early part of 1926. The personnel of the navy includes 337 officers, 130 engineers, 27 electrical engineers and 9,100 men (including 5,000 conscripts); the men have to serve for two years. A corps of coast artillery of some 450 men, a naval school and schools for mechanics, artillery and torpedo practice have been established. Before 1914 the army was trained and armed on the German pattern; a certain number of Argentine officers were sent each year for 18 months' training with the German Army, and German instructors were provided for the Argentine Army. Since 1914, however, certain features of the British, French and United States systems of training have been adopted.

II. ECONOMIC AND FINANCIAL HISTORY

The area of the Republic is 1,153,119 sq. m., divided into one Federal district, 14 provinces and 10 territories. The total population on Jan. 1 1924 was 9,203,797, an increase of 17·9% over the population in 1914, which was 7,885,237. The increase is well distributed over the whole of the area. The population of the Federal capital, Buenos Aires, increased from 1,575,814 in 1914 to 1,811,745 in 1924. From 1910 to 1913 inclusive the increase in the population of the country was largely due to immigration, the excess of immigrants over emigrants during the four years being 625,016. From 1914 to 1918, owing to war conditions, immigration almost ceased and emigrants exceeded immigrants. After the end of the World War the flow of emigrants recommenced: during the years 1922–4, inclusive, the net annual increase, *i.e.*, of immigrants over emigrants, averaged 114,000. In 1925 this average was not maintained, the excess of arrivals over departures dropping to 75,525. Argentina is not a suitable country for Anglo-Saxon immigrants of the labouring classes, the conditions being more favourable to Italians, Spaniards and other people of southern Europe. Limited opportunities in farming, dairying, and similar agricultural pursuits, are presented to Anglo-Saxons with a capital of from £500 to £1,000; a larger capital is required for stock-raising. Labour troubles were prevalent during the War and immediate post-War period, but later the relations between capital and labour improved.

National Finance.—The financial position of the Argentine nation at the end of 1925 was quite sound, though in one or two instances among the provinces the situation could not be considered satisfactory. During 1925 the Federal authority worked with marked success to rectify the national finances and put an end to a drift that had threatened to become serious. There had been an accumulation of budget deficits since 1913, with the exception of 1920, the total of these deficits amounting at the beginning of 1925 to about $1,000,000,000 paper. By the end of 1925, however, the Minister of Finance announced a prospective surplus for the year ended March 31 1926 of $50,000,000 paper. In 1923 the total indebtedness of Argentina, including national, provincial and municipal obligations, amounted to nearly $3,000,000,000 paper (about £261,000,000 at par of exchange). To a

[1]The Argentine dollar is also known as the peso, the two being convertible terms.

large extent this debt was incurred for essential public works, generally of a reproductive character, and on projects necessary for the development of the country.

The level of the public securities of Argentina is high in the financial world, owing to the regular payment of interest, and the 1% annual amortisation always carried by the nation's foreign loans. One or two of the provinces have not been so regular in their debt services. The floating debt of the nation stood at $746,812,099 on Jan. 1 1925. By the end of that year the debt had been decreased to $485,197,108 paper. The consolidated debt was $1,523,581,900 paper on Jan. 1 1925. By June 30 of the same year it had risen, largely as the result of the adjustment of the floating debt, to $1,673,647,300 paper. If the gross national debt of Argentina be taken as approximately (on June 30 1925) $2,275,000,000 paper, and accepting an estimated population on the same date of 9,500,000, the per capita indebtedness was $239.47, or nearly £21. Such a debt is lower than that of the great majority of nations of similar economic capacity. The budget for 1926 foreshadowed a national expenditure of $674,983,500 and a cash revenue of $695,000,000. Provision was also made for special expenditure, mainly on public works, of an additional $138,996,000 against which it was proposed to issue internal bonds for $150,000,000.

Production.—Argentina is essentially an agricultural and pastoral country. During the first quarter of the 20th century she rose from a position of comparative obscurity among the nations of the world to one of considerable importance as a source of cereals and animal products. Between 1909 and 1918 the value of her national production more than doubled, while the total area under cultivation increased by over 20%. The climatic conditions, together with the fertile soil, are almost ideal for the production of wheat, maize, oats, barley, linseed and lucerne. The wonderful lucerne crops provide unequalled feed for cattle, which, added to the climatic conditions, makes Argentina the finest cattle-raising country in the world. By 1910 she occupied the leading place among the countries of the world as an exporter of beef; on Jan. 1 1914 there were 25,866,763 cattle and 43,225,452 sheep in the country. In 1910 the republic experienced a "boom" in cattle and land. Excessive speculation led to a collapse, and from the beginning of 1912 until the outbreak of the World War a severe depression prevailed.

The World War greatly influenced the development of Argentina. While on the one hand she suffered by the cessation of developmental works that depended upon the provision of foreign capital and material, by the sudden stoppage of emigration from southern Europe, and by a dearth of the manufactured goods she required, she gained immensely by the increased demand, at higher prices than had hitherto been known, for her primary products. So far as the shortage of manufactured goods was concerned Argentina found a substantial source of supply in the United States. The national wealth increased substantially during the War, the high prices obtained for foodstuffs more than compensating for any loss the country suffered by the adverse effect of the War in retarding the normal development programme. The production of most cereals was enormously increased, and the pastoral industry became more prosperous than ever it had been before.

The wheat crop was of great importance to Great Britain and other wheat-importing countries. Good crops were obtained in 1915 and 1916, but that of 1917 was poor. Towards the end of 1917 the Allied governments entered into negotiations for the purchase of Argentine cereals. An agreement was concluded in Jan. 1918 whereby the British and French governments agreed to buy the surplus of wheat and other cereals to an approximate amount of 2,500,000 tons, at a minimum price of $12.50 (paper) for every 100 kilos of wheat, $7 (paper) for every 100 kilos of oats and $15 (paper) for every 100 kilos of linseed, f.o.b. The Argentine Government agreed to open credits in favour of both the British and French governments up to $100,000,000 (gold or equivalent in paper), the amounts drawn under these credits to carry interest at 5%.

The linseed crop was adversely affected by War conditions, due to the loss of markets and the difficulty of obtaining cargo space. In 1914–5 the crop amounted to 11,432,000 quintals, but in 1916–7 it only totalled 1,015,000 quintals. The scarcity prevented adequate marketing, and growers had great difficulty in disposing of their produce. Attempts were made to establish factories for crushing the seed in Argentina, in order to export the oil, which took up less cargo space than the seed. These attempts were not very successful, however, largely owing to the difficulty of obtaining the necessary machinery. The production of linseed was necessarily curtailed and normal production could not be resumed until the conclusion of peace. During the period 1919–25 Argentina has contributed over 50% of the world's supply of linseed.

Other important agricultural products are lucerne (alfalfa), cotton, rice, rye, barley, sugar cane, tobacco, potatoes, peanuts, grapes and olives. The development in cotton cultivation since 1909 has been very considerable, production increasing from 1,390 tons in 1909–10 to 10,000 tons in 1919–20 and to some 45,000 tons in 1924–5. The general trend in cultivation, particularly of cereals, is for more intensive methods to be adopted. The yield per hectare is rising, and since 1922 great progress, under the direction of the Ministry of Agriculture, has been made in scientific seed selection and in improved methods of cultivation.

The following table gives the production, in quintals, of wheat, maize, oats and linseed for each of the War years, and the average crop for the immediate pre-War and post-War periods:

Period	Wheat	Maize	Oats	Linseed
Average for 1909–10 to 1913–4	40,023,358	48,694,000	7,874,980	7,904,062
1914–5	46,040,000	87,320,303	7,170,000	11,432,000
1915–6	46,000,000	40,930,000	10,927,000	8,951,000
1916–7	21,804,010	14,946,000	4,613,000	1,015,000
1917–8	59,730,000	43,350,000	9,962,450	4,975,780
1918–9	46,702,880	56,961,500	4,900,560	7,817,400
Average for 1919–20 to 1924–5	54,381,113	55,224,161	7,207,985	12,557,003

Pastoral Products.—The chief feature of the period 1910–25 was the development of the canned, frozen and chilled meat traffic. The transition from the trade in live animals to this traffic was greatly accelerated during the War period, and has been of immense advantage to the country. Important meat refrigerating and packing industries have sprung up and a large trade has developed in valuable by-products such as hides, hair, wool, bones, manures, tallow and fat. The export of canned meat increased from 13,590 tons in 1913 to 102,153 tons in 1917. The post-War slump resulted in a great depression in the industry, but by 1925 conditions had largely improved under the influence of increased demand and higher prices. The livestock census of Dec. 31 1922 gave the number of cattle as 37,064,850 and of sheep as 36,208, 981: these figures, when compared with those for 1914, show an increase of 11,198,087 cattle, but a decrease of 7,021,471 sheep. During 1924, 3,812,890 cattle and 4,421,010 sheep were killed in the slaughtering yards of the large "frigoríficos" or meat refrigerating and exporting companies; over 1,000,000 tons of meat were exported during the year. Dairying and cheese-making are increasing in importance.

Manufactures and Fuel.—Owing to the lack of home supplies of coal and iron, Argentina has made but little progress as a manufacturing country. The reduction during the War period in foreign supplies of manufactured goods resulted in the development of home industry. Factories for the production of textiles, paper, chemicals, electrical machinery, etc., were established, but progress was not very rapid owing to the shortage of coal, iron and machine tools. These infant industries were protected by high duties on imports of manufactured goods. Their future, however, depends largely upon the development of the oil and water-power resources of the country. Petroleum was first discovered in the Comodoro Rivadavia area in 1907, and in 1913 about 20,000 tons were obtained; production increased to 200,000 tons in 1918 and to 750,000 tons in 1924. Government reserves have been established at Comodoro Rivadavia and at the smaller field of Plaza Huincul, near Neuquen; the greater part of the output is from these reserves.

Trade.—Although the War period resulted in a great development in the export of meat and cereals, it partly checked the normal development of the resources of the country, and it is possible that progress would have been greater if the World War had not occurred. One very beneficial effect of the War, however, was that the country was thrown upon its own resources, instead of depending upon foreign assistance, thus compelling increased

production and more economic methods of production and finance. The result was that Argentina was in a much better position in 1919 than she had been in 1913.

The visible balance of trade from 1913 to 1920 inclusive was favourable each year, the value of exports considerably exceeding the value of imports. In 1921, however, owing mainly to the fall in world prices, an adverse balance was recorded; in 1922 and 1923, also, imports exceeded exports, but in 1924 and 1925 a favourable balance was recorded. The following table gives the values of exports and imports, in gold pesos, for 1913, 1918 and from 1920 to 1925:—

	Imports	Exports		Imports	Exports
1913	496,000,000	519,156,000	1922	689,645,000	676,008,000
1918	500,603,000	801,466,000	1923	868,430,000	771,861,000
1920	934,968,000	1,044,085,000	1924	828,710,000	1,011,395,000
1921	749,534,000	671,129,000	1925[1]	880,000,000	930,000,000

[1]Estimated.

The visible adverse balance of trade for 1921–3 was further increased by invisible imports, estimated at an annual value of about 200,000,000 gold pesos: the largest items in these imports are interest payments on foreign capital invested in the country and on foreign loans, and payments for shipping and financial services.

The outstanding results of the outbreak of War in 1914 were the great falling-off in imports from the United Kingdom, the complete cessation of trade with Germany, and the great increase in trade with the United States. After 1918, however, trade largely returned to pre-War channels. The following table shows the distribution of the import trade with the principal countries concerned for 1913 and 1923:—

Country of Origin	Values in mill. of gold		Percentage of total	
	1913	1923	1913	1923
United Kingdom	154	207	31	23·8
United States	73	181	14·7	20·9
Germany	84	118	16·9	13·6
Italy	41	68	8·3	7·8
France	45	59	9·0	6·7
Belgium	26	45	5·2	5·2
Brazil	11	46	2·2	5·3
Mexico	2	15	·3	1·8
Spain	15	30	2·9	3·5

Communications.—Between the completion of the Transandine railway in 1909 and the year 1925 the railway system of Argentina was greatly extended. Construction was particularly rapid between 1909 and 1913, the total length of line in the latter year being about 20,000 miles. During the War period, owing largely to the lack of capital, very little progress was made. After 1918 a policy of state railway construction largely replaced the former policy of private enterprise, and a programme, at an estimated cost of £40,000,000, was drawn up. The line linking the system of Argentina with that of Bolivia was completed, two other Transandine lines were commenced, and the system was extended in the southern areas. By 1925 the total mileage reached 22,220, of which about 65% was British owned, 20% state owned and the remainder controlled by French interests.

Few good roads exist, the total length of roadway in 1925 being only about 10,000 m., less than one-half the railway mileage. A high power wireless station has been erected at Monte Grande in the province of Buenos Aires and submarine cable connection with Montevideo established. During the early years of war several naval transports were used in the coastal carrying trade, and formed the nucleus of a national freight fleet. Ships handed over by the Germans as compensation for the sinking of Argentine vessels were added to the fleet, which was still in being at the end of 1925.

Banking and Currency.—The monetary unit is the gold peso, or dollar, value at par, 47·58 pence. This coin is not in circulation, however, the unit of circulating currency being the paper peso, worth ·44 of the gold peso. Banking facilities have greatly increased during the period 1910–25. The central bank, the Banco de la Nacion Argentina, had over 210 branches and agencies throughout the country on Jan. 1 1925. Private banks are divided into native and foreign banks. In 10 important institutions the capital is wholly Argentine: the others, some 20 in all, are either branches of foreign banks or banks founded with foreign capital. A Government Postal Savings Bank was established in 1915.

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(W. H. Wi.)

ARGETOIANU, CONSTANTIN (1871–), Rumanian statesman, was born at Craiova. He studied law and medicine in Paris and was in the diplomatic service from 1907 to 1913. In 1914 he was elected a Senator and became Minister of Justice in Gen. Averescu's Cabinet in 1918. Together with Averescu and Cantacuzene he formed the People's League, which became the People's party in 1920. Later on, owing to dissensions, he left the party with a number of followers and joined the Nationalist-Democratic party under the presidency of Prof. Jorga. This group having coalesced with the Transylvanian party under Jules Maniu, Argetoianu became a prominent member of the new formation, which is called the National Rumanian party.

ARGONNE: *see* VICTORY, ADVANCE TO.

ARIZONA (*see* 2.544).—The population in the 1920 census was 334,162 consisting of: Whites, 291,449; negroes, 8,005; Indians, 32,989; Chinese, 1,137; Japanese, 550; all others, 32. As compared with the census of 1910 this represented an increase of 129,808, or 63·5%. The rural population constituted 64·8% of the whole in 1920 as against 69% in 1910. The population of the capital, Phoenix, was 11,134 in 1910 and 28,053 in 1920.

History.—In connection with the entrance of Arizona into the Union a question of national interest was raised. As provided by the Enabling Act signed by President Taft, June 30 1910, a convention met at Phoenix from Oct. 10 to Dec. 9 1910 to frame a constitution. The constitution then adopted provided that one-fourth of the electors of a judicial district might, by petition, demand the recall of a judge. If he did not then resign, a special election could be held to determine whether he should be recalled. In Aug. 1911 the House of Representatives passed a joint resolution providing for the admission of Arizona on condition that the constitutional provision for recall be submitted to a vote of the people. President Taft had already informed Congress that he would not sign the bill, and in a message to that body took the position that he must veto the measure or assume responsibility for the recall of the judges. Later in Aug. he approved a resolution granting statehood on condition that the provision for recall be struck out. This was done, and on Feb. 14 1912 President Taft signed the proclamation admitting Arizona.

After the state was admitted the people amended the constitution, inserting the original clause providing for the recall of judges. A second issue of national interest was the Alien Labour law enacted by the voters of the state in 1914. The Act provided that when any corporation, company, partnership or individual employed more than five workers, 80% of them should be qualified electors or native-born citizens. The ambassadors of Great Britain and Italy averred that the law violated existing treaties. The United States District Court declared the law unconstitutional as conflicting with the Fourteenth Amendment. On appeal the United States Supreme Court upheld the decision, Nov. 1 1915. The final decision was that it had already been established that aliens were entitled to equal protection under the laws of the United States.

The election of Nov. 1916 resulted in a situation that aroused high party feeling. Previously Gov. Hunt, supported by a Democratic Assembly, had been elected for two terms. In 1916 he ran for the third time. On the face of the returns, Mr. Campbell, the Republican candidate was elected; but both candidates came to Phoenix in Jan. to be inaugurated, and Mr. Hunt re-

fused to leave the executive office. Later he was compelled to surrender the office to Mr. Campbell, but resumed it again in Dec. 1917, after the State Supreme Court had declared him the legally elected governor. The bitter political struggle reflected a tense industrial situation that culminated in a number of strikes, the most important of which was the one at Clifton and Morenci beginning in Sept. 1915. The Bisbee deportation incident in July 1917, when over 1,100 members of the organisation called the Independent Workers of the World were deported to Columbus, New Mexico, produced an even more critical situation. President Wilson at once warned the governor of the danger of such a precedent and appointed a committee to investigate and adjust the dispute. The committee found that any adjustment between employers and labour organisations was impossible, and recommended a law making future deportations a Federal offence.

Irrigation.—In 1919 Arizona adopted a comprehensive code of water laws providing for the adjudication and control of water rights, and creating a State Water Commissioner. After 1920 especial attention centred in the Colorado river problem. (*See* COLORADO.) The utilisation of this river presents many difficulties, involving international as well as interstate interests in the water supply, and rouses controversy, not only as to the location of a dam or dams, but also as to whether the construction shall be by the Federal Govt. or by private corporations. The estimates for dam construction vary from $13,000,000 to $55,000,000, according to the location. The Colorado River Compact, formed Nov. 1922, in accordance with the provisions of an Act passed by Congress in the previous year, attempted to secure a division of the water among the seven states in the Colorado basin. The Compact was rejected by the Arizona Legislature in 1923. Two years later it was accepted with reservations by the Arizona Legislature, but vetoed by the governor. The objection to the Compact is that, if accepted, Arizona surrenders present rights to water and power. A conference of the states of the " lower basin " met on Aug. 17 1925 to discuss the possibility of agreement as to the division of water among these states, but it broke up immediately because of the uncompromising attitude of the states interested.

Education.—In 1916 a high school of the state was for the first time admitted to the North Central Association of Colleges and Secondary Schools. In 1925, 27 of the 52 high schools of the states were in the association. The growth of the normal schools at Tempe and Flagstaff kept pace in enrolment and equipment with the growth of the public schools, and in 1925 they were created into state teachers' colleges with four-year courses leading to the Bachelor degree. In 1910 a state school for the deaf was organised, at first affiliated with the university and under its direction, but later separated, with its own organisation. The University of Arizona increased from an enrolment of 84 regular college students in 1910–1 to one of 1,416 in 1923–4. The institution in 1925 was composed of five colleges on the campus at Tucson—College of Agriculture, College of Education, College of Law, College of Letters, Arts and Sciences, College of Mines and Engineering. The Agricultural Experiment Station, the Stewart Observatory, the Arizona Bureau of Mines, the State Pure Food Laboratory and the State Museum were also on the campus. In 1916 the University of Arizona was admitted to the North Central Assn.; in 1919 it became a member of the Assn. of American Colleges, and in Nov. 1924 the Assn. of American Universities voted that it should be added to the list of approved institutions.

Agriculture.—During the decade ending in 1920 the number of acres irrigated increased from 320,051 in 1910 to 467,565 in 1920, a gain of 46·1%. Almost a third of this gain was in Yuma co. as a result of the construction of the Laguna dam; the greater portion of the remainder was irrigated by pumping. The World War produced great changes in dairy-farming and cotton-growing. In 1916 the dairy industry reached its height when the number of dairy cattle in the Salt River Valley was estimated at 60,000. This number was reduced to about 8,000 at the end of 1920, when the high price of long staple cotton led to the increased production of that commodity. Later the fall in the price of long staple cotton caused the dairy industry to develop, and the dairy cattle in the valley in 1925 numbered about 24,000. The number of acres under cotton rose from 13,300 ac. in 1914 to 180,000 ac. in 1920. The low price of long staple in 1921 turned the farmers to the production of short staple, but the rise in price of long staple in 1924 again tended to increase the production of that variety. Horticulture greatly developed, and the production of orchard and subtropical fruits increased. The most important of the latter are grapefruit, oranges and dates.

Minerals.—In 1910 the production of copper was 297,250,538 pounds. This rose to 615,493,561 lb. in 1923, representing 42·89% of the total in the United States. The tendency during 1910–25 was toward the development of low-grade deposits, but the older companies were still working high-grade deposits in 1925. The stripping of Sacramento Hill, near Bisbee, was practically completed in 1920. The plant for handling this huge low-grade deposit began operations April 2 1923, and by the end of the year had treated 615,177 tons of ore, averaging 1·83% copper. Gold production in the state increased from 152,350 oz. in 1910 to 296,437 oz. in 1923, and silver from 2,566,528 oz. in 1910 to 7,376,832 oz. in 1923.

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ARKANSAS (*see* 2.551).—In 1920 the population was 1,752,204, an increase of 177,755, or 11·3% over that of 1910. It was divided 72·2% white, 27% coloured. Only 13,975 were foreign-born. The estimated population in 1925 was 1,907,000. The population was decidedly rural, only 290,497 being classified as urban in 1920. The density was 33·4 per sq. mile. Little Rock was the largest city, with a population of 65,142 in 1920, and estimated at 72,566 in 1925. Other leading cities were Fort Smith, Pine Bluff and Hot Springs. Since 1920 two small towns have enjoyed a remarkable growth, due to the discovery of oil—El Dorado, estimated at 25,000; Smackover, at 20,000, in 1925.

Agriculture.—Agriculture was still the leading industry and cotton the leading crop. The output for 1924 was 1,100,000 bales, valued at $125,400,000; for 1925, 1,349,184 bales. The seed crop in 1924 was 541,800 bu. valued at $17,338,000. The Arkansas cotton is of a high quality. The corn crop in 1924 was 36,300,000 bu. valued at $38,841,000. The development of the rice industry has been rapid. Introduced in 1904, the production was 2,400,000 bu. in 1910, 7,780,000 in 1920, 7,431,671 in 1925. In the amount produced per acre Texas alone exceeds Arkansas by about half a bushel. The state ranks well in the production of apples, both as to quantity and quality. Strawberries bring in about $1,500,000. In 1920 the state ranked fourth in the acreage devoted to vineyards, and many more have been set out since then. More and more attention is given to the raising of pure-bred live stock. The dairy industry also flourishes. The total value of agricultural crops in 1924 was $230,128,200, plus $58,832,400 for live stock. Since 1920 many counties have shown a decrease in the number of farms operated by owners and an increase in the number operated by tenants.

Manufactures.—Lumber and timber products still hold first place. The annual cut is about one and a half billion board ft., exclusive of firewood. Car and general construction and repairs have pushed ahead of cottonseed oil for second place, while furniture, made mainly at Fort Smith, is a valuable product.

Banks and Finance.—In 1925 there were 396 state and private banks and trust companies and 86 national banks with capital and surplus amounting to $24,759,000 and resources amounting to $270,252,000. Individual deposits amounted to $92,927,000, besides $22,413,000 on savings accounts. The increase in the ratio of the banking resources of the state to those of the nation

was exceeded in 1909–19 only by those of Oklahoma and Nevada. The state budget for 1925–6 amounted to $16,460,034. The total recognised debt was $2,597,166, of which $1,447,166 was considered permanent.

The school population in 1924 was 668,690, of whom 501,758 attended school. The state university is supported by taxation. The Legislature in 1925 changed the state normal school and the four agricultural high schools into colleges.

Transport.—In 1922 the state had 5,085 m. of steam railway and 126 m. of electric railway. The number of motor-cars, trucks and tractors had risen to 185,242 in 1925. There were 4,200 m. of hard-surfaced roads, some of them concrete, and in addition about 5,000 m. of improved highways. Most of the roads were built by improvement districts, but are maintained by the state. The Legislature in 1925 appropriated $6,500,000 for construction, maintenance and retirement of district bonds. The Federal subvention for 1925 amounted to $1,250,000.

Minerals and Mining.—Petroleum, first discovered in paying quantities in 1921, was in 1925 the leading mineral industry. The industry centres around El Dorado and Smackover. The production in 1925 amounted to 74,749,000 barrels, giving the state fourth place. The output of coal rose rapidly until 1913, since when there has been a decline, due in part to labour troubles. The bauxite industry reached its zenith in 1918 with a production of 532,000 tons. In 1924 the output was 442,451 tons. The first strong well of gas was opened in Crawford county in 1915 and one near El Dorado in 1921. In 1925 wells were in operation in Crawford, Sebastian, Nevada, Ouachita and Union counties. The state ranks first in the production of whetstones. The clay found in Saline county is used for the making of pottery of a very artistic type, called Niloak. Building stone and granite of a high type are found near Batesville. The only known diamond field in North America is in Arkansas.

History.—The state has continued under the control of the Democratic party since 1874. Down to 1924 only 10 out of 39 proposed amendments to the constitution of 1874 had been adopted. This was largely due to a ruling of the Supreme Court that, even after the adoption of the new initiative and referendum measure in 1910, a majority of the total vote was necessary for adoption. In 1920 a new initiative and referendum measure, which declared that only a majority of the votes cast on a measure was necessary for its adoption, forbade all local legislation by the Legislature, and provided for the initiative and referendum in counties and municipalities, received a majority of the votes cast on it, but not a majority of the total vote. Submitted again in 1922, it failed to receive a majority of the votes cast on it.

In 1924 three amendments received a majority of the votes cast, but not a majority of the total vote. A writ of mandamus was sought against the Speaker to compel him to declare the second of these adopted. As all the amendments were in the same class, the Supreme Court judges declared themselves disqualified because one of these measures affected their salaries. The governor accordingly appointed a special supreme court, which reversed the earlier decision and declared that only a majority of the votes cast on a measure was necessary for its adoption. This was made retroactive and brought to life the new initiative and referendum measure which had been declared not adopted in 1920.

Important legislation after 1910 included provision for a state farm for convicts, industrial schools for delinquent women and children, a minimum wage law, since declared unconstitutional by the U.S. District Court, a compulsory education law, and measures giving women the right to hold office, requiring teachers to present certificates of freedom from tuberculosis, legalising co-operative marketing associations, and creating a warehouse and marketing bureau. All efforts to reform the general property tax have failed, but more revenue has been secured by new taxes. The governors since 1909 have been: George W. Donaghey (1909–13); Joseph T. Robinson (Jan. 8—March 1913); W. K. Oldham (acting) (March 8–23); J. M. Futrell (acting) (March 23—Aug. 6); G. W. Hayes (Aug. 6 1913–7); C. H. Brough (1917–21); J. T. McRae (1921–5); Tom J. Terral (1925–).

(D. Y. T.)

ARMAMENTS; *see* AIR FORCES; ARMY; BATTLESHIP; NAVY, etc.

ARMENIA (*see* 1.564).—The Soviet Socialist Republic of Armenia is a component part of the Federation of the S.S. Republics of Transcaucasia, itself a unit of the Russian Soviet Union (U.S.S.R.). The area of the republic is about 27,000 sq. km., and its population, 1,000,000, 86% of which is Armenian. It consists of the provinces of Erivan and Alexandropol, and lies between the Araxes and the Kura rivers. There are about 600,000 Armenians in Georgia and Azerbaijan, and another 500,000 in Northern Caucasus and in other parts of the Union of Russian Soviet Republics.

Under Turkish Rule.—In 1911 the Young Turk administration had produced noticeable improvement in the conditions of Armenian life in the Ottoman Empire. Although there were occasional disorders and acts of injustice, the general security prevailing in the vilayets bestowed economic and social benefits on the people. Freedom of movement and travel gave great impetus to agriculture, cattle-breeding and commerce. Tens of thousands of Armenian exiles had returned home and recovered their lands and properties. Military service by Armenian youth in the Ottoman Army and the presence of Armenian Deputies in the Chamber gave the nation a new status in the empire.

Armenians under Tsarist Rule.—The Armenian people in Transcaucasia were in a not less favourable condition. As a counterpoise to the restoration of their lands to the Armenian peasants in Turkey, the Russian Imperial Duma voted a credit to enable Armenian and Tatar peasants in Transcaucasia to repurchase their lands and become independent proprietors. The comparatively impartial administration of Count Vorontsov Dashkov, the Viceroy of the Caucasus from 1905 to 1915, had given opportunities for national and economic development. Yet at this period even the Armenian leaders of Transcaucasia looked across the frontiers to progressive Turkey as the rallying ground for the Armenian race.

"Reform Programme" of 1913.—After the overthrow of the balance of power in the Balkans by the Balkan Wars of 1912–3, Russia,[1] supported by Great Britain and France and reluctantly followed by the Central Powers and Italy, took the initiative in drawing up a scheme of "reforms" for the Armenian vilayets, Trebizond being added to the other six vilayets defined as Armenian in the Treaty of Berlin, 1878. No Armenian then asked for reforms. Fearing, however, that the European negotiations might compromise his people, the Catholicos of Ejmiadzin persuaded Boghos Nubar Pasha to visit Petrograd as his delegate in May 1913.

The diplomatic representatives of six European Powers met on the Bosporus in the summer of 1913 to discuss the Russian draft. A scheme emerged in the autumn, according to which the seven vilayets of Erzerum, Van, Bitlis, Diarbekr, Trebizond, Kharput and Sivas were to be divided into two sectors over each of which a European inspector was to supervise the carrying out of reforms. At the time when the scheme was imposed on a defeated Turkey, in 1914, the Armenian people on both sides of the frontier had never been more compact and prosperous. Between the watersheds of the Euphrates and the Kura, about 3,000,000 Armenians constituted a strong and healthy nationality.

Armenians in the World War.—When the Turks mobilised in Aug. 1914, Armenian recruits responded to the call. The Armenian ecclesiastical authorities and the party leaders assured the Turks of their loyalty, but could not vouch for their compatriots in Transcaucasia. The declaration of war between the Allied Powers and Turkey (Nov. 1914) immediately turned the thickly populated Armenian-Kurdish frontier districts into a battlefield. The harshness of Turkish requisitions and ill-treatment of Armenian troops in the Turkish Army increased the number of deserters, and caused racial friction. Among the Russian forces operating on the Caucasian front were various volunteer units, as well as some Armenian regiments consisting mostly of Ar-

[1] See *Orange Book* of Russian Foreign Office, Feb. 1915.

menians from Russia, but including Armenian political refugees from Turkey encouraged by the repeated declarations of Allied war aims to follow a doubtful course. The Turks confounded Armenian resistance to injustice with sympathy for the Allies. The successful defence of the Armenians in Van strengthened Turkish suspicions. Armenian peasants in the war area were forcibly driven from their homes in April 1915 and many of them were murdered. Simultaneously with one of the worst defeats of Tsarist Russia in Galicia and the utter failure of the British naval attack on the Dardanelles, the three Entente Powers issued in the third week of May a joint threat to the Turkish Govt. to the effect that they would hold them individually and severally responsible for any further Armenian "atrocities." The Turks translated this official threat into the language they were accustomed to understand by past experiences, and drew their own conclusion therefrom.

The Committee of Union and Progress, which had been wavering in April and May in their Armenian programme, resolved at the end of May on the murder, deportation and spoliation of the entire Armenian people in Turkey (see J. Lepsius, *Deutschland und Armenien*, 1919, page 19). Telegraphic instructions were issued by the Turkish Govt. to provincial authorities to "evacuate" all Armenians from the military zones, where they represented "danger" to Turkish defence and deport them to the deserts of Mesopotamia and Syria. This scheme was carried out in June–July 1915, with unparalleled barbarity; men, women and children were murdered indiscriminately and the remainder driven to the desert to fend for themselves.

This "evacuation" of the Armenians produced a fundamental change in the attitude of Entente Powers toward the Armenian question. The Grand Duke Nicholas, who had replaced the former Viceroy, occupied Erzerum, Trebizond and the upper valleys of Euphrates and Tigris. This achievement enabled the Grand Duke to proclaim in the summer of 1916 "the liberation of Armenia from the Turkish yoke." He tried, however, to bar the native surviving Armenians from returning to settle in the occupied region, because Tsarist Russia had planned to plant Cossack settlements in the Araxes and Euphrates valleys on Armenian-Kurdish fertile lands.

This "Euphrates Cossack" idea had its repercussion in Great Britain. In spite of the secret treaties concluded by the Allied Powers for the partition of Turkey, the British Prime Minister declared in his Guildhall speech in 1916 "that H.M. Govt. was resolved to secure the liberation of this ancient (Armenian) people."

Soviet Russia and Armenia.—The Russian Revolution of 1917 eventually resulted in the secession of Transcaucasia from Russia after the dispersal of the Russian armies. On his accession to power, Lenin proclaimed the unity of Armenian lands and sent Shahumian to organise it. By the Brest-Litovsk Treaty of March 1918, however, Soviet Russia was compelled to cede the Batum, Kars and Ardahan districts to Turkey. The Federated Republic of Georgians, Armenians and Tatars, which was formed in consequence of Bolshevik Revolution, attempted to resist the Turkish advance. But misunderstanding broke out among the three peoples, and the Turks occupied the three ceded districts. Under the auspices of German military leaders then in Transcaucasia and with the help of Turkey, the Armenians in Transcaucasia proclaimed their independence on May 28 1918, with their capital at Erivan.

After the Armistice the victorious Allied Powers again promised to reconstitute Armenian nationality. Some efforts were made to concentrate the surviving Armenians in Turkey in Cilicia, then occupied by British troops, presumably with the idea of making that area the home of the Ottoman Armenians; whereas in Transcaucasia the British military authorities in occupation were indifferent to Armenian legitimate rights. A small war between Georgia and Armenia was stopped by them.

Armenian Delegates at the Paris Conferences.—At the Peace Conference in Paris the Armenian Delegation were induced to demand a "great Armenia" extending from sea to sea. President Wilson was being urged to accept a mandate for this "great Armenia." Consequently the two Armenian delegates, Boghos Nubar Pasha and M. Aharonian, presented a memorandum to the Supreme Council in Feb. 1919. The demand was conditional on the acceptance of a mandate by the United States, which the American Senate did not want. While the negotiations for peace with Turkey were dragging on, the Armenian delegates concluded an Agreement with Sherif Pasha, the Kurdish delegate to the Peace Conference, in Oct. 1919. In the Conference held in London in March 1920, the Armenian delegates again pleaded their case. In April at the San Remo Conference the Supreme Council offered the mandate for Armenia to the League of Nations. The arrangements made with regard to oil at San Remo, however, hastened the reappearance of Russia at Baku. This approach of Soviet Russia had its immediate effect in Armenia and Georgia, both of which negotiated peace treaties with her in May. The Armenian delegates in Moscow were offered assistance if the Armenian Govt. allowed the transport of Russian troops over the railway line of Alexandropol-Kars-Erzerum to go to the rescue of the Turks, who, hard pressed by the Greeks in the west, were willing to make any concession. The Armenian Govt., after consultation with the British representatives, rejected the Russian offer. In the summer of 1920 the Turkish Nationalist Govt. at Angora repeatedly invited Erivan to negotiate a separate peace, but the delegate of the Armenian Republic signed the Treaty of Sèvres on Aug. 10, which provided a *de jure* recognition of the independent Armenian state.

Two months after the signature of the Treaty of Sèvres the Turks attacked Armenia. Abandoned by the Allied Powers and badly equipped, the Armenian Army put up little resistance to the Turks, who by the end of Nov. had occupied Kars and Alexandropol. After the Armenian Govt. had signed a treaty of peace, Soviet Russia rushed troops, led by Armenian Bolsheviks, to Erivan, and by an open telegram invited the Turks instantly to stop the operation.

S.S. Republic of Armenia.—A Soviet Armenian Govt. was established in Erivan in Dec. 1920 amid circumstances of famine and disruption. Since that time the Armenian Communist party, about 1,000 strong, has been governing the country. With the financial support of Soviet Russia and the Federated republics of Georgia and Azerbaijan, the Armenian Soviet Govt. has established peace and a measure of prosperity. Barren land and marshes have been reclaimed by a scientific system of irrigation, and considerable encouragement is given to cotton and tobacco growing. Copper mines at Allahverdi and Ghatar are in process of exploitation, and schemes of generating electric power are in progress.

Armenians Abroad.—The position of Armenians of Turkey stands to-day as follows: there are about 100,000 Armenians in Constantinople. When the French evacuated Cilicia in 1921, about 80,000 Armenians migrated from that district to Syria under deplorable circumstances. There they still remain, insecure and helpless. The Greek rout at Smyrna in 1922 drove about 100,000 Armenians to Greece and the Balkans, where they remain since in uncertainty. There are large or small communities of Armenians in the United States of America, Persia, France, Egypt and smaller groups in various European and Asiatic countries.

Nansen Settlement Scheme.—After five years of discussion, the League of Nations at last sent a commission in 1925 to Armenia headed by Dr. Nansen to report upon the possibilities of settling refugees within the frontier of the republic. Dr. Nansen recommended a loan of £900,000 to the Armenian Govt. for this object, and the Council of the League has set up a commission to arrange the loan.

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ARMOUR, JONATHAN OGDEN (1863–), American merchant, was born in Milwaukee, Wis., Nov. 11 1863, the son of Philip D. Armour (*see* 2.578). He entered Yale in 1881, but did not finish his course, as in 1883 he joined the business of Armour & Co. Made a partner the following year, he became general manager and head of the company after the death of his father in 1901. Under his guidance the business became one of the largest

in the United States, branching out into the preparation of by-products. In 1920 the company was forced by the action of the U.S. Govt. to restrict its operations to a wholesale business in meat, poultry, eggs, butter and cheese.

ARMOURED CAR, a motor-car or lorry provided with protective armour and adapted as a fighting machine. The main characteristic of an armoured car is great mobility. An objective which is situated as far as 200 m. from the main body of an army can be attacked by an armoured car within 10 hours under suitable conditions. The early types of armoured car consisted of motor-cars or lorries with iron plating fastened on the sides. The design developed rapidly into cars that were completely protected by armour plate and provided with one or two turrets with all-round fire.

On the outbreak of the World War in 1914, the possibility of using armoured cars was at once apparent; but, owing to the numerous requirements for motor transport in other directions, it was not found possible to supply them in any numbers while the mobile warfare on the Western Front lasted, though the armoured cars of the Royal Naval Air Service rendered valuable service on the Belgian coast a few weeks before the trench deadlock became established. Later, when the armies settled down to trench warfare, the roads were blocked and armoured cars could not be used. They were, however, employed with considerable success on several occasions during the last few months of the War when the mobility of the armies was partially restored. Although armoured cars are confined to roads in most parts of Europe, they can traverse large tracts of desert in countries such as Egypt. During the War, British armoured cars were successfully used in Egypt, Mesopotamia, east and south-west Africa, Rumania and south Russia.

Attempts have been made to give armoured cars some means of leaving the roads and traversing ordinary country when required. These attempts have taken the form of replacing the rear wheels by short endless belts of the tractor type, or of arranging that the wheels can, when desired, be removed and the weight taken by a pair of steel or rubber tracks. These experiments have so far resulted in machines that have a reduced mobility compared with an armoured car and less fighting power than the tank. Wheels have therefore been retained for armoured cars, and cross-country work is confined in most countries to tanks. (*See* TANKS.)

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(G. LE Q. M.)

ARMOURED TRAINS.—In the earliest days of the application of railways to war uses, the idea presented itself of utilising the weight-carrying capacity of the railway and the pulling power of the locomotive for tactical as well as for strategic purposes. "Railroad batteries" figured in the American Civil War and in the war of 1870–1 and armoured trains have appeared thereafter sporadically in most wars. Their utility, though it was confined within rather narrow limits, was unquestionable until the development of mechanical road transport.

Nowadays, however, in countries where the rail system is sufficiently developed to give such trains real freedom of movement there exists an even fuller system of main roads on which armoured cars can operate, and in the World-War period the fighting train only figured in such theatres as those of the Russian civil wars, in which roads fit for heavy traffic are as a rule rarer than railways. As against the armoured car working on good roads the train must always suffer from being limited to certain tracks which are very easily interrupted by raids, air bombing, or artillery fire, and in the future, as cars of the four-wheel drive or caterpillar types improve, the freedom of movement of the armoured car cannot but increase even in theatres of war in which roads are few.

On the other hand, the old railroad battery, considered as a form of gun-mounting, possesses many advantages over other forms of mounting heavy ordnance for field warfare. In the well-laid bed of a railway track, organised to distribute heavy strains equably, such mountings have their firing platform ready made, and the power of the locomotive gives heavy artillery a mobility that otherwise it would lack. In this form, then, the train represents the battery vehicles of horsed or motor artillery. The central member is the heavy truck carrying the gun, and the others are arranged for ammunition and for the accommodation of the gun personnel. Light armour is frequently used for the protection of the vehicles against shrapnel bullets, and in some cases the gun itself is provided with a shield. (*See* ORDNANCE.)

ARMSTRONG, HENRY EDWARD, British chemist, became, in 1874, professor of chemistry in the London Institution. In 1876 he was elected F. R. S. and served on the council of the Royal Society 1888–90, 1900–2 and was vice-president in 1901–2. He achieved considerable success in his researches on organic and general chemistry, particularly in his work on the terpenes, the naphthalene and benzene series, and on physical chemistry. He was professor of chemistry in the City and Guilds College, South Kensington, and took a prominent part in the advancement of his science.

ARMY (*see* 2.592).—The following article constitutes an account of the outstanding changes which have taken place since 1910 in the general principles governing the organisation and maintenance of armies. The first section of the article may be taken as applying to the military forces of all the Great Powers. There follow more particular discussions of the armies of the British Empire and the United States. For details concerning the armies of the other Great Powers (France, Germany, Russia, Italy, etc.), the reader should consult the articles on those countries.

I. GENERAL

As was only to be expected in view of the vast scale on which the World War was fought, of its protracted character, and of the impetus which was given during its progress to scientific investigation for military purposes, certain modifications were brought about during its course in the organisation of the armies that participated in the struggle.

Aviation.—One very important fresh factor had been brought into play even before hostilities commenced in Aug. 1914, although it was then still almost in the embryo stage. This was the discovery between 1909 and 1911 that aviation was a practicable undertaking, and the immediate recognition by soldiers that this new art could be turned to good account in the furtherance of military operations on land. The consequence was that flying corps were introduced into several of the European armies between the years 1911 and 1913, and that, by the summer of 1914, each one of the major countries to become involved in the conflict could lay claim to possessing a number of efficient air units, fully equipped and ready to take the field. Military authorities in general were, however, at that time disposed to take the view that the main purpose which aviators would be able to fulfil satisfactorily in face of the enemy was the carrying out of reconnaissance work, in some measure taking the place of cavalry in the performance of this important duty.

But at a very early stage of the hostilities it became apparent that aeronautical units could and should fulfil other functions as well (*see* AIR WARFARE). The experience gained between 1914 and 1918 has caused all the more important European States, other than the United Kingdom, Italy and Germany, to include in their armies aviation corps which are in all cases organised on a considerably more ambitious scale than were the aviation corps which they possessed in 1914. The United Kingdom and Italy have elected to divorce their flying corps entirely from their armies. Germany is precluded by treaty from maintaining one.

Weapons.—The most notable changes in this category are the increase in the proportion of machine guns and the number, calibre and mobility of heavy guns and howitzers; and the introduction of an entirely new weapon, namely the tank (*q.v.*).

As regards machine guns, it should be mentioned that the Germans took the field in 1914 with a far larger proportion of

them than did any other belligerent. It was one cause of their early successes. Their opponents speedily realised the importance of the question, and they made desperate efforts to multiply their stock; this proved to be but a slow process, seeing that machine-guns take a particularly long time to manufacture. The lesson has, however, been learnt, and most armies to-day are adequately supplied with these weapons.

Although the Germans were better fitted out at the outset of the struggle with mobile heavy howitzers than were the other belligerents, the full value of these and of mobile heavy guns in modern warfare only came to be recognised gradually even by them. The paramount importance that these forms of artillery acquired on the Western Front as the conflict proceeded, was to some extent due to the form of sedentary trench warfare which the operations assumed after the first three months. But during the progress of the struggle in various theatres it became apparent that the "caterpillar" form of mechanical traction could be so developed as to make howitzers of great weight reasonably mobile and howitzers of medium weight highly mobile, and that such relatively ponderous forms of artillery were in consequence capable of being employed to good purpose even in campaigns of movement. The result of these experiences is to be seen in the numbers of batteries armed with such weapons maintained as an item in most armies of the present day (*see* ARTILLERY).

Tanks first appeared in the field in the summer of 1916 during the British offensive in the Somme region, their manufacture and their presence with the troops having been kept a secret. Their potentialities in trench warfare were recognised at once, but the United Kingdom enjoyed a great advantage in having the start. The French immediately embarked on manufacture, and the Germans followed suit after capturing a few tanks. Many improvements on the original pattern were devised before the close of hostilities, and further improvements have been carried out since that date, with the result that tanks, which were in the first instance introduced merely for the special purpose of attacking elaborate lines of trenches, are now capable also of playing a prominent rôle in the most mobile military operations. Their design, moreover, is continuously undergoing elaboration and development.

Transport.—Just as in civil life mechanical traction is tending to oust horse traction, so also in the military world lorries and the lighter forms of motor vehicle are more and more replacing the old horse-drawn wagons and carts and ambulances which used to trail behind the troops. But in the case of armies, the caterpillar type necessarily assumes a far greater importance than it does in civil life in countries that are provided with roads. Although certain developments in respect of the employment of mechanical traction took place during the World War (quite apart from the question of tanks or of heavy artillery), the tendency of the day is to carry this considerably further. The idea is to make armies entirely independent of roads.

Cavalry.—The relative value of cavalry in normal conditions of warfare, as compared with that of the other two main arms—infantry and artillery—has been tending to decrease steadily, as the power of fire-arms in all forms has grown. The experiences of the World War have, on the whole, had the effect of thrusting mounted troops still more into the back-ground, partly owing to the development of aviation, and partly because cavalry can be of little assistance when trench warfare prevails. Nevertheless, it was shown in Palestine and also in Mesopotamia that there was still plenty of scope for mounted troops and, even if most countries have been showing a disposition to reduce the strength of the mounted troops they maintain, the day of the mounted combatant is by no means over.

In the course of the World War permanent troops, troops of the militia type and new formations all underwent exhaustive trial under varied circumstances, and each of the three categories gave evidence of its worth under at least certain conditions. Of regular troops nothing need be said. It has never been suggested even by the most enthusiastic believers in forces such as the British Territorial Army, that they come up to the high standard of efficiency expected of standing armies.

Territorials and Reserves.—In regard to semi-permanent troops, it has to be acknowledged that the German Reserve divisions, the French Territorial divisions and the British Territorial divisions, when first pitted against regular troops, were considerably below the standard of efficiency which they afterwards attained. They required time, coupled with a form of operations not calling for a high standard of training. And they were granted both. The first British Territorial units to be placed in the field crossed the Channel in Sept. 1914; the last took the field some 17 months later; these troops were thus actually fighting from $2\frac{3}{4}$ years to four years, and they were bound to learn their work before the War ended. The Germans put most of their Reserve divisions into the field at once, as did the French in the case of their Territorial divisions, and neither German nor French non-permanent troops compared with permanent troops during their early months in face of the enemy.

New Armies.—As regards troops only created at the outbreak of War, the British new armies set on foot by Lord Kitchener afforded a shining example in the World War. Speaking generally, these troops did well quite early, always provided that, after reaching the theatre of operations to which they were sent, they had been broken in to their duties by slow degrees. Trench warfare generally admitted of this important principle being carried out. If tried severely at the start—as at the Dardanelles—they were apt to fail. The first new army division crossed the Channel to France in May 1915, nine months after the units composing it had been created; the last one took the field a year later. They performed magnificent service in all the later stages of the War; but they had all by that time met with ample opportunities for learning their work, and nearly all of them, moreover, had spent many months in sedentary warfare before they were put to higher tests. Opinion at British G.H.Q. in France was at first disposed to ridicule the creation of these new armies. If that was partly because the magnitude of the struggle was not realised, nor its duration forseen, it was also a result of mistaken notions as to the time required before newly created troops can be made fit to fight. It was generally assumed that a recruit must undergo several months of training before he was fit to be drafted to a regiment serving in the field, but experience in the later years of the War proved that a few weeks' training is quite sufficient for drafting purposes. There were men in the corps which broke the Hindenburg line at the end of Sept. 1918 who four months before had not yet put uniform on.

War Wastage.—Military ideas upon the subject of war wastage have perforce undergone a transformation since 1914 as a result of bitter experience. Not one of the belligerent states taking part in the World War was prepared for the rate at which this wastage was to occur. It proved to be incomparably higher than it had been in any previous contest, in spite of the fact that, thanks to improved medical arrangements and more efficient surgery, wastage from disease (except in unhealthy theatres like Macedonia and East Africa) was relatively small and the proportion of wounded men who speedily recovered was relatively very high. The premises upon which calculations as to strength of reserves required to keep a force of given strength in the field had been based proved to be valueless at a very early stage of the contest. The Dardanelles campaign, for instance, lasted only $8\frac{1}{2}$ months; but, although the maximum strength of the British Army in the field was only 128,000, the casualties amounted to 112,000, including 39,000 killed or missing. An army to be properly organised for great operations of war must possess far greater reserves in some form or other than had been supposed to be necessary in the summer of 1914.

Chemical Warfare.—Chemical warfare played an important rôle in some of the theatres of operations during the World War, and is not unlikely to play a still more important one in wars of the future. But its introduction as an element in warfare is rather a question of tactics, equipment and research than of army organisation. The same holds good with respect to the employment of hand grenades, of trench mortars and other devices especially applicable to trench fighting (*see* CHEMICAL WARFARE).

II. THE BRITISH EMPIRE

The British Army, in respect to organisation, stands very much where it did in 1914. Its system of command and of administration has undergone little alteration. The system of recruiting, alike for the regular forces and for the territorial forces, remains practically as it was. Its order of battle, supposing it to be brought to a war footing, has only changed in points of detail. Its powers of expansion in an emergency have been increased neither in principle nor in practice, in spite of all that has occurred since the year 1911. At the beginning of Aug. 1914 the military forces of the United Kingdom, comprising the regular army, the special reserve and the territorial force, were designed in case of a grave national emergency to place an expeditionary force of six divisions and a cavalry division in the field oversea, with an additional division to follow, and to retain 14 territorial divisions in the British Isles for the purpose of home defence. The regular army also provided garrisons for a number of localities oversea.

Expansion in 1914–5.—No plan for the expansion of the British regular forces at home beyond the requirements of the expeditionary force, with its additional division, existed when the World War broke out, apart from the automatic embodiment of the special reserve, which provided units for home defence, and could be utilised for draft-producing purposes to replace wastage in the expeditionary force after the army reserve had been used up. Lord Kitchener, however, immediately called home the bulk of the regulars from India and from the other oversea garrisons, and by this means four further divisions were provided as an addition to the seven already contemplated. He, moreover, took immediate steps to duplicate the 14 territorial divisions and one of these newly improvised divisions, besides two of the old ones, had left England for India before the end of Oct. to replace regulars brought home. But the greatest expansion of all took place in the form of the so-called "New Army." Its first six divisions were created in Sept., the next twelve were created in Oct., the next six in Nov. and the last six in Jan. 1915.

There was also a certain expansion of mounted troops, but not on a large scale. Actually, 55 divisions, recruited in the United Kingdom, took part in the War, and there were also the three territorial divisions sent out to India in the autumn of 1914. When war was declared it had only been hoped to send abroad a force of 160,000 men, to be followed soon afterwards by another 20,000; but during the later stages of the contest the United Kingdom had a field army of nearly a million and a half fighting in various theatres, besides the forces supplied by the Dominions and Colonies and India.

In July 1914 the strength of the regulars, army reserve, special reserve and territorial forces was approximately 670,000; 4,970,000 men were recruited during the following $4\frac{1}{4}$ years within the United Kingdom. Recruiting remained voluntary up till March 1916, when compulsory service was introduced, in the first place for unmarried men, and subsequently for married men, between the ages of 18 and 41, unless exempted for medical or other special reasons. In the spring of 1918 an Act was passed raising the age limit to 50 and cancelling various exemptions previously in operation.

Dominions and Colonies.—At the beginning of the War the Dominions and Colonies had no more than some relatively small forces of permanent troops; they nevertheless placed large fighting forces in the field, the troops being in almost all cases freshly recruited and specially organised for the purpose. Canada produced four divisions which took the field, besides another which was used for drafting purposes. Australia produced five divisions, and New Zealand one. Australia and New Zealand, between them, also placed two divisions of mounted troops in the field. The troops raised in South Africa were almost entirely employed in Africa. Table I. shows the numbers enlisted and sent oversea.

India.—The Indian Army at the outbreak of the War was organised in nine divisions, together with an incomplete division in Burma. This organisation was, however, to some extent thrown out of gear by the recall of the greater part of the British troops to Europe to fight on the Western Front; the territorial divisions sent out to replace these troops were not, at all events for the first few months, sufficiently trained to take the field, and they were to a large extent broken up and at first used for garrison purposes. India, nevertheless, contributed 10 divisions for work in field armies, besides finding the force which originally embarked on the campaign in East Africa. Of the divisions that took the field, only three were divisions that had existed before hostilities broke out; three more were organised during the early months of the contest. Then, after the disasters in Mesopotamia early in 1916, five entirely new divisions were created, of which four took the field before the end of the War, all of them proceeding to Mesopotamia. Of the divisions actually employed in various theatres, one was captured at Kut and three were broken up during the conflict; so that at the time of the Armistice there were actually only six in the field. The total number of natives of India enlisted during the progress of the War amounted to 1,524,187. The number of casualties suffered by the Indian Army during the course of the contest was approximately 160,000, chiefly in Mesopotamia, Egypt and Palestine.

TABLE I.

Dominion	Total in arms	Sent oversea
Canada	628,964	418,035
Australia and Tasmania	416,809	330,000
New Zealand	220,099	100,471
South Africa	136,070	74,196
Newfoundland	11,922	10,610

The Army Since the War.—The reduction of the military forces recruited in the United Kingdom to their peace footing necessarily occupied considerable time; and even after the Armistice they had to be kept more or less on war establishment for many months. Not until 1921 could it be said that the army had got back to pre-War conditions, and its strength still greatly exceeded that of 1913, in spite of the Air Force having been detached. The army estimates in 1922–3 amounted to £62,000,000, as compared with the figure £28,220,000 for the year 1913–4. The Geddes Committee, however, took the matter in hand, and the equivalent of five cavalry regiments, 24 infantry battalions and a number of artillery units were reduced, saving £10,000,000.

One important change carried out since the War has been the disappearance of the special reserve; there is, however, an intention to restore the Militia in course of time, and its battalions appear in the Army List as skeletons. A supplementary reserve of officers and men was set on foot in 1924, the rank-and-file being mainly technical and arranged in two categories, trained and untrained. Moreover, the territorial army is now asked to accept liability for service oversea in time of war, subject to sanction of Parliament, instead of being intended purely for home defence as it was before 1914. The three branches of the Royal Artillery were re-amalgamated as regards officers in 1921, as a consequence of war experiences. Two entirely new corps have been constituted—the Royal Corps of Signallers and the Royal Tank Corps. The former is an expansion of the arrangement under which signalling was mainly in the hands of the Royal Engineers, the latter a consequence of the introduction of the tank for war purposes in 1916. Table II. shows the establishments of the home forces provided for in Army Estimates in 1911 and 1926, and the establishments of the different branches of the regular army in those two years.

The Indian Army since the War.—The demobilisation of the Indian Army was carried out more rapidly on the conclusion of hostilities after 1918 than was the case with the home troops, although the Afghan War to some extent delayed the process. Moreover, soon after demobilisation was complete, a reorganisation took place, the result of which was to reduce the strength of both the British and the Native portions of the army to below the pre-War figure. Some other changes of importance have also taken place. In 1921, the forces as a whole were divided into four army commands—Northern, Eastern, Southern and Western. In that year a territorial army was started, as also an Indian army reserve of officers in two classes. The auxiliary forces were

TABLE II.

Category	1911	1926
Regular Forces	168,233	142,432
Army Reserve	138,000	96,000
Special Reserve	86,539	..
Supplementary Reserve	..	23,151
Militia Reserve	700	..
Militia Channel Islands	3,163	1,325
Malta and Bermuda Militia	2,894	1,437
Territorial Forces	315,408[1]	186,093
Officers' Training Corps	823	1,245
Total	715,760	451,683

Branch	1911	1926
Cavalry	14,762	9,680
Artillery	32,881	24,233
Engineers	9,610	6,623
Corps of Signallers	..	5,013
Infantry	96,182	77,457
Tank Corps	..	3,294
A.S.C.	6,696	6,303
R.A.M.C.	4,637	4,163
Other Departmental Corps and Establishments	3,465	5,666

[1] 267,500 effective

also reorganised and rendered more efficient. It was decided that the field army should consist of four divisions and five cavalry brigades.

The following table shows the numbers of combatant British regular units maintained in India in the years 1911 and 1926 respectively:—

	1911	1926
British:		
Cavalry Regiments	9	5
Batteries	66	64
Infantry Battalions	52	46

The establishments of various units making up the British military forces in India in 1926 made an approximate total of 61,550.

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III. THE UNITED STATES

On Feb. 27 1911 Congress added 200 line officers to the regular army in order to meet the demands of the National Guard for instructors; increased the Corps of Engineers by 60 officers; gave 60 dental surgeons to the service, and rectified relative rank for those adversely affected by regimental promotion. On Aug. 24 1912 an Act, commonly known as the "Manchu law," required line officers to serve two years out of every six with troops. On April 27 1914 Congress gave $250,000 for aircraft, and on July 18 1914 it authorised an aviation section of the Signal Corps, totalling 60 officers and 260 enlisted men.

On June 3 1916 came the National Defence Act, which increased the regular army from a war maximum of 128,653 to one of 287,846; organised the army of the United States into the regular army, volunteer army, officers reserve corps, enlisted reserve corps and the National Guard while in the service of the United States; provided for the aforesaid increase in five annual increments, unless the President desired in an emergency to call out the whole force; limited the number of enlisted men of the line to 175,000; proportioned the regular army into 65 regiments of infantry, 25 of cavalry, 21 of field artillery, seven of engineers, a coast artillery corps, two battalions of mounted engineers and other corps, and bureaux of the War Dept.; established the organisation of a division into three brigades of three regiments each, with auxiliary troops; made the term of enlistment seven years, three with the colours and four with the reserve; inaugurated vocational training and federalised the National Guard by causing each member thereof to take a new oath, which bound him to the will of the President as well as to State authority. On Aug. 29 1916 another Act created a Council of National Defence, composed of the secretaries of War, the Navy, the Interior, Agriculture, Commerce and Labour, for the "co-ordination of industries and resources for the national security and welfare."

Mexico.—On March 9 1916 the Mexican bandit, Pancho Villa, with about 1,500 men, having attacked Columbus, N.M., and having killed 18 Americans and wounded many others, units of the regular army and National Guard were concentrated along the border, and Brig.-Gen. J. J. Pershing was sent into Mexico at the head of a provisional division of regulars (two brigades of cavalry and one of infantry with auxiliary troops). After about 12 minor engagements the expedition was called home and the National Guard organisations were ordered to their respective states (Feb. 1917). For the great conflict about to ensue this Mexican campaign gave extra training to the National Guard and demonstrated to the War Dept. a deficiency in means of transportation for all troops.

The World War.—On April 6 1917, when the United States came into the World War, the regular army had received only its first increment from the Act of 1916, and the National Guard was undergoing combined demobilisation and reorganisation. The strength of the United States forces on April 1 1917 was 199,705 officers and enlisted men, of whom 127,588 were regular army, 5,523 Philippine Scouts and 66,594 National Guard in the Federal service. In addition, there were some 4,000 in the enlisted reserve corps and some 117,500 national guardsmen not in the Federal service. The regular army was distributed as follows: United States (especially on the Mexican frontier), 88,798; Philippines, 17,951; China, 1,383; Hawaii, 9,900; Panama Canal zone, 7,300; Porto Rico, 1,484; Alaska, 772. As to officers, there were 5,960 in the regular army, some 3,000 in the officers' reserve corps and 3,199 national guardsmen in the Federal service, making a total of over 12,000. In addition, there were some 5,000 National Guard officers in state service.

Mobilisation.—The three great problems which confronted the general staff in obtaining a proper army were: first, the lack of any legalised system for raising a sufficient number of men in an equitable and efficient way; second, the great dearth of officers as instructors and trainers; and third, the immediate demand for sufficient shelter and supplies for the large numbers of men necessary for the work in hand.

The first problem was met by the Selective Service Act, May 18 1917, which in substance brought the regular army to full war strength and provided for drafting all members of the National Guard and its reserves, for raising by voluntary enlistment only four infantry divisions, and for conscripting a force of 1,000,000 men. As a result, on June 5 1917, there registered for the draft 9,925,751 men; and on July 3 1917 the President called into service the entire National Guard, with a resulting total of 379,323 by Aug. 5 1917. The calling of the first draft to the colours was delayed by lack of shelter and supplies, especially woollen clothing, until Sept. 5 1917, between which time and the spring of 1918 some 687,000 reported. On Dec. 15 1917 all registrants were placed in five classes, according to personal conditions and national needs. Out of some 3,700,000 men in the army at the end of the War, about 2,800,000 came from the draft, which had made possible a uniform supply of recruits and replacements for American arms.

The second problem was met principally by three sets of reserve officers' training camps. The first series of 16 camps, beginning May 15 1917 at 13 army posts in the United States, enrolled approximately 38,000 qualified applicants. On Aug. 11 1917, at the conclusion of the course, commissions in various grades up to colonel were awarded 27,341 graduates. The second series of eight camps, beginning Aug. 27 1917, enrolled over 20,000 candidates. On Nov. 27 1917 commissions as in the first series were awarded to 17,237 graduates. These two series were composed largely of college men. Since no coloured candidates had been admitted to these camps, a special school for them at Fort Des Moines, Ia., beginning June 18 1917 and ending Oct.

18 1917, graduated 639 captains and lieutenants. In Porto Rico three camps, covering the period from Aug. 27 1917 to Nov. 6 1918, graduated 711 captains and lieutenants.

The third series of 27 training camps, beginning Jan. 5 1918, were more in the nature of schools; and 90% of the applicants were former enlisted men. From this series, on April 19 1918, three were graduated and listed as eligible for appointment as second lieutenants 11,659 men. At this time, the total output of the camps was over 57,000 graduates. After May 15 1918 officers' training schools, established throughout the United States and its possessions, replaced the camps until the end of the War.

The Supply Question.—The third problem was not so speedily solved, principally because of the lack of preparation for undertakings of such kind and magnitude. It was necessary at once to mobilise resources and industry, to organise adequate transportation, to obtain storage, distribution, and ports in the United States and France and to construct cantonments for training the vast numbers of recruits soon to come. The Council of National Defence by its sub-committees and dollar-a-year men[1] gained immediate contact with commerce and industry and was the father of the powerful War Industries Board, created formally on March 4 1918, with Mr. Bernard M. Baruch as its chairman. The new board co-ordinated and controlled resources, industry and transportation so as to produce an adequate flow of supply to the army and navy, without impeding unnecessarily commercial activity in the United States. Operating within the army, much as the board was acting for the country, were the operations and the purchase, storage and traffic divisions of the general staff.

By an interlocking organisation of these various co-operating agencies, tedious, duplicating and extravagant systems of supply were gradually eliminated. The flow of materials through the United States to the Western Front is shown by the fact that by the date of the Armistice the embarkation service had sent about 9,000,000 tons of cargo over a line of communication 3,500 m. long. Within a few weeks after the inauguration of the system of control made by the inland traffic service, the freight congestion in the United States was removed, and from May 1917 to the Armistice the railways had transported 8,714,582 men. Shortly after war was declared the construction division was called upon to build in 90 days 16 national army cantonments with an aggregate capacity of 640,000 men. In addition, housing for 16 officers' training camps and for 16 National Guard cantonments had to be expeditiously procured. By Nov. 1 1918 the construction division, with 130,000 employees, was engaged on 448 projects involving $756,000,000.

American Expeditionary Forces.—On May 26 1917 the Secretary of War, in a letter to Maj.-Gen. J. J. Pershing, directed him to command the land forces of the United States operating in continental Europe; to proceed there with his staff and establish, after consultation with the French War Office, bases, lines of communication and depôts for active participation at the front; to co-operate with the troops of the other countries employed against the enemy and in so doing to preserve the identity of the forces of the United States.

Pershing sailed immediately with a small staff, and one month after the date of the above letter Maj.-Gen. Sibert, with the 16th, 18th, 26th and 28th Infantry of the regular army and the 5th Marines, arrived in France as the first contingent of Pershing's command. The next to begin to arrive was the 2nd Div. in Aug. 1917, and by March 1918 four complete combat divisions, the 1st, 2nd, 26th and 42nd, were in Europe. Pershing's "organisation project of July 10 1917" contemplated a shipment overseas during 1917 and 1918 of 30 divisions. By July 1918, under his "schedule of priority shipments," there were transported 996,000 men. A subsequent programme of Gen. P. C. March, Chief of Staff, July 18 1918, proposed the landing of 80 divisions by the middle of 1919, or a force of 3,360,000. Under the latter scheme, by Aug. 1918 the number sent overseas increased to 1,576,000, and by the time of the Armistice rose to 2,085,000, or to 41 American divisions and a part of another.

The 1st Div. entered the trenches for instruction on Oct. 20 1917, and took over a division sector on Jan. 19 1918, north of Toul. On March 28 1918 Pershing placed all the American forces, four trained and two untrained divisions,[2] at the disposal of the Allied Commander-in-Chief. On May 28 1918 the 1st Div., fighting as a unit, made a successful attack on Cantigny; at the same time 16 American divisions (six trained) were placed at the disposal of the Allies. During July 15–18 the 3rd, 28th, 42nd and parts of the 92nd Divs. aided in the defeat of the last German offensive on the Champagne-Marne front.

Meanwhile, the organisations of divisions into higher units was proceeding with difficulty. Although the I., II., III. and IV. Corps headquarters were organised between Jan. and June, it was not until July 4 that the I. Corps, consisting of the 26th American and 167th French Divs., was assigned a tactical command at the point of the Marne salient west of Château-Thierry. From July 18 to Aug. 6 the 1st, 2nd, 3rd, 4th, 26th, 28th, 32nd and 42nd Divs. (mainly comprehended in the I. and III. Corps) formed 30% of the Allied strength in the Aisne-Marne offensive. The American I. Army, under the command of Gen. Pershing, was organised in the Château-Thierry region and began to function on Aug. 10, but upon stabilisation of the Aisne-Marne offensive along the Vesle river shifted its operations eastward.

From Sept. 12–16 the I. Army, containing the I., IV. and V. Corps with a total of 11 American and four French divisions, reduced the St. Mihiel salient. This army, beginning its attack on Sept. 26 in the Meuse-Argonne operation with the III., V. and I. Corps, employed in this offensive 25 American divisions and one French cavalry division. By Oct. 12 the American II. Army had completed its organisation, and with the IV. and VI. Corps went into line generally west of the Moselle. In addition to these operations two American divisions served with the British on the Ypres-Lys and three in the Somme offensive; three participated with the French in the Oise-Aisne operation, two with the French IV. Army in Champagne, and two with the French and the Belgians in Flanders. By the date of the Armistice, 29 American divisions had been engaged in active fighting and American forces were holding 134 km. or 22% of the entire Western Front, having captured some 63,000 prisoners, 1,378 cannon and 9,650 machine-guns. Their casualties were: killed in action, 36,780; died of wounds, 13,466; died of disease and other causes, 27,293; total overseas dead, 77,539; total wounded, 234,852; prisoners, 4,416.

The supply of the American expeditionary forces was handled in France by the line of communications, which in Feb. 1918 was changed to the services of supply or S.O.S. This vast organisation in rear of the combat zone was charged with immense projects involving roads, docks, railways and buildings; the transportation of men, animals and munitions by sea, rail and inland waterways; the operation of telephone and telegraph systems; the control of replacements; the hospitalisation necessary for an army of 2,000,000 men; the reclassification of officers and men; the establishment of leave areas and of welfare and entertainment projects; the liquidation of American affairs in France; and the embarkation of troops for home. In addition to the materials sent from the United States, these services purchased 10,000,000 tons abroad; the communication system covered 215,500 km. of telephone and telegraph lines; the engineers produced 200,000,000 feet of lumber; the transportation corps put 20,000 American cars and 1,500 American locomotives on French railways; and the medical units on Nov. 12 1918 were caring for 193,026 patients in hospitals. By the time of the Armistice the strength of the S.O.S. was 668,312 men.

Other Fronts.—In Sept. 1918 an expeditionary force of some 10,000 men was sent to Siberia. At other times some 5,000 men went to north Russia and one regiment served in Italy.

Demobilisation.—The Armistice necessitated the demobilisa-

[1] People who carried out public duties for a purely nominal remuneration.

[2] An American division was practically twice the size of a British, French or German division.

tion of some 3,700,000 in service oversea and in the United States, the termination of contracts with due regard to the interests of industry and the government, the co-ordination with labour over the employment situation and the prevention of congestion of ex-soldiers in the larger cities.

On the morning of Nov. 11 1918 Gen. March issued orders for the immediate discontinuance of all mobilisation; on Nov. 16 he gave specific instructions for the discharge of certain temporary forces in the United States; on Nov. 22 he issued instructions to Pershing covering procedure which would facilitate discharge in the United States of the oversea forces, but left to the commander-in-chief of the American expeditionary forces the order of return of units. The demobilisation of personnel involved intricate problems of the care and habilitation of sick and wounded, the location of demobilisation camps, the discharge of special classes for relief of distress and the needs of industry, the avoidance of congestion of labour, the economy to be exercised in transporting discharged soldiers and the procedure at demobilisation camps involving physical examinations and disinfection of discharged soldiers.

It was necessary to retain in the service, in addition to the regular army, a large number who were indispensable to the care of billions of dollars' worth of property, and to the work connected with debarkation, demobilisation and convalescent centres, hospitals, domestic guard duty, fire protection and border police. By Jan. 4 1919 there were discharged 732,766 men; by Feb. 1 the number had increased to 1,026,664; by May 1, to 1,936,011; and by July 1, to 2,736,654. By April 1 1920 demobilisation of enlisted men was practically completed. In addition to the demobilisation of personnel, the army was called upon to cause industry to return speedily to its peacetime course, after labour, capital and manufacture had been occupied for a year and a half in preparing materials for war. The problems confronting the War Dept. during the transition included the disposal of war supplies, the appropriate rate of curtailment of war production so as not to create widespread unemployment and economic disturbance, the settlement of claims and contracts, the adjustment of real estate connected with war activities, the liquidation of international obligations and of sales abroad.

On Nov. 11 1918 the equipment branch of the operations division, general staff, made a study of existing supplies, which resulted in the classification of materials and the retention of a war reserve. During Jan. 1919 there was established a Claims Board, which by the middle of the year had adjusted 25,196 contracts, besides those allowed to run. By Sept. 1 1919 property in the United States costing about $700,000,000 had been sold for about $530,000,000 or 77% of its cost. Surplus property in France estimated to have cost $1,250,000,000 was sold for about $500,000,000. Out of an estimated value of $3,276,349,533 worth of surplus property on hand at the Armistice, there remained in Jan. 1926 only $9,278,269 worth, the materials represented by the difference having been sold at an average of 36% of their cost.

Phases since the War.—In order to overcome the waste and confusion incident to unpreparedness, Congress passed on June 4 1920 the National Defence Act, which established the army of the United States in the approximate proportions of one-half organised reserves, one-third National Guard when called into service, and one-sixth regular army, the last factor being limited to 280,000 officers and men. For training and tactical control, the country and its possessions were divided into corps areas, all three components of the army within each area being potentially organised for prompt mobilisation. The regular army, the component engaged primarily in military training, was to be responsible for the instruction and proficiency of the other two components. The President could change the strength of the different arms to suit varying demands of national defence and the developments of the new services, such as air, chemical warfare and tank corps. Within the regular army a single promotion list for officers throughout all branches, except the Medical Corps, equalised advancement by seniority. Provision was made for reserve officers' training corps in colleges and for training camps during summer months. Altogether, the legislation was viewed generally as the first sound military policy of the United States. Accordingly, in 1921, the army spent its efforts upon training and recruiting qualified personnel. On June 30 1922 Congress reduced the regular army to a maximum of 175,000 officers and men, and later in the year made the maximum for officers 12,000, so that it was necessary to separate from the service over 100,000 officers and men, many of whom had recently enlisted or been commissioned. By Dec. 1 1925 the strength of the army of the United States was: organised reserves, 98,585 officers and 5,600 enlisted men; National Guard, 11,673 officers and 166,080 enlisted men; regular army, 11,957 officers and 124,249 enlisted men, 38,714 of the regular force being stationed abroad. See *The War with Germany: A Statistical Summary* (U.S.A. War Office, 1919). (D. D.)

ARRAS, BATTLE OF.—The great battles which opened the campaign of the Allies in 1917 on the Western Front were the direct outcome of two main causes, the first was the strategical position resulting from the battle of the Aisne in 1914, and the second the tactical position resulting from the battle of the Somme in 1916.

The former placed the bulk of the German forces in the West in the huge salient Nieuport-Noyon-Verdun, and the second

a considerable portion of these forces in the smaller salient Arras-Gommecourt-Morval. The first offered considerable possibilities for the Allies to get in a right and left hand blow on Valenciennes and Mézières, the main centres of the German lateral communications, and the second of similar blows in the direction of Quéant against the northern and southern flanks of the German VI. and I. Armies. If it had been possible to bring off this last operation successfully, such a debacle of the German forces would have resulted that not only would the advance of the British armies seriously threaten Valenciennes, but the rush of

German reserves to stop the gap would have withdrawn pressure from before the French about Reims, and would probably have enabled them to advance on Mézières.

Alternative Plans.—In June 1916 a plan, known as the Blaireville project, was prepared, the object of which was to strike at the Germans between Monchy-au-Bois and Beaurains during the later stages of the battle of the Somme, but on account of the casualties sustained during the early stages of this battle, this project was abandoned. In Oct. the project was revived and its scope extended. A simultaneous offensive on all fronts was suggested, in which, whilst the main attack was to be made by the British, a subsidiary attack was to be carried out by the French in the neighbourhood of Reims. In Oct. the British plan included the following operations. At the earliest date possible (about March 15 1917) the IV. and V. Armies were to reassume the offensive and the III. to strike between Beaurains and Arras, occupy Monchy-le-Preux, and by pushing southeast, deny to the Germans the Cojeul Valley as a line of retreat, and, if possible, that of the Sensée also. Meanwhile the I. Army was to attack north of the Scarpe and form a defensive flank.

In Dec. Gen. Nivelle, who had recently been appointed to the chief command of the French Armies, objected to the subsidiary part to be played by the French, and put forward a plan in which the decisive blow was to be delivered from the Aisne. The task of the British, according to this plan, was to deliver an offensive in Artois which would draw in large forces of the enemy, and so reduce opposition on the French front. Further, to assist in the French concentration, as a preliminary measure, Gen. Nivelle insisted that the British should relieve the French forces as far south as the Amiens-Roye road, and that this relief should be completed by March 1, the offensive to open on April 1.

From Oct. onwards vast preparations, which were impossible to disguise, were put in hand. Railways and roads were extended, dumps formed, gun emplacements built, aerodromes levelled and the greater portion of the underground quarries of Arras, St. Sauveur and Ronville opened up and made ready in every detail to accommodate two divisions which were to reinforce the attack by passing underground. This sudden and unexpected reinforcing of the front was to be the surprise of the battle.

Preliminaries.—Meanwhile a hostile operation was begun which bid fair to filch from the British the tactical advantage won during the preceding summer. Towards the end of Feb. it became apparent that the Germans intended to evacuate the Gommecourt salient, and the recent construction of the Hindenburg line suggested a rounding off of the right angle between Arras and Craonne. If this could be successfully accomplished, not only could the tactical blow against the Gommecourt salient be avoided, but the strategical blows against Valenciennes and Mézières be impeded or delayed. The problem which now faced the Allies was a threefold one, namely, whether to hit at once, or recast their plan, or finish their preparations and carry it out as originally intended. As weather impeded the first and want of time the second, the third was adopted with the following modifications. The III. Army was now to play the leading part, and by attacking north and south of the river Scarpe with three corps, whilst holding one corps and the Cavalry Corps in reserve, was to penetrate the German defences and by advancing on Cambrai turn the Hindenburg line from Heninel and Marcoing. The I. and V. Armies were to operate on the left and right flanks of the III. Army.

The battle front, some 15 m. in width, extended from just north of Croisilles to a little south of Givenchy-en-Gohelle, at the northern foot of the Vimy ridge. This ridge which rises to a height of 475 ft. above sea level dominated the whole battlefield from the north. From its summit overlooking Lens the ground falls away to the river Scarpe, between which and the Cojeul river it is in nature undulating. In the forward zone of defence the Germans had dug three lines of trenches, each of which was heavily wired. Then four to five miles east of this system was dug the Drocourt-Quéant line, which at the date of the battle was still unfinished and but lightly wired.

At the beginning of April the German reserves numbered some 600,000 men, and consequently the success of the battle depended on the time it would take to penetrate the Drocourt-Quéant line. If this line could be broken within 48 hours of the initial attack, the intervention of these reserves might be avoided and so large a gap created that eventually great numbers would be drawn towards it and away from the French offensive in the south, where the main blow was to fall. This time could only have been gained by the employment of a considerable number of tanks, or by a preliminary bombardment of not more than 24 hours' duration. After denuding the training grounds of both France and England, only 60 tanks could be assembled, therefore the only alternative was a hurricane bombardment, and though the III. Army for long suggested such an operation, G.H.Q. insisted on three weeks' systematic wire cutting culminating in a general bombardment of several days' duration. During this period 2,700,000 shells were fired, and though the wire was destroyed all chance of surprise vanished.

Plan of Attack.—The final plan of attack was as follows:—

(*a*) III. Army (Gen. Sir E. H. H. Allenby). The VI. and VII. Corps were to attack south of the Scarpe between Arras and Mercatel. Their objective ran from a point 2,000 yd. southeast of Hénin sur Cojeul northwards to Guémappe, thence east of Monchy-le-Preux to the Scarpe. This objective contained two formidable lines of defence, namely, the Cojeul-Neuville Vitasse-Telegraph Hill-Tilloy-lez-Mofflaines line, and the Feuchy Chapel-Feuchy line. South of these were some 3,000 yd. of the Hindenburg line, and east the strong position of Monchy-le-Preux which dominates the whole of the surrounding country. The XVII. Corps was to continue the front of attack north of the Scarpe.

(*b*) I. Army (Gen. Sir H. S. Horne). The Canadian Corps and the 13th Bde. of the 5th British Div. were to attack the Vimy heights, Thélus and the hill north of Thélus, a position considered one of the strongest in France.

(*c*) V. Army (Gen. Sir H. Gough). The Australian Corps and the V. Corps were to operate between Lagnicourt and the right of the III. Army northwards towards Vis-en-Artois. The position of this Army was a most difficult one, as the destruction of the roads and the bad weather had rendered it impossible to move forward much artillery, a *sine qua non* of the battles of this period.

(*d*) The whole of the above operations was to be considered as a preliminary step to the advance of the Cavalry Corps and the XVIII. Corps south of the Scarpe. These corps were to break through at Monchy-le-Preux and advance eastwards through the Drocourt-Quéant line.

Opening of the Attack.—On April 9, at 5.30 A.M., the general attack was launched under cover of a magnificently timed creeping barrage, and within 40 minutes the whole of the German first line system, except a small portion of the Vimy ridge, was captured. About Tilloy-lez-Mafflaines and Telegraph Hill tanks accounted for a good many of the enemy and then proceeded eastwards to assist in the reduction of the Blue line and such parts of the Brown line as they were able to reach during daylight. By noon the greater part of the second objective had fallen and a number of hostile batteries were captured. By the close of the day practically the whole of the objectives north of the Scarpe had been taken, but south of this river the third objective had only been penetrated in places, and the fourth objective remained untouched.

During the night of the 9th–10th, the 37th Div., which had been held in reserve, advanced to the northern slopes of Orange Hill; and during the morning of the 10th this advance was followed by a general attack on the Brown line which enabled the 37th Div. to reach the outskirts of Monchy-le-Preux, which on the morning of the 11th was captured by this division assisted by tanks. Whilst these operations were in progress the Germans strongly reinforced their front, and so stubborn had become the opposition that to relieve the pressure on the VII. and VI. Corps fronts the V. Army was ordered to attack on the morning of the 11th from the direction of Bullecourt northwards. At 4.30 A.M. 11 tanks, followed by the 62nd Div. on the left and the 4th Australian Div. on the right, stormed the Hindenburg line, but on account of the width of the trenches and inadequate artillery support only two tanks, co-operating with the Australians, were able to cross this line. These led the attack as far as Riencourt-lez-Cagnicourt when a strong German counter-attack drove the Australians back; meanwhile the attack of the 62nd Div. had

been completely held up on the southern outskirts of the village of Bullecourt.

On the 12th, Heninel and Wancourt were captured by the 21st and 56th Div., and minor operations were carried out on the 13th and 14th when the main offensive of the III. and V. Armies terminated, 13,000 prisoners and 200 guns having been captured. Pressure, however, was not altogether relaxed, as on the 16th the French launched their grand offensive on the Aisne, and to assist in this operation it was considered necessary to hold the enemy. Though this attack proved a complete fiasco, pressure was maintained on the Arras Front, and the line pushed forward to include the villages of Guémappe, Gavrelle and Arleux-en-Gohelle. On May 5 the battle of Arras was brought to a close. Since April 14 6,000 additional prisoners and some 50 guns were taken, but British casualties had been severe, totalling, between April 9 and May 5, no less than 132,000 officers and men killed, wounded and missing.

Results of the Battle.—The failure of the Allied spring offensive may be traced to various causes, the most important being: The exhaustion of the French due to the battles of Verdun and the Somme in 1916, the total lack of surprise on both the British and French fronts; the distance apart of the two battlefields, and the comparative narrowness of the fronts attacked when compared with the strength of the German reserves. The results of this failure and their influence on future operations were clearly brought out by Sir Douglas Haig at a conference of army commanders held at Noyelle-Vion on April 30. On this occasion he said:—

As regards the French, their losses had been heavy and they could not continue to operate by similar methods to those which they had employed since their main offensive launched on the 16th April. There was a possibility of changes in the French higher command. This contingency would doubtless alter the military policy of the French, which would then probably be of a defensive nature with a tendency to avoid losses. Although the French War Minister and Prime Minister had given an assurance that offensive operations would be carried on, it was doubtful whether it was possible for the French Army to prosecute these on a large scale . . . he continued that it was his intention to move steadily forward up to a good defensive line. . . . Once this line has been reached it will be possible to decide further action. It may then be necessary to continue on our present front, to attack on the Havrincourt front, or to shift the centre of gravity up to the Second Army. In the meantime it is necessary to hold the enemy and make him think that we are undertaking a methodical offensive similar to our operations last year on the Somme.

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(J. F. C. F.)

ARRHENIUS, SVANTE AUGUST (1859–) Swedish chemist (*see* 2.648), was born at Wijk, near Uppsala, Sweden, on Feb. 19 1859. He was educated at the Cathedral School and the University of Uppsala. In 1895 he was appointed professor of physics in the University of Stockholm, and in 1905 became director of the physico-chemical department of the Nobel Institute. He devoted himself especially to the study of electrolysis and evolved the theory of electrolytic dissociation. In 1903 he was awarded the Nobel Prize for chemistry, and received, among numerous other foreign distinctions, the Davy and Faraday Medals of the Royal Society.

Among his works are *Immunochemistry* (1907); *Theories of Chemistry* (1907); *Worlds in the Making* (1908); *Quantitative Laws in Biological Chemistry* (1915), all written in Swedish and translated.

ARRIAGA BRUN DA SILVEIRA E PEYRELONGUE, MANOEL JOSÉ D' (1839–1917), Portuguese politician, was born in Horta, in the Azores, July 8 1839. Educated at the University of Coimbra, he graduated in law in 1866. Arriaga early showed signs of his Republican sympathies, with the result that his father, an ardent Royalist, disinherited him; and as a student he was obliged to support himself by coaching his juniors. He had a distinguished scholastic career, among his appointments being the rectorship of the University of Coimbra and a professorship at the Lyceum in Lisbon. His political career opened in 1882, when he was elected Republican deputy for Funchal. From 1890 to 1892 he represented Lisbon. During the revolution of 1910 (*see* PORTUGAL) he was a prominent figure on the Republican side; and on Aug. 24 1911 he was elected first constitutional President of the Portuguese Republic. The Royalist risings of 1911 and 1912 taxed the strength of the president; and in 1915, feeling no longer able to cope with the difficulties of the situation particularly in face of the coup d'état of May 14, he resigned on May 27. Arriaga died March 5 1917.

ART: *see* AESTHETICS; DECORATIVE ART; PAINTING, ETC.

ARTIFICIAL SILK, or RAYON.—Any plastic form of cellulose or derivative can be extended or drawn in continuous length. The plastic form is conditioned by associated solvents, which, in the case of fluid solutions, are in multiple proportion by weight of the cellulose or derivative. The drawing to thread, filament or film can be taken to a limit of attenuation dependent upon the structural qualities of the colloidal matter present in its 7 to 12% solution.

The silkworm elaborates, from its vegetable diet, a nitrogenous, colloidal complex, very different from cellulose in constitution and properties, in the form of a hydrated, plastic mass, which it spins, or rather draws to a thread; the thread is laid into the symmetrical form of cocoon, incidentally passing, by chemical changes of internal and external reaction, to insoluble forms. Thus the insect labours, and man enters into the fruit of its labours, largely forgetful of the wonderful worm. The artificial silk industry owes its obvious debt to the worm, and is prevented from forgetting it by the difficulty of coining an autobasic descriptive term. If in the course of this article we use the alternative "Lustra Cellulose," it is only as an expedient.

Rise of the Industry.—Industrial artificial silk is a wonder even of the 20th century. Its development may be briefly set out under the dates of the various stages:—

1883. Hilaire de Chardonnet described the invention of producing thread by drawing solution of nitrocellulose through fine orifices.

1890–1900. The industrial process including regeneration of cellulose from the nitrate thread perfected. Formation of the Société d'Exploitation "Soie Artificielle Chardonnet" and production of artificial silk at Besançon.

1892. Cross and Bevan patented the viscose process of dissolving cellulose, and

1895. Formed the Viscose Spinning Syndicate and applied the process to the production of thread in association with C. H. Stearn and C. Topham. The latter invented the centrifugal spinning box and process in substitution of the method of parallel drawing, and afterwards twisting the fibres to the textile compound thread.

1900–1902. Société Française de la Viscose was formed and reached industrial production of viscose silk at Arques la Bataille.

1902–1907. British-American developments organised by S. Courtauld & Co. (H. G. Tetley & T. Latham).

In these earlier stages a third process played a leading part in competition with the Chardonnet. This was the Cuprammonium process of dissolving the cellulose and drawing it to thread by coagulation to hydrated colloid in either acid or alkaline medium. This was based on the pioneer labours of Pauly, Frémery, Urbain and Bronnert, and the silk known as Glanzstoff constituted a considerable proportion of the 8,000 to 9,000 tons which was the average annual production of the new textile material in the period 1910–2. To complete the story of increase and ever-widening production, and of the survival under competition of the three systems, we give the aggregate figures for the several producing countries of 1924.

Estimate of Production of Artificial Silk, 1924

	Metric Tons		Metric Tons
United States	16,245	Austria	1,200
England	10,885	Poland	700
Germany	10,760	Czechoslovakia	588
Italy	8,400	Japan	545
France	5,606	Hungary	280
Belgium	4,034	Spain	84
Switzerland	1,820	Sweden	80
Holland	1,530	Russia	40

This amount of 62,797 tons was produced by 79 firms, operating 95 factories, and includes 4,900 tons of Chardonnet silk, 900 tons of Cuprammonium silk and 54,197 tons of Viscose silk. These figures are compiled from the statistical records of Court-

aulds, Ltd. The output of the three cellulose silks mentioned above is less than the aggregate of the preceding table by 2,800 tons. This is attributable to the introduction of celanese, which is produced mainly by the British company of that name. The antecedent British Cellulose Co. with works at Spondon, Derbyshire, undertook the manufacture of the acetate in Great Britain as the colloidal basis of the varnish or dope applied to aeroplane wings. As a war service the enterprise was in part financed by the British Government. In the last year of the World War the production of the dope reached the figure of 5,000,000 gal., which at 1 lb. of acetate per gal. would account for the production of 8 tons a day at Spondon. At the conclusion of the War the demand for the dope fell to fractional proportions, and the technical staff of the company developed commercially the potentialities of the acetate in the production of silk thread, non-inflammable photographic film, and solid celluloid substitute.

As for the uses to which the material is put it has been estimated that, as regards the United States, which is the largest market for it in the world, 28% is made into hosiery, 26% is mixed with cotton and 16% with silk. About 13% is used in the manufacture of underwear and the balance is put to a variety of uses, which are increasing almost every day. The potentialities of the yarn appear therefore to be tremendous both in the old and the new world.

Processes.—In considering various qualifying factors we have to revert to the process itself, and to the technical principles involved in drawing the solution of cellulose to thread. The unit thread is coarse or fine in terms of its diameter; in exact terms it is the ratio of weight to length. In the silk counts the unit is the denier. For the present purpose the denier is the metric denier of 1 milligram per 10 metres; natural silk is a thread of 1 to 2 deniers. Artificial silk, in the early years of production, was a unit of 6 to 7 deniers, but it was evident to the inventors that finer dimensions were attainable; in the case of the anhydro ester silks by merely reducing the diameter of the "spinning" orifice, and in the case of aqueous solutions, by "drawing down" the thread in the fixing bath. This process of stretch drawing is a refinement of the earlier processes of direct "spinning," in which the thread of cellulose-hydrate (cellulose 17%, hydration water 83%) is formed in the first few cm. of contact of the cellulose solution with the fixing solution of the setting bath. It has been especially developed under the Thiele patents and in connection with the cuprammonium solution of cellulose. The present industrial specialisation in yarns of fine counts is that of the Brysilka Co. (Apperley Bridge, Yorkshire), and of certain firms on the Continent of Europe. The process involves drawing under vacuum through a column of fixing solution contained in a funnel, and exact control of all the auxiliary conditions.

The viscose reactions of decomposition with ultimate regeneration of cellulose (hydrate) are by contrast intrinsic and accompanied by interior effects of reaggregation; there are therefore a number of "fixing" reagents which condition a graduated action of the "setting" bath, which allows the drawing tension on the thread to take effect in attenuation. Viscose threads of 1 to 3 deniers can therefore be "spun" by the direct process and by various of the more obvious alternatives. But on the trend of the market during 1924 toward yarns of the heavier deniers, the viscose companies have not found it advantageous to compete with their rivals in concentrating on fine production. This question of range of yarn counts was introduced in connection with the statistics of production, so that the figures for weight may require revision in terms of yarn grades and corresponding values.

Competition with Natural Silk.—Up to the present the new cellulose product has made its own developments rather than entered into direct competition with silk. But competition has necessarily arisen, and there is in fact a recognised displacement in certain directions, and further progress must be estimated in terms of the capabilities of artificial silk, that is, of fundamental qualities. Obviously the most important is the ratio of weight to length. With this quality are directly associated the covering power of the yarn as a weaving and optical effect, and, indirectly, the effects of softness and lustre. The present stage of development has been mainly realised on the basis of a unit thread of 5 to 7 deniers, which is a multiple of the "size" of the natural silk. It is now established that the cellulose can be drawn to these dimensions and incidentally produced as yarn. The next fundamental point is that of specific weight, which is an ultimate characteristic of the respective substances; silk-serin has the density 1·23 and cellulose 1·53.

The earlier spinning methods applied to viscose produced a cylindrical thread in close imitation of the natural fibre. Important technical progress resulted from study of the cellulose fibre in regard to form and contour as revealed by cross sections. With changes of the setting bath there were differentiations toward ovoid and kidney-shaped forms; by further correlating the stages of "ripening" of the viscose with the conditions of the setting bath, it was found possible to exaggerate an irregular contour to one having deep indentation, the effect of which was to increase the perimeter by 50% above that of the regular cylinder of equal denier. The effect of this is the increase of apparent bulk of the thread, and of the covering power of the twisted multiple thread or yarn. The new element of technical control is a point of manifest superiority of the artificial process, since the added qualities of the thread and yarn compensate for the major defect due to greater density of substance. Next in order are the mechanical and chemical qualities or properties which (1) are expressed as strength (tenacity) and elasticity, and (2) which condition resistance to the inevitable water-oxygen environment.

Tenacity and Elasticity.—The earlier forms of lustra cellulose showed a specific tenacity of 1·0 to 1·4 grammes per denier, reduced to about 30% on wetting. Technical progress has realised a substantial increase on these figures and especially in respect of "wet strength" which reaches 60% of that of the original dry thread. The statistical records of Courtaulds, Ltd., show a breaking strain in grammes per denier of 1·2 to 2·2 dry and 0·5 to 1·1 wet. The variations are those conditioned by methods of manufacture together with the deniers of the unit thread. The present averages for the production of this firm are deniers 6 to 7, but with the range 3 to 11; the breaking strain is 1·5 dry and 0·7 wet, in grammes per denier.

In practice the true elasticity comes little into reckoning; the extensibility, or stretch, reaches 16 to 20%, which is of the order of the elongations of the natural silks under breaking strain. The results obtained from the observation kept over cellulose substance yarns produced in the period 1895–1900 fully confirm the *a priori* assumptions of permanence of material, based on the actual chemical constitution of cellulose and the experience of its utilisation in various forms.

It has been necessary to set out in some detail the fundamental qualities of the material as the primary conditioning factors. Two others of scarcely less importance are self evident. The viscose process and products have the advantage in respect of costs of production and adaptability, representing a wide range of controlled variations in correlation with the wide and varying requirements of the textile industry. Lastly, the new material was launched into a world of already highly developed technical and competitive activity, ready to exploit the potentialities of the new product in the confection of the new fabrics, plain and mixtures, and in the auxiliary effects of decorative design and colouring.

Production.—The long-deferred realisation of the acetate "silk" is a postponement due to a number of interferences, in a sense accidental, amongst which was the World War; for the realisation was foreseen by the viscose pioneers and others, who recognised *a priori* a basis of first principles as the promise of achievement. Thus the production of the acetate involves the simplest of factors; cellulose, carbon (coal), chalk and electrical energy. The product, as an ester, represents an increase of yield of 50% matter added by synthesis to the original cellulose; it has the relatively low specific gravity of 1·34; its combining relationships with dyestuffs are specific. *A posteriori* the celanese product proves to have a special form, divergent from the

cylindrical, and realising a high covering power. These, with other advantages, must be recognised as assuring industrial developments. On the other hand the process of spinning is elaborate, and requires a special cellulose raw material (cotton) specially prepared, and generally a higher scale of capitalisation and factory costs. These disadvantages have been increased under the present conditions of altered industrial values, and, moreover, the product has now to compete with its viscose rival, which is firmly established, and protected by the goodwill of routine consumption and the progressive development of textile quality and novel effects.

Waste Products.—It will be obvious that there are incidental waste products of the "silk" process as there are of the cocoon silks. The latter are in a form which can only be treated for mechanical separation of the fibres reduced to short length. These are graded and spun or twisted to the yarns known as schappe or spun silk. The fibrous wastes of the artificial silk process can be similarly treated. The results have led to a direct production, especially of the viscose silk, in short length, by reeling the thread as formed on bobbins of suitable diameter, and cutting through the mass of filaments which are liberated in calculated short length or staple. The fibre is known as "staple fibre," "vistra," "fibro," "artificial wool." It is spun usually in admixture by the methods required for discontinuous or ultimate fibre, *e.g.*, wool, cotton.

The silks, natural and artificial, are solid; in the production of the latter the viscous solutions are carefully prepared to be free from bubbles. The presence of bubbles leads to curious deformations of the thread and defective yarns; on the other hand a study of these defects has led to the industrial production of the air-filled fibre—in the case of the viscose process by charging the viscose to its maximum with bubbles of air, and increasing the effect in the setting bath by the addition of compounds reacting with liberation of gas (*see* CELLULOSE). (C. F. C.)

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ARTILLERY (*see* 2.685). The Old French word *artiller*, to equip with engines of war, is from the Low Latin *artillare*, to make machines. The English word *artillery* dates from the early 17th century. It is now used to mean firearms of greater power than those carried by hand, and also the personnel who use them. The present article deals with the contemporary state of the artillery arm in land warfare.

I. TYPES OF ARTILLERY

The function of land artillery is to kill troops at a range beyond that of a hand weapon, and to destroy material, obstacles, and defences. Various natures of artillery have been developed, suitable to the tasks to be fulfilled. These are:—

Field artillery.	Super-heavy artillery.
Medium artillery.	Anti-aircraft artillery.
Heavy artillery.	Trench artillery.

Field Artillery.—This is capable of accompanying the advanced fighting line of an army. It consists of light guns and howitzers able to move at 10 m. an hour on the road, and able to keep pace with infantry, or cavalry, in the case of the horse artillery, across country. It can come into action without previous preparation of the ground, and, like all other natures of artillery, it can engage a target either from a position in the open by direct vision over the sights, or from a concealed position by means of angles of direction and elevation signalled from an advanced observing position or from an aeroplane. It consists of light guns and light howitzers.

The field gun is, in all armies, a piece throwing a shell of from 15 to 18 lb. to a distance of at least 10,000 yd., and weighing less than 30 cwt. in action. Before the introduction of mechanical traction the weight was limited to 24 cwt. and the range to 6,000 yards. The present limit of 30 cwt. is due principally to the fact that this weight is as much as a gun-detachment of 6 men can manhandle. All modern field guns are quick-firing; that is, the gun recoils on the carriage and returns to the firing position, while the carriage remains steady. This saves the delay due to running up and relaying the gun after each shot, and increases the rate of fire from 2 rounds a minute to 25. It also enables the gun-detachment to remain behind the gun-shield, instead of having to stand clear of it during the recoil of the carriage.

The field howitzer differs from the field gun in that it throws its shell high into the air, so as to descend at an angle of about 45°. This enables it to reach targets, such as men in deep trenches, protected from the direct fire of guns. Since this high-angle fire requires less effort than direct fire, the field howitzer is able to fire a shell double the weight of that of the field gun, without exceeding the same weight of equipment. Howitzer fire, from its nature, is local in effect, and at targets of considerable depth from front to rear, such as advancing infantry, it is far inferior to the flat-trajectory fire of guns. In most armies one-fourth of the field artillery consists of howitzers, and three-fourths of guns.

Special natures of field artillery are:—

Horse artillery, which can keep pace with cavalry across country. Usually, for simplicity of ammunition supply, the gun is the same as that of the ordinary field artillery, but the weight behind the team is reduced by mounting the gunners on horses, instead of carrying them on the limbers and ammunition wagons. Mountain or pack artillery is divided into separate loads which can be carried on pack animals or transported for short distances by hand. It is used in country impassable to wheeled carriages, and is sometimes employed as artillery of accompaniment. The gun itself is divided into two pieces, forming mule loads not exceeding 320 lb., including 65 lb. of saddle and equipment. The old "screw-gun" used by the British mountain artillery was divided half-way down the bore, but the modern tendency is to divide the gun behind the base of the cartridge, so that the chase forms one load and the breech another. The carriage of a mountain gun has a cranked axletree, which is turned upward when firing at high elevations, so as to afford room for recoil without the breech striking the ground. In other respects the mountain gun is a smaller edition of the field gun, and fires a shell of 12 to 15 lb. to a distance of about 5,000 yards. Mountain howitzers, firing a shell of about 22 lb., are also used.

Artillery of Accompaniment.—The provision of a special light gun to accompany the infantry firing line is now a subject of controversy.

A good specimen of the modern field gun is the U.S. 75-mm. gun, model 1921 on 1924 carriage (see fig. 1 on plate). This gun weighs 30 cwt. in action, and fires a 15-lb. shell ranging, with super-charge, 15,000 yards. With the normal charge the range is about 11,000 yd.; the super-charge, with stream-lined shell, is not used for ordinary fire, on account of the excessive wear which it causes to the gun. For the same reason it is probable that a reduced charge for ranges below 6,000 yd. will be introduced. Flashless powder is used, and the shrapnel has a clockwork fuse. The carriage has hydropneumatic recoil gear of the St. Chamond pattern, and a split trail, which permits of rapid traverse through a wide angle for the purpose of firing at tanks moving across the front. It allows of the gun being elevated to a high angle for firing at aircraft.

Although a field gun is not a fully effective anti-aircraft gun, it is desirable that it shall be capable of engaging low-flying aeroplanes when these attack the troops with machine-guns. The wheels of the American field gun have rubber tires, to obviate, or at least to reduce, the damage to the equipment caused by tractor draught at a speed of 10 m. an hour. The French 75-mm. field gun is a Schneider model similar in essentials to the American gun. In England, Armstrongs have a

1925 pattern 3-in. field gun rather more powerful than the American gun. Vickers have a 3·3-in. 18-pdr. M.V. 2,100 fs., ranging 12,700 yd. with stream-lined shell and super-charge and weighing 30 cwt. in action. (*See* fig. 1).

Medium Artillery.—This consists of guns and howitzers of greater range and shell-power than field artillery, yet sufficiently mobile to accompany the infantry advance. The usual types are a 4·7-in. gun firing a 50-lb. shell to a range of 15,000 yd. and a 6-in. howitzer firing a 100-lb. shell to a range of 12,000 yards. The 4·7-in. gun is designed to fire upon distant road crossings, railway junctions and other important points which have to be engaged without delay, before the heavy artillery can come up. The 6-in. howitzer fires a powerful shell capable of demolishing buildings and of destroying entrenchments, other than those of a semi-permanent nature. It is the principal weapon used in trench warfare. Both pieces are available for counter-battery work, that is, for attacking entrenched guns which have been located by aircraft or by sound-ranging.

The medium gun is an enlarged edition of the field gun. The 6-in. howitzer was formerly a short, handy piece, but owing to the increased range now required of it the length of the modern type is as much as 25 calibres. Fig. 2 on plate shows a short Krupp 6-in. gun used as a howitzer by the Germans. This would now be mounted on a carriage with split trail. The girdles on the wheels prevent them from sinking into the ground.

Heavy Artillery.—This term is applied to pieces heavier than medium artillery, including guns up to 8-in. calibre and howitzers up to 9·2-in. calibre. In modern war it is necessary to attack objectives at least 10 m. behind the fighting front, and accordingly road-mobile heavy artillery, which can engage targets beyond the range of medium artillery, has been introduced.

The principal gun of this type is the 6-in. gun, the latest pattern of which ranges 15 m. with 100-lb. shell. It can be fired from the ground, without the delay entailed by building a platform; wire mats or similar appliances are used to prevent the wheels from sinking. Modern 6-in. guns have split-trail carriages to enable them to be traversed quickly.

A howitzer heavier than the 6-in. is required for destroying bridges and semi-permanent entrenchments. The 8-in. howitzer fires a 200-lb. shell and ranges 18,000 yards; the British 9·2-in. howitzer, known in the War as "Mother," fires a 290-lb. shell ranging 12,700 yd.; and the new American 240-mm. (9·45-in.) howitzer fires a 356-lb. shell to a range of 25,000 yards. The latter piece is accepted as the typical modern heavy howitzer, and is about the largest piece likely to be transported by road in future warfare, as it is considered that heavier natures are better transported by rail. Fig. 3 on plate shows a French Schneider 6-in. gun, 1925 pattern, with rubber-tyre wheels, intended for tractor draught. A platform would be built for it if it were intended to remain long in the same position.

Super-heavy Artillery.—As the size of a shell is increased, the effect increases in a higher ratio. Much of the destructive effect of a 1,000-lb. shell is due to the blast, not to the local destruction caused by the high-explosive charge. The effect of the blast is to bring down walls as much as 50 yd. from the point of burst, to cause roofs to fall in, and generally to wreck a great building such as a railway station or factory. A single hit from a 12-in. shell might destroy a bridge altogether, whereas ten hits from 6-in. shells, equal to the same weight of ammunition, would only cause easily reparable damage.

A further advantage gained by the use of very heavy guns is the greatly increased range. Thus the British 9·2-in. gun throws a 380-lb. shell 14 m., while the new U.S. 14-in. gun ranges 22 m. with 1,560-lb. armour-piercing shell, and nearly 30 m. with a somewhat lighter stream-lined shell. These considerations have led to the extensive employment of super-heavy pieces in land warfare.

Gun versus Howitzer.—Formerly a howitzer was a low-velocity weapon fired at a high angle of elevation, while a gun was a high-velocity piece with a flat trajectory. The howitzer conveyed the shell to the target with a much smaller propelling charge than the gun, and consequently lasted much longer than the gun before it was worn out. At present all guns are mounted so as to fire at high angles of elevation, in order to attain their extreme range, and use reduced charges as well as full charges and super-charges in order to save wear. On the other hand, the range required of howitzers is now greatly increased, so that the 1914 pattern, 12 calibres long, has been superseded by howitzers of 25 calibres and over, firing much heavier charges.

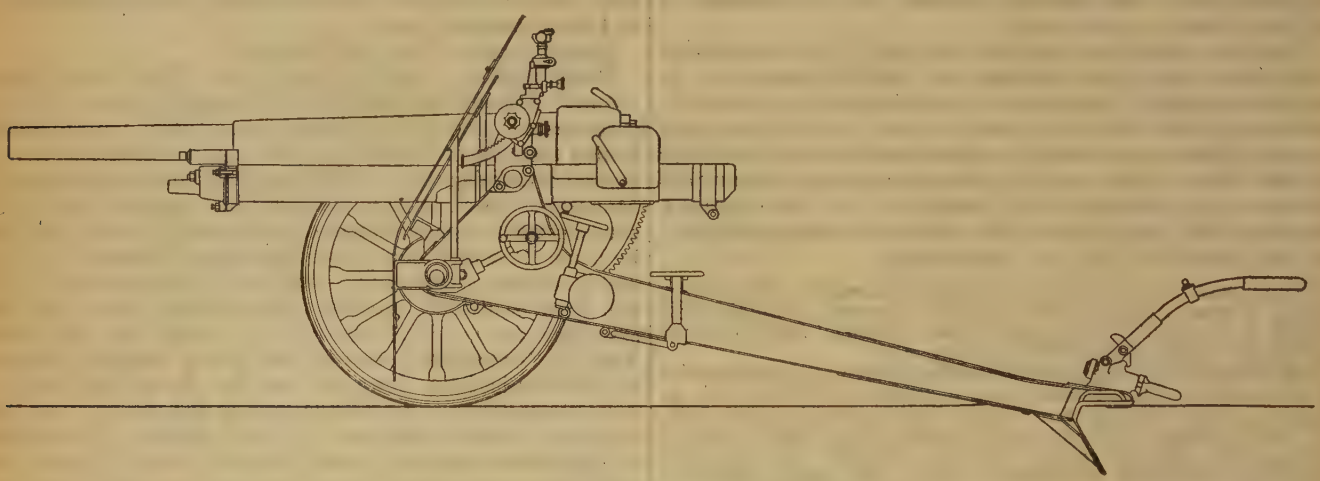
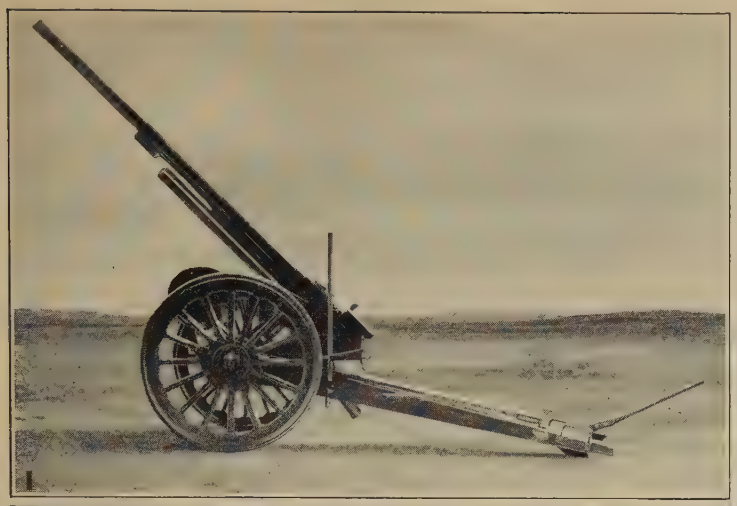
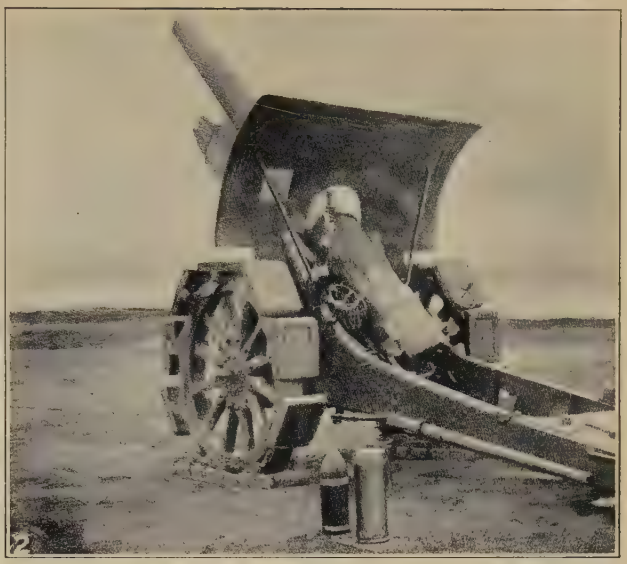


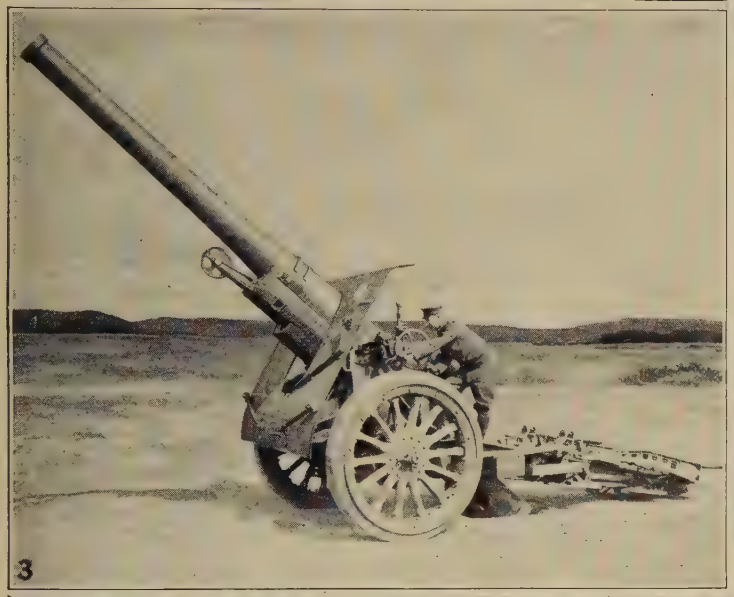
FIG. 1.—Vickers 3·3-in., High Velocity, 18-pdr. Field Gun (1925).

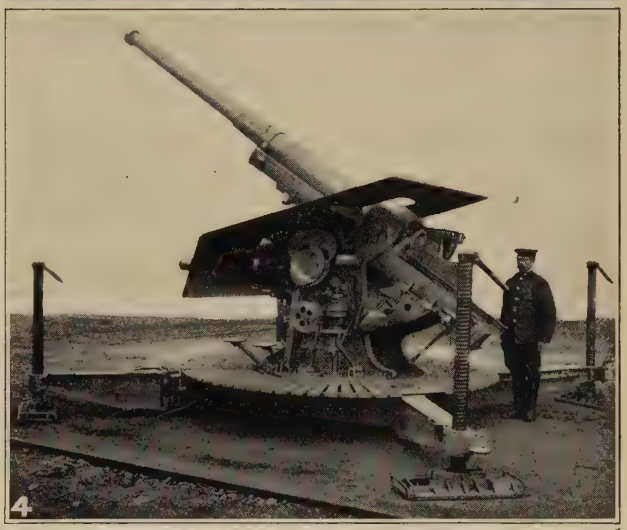
The distinction between gun and howitzer is therefore tending to disappear. It may be said, generally, that where a high striking velocity is required, as in the case of an attack on armour, a 50-calibre flat-trajectory gun is used; where the object is to convey a mine shell to the target, a 25-calibre howitzer, with a powder-charge only sufficient to carry the distance at 45 degrees of elevation, is preferred. Thus, in the World War, the French had a 520-mm. (20½-in.) howitzer throwing a shell weighing 1 ton 8 cwt. to a range of 12 m.; the Germans had a 380-mm. (15-in.) gun which threw an 8-cwt. shell 28 miles. The comparatively short range required of the 20½-in. howitzer is an instance of economy of force; it was built to fire from a railway mount, and the French reckoned that it could thus be brought within 12 m. of its prospective targets. The German 15-in. gun was transported by rail and fired from a permanent platform; its long range of 28 m. was necessary in order to bombard Dunkirk from the German lines. For the same reason, its shell weighed only 8 cwt., whereas a typical 15-in. gun fires a shell of 17 cwt. to a proportionately shorter range.

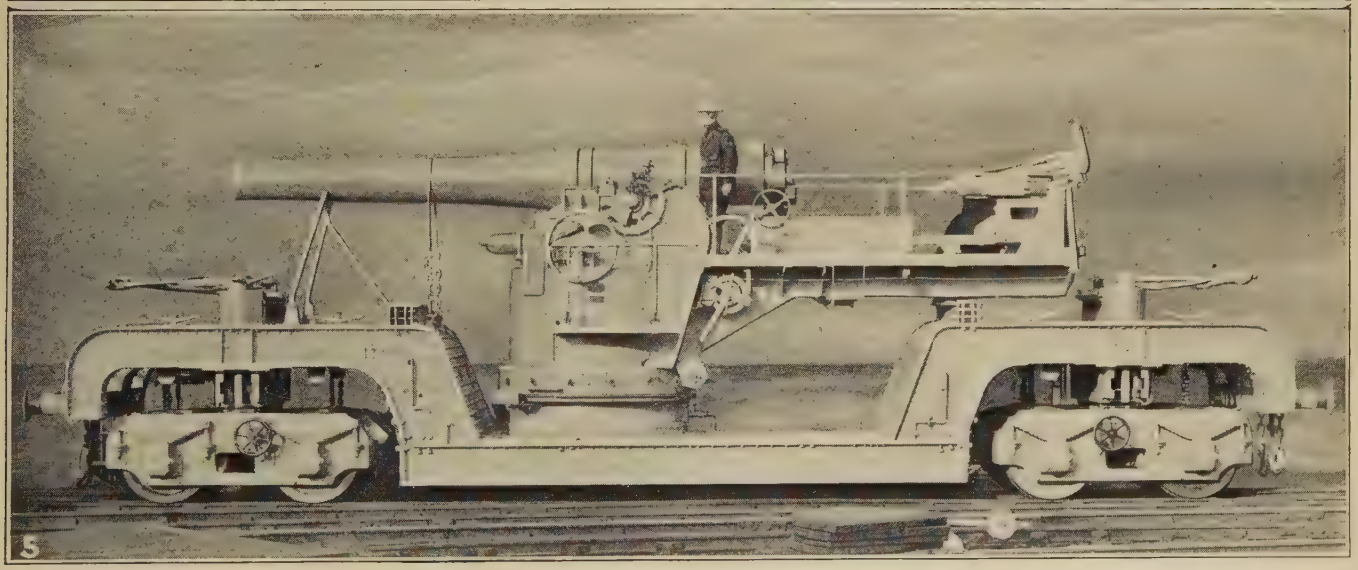
Super-heavy pieces are usually fired from railway mountings, or at least are transported by rail. But an invader may find











REPRESENTATIVE TYPES OF MODERN ARTILLERY

FIG. 1. American 75-mm. Field Gun (1921). FIG. 2. German Krupp 6-in. Howitzer. FIG. 3. French Schneider 6-in. Gun (1925). FIG. 4. French Schneider 4·2-in. Anti-Aircraft Gun. FIG. 5. British Armstrong 12-in. Howitzer, on railway mounting.

(*Fig. 1. Courtesy of U.S. Ordnance Dept.*)

it necessary to bring up large howitzers, for the reduction of fortresses near the frontier, before the captured railways can be made available. The difficulty in the way of transporting these pieces by road is the limit of the weight which bridges can carry. Even on the great main roads of western Europe this weight is not more than 30 tons, and on country roads it may be as little as 5 tons. This implies a special type of howitzer, comparatively short and light, capable of throwing a heavy shell to a short range. The German 42-cm. (16·5-in.) howitzer brought up for the siege of Antwerp was only 12 calibres long, and weighed 21½ tons, or about 29 tons on its special wagon. It threw a shell of 15·7 cwt. to a range of 10,300 yards. It was drawn by 3 traction engines, with a fourth in reserve for hills. The recoil gear, carriage, platform (in 2 parts), and gear for mounting the howitzer formed separate loads, and the piece required 13 traction engines altogether.

The French have a 370-mm. (14·6-in.) howitzer, only 8 calibres long, throwing an 8-cwt. shell 11,500 yards. It is rendered road-mobile by being carried on 2 road-trucks, one following the other, with an arched girder between them from which the piece is suspended. The United States has a 9·45-in. howitzer on a caterpillar mounting, driven by electricity from a separate vehicle which carries the 150-H.P. power unit. The total weight of the vehicle carrying the howitzer is 13 tons.

Long-Range Guns.—During the World War the Germans bombarded Paris from a distance of 76 m. with specially built long-range guns, throwing 265-lb. shells. This long range was obtained by using a velocity of 5,000 fs. and firing at an elevation of 55 degrees, so that the shell passed through the layer of dense air nearest to the earth, and reached the comparatively thin air at a height of 10 m. which opposed little resistance to its flight. In this case the greatest height of the trajectory was 24 miles. Guns of this type cannot fire more than about 30 rounds before they are worn out. Owing to uncertain weather conditions, the accuracy is poor; while the gun is new the shells may be expected to fall within a space of 2 m. long by ¾ m. wide, but as the gun becomes worn these limits are soon exceeded. It is now considered that aeroplanes are more efficient than guns for this kind of bombardment, as an aeroplane can now carry a 2,000-lb. bomb and can drop it with far greater accuracy than the gun.

Anti-aircraft Artillery.—The problem of hitting a target moving in three dimensions is a difficult one and the additional complication due to a curved trajectory has to be eliminated as far as possible. All A.A. guns are therefore flat-trajectory weapons, with muzzle velocities of the order of 2,000 fs. for light guns up to 3,000 fs. for medium guns. Ordinary field guns mounted on lorries, as employed in the World War, are of little use. However, modern field gun carriages are built to allow of high angles of elevation, to fire upon low-flying aeroplanes when these attack the troops with machine-guns. Regular A.A. guns are mounted on substantial pivots, with hydro-pneumatic gear to check the severe recoil. Mobile guns, used in the fighting line, are usually on low, wheeled platforms, which can be drawn behind a lorry.

On coming into action, the platform is lowered to the ground, and levelled by screw-jacks at each corner, so as to bring the pivot exactly vertical. Semi-mobile guns, used in sedentary warfare, are on heavier platforms which are carried in sections and put together before firing; and non-mobile guns, for the defence of fortresses and cities, are on solid concrete or caisson platforms. Mobile A.A. guns are usually 12-pdrs.; the greatest height of the trajectory is over 20,000 ft. and, up to 5,000 ft., the height at which reconnoitering aeroplanes usually fly, the trajectory is very flat. Semi-mobile and non-mobile guns are usually 40-pdrs. of about 105 mm. (4·2-in.) calibre. This calibre is used principally to obtain a flat trajectory up to 10,000 ft.; the additional weight of shell does not materially increase the effect.

The ammunition used with A.A. guns is shrapnel or high-explosive shell; a proportion of the shells are fitted with tracers. A tracer is a small firework in the base of the shell, which leaves a trail of smoke to mark its flight. This is necessary, since an ordinary shell fired into the air disappears until it bursts, and there is nothing to show whether it has passed close to the target or otherwise. The shell is fused so as to burst close to the target. If the fuse fails to act at this height, it explodes the shell at the highest point of the trajectory, so as to avoid endangering one's own troops by the shell falling among them.

Fire at aeroplanes is entirely by prediction; the course and speed of the target are measured by optical instruments, and the gun is fired at the point where the aeroplane is expected to be, making due allowance for the time of flight of the shell. If the first shot or salvo misses, the plane will at once begin to dodge, and it is useless to fire at it until it has again settled down to a regular course.

A good instance of the semi-mobile type of anti-aircraft gun is the French Schneider gun shown in fig. 4 on plate. This is a 4·2-in. gun firing a 37-lb. shell with a muzzle velocity of 2,300 feet per second. The pivot mounting is fixed on a steel platform, transported on wheels; the extensions carrying the screw-jacks are folded inward for travelling. The total weight is 8·8 tons. The overhead shield serves principally to conceal the movements of the detachment from above.

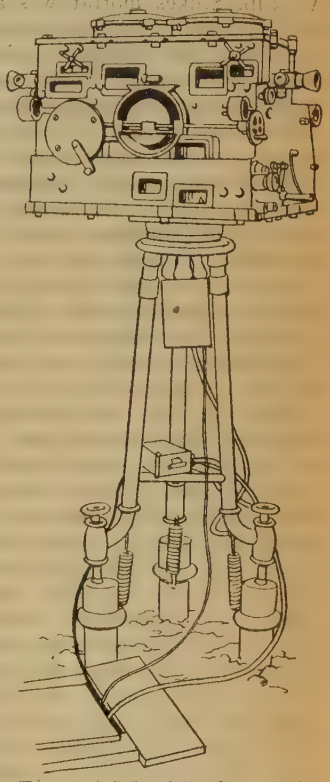


FIG. 2.—Schneider Control Instrument for Anti-aircraft Fire.

The special feature of this gun is the control apparatus. This is an instrument which is set up at a suitable observing position affording a clear all-round view; it is electrically connected to the gun, and may be half a mile distant from it. Six gunners tend the instrument, and observe the aeroplane with a short-base rangefinder and telescopes attached to the instrument, thus determining its range, height, speed and course. The instrument translates these data into simple elements of elevation and training of the gun. These are transmitted to the gun by electric connections which actuate dials on the gun-mounting. The gun-detachment have only to follow up the reading of these dials with the elevating and traversing hand-wheels; they need not see the target at all. When the course of the aeroplane has been determined, the officer at the observing position makes a "prediction" of the point which it should reach, say 30 sec. later, and directs his telescope on this point; the dials at the gun move forward accordingly. If the aeroplane duly appears on the cross-wires of the telescope, the officer fires the gun electrically; if it has changed its course in the meantime, a fresh prediction is made.

Trench Artillery.—When two opposing forces are entrenched, they tend to press forward till their advanced works are within 100 yd., or less, of each other. The same thing occurs in siege warfare, when the besieger extends his front trench till it is close to the fortress. The need then arises for a weapon capable of throwing a heavy bomb to a short distance, yet which is so small and light that it can be carried up through the trenches. The original piece of this type is the Coehorn mortar used in the sieges of the 18th century. The modern type was introduced by the Germans at the beginning of the World War.

The Krupp Minenwerfer is a light gun of 2-in. calibre mounted on a short plank. The 50-lb. spherical bomb rests on the muzzle, and has a tubular steel "stick" which extends down the bore of

the gun. The piece is fired at an angle of 45 to 75 degrees of elevation, and its extreme range is about 450 yards. The 50-lb. bomb, with its high-explosive charge, is capable of wrecking a "dug-out" or blowing in the walls of a trench so as to block it.

As the weight of the 50-lb. bomb rendered ammunition supply, in the front trenches, a laborious proceeding, the British introduced the light Stokes trench mortar, firing a 10-lb. bomb. This is a weapon of a different type. It is a light steel tube of 3-in. calibre, with a spike projecting into the breech end of the bore. The cylindrical bomb has a small cartridge and percussion cap fixed to its base; it is dropped into the muzzle, and slides down till the percussion cap strikes the spike, when the cartridge is ignited and the bomb blown out. The extreme range is about 1,200 yd.; this enables it to be used from a point well back in the trench system, where it is safer and less likely to draw fire than in the advanced works of the outpost zone. A 25-lb. Stokes mortar was afterwards introduced, and was used principally for firing smoke shell. Later on, the bombs were fitted with air-vanes to increase their accuracy. The 3-in. Stokes proved such a handy weapon that it was used in mobile warfare as an infantry gun, for the reduction of "strong points" encountered in the infantry advance. Being a high-angle weapon, it was useless against moving tanks.

The French used the Dumezil trench mortar, which is on the same principle as the Krupp Minenwerfer, but heavier. It throws stick-bombs of various weights, from 35 to 99 lb.; with the former it ranges over 700 yards. They tried a compressed air mortar, in which the range was determined by varying the pressure in an air-chamber; this was an efficient weapon, but was considered too complicated to manufacture in large numbers.

The Germans had a 9-lb. trench mortar, ranging 1,400 yards, and in 1918 they adapted it so that it could be used as a mobile infantry gun, for direct as well as for high-angle fire. This is a miniature field howitzer, fired from a bedplate in the trenches and mounted on a small wheeled carriage for work in the open.

Heavy Trench Mortars.—Owing to the difficulty of supplying heavy ordnance in sufficient quantities, trench mortars were introduced, in 1915, capable of throwing a 200-lb. shell about 1,200 yards. The principal piece of this type was the Batignolles 240-mm. (9·45-in.) mortar. This is in two pieces screwed together, and is fired from a mounting fixed on a bed of wooden balks. It is intended to be carried into the trenches on special iron barrows. The total weight is about a ton, and it is divisible into five barrow-loads. The Allies used this weapon for firing from positions towards the rear of the trench system, where it could be turned on the front trenches in case the enemy invaded them. The Germans used, for the same purpose, a rifled 170-mm. (6·69-in.) trench mortar, firing a shell of 110 lb. to a range of 1,250 yards.

II. AMMUNITION AND TRANSPORT

All modern guns fire smokeless powder consisting of gun-cotton and nitro-glycerine in varying proportions. This powder makes a broad white flash at the muzzle of the gun, which enables the enemy to locate it, especially at night, unless the gun is behind cover extending at least 10 ft. above the muzzle. Therefore field guns and other guns which have to be in action within 5,000 yd. of the enemy are now provided with flashless powder, which makes only a dull red glow. The flashless quality is secured by adding certain ingredients to the smokeless powder.

Projectiles.—The most effective man-killing projectile against troops in the open is shrapnel shell, which is a steel case containing bullets and a small propelling charge. A time fuse, in which time is measured by a column of burning composition, or by clockwork, is set to ignite the charge behind the bullets when the shell arrives at a point about 50 yards from the enemy. The head of the shell is then blown off and the bullets released from the case which falls to the ground, the bullets going forward with the velocity of the shell at the moment of burst.

However in the World War, in view of the enormous requirements of ammunition and the predominance of trench warfare, it was decided that the proportion of shrapnel should be considerably reduced. Even field artillery, which, at the outset, carried at least 80% of shrapnel, were reduced to 5%, the remainder being common shell. The common or high-explosive shell is merely a hollow projectile containing high explosive, detonated on impact by a simple percussion fuse. It may be either thick-walled, producing effect by its splinters, or thin-walled ("mine") shell, containing a large burster for the demolition of earthworks, etc. The former has an "instantaneous" fuse which bursts the shell before it has time to penetrate into the ground, the latter has a "delay action" fuse which allows the shell to penetrate some 6 ft. before exploding.

Special natures of shell are star shell for illuminating, smoke shell to conceal troop movements by obscuring the enemy's view, incendiary shell, armour-piercing shell and chemical or gas shell, containing lethal or disabling gas. Although the latter were used in the World War, their employment was condemned by the Treaty of Versailles, 1919, and by the Washington Conference, 1922. Whether they will be used in future wars is a question beyond the scope of this article, but it may be said that all nations are taking measures for defence against chemical warfare.

Explosives are used for the bursting charges of shells. The substance principally used is picric acid, otherwise known as lyddite, melinite, shimosé, etc. Various substitutes, such as trinitrotoluene (trotyl) and ammonal are used on account of difficulties of supply (*see* EXPLOSIVES, MILITARY).

EFFECT OF SHELLFIRE

The field artillery shrapnel shell discharges about 300 bullets, spread over a space of 150 to 300 yd. (according to the angle of descent of the projectile) from front to rear, and about 25 yd. wide. Fire at troops is therefore so controlled that the lines of fire of the guns are 25 yd. apart and so that a shrapnel shell can be burst once a minute at least in front of each 25-yd. unit of target. This is the normal rate of field artillery fire, and the rates of barrage fire are based on this. The rate may be reduced for fire of interdiction, or doubled or quadrupled at decisive moments. Or the lines of fire may be concentrated, so that the fire of several guns converges on one target, when attacking a single gun or group of machine-guns. Common shell, when used with instantaneous fuses against troops in the open, is less effective than shrapnel, but its moral effect is greater.

Bombardment.—Effect on earthworks depends on the mine-power of the individual shell, as measured by the size of the crater which it produces. For instance, a 6-in. howitzer mine shell, containing some 13 lb. of explosive, produces a cylindrical crater about four yards across and 10 ft. deep, partly filled up by earth falling back into it. Therefore to breach a 12-ft. parapet it must be struck by one such shell per 4 yards. If the diameter of the crater is less than the thickness of the parapet, great waste of ammunition ensues; for this reason field gun and field howitzer shell are practically ineffective against entrenchments. At guns in the open, a modern field gun takes 15 rounds of shell at 3,000 yd., or 25 rounds at 3,500 yd., to make a disabling hit.

Wire Cutting.—Defensive belts of barbed wire are a leading feature of modern defences, and it is of great importance to provide means of cutting lanes in them for attacking troops to pass through. In 1915 this was done by the precise and deliberate fire of shrapnel, and had to be carried out on the day previous to the attack, thus forfeiting the advantage of surprise. The introduction of the instantaneous fuse for common shell has enabled wire-cutting to be done quickly, but a large expenditure of ammunition is still required. The French found in 1918 that 600 rounds of field common shell were required to cut a lane 25 metres wide through a belt of strong wire 25 metres deep at ranges of 2,000 to 4,000 metres. The time taken was 15 min., after ranging had been completed.

Fire at Tanks.—Any gun, down to a 6-pdr., is capable of disabling a tank with a direct hit at ranges up to 2,000 yards. At longer ranges, field and mountain guns have to be provided with

armour-piercing shell to attack armoured tanks. The 18-pdr. field gun will penetrate about 2½ in. of armour at 1,000 yd. and 1½ in. at 4,000 yards.

Fire at Armoured Forts.—The Belgian forts destroyed by the German super-heavy artillery in 1914 were not attacked by firing at the armour, but by undermining the armoured turrets with mine shell which exploded in the earth under them. It has been proposed to obviate this by covering the ground in front of the turret, to a distance of 50 metres, with an apron of cast-iron blocks one metre cube, which will burst the "undermining" shell harmlessly on the surface.

Armoured forts are very vulnerable to gas attack and to heavy bombs dropped from aeroplanes, and it is probable that, in future land defences, they will be replaced by entrenchments.

Supply of Ammunition

Modern methods of warfare developed in the World War necessitated the employment of enormous quantities of artillery ammunition. Thus in Aug. 1918 the Germans had over 30,000,000 shells in their ammunition columns and depôts in France. In 1914 it was considered that 1,500 rounds per field gun should be in hand at the beginning of a campaign; of these, on the average, 300 were carried with the battery, 100 in a light ammunition column capable of moving across country, and 100 in a heavy ammunition column. The remaining 1,000 were kept ready in arsenals. It was soon found that this allowance was insufficient. It was found necessary, for a great attack, to put in one field gun per 10 yd. of a 50-m. front, and in view of the fact that each gun might have to fire 500 rounds in a day, the old methods had to be revised. The solution was to bring the daily output of the arsenals as close as possible to the fighting front, by using ordinary railways, light railways and specially-laid trench railways.

The ammunition columns, which now consist entirely of motor lorries, are no longer looked upon as reserves of ammunition, but as carriers between the advanced ammunition depôts, called dumps, at the various railheads and the guns. They formed advanced dumps by the roadside as near as possible to the gun positions, and the battery ammunition wagons took the ammunition up to the guns. The view of those who base their ideas on the World War experience, is that before an action each gun should have 300 rounds beside it, in addition to the number carried in the battery wagons. The railhead dump is usually at least 5 m. behind the guns, to secure comparative immunity from fire, and the motor ammunition columns are expected to make 4 double trips a day, covering 40 to 50 m., besides the additional ground covered in an advance.

Special artillery vehicles are no longer used in ammunition columns; these consist mainly of civilian motor vehicles, either lorries or stripped chassis fitted with platforms. In principle, all transport has to be "general service," capable of carrying ammunition, stores or troops, as required.

At the gun itself, a shielded ammunition wagon, containing about 100 rounds, is run up beside the gun, forming a protection for the gunners employed in setting fuses and in passing shells to the loading number.

Transport of Artillery

At the present time the draught horse is in process of being replaced by mechanical transport for all artillery. This change is necessarily a gradual one, and its nature and progress in different countries are partly determined by the extent to which the mechanical transport which has replaced the horse in civil life can be rendered available for military purposes.

Artillery may be mechanicalised in several ways. The automobile gun-carriage has the gun-mounting built into it, and is preferably of the "caterpillar" type. The artillery tractor pulls the gun behind it, and carries the detachment and first supply of ammunition, and the artillery carrier carries the gun on a platform from which it is dismounted, by a ramp, for firing. From the tactical point of view, the automobile gun-carriage is at the moment not satisfactory, as it is too vulnerable and too large for concealment, and requires an undue amount of labour to entrench. The motor is useless while the gun is in action, when, if it were separable from the gun, it would be most useful in bringing up ammunition.

Tractors.—The artillery tractor may be a caterpillar or a vehicle of the lorry type. Both forms are open to the objection that the complicated mechanism of a Q.F. gun is damaged by rapid travelling on the road, even if the wheels be provided with rubber tires. The caterpillar tractor is good across country, but cuts up the roads; the least unsatisfactory in this respect is the tractor of the French Kégresse type, with rubber caterpillar bands, which are said to last as long as linked steel bands. On the other hand, the rubber bands do not grip so well as steel ones on slippery ground. Various attempts have been made to construct tractors and carriers having both road wheels and caterpillar tracks. The American Christie tractor travels normally on road wheels, and has a caterpillar band which is put on round the wheels for cross country work; the French St. Chamond carrier-tractor is a complete caterpillar vehicle, with an extra pair of road wheels on extensions of the chassis at each end, which can be raised well clear of the ground, allowing the vehicle to rest on the caterpillar tracks.

Another vehicle, of a different type, is the "4-wheel drive" lorry, in which the wheels are driven independently. This is excellent on the road, and is capable of moving over easy country. But, owing to the extra complication and expense, the civil demand for it as a vehicle is very small. The Pavesi agricultural tractor is a small, 4-wheeled vehicle with a flexible connection between the fore and hind carriages, which enables it to adjust itself to irregularities of the surface of the ground. Its 4 wheels are driven independently, and have removable "spuds" which are put on for cross-country work. It has a 16-H.P. engine burning paraffin or petrol. The road speed is about 5 miles an hour, and the machine is therefore unsuited for the rapid transport of reserve field artillery. It has, however, been adopted for the Italian divisional artillery, and it is under consideration as the tractor for the French artillery of accompaniment.

The artillery carrier saves the gun from road strains, but entails delay in lowering the gun on to the ground when it comes into action, and in hoisting it up again with a ramp and winch. Many tractors, such as those of the American Holt type, can be fitted with platforms and used as carriers. It is not practically possible to fire the gun from the carrier, as this would entail a considerable increase of weight and complication. Any commercial lorry can be readily adapted as an artillery carrier, for travel on the road only, by the addition of a winch. As regards the difficulty of combining a road vehicle and a cross-country vehicle, the carrier is subject to the same disadvantages as the tractor.

French and Italian Practice.—The French, in 1920, proposed to introduce an agricultural tractor, encouraged by a government subsidy, which should be available for the transport of artillery. But it was found that owing to the small size of fields in France there was little demand for the tractor, and no immediate prospect of its superseding the horse. On the other hand, the use of motor-lorries is extending rapidly. The French have now decided to carry the army field artillery, which is required to be highly mobile, on lorries, thus accepting the principle of the carrier, not the tractor. These lorries cannot move off the road, except on favourable ground; therefore each battery carries a pair of draught horses per gun on its lorries, to take the guns into position. The French had 83 of these *batteries portées* at the end of the War. The French gun of accompaniment, at the rate of 2 per battalion in the fighting line, is to be drawn by a small agricultural tractor of the Pavesi type standing about one metre high.

The Italians have arrived at a somewhat different solution. No draught horses are bred in Italy; they have to be imported from Germany. It has therefore been decided that the divisional field guns are to be drawn by the Pavesi agricultural tractors already described. The Italian army field artillery, which is required to be highly mobile, will be carried on low

platforms, which have springs and rubber-tired wheels, pulled by fast lorries. When the guns have to leave the road, they will be taken into position by the divisional Pavesi tractors.

The Americans have finally condemned the automobile gun-carriage, and favour the caterpillar tractor. They consider it possible to produce a pattern of caterpillar band which will not cut up the road unduly. Other nations are still experimenting. Medium guns are usually tractor-drawn, the gun being shifted to a "travelling" position in which the weight is divided between the gun wheels and limber wheels. Heavy guns are transported on special wagons, drawn by tractors, which carry the piece itself, while the empty carriage is drawn by a second tractor.

Super-heavy artillery is transported almost entirely by rail, though in 1914 the Germans brought up their siege howitzers, divided into separate loads, on special road-wagons. The railway mounting consists of a massive platform supported by bogies, on which the gun mounting is built (see fig. 5 on plate). In the English Elswick type the gun is fired while the mounting is "alive" on its wheels; in other types the central platform is lowered on to the rails before firing. All-round fire from the truck, without special preparation, is only possible with medium guns; for heavier natures the gun is laid for direction by running the truck up or back along a curved siding. Or, in some railway mountings, the gun-truck is supported laterally by heavy "outriggers" sunk in the ground.

For the heaviest natures the railway is used for transport only, and the gun is lowered on to a previously built platform. Permanent concrete platforms were used in 1914, but these were superseded by "caisson" platforms consisting of iron boxes bolted together and filled with earth, surmounted by a steel platform plate which carried the mounting. Recent American platforms dispense with the caissons, and consist of the platform plate only; this is divided into sectors for transport, bolted together on the spot, and pegged down with a number of steel stakes. These platforms can be laid in a few hours, this being a great addition to the value in the field.

Railway mountings can be used for the transport of artillery on light railways, and even on trench railways. Additional narrow-gauge wheels are fitted to the gun-truck for this purpose. In this case a platform must be used for firing. The limit of the height and width of a railway mounting is the loading gauge of the railways on which it may have to be used; this depends principally on the size of the tunnels. Practically there is no limit to the length or weight.

III. TECHNIQUE AND ORGANISATION

In modern war, guns are quickly silenced if they come into action in full view of the observing posts of artillery already in position. Except in special cases, as that of guns of accompaniment, artillery always use the concealed position behind a ridge or other cover from view, in which the elevation and direction necessary to hit the target are signalled by an advanced observer. An aeroplane may be used, when available, to correct the fire; modern developments of wireless telephony enable the airman both to send and to receive messages. Advanced observers on the ground now use "ground wireless" instruments. It is now considered that with wireless telegraphy, which is more reliable than wireless telephony, it is possible to use one instrument per 500 metres of front without interference.

Ranging.—This process serves to determine the elevation at which a gun will hit the target, or, more correctly, the elevation at which the mean point of impact of the shells will coincide with the target. This elevation is not necessarily that due to the map range, as it is affected by the temperature, height of barometer, strength of the powder, degree of wear of the gun and other factors which together constitute the "error of the day."

When a number of shells are fired from a gun which is pointed at a given elevation above the target, they do not fall in the same place, but are distributed over a space which, at medium ranges, may be 100 yd. in depth. Together they form a "sheaf of fire." The first step in ranging is to determine, by observation of the fall of the shells, 2 elevations, at the higher of which the sheaf of fire will fall beyond the target, and at the lower of which it will fall short. These 2 elevations must be such that the sheaves of fire do not overlap, as otherwise they would afford no definite information. The 2 elevations constitute the "long bracket," within the limits of which the true elevation must lie. The usual long bracket is one of 300 yards. This bracket is then "split" by firing at the 2 intermediate hundreds of yards, and observing the results, thus obtaining a closer approximation to the elevation required. Finally, corrections of 25 yd. are made till an equal proportion of rounds are observed to burst over and short. Ranging for line, that is, for lateral direction, is carried out in the same way.

Map Ranging.—It is of great importance to be able to open effective fire by surprise, without preliminary ranging. It is possible to do this if the exact map range, and the factors constituting the error of the day, are known beforehand. In position warfare the ground is accurately surveyed, and the emplacement of each gun is marked on the survey. Guns are carefully "calibrated," a process which consists in determining the error due to wear by firing at a known range. The error of the powder is measured in the same way. A special section in each army corps, known as "Meteor," keeps the batteries informed as to the atmospheric conditions. By this method it is possible to open effective fire without ranging, even on unseen targets, with sufficient accuracy for purposes of bombardment. Map ranging is hardly applicable to mobile warfare.

Another method of ranging, much used in trench warfare, is the employment of a "witness point." This is an easily observed point in the enemy's lines, such that its range can be measured exactly; it should be in the general direction of the prospective target, and within about 500 yd. of it. By firing a few preliminary rounds at the witness point, and observing the result, the data necessary to hit the target can be obtained.

Sound Ranging.—This is effected by observing the moment at which the report of an enemy gun, or the burst of a shell fired at it, reaches each of a chain of recording instruments. It has recently been improved so as to give very accurate results under suitable weather conditions, from a set of instruments occupying as little as 2,500 yd. of front. Setting up the instruments takes the rather lengthy time of from 24 to 48 hr., which limits the employment of this method in mobile warfare. (*See* SOUND RANGING.)

The proportion of field artillery to infantry in an army was for long fixed at about 6 guns to 1,000 rifles, and infantry divisions were formerly organised on this scale. It was found, however, that this proportion of guns was excessive for sedentary warfare, and utterly insufficient for active warfare. A modern division has therefore only 4 guns per 1,000 rifles, the 2 additional field guns being formed into mobile "army" brigades to be put in as reinforcements where required. A division has one battery of medium guns for long-range work: heavy guns and howitzers, which can fire over a front exceeding that of a division, are allotted to army corps; and super-heavy guns are under army command.

The proportion of artillery of all natures arrived at by the end of the World War was 10 guns and howitzers per 1,000 rifles, roughly 6 field, 2 medium, 1½ heavy, and ½ super-heavy. This did not include the trench mortars, at the rate of one per 100 yd. of front, used in trench warfare.

The usual field artillery fire unit is the battery of 4 guns, which is capable of firing 100 rounds a minute on emergency. Six-gun batteries are sometimes used for the sake of economy, as they require proportionately fewer officers and battery staffs. Field batteries are organised in brigades (French *groupes*, German *Abteilungen*) usually of 3 gun batteries and one howitzer battery. Medium artillery work in single batteries of 4 guns, heavier natures work singly.

Prior to 1914 the highest artillery command was that of the divisional artillery, but when the artillery of a given front had to be increased to treble its normal strength, for attack or defence, it was found that a higher artillery command was

required. The G.O.C. the artillery of an army corps of 3 divisions (sometimes 4), now commands the 3 divisional artilleries (reinforced if necessary by army field artillery); the corps artillery (also reinforced); and any super-heavy artillery allotted to him for the operation.

IV. TACTICS OF ARTILLERY

In modern war it is found that infantry units opposed to each other are driven to seek cover, and immobilised, as soon as they get within the zone of each other's aimed fire. Their only means of arriving at a tactical decision is to enlist the aid of an arm which is capable of keeping down the fire of troops opposed to them while itself keeping beyond the range of effective rifle fire, or which is capable of withstanding rifle fire, as in the case of shielded guns and tanks.[1] The assistance afforded to the infantry by the artillery during the World War was so effective that the artillery came to be regarded, at least until 1918, as the most important arm, although it is incapable of achieving victory by its own efforts.

Before 1914 it was held that infantry and artillery should work in intimate co-operation (*liaison*) so that when an infantry unit was checked it could at once communicate with the artillery behind it, and inform them as to the exact points which the infantry required to be shelled. The first battles of the World War showed this ideal to be impracticable, as communications broke down at once. Neither telephoning, visual signalling nor communication by orderly, were possible under heavy fire. In addition to this not even the infantry themselves were capable of locating the enemy which was causing them casualties. When troops were in permanent trench systems, telephonic communication, by deeply laid cables, was maintained; but the moment the infantry advanced or retreated from their trenches they lost touch with the guns.

Barrage.—This led to the introduction of the barrage, which is a screen of bursting shell across the whole front of the infantry advance. The smoke and the dust thrown up conceal the infantry and protect them from aimed fire. The "creeping" barrage is advanced according to a time-table, by "bounds" of perhaps 100 yd.; it is "halted" on each successive objective to "pound" it before the infantry assault it, and when the final objective is attained it becomes a "standing" barrage to screen the infantry while they consolidate the position. The infantry follow the creeping barrage closely, keeping just behind the zone of bursting shells. It is intended that the barrage shall destroy all opposition, but however dense and however deep the zone of bursting shells is made, this is almost impossible to attain, as infantry and machine-gunners take refuge in deep trenches while the barrage passes over them, and then re-appear.

The objections to the barrage are serious. It cannot be put down without considerable delay and once started, it cannot be controlled. Moreover, since it has to be fired by a large number of dispersed batteries, it is impossible to communicate with them all, through a "chain of command," in time to check it if the infantry are unable to keep up with it. Since the whole area of the advance has to be covered progressively with bursting shells, the greater part of these are ineffective, except as contributing to the smoke screen. It requires elaborate preparation and a very heavy expenditure of ammunition. The modern tendency is therefore to restrict the barrage, and the number of guns detailed to fire it, to the minimum required for safety; that is, to form a protective rather than a destructive barrage, and to employ as many guns as can be rendered available in accurate fire at important targets in and behind the enemy's line. It is obvious therefore that when a situation demands a barrage, the fight has temporarily become of a stationary nature.

The creeping barrage is also used to screen retreating troops; a "flank" barrage screens the flank of troops halted or on the move, and a "standing" barrage is used for many purposes, such as to prevent the enemy from reinforcing the portion of his line which is being attacked. The barrage, with all its defects, is necessitated by the impossibility, under present conditions, of communication between units on the battle-field. Should wireless telephony be so developed as to be directive, selective and proof against interference, the crude method of barrage may disappear.

[1] Gas warfare is not here considered.

Mobile Warfare

The creeping barrage may not be sufficient to overcome all opposition to the advance, and the infantry are liable to be held up by machine-guns and troops protected by overhead cover. It is necessary that they shall be accompanied by artillery, following the firing line so closely that they can see what is going on, and can open fire on machine-gun nests, etc., without the delay caused by signalling messages.

Guns of Accompaniment.—So much is generally admitted; but the nature, command and organisation of the accompanying artillery are matters on which opinions differ. Moreover, the infantry are not satisfied with guns of accompaniment, but demand a weapon of their own in the actual firing line to deal with sudden attacks by tanks and machine-guns. It is impossible to go into the whole controversy in this article. The opinion of the French, which carries great weight, is as follows:—

> The artillery of accompaniment must have a fully efficient shrapnel weapon; miniature guns are of little use; the gun will be the service 75 mm. field gun on a low carriage, and will be taken into action by a small tractor standing less than one metre high. It may have a special light shell to facilitate ammunition supply. The artillery will be tactically under infantry command, but will be free to choose its own technical methods.

Other nations are introducing pack guns, or special light guns or howitzers which can be drawn as far forward as possible by small tractors, and can then be divided into loads and carried up by hand. The British gun of accompaniment is at present the 3.7-in. pack howitzer, but it is generally considered that its 20-lb. shell is so heavy as to present serious difficulties in ammunition supply.

The infantry gun, as distinguished from the artillery of accompaniment, will probably be a small piece firing a shell of about

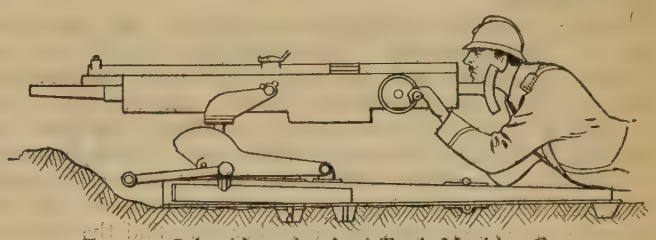


Fig. 3.—Schneider 1-in. Anti-Tank Machine-Gun.

1½ lb. capable of stopping tanks up to 1,000 yd. range, and of destroying machine-guns. It will be on a low sleigh mounting. This is in effect a development of the elephant rifle issued to the German infantry as a tank-stopper. The recoil of this rifle was too severe for firing from the shoulder, and it was in process of withdrawal and re-issue as a machine-gun at the end of the War. Fig. 3 represents a Schneider one-inch machine-gun firing armour-piercing shells, intended especially for stopping tanks.

Phases of the World War

The World War was divided into four phases: the invader's dash into enemy country, a long period of trench warfare, the breaking of the line, and the retreat of the invader. It is of the utmost importance to the invader to make his initial dash so rapid and effective as to finish the war at once; similarly the defender hopes to drive back the invader without entering on an exhausting period of sedentary defence. Therefore both sides must be able to dispose of highly-mobile troops and the light and medium artillery must be able to keep pace with an advance at the rate of 50–100 m. per day.

Salients and Re-entrants.—The tactical method will be, as heretofore, the rapid deployment of a superior force of infantry and artillery wherever opposition is encountered. The length of the battle-front will be measured in hundreds of miles. The battle-front will naturally assume an indented shape, with salients where slight opposition is encountered, separated by

re-entrants where the resistance is obstinate; these salients will be fed by reserves so as to spread out laterally and to encircle and pinch out the re-entrants between them. In this warfare the light artillery is relied upon to form the salients, while the heavy and superheavy artillery, the latter ranging about 30 m., bombards the re-entrants and renders them untenable.

The attacking force is preceded by a screen of motor-cyclist infantry supported by light artillery. This force moves about 20 m. in advance of the main body; its function is to conceal the movements of the main body, to overcome slight resistance, and to locate the positions taken up by the defending army. The object of including artillery in this force is to overcome resistance with which the combat troops (*e.g.*, mechanicalised infantry or tank infantry) cannot cope; thus a machine-gun in a house commanding a bridge or defile might hold up infantry for hours, whereas a field gun would wreck the house in a few minutes. It is necessary that the artillery accompanying this force shall be highly mobile, in order that it may be brought to any point where resistance is experienced with the least possible delay. Some authorities consider that it is worth while to introduce an automobile gun for this purpose alone, in spite of the objections to it already mentioned. In any case it must be a piece capable of a higher degree of mobility than that required of the divisional artillery.

Deployment.—Wherever a defensive position is located by the advanced screen, and the aeroplanes which accompany it, the long columns in rear deploy as quickly as possible. The attacker cannot tell how serious the resistance will be, but if he underestimates the strength of the defence, and delivers an attack with insufficient artillery support, he exposes himself to a severe check. His safest course is to prepare for an attack *en règle*, preceded by an artillery bombardment, led by tanks, and protected by a barrage.[1] This entails bringing up a large supply of ammunition, since each field gun should have 300 rounds "dumped" beside it, in addition to the supply that is carried with the battery.

Further, it entails reinforcing the artillery on that particular front to "attack strength" of one gun per 10 yd. of front, by bringing up artillery from the reserve and from neighbouring columns. This is because one field gun can only barrage 30 yd. of front effectively, and because only one-third of the guns are available for barrage purposes, as will be seen. The deployment and formation of artillery dumps will take at least 24 hr., and the attack will take another day, from dawn to dusk; after all this preparation and delay the attacker may find that he has deployed against a sham position, and wasted time and ammunition. He is therefore tempted to endeavour to rush the position with his advanced guard, a proceeding which affords great opportunities to an alert defender.

Supporting Artillery.—As regards the action of the supporting artillery, that of the guns of accompaniment has already been referred to. Of the remainder, one-third of the guns will bombard and afterwards barrage; the other two-thirds, including all the medium and heavy guns available, will bombard the position and will afterwards concentrate on important points in the defender's line and on objectives such as cross roads and railway stations in rear of it. The French regulations of 1912 advised deploying only a sufficient number of guns for the immediate purpose in view. But it is now generally considered that the German method is preferable; this consists of getting all the batteries into position, ready to open fire if required, as quickly as possible. One reason for this preference is that a battery in action in a concealed position is much safer from fire than if it remains in column on the road, where it can be located by aeroplanes.

Defensive Positions.—The local conduct of the attack consists in forming salients wherever the infantry or other combat troops can get forward, feeding the salients with reserves so as to form offensive features, and surrounding and "pinching out" the re-entrants between them. A modern defensive position is not a well-marked continuous line, which would be untenable under artillery fire; it is a chain of small centres of resistance, or localities organised for defence, each as inconspicuous as possible, held by detachments varying from a platoon to a company with machine-guns. These defended localities and the posts comprising them flank and support each other by their fire; they are

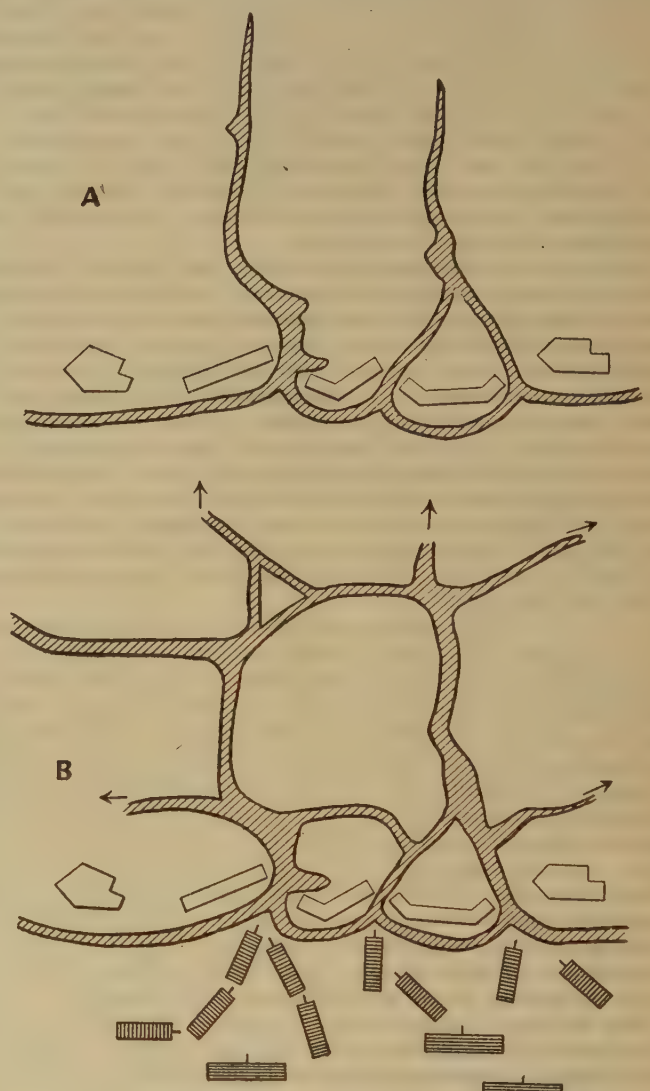


FIG. 4.—The Penetration of a Position. *A*, Weak salients liable to be cut off; *B*, Salients fed by reserves, and pinching out re-entrants.

protected as far as possible by obstacles, but they cannot be provided with barbed wire and overhead cover as in a regular system of entrenchments.

Each of these centres of resistance has to be taken, or enveloped and cut off, by the attackers, and for this they require the assistance of the guns of accompaniment. For the fighting is too confused and complicated for the divisional artillery in the rear to afford much help to their infantry at this stage, especially as the enemy posts, being carefully concealed, often remain undiscovered till the infantry are close upon them. However, the divisional artillery must press forward as their infantry gain ground, keeping in touch with them as closely as possible. Aeroplanes, dropping messages, will assist in keeping up communication between the infantry and the guns. If the infantry are seriously checked, and have to await reinforcements, the divisional artillery must be prepared to put down a barrage in front of them. Medium and heavy guns gain little

[1] This and most of the subsequent detail is inevitably based on the conditions of the World War and is thus liable to be radically modified by the mechanical evolution which is taking place in all armies. Further it visualises a scale of artillery support which is beyond the means of the British Army, at least under its post-War organisation.

by advancing to a shorter range, and their fire is interrupted while they are moving; consequently they do not usually advance till several miles of ground have been gained.

A fully-organised defensive position may be 4 or 5 m. in depth, consisting of several successive chains of defended localities. As each of these is taken by the attack, the bombardment, which has been "lifted" at the moment of assault, is shifted to the next line of defences; these have hitherto been invisible to the artillery of the attack, but are now in view of the advanced artillery observing officers, who press forward to the first-line positions as soon as they are taken. The infantry advance is resumed (usually by fresh troops); a fresh barrage is started, and the attack pushes on till success is achieved, or till the attacker's forces are exhausted.

In modern warfare there is no question of keeping any of the attacker's guns in reserve to cover a possible retreat; it is considered preferable to use all the available gun-power to strengthen the offensive.

Pursuit of the Enemy.—After a position is captured, it is most important to keep up pressure on the retreating enemy, in order to convert his retreat into a rout. Horse-drawn artillery is usually too exhausted to pursue, but motor artillery can go on as long as its petrol lasts. The pursuit is one of the few occasions when artillery should fire at night; even if accurate fire is impossible, a few shells taking effect on the men and transport of a crowded column will do a great deal to lower the enemy's morale.

The strategy of the defender consists mainly in keeping the attacker in ignorance of the real defensive position; he is thus induced to deploy prematurely against sham positions lightly held by mobile troops and guns, so that the defender can counter-attack his weak, extended line with a strong, concentrated force. Here, again, a high degree of mobility is required in order to assemble the field artillery quickly enough to take advantage of any momentary weakness in the attacker's line. The same principle applies to the tactics of mobile defence. The attacker's communications are impeded by long-range shell fire, which hinders him in bringing up his reserves and heavy artillery, and his advancing infantry are weakened by shrapnel fire. Wherever the defender can secure a superiority of force he delivers a counter-attack, protected by an artillery barrage and supported by accompanying and divisional artillery.

Similarly, in the defence of the real position, the defender endeavours to conceal his trenches and defended posts, and thus save them from concentrated artillery fire, till the attacking infantry arrive within short rifle range of them, and are mowed down by machine-guns which have hitherto been kept silent. The defending artillery have the advantage of knowing the ground and the precise range of every point in their defences, and must do their utmost to keep up communication with their infantry, in spite of the damage to telephone lines caused by the bombardment. (The "ground wireless" instruments already referred to may here be most useful.) Therefore they should be able to deliver sudden bursts of fire on the attacking infantry at critical moments, and to afford efficient support to local and general counter-attacks.

Artillery in Trench Warfare

As the invader advances into the enemy's country, the hastily mobilised defending forces will grow stronger, and the resistance will become stiffer. If the defender succeeds in assembling a force nearly equal to that of the invader, and in establishing it in a strong, entrenched line, before the invader reaches the capital or other vital point, there will then ensue a period of trench warfare.

A modern entrenched line consists of a forward or covering zone some 2 m. deep, consisting of small detached works lightly held, intended to delay the enemy, to break up his line, and to mask the defences in rear; a main zone of strong detached works capable of all-round fire, connected with each other by a chain of short lengths of trench and with the troops in rear by communication trenches; and a reserve zone or second line, which must be far enough in rear to compel an enemy who has penetrated the main zone to form up for a fresh attack.

When both sides are comparatively inactive, the field artillery defending the line is kept at its minimum defensive strength of one gun per 30 yd. of front, of which one-third is in the main zone for the defence of the covering zone, and two-thirds in positions in rear for the defence of the main zone. Heavier natures are still further in rear, in positions where their long range enables them to cover a wide front.

The work of artillery in routine trench warfare is to exhaust the enemy's strength by inflicting constant losses on him, and to take part in the daily minor engagements between the covering zones. These daily combats are necessary to prevent the defence from degenerating into mere passive resistance, to keep the enemy on the alert, and to prevent him from withdrawing troops in order to strengthen his offensive on other fronts. Counter-battery work is constantly carried on, the enemy batteries being located by flash-spotting, sound ranging and by observation from aeroplanes and captive balloons. Since any battery which has been located will be shelled out when the line is bombarded, as many batteries as possible are kept in "silent positions," from which they are not allowed to fire; the daily work of harassing the enemy is carried out by a comparatively small number of guns.

Breaking the Line

It is useless to break through on a narrow front, where the troops who penetrated the line would be exposed to artillery fire from both flanks. The Germans, in April 1918, attacked on a front of 50 m., and for this attack they assembled about 9,500 guns and howitzers of all calibres, mostly field guns, or rather more than one gun to every 10 yd. of front. Their attack was pressed home only on alternate sections of about 3,000 yd., so that the fire of one gun per 5 yd. was concentrated on the real fronts of attack. Instead of a week's bombardment, as in previous battles, the opening bombardment was compressed into 6 hours of rapid fire, gas shell being used against the front trenches, and high-explosive shell against important points up to 10 m. in rear. Wherever the infantry penetrated the front line they were accompanied and closely followed up by field artillery. The leading features of this attack were the "surprise" bombardment and the bold use of accompanying and supporting field artillery. The former was due to the development of "map" firing, which enabled preliminary ranging to be dispensed with. In future battles an even shorter bombardment may be used, especially if tanks are available to break through the barbed-wire defences.

The main difficulty in the operation of breaking the line is that of assembling a sufficient force of infantry and artillery on the front of attack without the enemy's knowledge, or so quickly that he has not time to collect an equal force to oppose it. The normal artillery strength of the front has to be trebled. Positions for the reinforcing batteries have to be prepared, telephone cables laid and buried and ranges measured, so that a fully effective bombardment can be opened suddenly, without warning, on the day of attack. The assault may have to be driven home to a depth of 50 m. before the defender's line is broken so that troops can pour through the gap, and this implies that preparations must be made to push forward guns and ammunition over the battle-field (which is probably a mass of shell-holes, with all roads and bridges destroyed) so as to maintain an unremitting pressure on the defender and prevent him from disengaging his troops and forming them up for a fresh stand. It was the difficulty of bringing up men, guns and ammunition over the battle-field that brought most of the attacks in the World War to a standstill.

Tactics of Attack.—The tactics of the attack on an entrenched position are much the same as those of the attack on a position in mobile warfare. The points of difference are: (*a*) the details of the defences are definitely known from aerial photos; (*b*) the obstacles, such as barbed wire, are more formidable; (*c*) the defenders will have plenty of deep "dug-outs," so that the barrage and bombardment will be less effective. The first point

implies that the bombardment can be concentrated on definite points, instead of being more or less spread over the country; the second requires that field guns and, if possible, tanks, must be pushed forward to cut the wire; the third is simply a matter of plenty of heavy howitzers.

Generally speaking, the result of an attack on the grand scale is a matter of strategy rather than tactics, and depends on the relative strength of the forces (especially artillery and tanks) which the combatants are able to assemble on the front attacked. If the defender is able to reply to the bombardment with an equally effective bombardment, and to the barrage with a counter-barrage, no decisive result can be obtained—by infantry at least. Failing this, the defender must give ground without allowing his line to be broken, remembering that every mile of advance increases the difficulties of the attacker, till the impetus of the attack is exhausted.

Gas Warfare.—Though all civilised nations have condemned the use of poison gas in warfare, it is considered necessary to take measures for defence against it. The chemical composition of poison gases is described under CHEMICAL WARFARE; we are here concerned with their tactical employment.

Poison gas may be lethal or disabling; phosgene is an instance of the deadly kind, while mustard gas and lachrymatory gas are not fatal. Chlorine is disabling and ultimately fatal. Further, these gases may be so volatile as to disappear in a few minutes, or they may impregnate the ground so that the effect lasts for weeks. These are known as non-persistent and persistent forms of gas.

Troops may be protected from breathing gas by gas-masks and respirators, but these cannot be worn indefinitely; men must remove them to eat and sleep. It is impossible to protect them from mustard gas, which causes painful burns on the hands and legs. Mustard gas is persistent; a wood or a village impregnated with it will remain impossible to enter for weeks. Phosgene is comparatively volatile, and a light breeze is sufficient to dissipate it; chlorine is a heavy gas, and may remain in trenches and hollows for many hours if there is no wind.

Poison gas may be discharged from cylinders, and carried by the wind towards the enemy, or it may be discharged by gas projectors, which are special mortars throwing a 60-lb. drum containing gas-generating liquid; or gas shells may be fired by ordinary artillery, usually light and medium howitzers.

Gas shells require a special range table, as they are lighter than ordinary shell. They are fired either entirely by map, or after preliminary ranging with ordinary shell, as their impact cannot be observed. Hot sunshine causes volatile gas to disperse quickly, and a strong wind blows it away; gas is therefore most effective on a cloudy, still day. The shells are pitched to windward of the target so that the breeze will carry the gas in the required direction. In this respect guns are more efficient than gas cylinders, as they are not obliged to await the coming of a favourable wind.

Gas bombardments are used for various purposes. Thus a piece of ground soaked with persistent gas is denied to the enemy; batteries of artillery, especially when sited in hollows or woods, may be neutralised; trenches which are being attacked may be bombarded with non-persistent gas, which will have cleared away by the time the attacking infantry reach them. Enclosed spaces, such as houses and dug-outs, are readily made untenable. Troops wearing masks lose much of their fighting efficiency and even a small number of gas shells may induce the enemy to put on their gas-masks, and so reduce their fire-effect.

The number of gas shells required for an effective bombardment varies according to the weather, the calibre of the piece, and the nature of the gas used. With the light field howitzer of 105-mm. (4·2-in.) calibre, in fairly still weather, it is reckoned that one round per metre of front is required with non-persistent gas, or two rounds with persistent gas. These figures include only the shells which pitch in the target or within 50 metres to windward of it. *See* AMMUNITION; BALLISTICS; EXPLOSIVES; ORDNANCE; for naval guns *see* GUNNERY, NAVAL.

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ART SALES (*see* 2.699).—The public and private art sales in Great Britain from 1911 form in the main a sad record of the depletion of national treasures, and show an extraordinary revision in values. Many of the finest works of art formerly in Britain have gone to America, and the exodus is bound to continue. There are still collectors of taste and judgment in the country, but transatlantic competition makes it impossible for most of them to purchase early works of the highest importance. But this inability to buy Old Masters should induce collectors of limited means to patronise the art of modern men, and keep an eye particularly on the work of promising youngsters. Again and again in the past has this foresight been richly rewarded.

The Sargent sale in 1925 may be mentioned, although the prices paid were the result of sentiment rather than artistic appreciation. Works which he himself may have regarded merely as studio "property" fetched extravagant sums: for example, a copy by him of "Prince Batasar Carlos" by Velasquez, measuring 21½ in. by 17¾ in. realised £6,300, a small water-colour made £4,830, an oil painting of "San Vigilio" £7,350, and the total for 163 lots on the first day reached £145,984. Rembrandt etchings also grow in favour. In 1924 the Rudge collection, which was unknown to the experts, established a new maximum in realising £34,000, and the £3,780 given for a first state of "Dr. Arnoldus Tholinx" broke all records for any etching or engraving, the nearest to that figure being the £3,045 paid two years earlier for Valentine Green's mezzotint translation of "The Ladies Waldegrave" by Reynolds.

As already said, many famous pictures have passed from Britain to America in the period under review, but the greatest excitement was caused by the private sale of the Duke of Westminster's pictures, "The Blue Boy," by Gainsborough, and "Mrs. Siddons as the Tragic Muse," by Reynolds, for £200,000 in 1921. Previously, it will be recalled, the Reynolds was withdrawn at Christie's at £52,500 and it was said that £150,000 had been refused for "The Blue Boy" which, as Farington records, was purchased by John Hoppner for 65 guineas in 1803, after having been sold for 35 guineas in 1796. The highest auction price for a Gainsborough was the £20,160 realised for "The Market Cart" in 1913, while the Reynolds maximum stands at £15,520 in 1919 for the portrait of "Mrs. Freeman." That year was one of the most memorable in the annals of art sales. For the first time in history each of 100 pictures realised not less than 1,400 guineas in British auction rooms. The Hamilton Palace sale on Nov. 6 1919 fetched £168,957, the highest sum ever obtained in one day at Christie's, beating the £150,000 record for a two-days dispersal, amassed earlier in the year by the Drummond collection. Three other records were made in that sale: the £6,500 for Turner's drawing of "Zürich," a similar sum for Guardi's "Fête on the Grand Canal," which cost Sir George Drummond £800, and £26,775 for a portrait of "Joseph Coymans" by Franz Hals which, however, was exceeded by the £27,400 paid in America for the same artist's "Old Lady" that figured in the Yerkes collection.

Notable Sales.—Nor were these the only records for 1919. In the Hamilton Palace sale the £54,600 paid for Romney's group of "The Beckford Children" was the highest price given in the public market for any picture. The artist received £105 for the painting of the two girls. A picture of "St. Eustace" ascribed to Carpaccio brought £33,600 in the Vernon-Wentworth sale, "The Spendthrift" by Jan Steen, £17,010, the former record was the £3,412 10s. for "The Sick Lady" in 1910, and Ruysdael's "Landscape," £12,600. James Ward's portrait of "Miss Georgiana Musgrave" made £7,140 against £1,680 in 1905, which was then the maximum for this artist's works. The remarkable events of 1919 may be compared with the auction doings in 1913, when, by the middle of June, the turnover at Christie's alone reached more than £1,000,000. Romney's "Anne, Lady de la Pole" fetched £41,370; Gainsborough's "Market Cart"

£20,160, as against £4,750 10s. in 1894; Hobbema's "Woody Landscape" £15,750 as against £3,460 in 1890; a Hals "Portrait of a Gentleman" £9,000 as against a price of £5 5s. with a still-life subject into the bargain in 1884.

The two abundant years before the World War had filled the warehouses of the dealers with stock, and that fact, combined with financial depression, brought about the result that when on Friday, July 24 1914, Christie's season ended, there were few notable things to report. Only 38 pictures, compared with 85 in 1913, realised 1,400 guineas or over. Two of these works were "A Man with a Red Cap," attributed to Titian, which made £13,650 and Peter de Hooch's "Interior with Figures," which was sold for £8,610 at Robinson and Fisher's, four days before War was declared.

The War Period.—The years between that date and 1919 were memorable for the sales conducted free of charge by Messrs. Christie on behalf of the Red Cross Fund. The great success of these charitable sales helped to restore confidence in the art markets, which also were affected by the Duveen purchase of portions of the Pierpont Morgan collections costing £1,000,000. One of the tragedies of the War was the loss of Sir Hugh Lane in the "Lusitania." In 1916 Christie's celebrated the 150th anniversary of the firm's existence.

Raeburn's art was long in winning favour in the sale-room. In 1877, 49 of his pictures fetched only £6,000. Since then, however, very high prices have been realised for his portraits; for example, "Mrs. Robertson Williamson" brought £23,415 (1911) and "The McNab" £25,410 (1917). These two works remained in England. Gainsborough's charming sketch of his daughters, which fetched £3,045 (1923), went to the National Gallery, London, and Hoppner's fine "Portrait of William Pitt" was purchased for a British peer at £7,350. It came from the Baroness Burdett-Coutts' collection (1922), as did Raeburn's "Portrait of Sir Walter Scott," which made £9,660 and went to America.

In the following year the Brownlow Van Dyck "Portrait of Anton Triest" fetched £29,400. Mention should be made of the futile sale of Sir John Robinson's pictures on July 7 1923. The nominal total for the 114 works by Old Masters was £205,741 10s, but in most cases the excessive reserves were not reached, so that in no previous sale in England had such a large percentage of lots been bought in, in spite of the fact that most of those actually sold showed a profit, and that many of the withdrawn pictures were knocked down at larger prices than those originally given for them by Sir John. In the autumn of 1923 it became known that 10 of the finest pictures in Lord Glenconner's collection of British master-pieces had been acquired by Messrs. Knoedler, and shipped to the United States.

Reference has been made solely to the disposal of pictures, but numerous other works of art have been sold privately and in the open market at prices not less sensational than those obtained for paintings.

On the continent of Europe, too, competition has been acute, with the result that prices were abnormally high in 1911, 1912 and 1913, as they were in Great Britain. In Paris in 1911, the Maurice Kann collection, consisting of 85 lots, realised £108,850, to which must be added the tax of 10% paid then by purchasers. With a few exceptions the profits were enormous. So, too, with the collection of his brother Rodolphe Kann, which cost him about £200,000 and fetched about £1,200,000. Rembrandts, which were bought by him for £1,600 and £2,000, brought £20,000 to £30,000 and a Vermeer of Delft, for which he gave £48, sold for £2,000.

Paris and New York Sales.—In 1912 there were five great Paris sales, the Roussel, Dollfus, Carcano, Doucet and Rouart, which together realised over £1,250,000. A few individual prices may be given. In the Doucet sale a pastel portrait of "Duval de l'Epinoy" by Quentin de la Tour made £26,400, which was eight times the previous maximum for a pastel; John Russell's "Mrs. Elizabeth Curie" sold in Paris for £3,200; H. Regnault's "Salomé," £19,000; "The Countess of Wilton" by Sir Thomas Lawrence, £19,104; "Les Danseuses à la Barre" by Degas, £19,400 (the artist sold it for £20); Chardin's "Les Bulles de Savon," £12,000, and in the following year (1913), Rembrandt's "Bathsheba," £44,000.

Mantegna's "Madonna and Child" in the Weber sale, Berlin (1912), fetched £31,000 against £4,000 paid for it in 1902. In Amsterdam 32 Rembrandt drawings from the J. P. Heseltine collection totalled over £25,000, the highest individual price being £2,508 paid for "The Farm." In the same city (Nov. 1925) the Castiglione collection realised £150,000. Of that sum, a signed and dated (1635) Rembrandt "Portrait of a Syndic of Amsterdam" brought £17,833, Nicholas Froment's "Resurrection of Lazarus," £12,833 and Correggio's "Mystic Marriage of Saint Catharine," £10,666.

The two greatest sales ever held in America were the Yerkes in 1910, which, at £400,000, established a record in New York, and the William Salomon in 1923 which realised £258,569 for 764 lots. Before the latter sale took place, Sir Joseph Duveen purchased privately 15 of the more important pictures at an estimated cost of £200,000. In the Yerkes sale, Franz Hals' "Portrait of a Woman" fetched £27,406, Troyon's "Going to the Market," £12,000 and Turner's "Rockets and Blue Lights," £25,800.

It should be mentioned that the transference in 1925 of a portion of Lord Leverhulme's collection from his Hampstead residence for sale in America caused some excitement, as that transaction was thought to be the beginning of an attempt to make New York the centre of the world's art sales instead of London.

(J. Gr.)

ART TREASURES.—The flow of art treasures from the old to the New World is no novelty. From the days of colonisation onward Americans have naturally desired to possess European heirlooms. Nor has the drain been on Europe alone. The merchantmen of the days of sailing ships bringing back to Salem and other ports their cargoes of tea and spices inaugurated that importation of souvenirs from across the Pacific which, continuing with increasing volume, has resulted in the great American collections of the art of the Far East.

I. THE TRANSFER FROM EUROPE TO AMERICA

Public Interest in European Art.—It has been, however, the importation of European art in recent years that has attracted widespread attention to the transfer of art treasures to America. There are various reasons for the growth of public interest in this transfer. In the first place, values are well known in European art. The relative merit or even the identity of Chinese and Japanese painters is in the main obscure to the uninitiated, but the mention of a picture by Hobbema or Botticelli means something to the merest novice. Moreover, the European picture or other art object has commonly a recorded history, with frequently an ascending series of preceding sale prices to attest its steady appreciation; if not, it can be compared with a pedigreed object. Secondly, in the case of European art the limit of the market supply is known more or less exactly. Thus a picture by Vermeer is considered as a certain fraction of the total work of Vermeer which might come on the market. If it passes into the inalienable ownership of a public gallery the next Vermeer to come on the market is by so much a larger fraction. Thirdly, competition in collecting European art has become very keen. When the Jarves collection came to America two generations ago it attracted less attention than a single picture of that collection might attract now. The solidity of art values has been made conspicuous by the economic and monetary crises of recent years, and, as a result, the art collection has come to be looked upon as a form of investment. Finally, art objects, however owned, are apt to be regarded as semi-public in nature, and their vicissitudes are therefore a matter of public interest. This is particularly true in the case of large collections.

Private Collections.—Of the large collections which have come to America since 1910 the most important is that of the late Mr. J. Pierpont Morgan, most of which is now in the Metropolitan Museum of Art and the J. Pierpont Morgan Library, New York. The objects brought in 1912 to the Metropolitan Museum came partly from the Victoria and Albert Museum and other European

museums, to which they had previously been lent. Paintings which may be mentioned are the Colonna Raphael, the "Virgin and Child with Saints," the "Portrait of a Genoese Lady and Child" by Van Dyck; the "Holford Landscape" by Hobbema; three panels by Filippo Lippi; three saints and donors, mentioned by Vasari; portraits by La Tour, Reynolds, Hoppner, etc. The Fragonard room imported by Mr. Morgan subsequently found its way to the Henry Clay Frick collection. The Metropolitan Museum is indebted to the Morgans for the sculptures from the Château de Biron, many others from the Hoentschel collection, and objects of applied arts of all kinds. It is particularly rich in ivories and possesses, in the Swenigorodski collection of Byzantine enamels, the Cyprus treasure, the Albanian treasure, and the collection of Germanic—largely Merovingian—antiquities, assembled by Baron and by Queckenberg, ample evidence of Mr. Morgan's wide interests and of his forehandedness in acquiring material of a sort not likely to appear often on the market.

Another collection which was brought from public exhibition in a European museum to America is the Goloubew collection of Persian and Indian paintings. For some years prior to its purchase in 1914 by the Museum of Fine Arts, Boston, it had been exhibited in the Musée des Arts Décoratifs, Paris. The Boston Museum has since added Persian miniatures and a collection of Indian art rich in examples of painting, so that it is now able to illustrate to a degree unattained elsewhere the history of Mahommedan painting from the 12th century onward.

The Riggs collection of arms and armour came from Paris also. But it had been formed by an American living there. In 1913, when it left Paris to come to the Metropolitan Museum, it was unrivalled among private collections of armour; its addition to the Metropolitan Museum has been followed by further gifts from the same donor and others, until the museum's collection of armour has become one of the most important.

Museums.—Most of the collections that have come into the possession of American museums in recent years have not been transferred entire from Europe but have been formed gradually, largely through the agency of dealers, by collectors in America. Characteristic examples, to take a single museum, the Metropolitan Museum of Art, are the collections bearing the following names: Altman, 1913 (paintings by Fra Angelico, Botticelli, Mantegna, Dürer, Vermeer and others, a much-discussed group of Rembrandts, sculptures, furniture, an exceptional collection of Chinese porcelains); Jesup, 1915 (71 pictures, 24 of the British, 23 of the French school, the rest of miscellaneous schools); Fletcher, 1917 (251 objects, including good Gothic sculpture and David's portrait of Mlle. Charlotte du Val-d'Ognes); Vanderbilt, 1920 (paintings and furniture); Dreicer, 1921 (largely paintings and sculpture); Ballard, 1922 (rugs); Barnard, 1925 (medieval sculpture, including the unfinished cloisters from St. Michel-de-Cuxa and extensive fragments from the cloisters of St. Guilhem-le-Désert); Huntington, 1925 (188 objects, including paintings by Vermeer, Rembrandt, etc.). The background of every large American museum is a group of men who form collections that they eventually give to it. The size and number of such collections are much more significant for the transfer of art objects to America than are the occasional, widely heralded, but commonly second-rate, European collections that are brought over entire to be sold in American auction rooms.

Fashions in American Collecting.—There have been fashions in American collecting, but so diverse are the interests of different communities and social groups that few considerable fields have been slighted. Certainly, Sienese painting has been greatly favoured, but that has not prevented collectors from acquiring pictures of the other Italian schools. A nation that enjoyed nearly a century ago the bituminous painting of Germany—particularly of the Düsseldorf and Munich schools—then furnished the chief foreign market for the murky and sentimental Dutch of Israels' type, could hardly be free from the contemporary adulation of anything even remotely Rembrandtesque. The rediscovery of the art of Spain, which began with the obvious later masters and has gradually worked backward through the primitives to the Middle Ages, was beginning about 1925 to arouse great interest in America. Americans have taken an active part in exploration and excavation, especially in Egypt; as a result the collections of Egyptian art that have recently been forming in the museums of Boston, New York and Chicago are surprising both in size and quality, the more so the better one knows the great collections at London, Paris, Berlin, Turin and Cairo.

German art, except prints, has not emigrated extensively to America any more than it has to neighbouring European countries. Scandinavian art, apart from the works of a few modern painters, has stayed at home and so has in general the medieval and modern art of eastern Europe except smaller portable objects of the Byzantine period. This is the more remarkable in view of the eager assemblage of objects from most parts of Asia and the recent enthusiasm for the art of the African negroes and the American aborigines. In the case of modern art there is a wide discrepancy in the distribution of the work of various countries. French art is, of course, collected everywhere. But while the painters of Spain find a good market in America, the modern painters of Italy, despite their prominence in the Venice expositions and the flood of American tourists to Italy, are little known in the United States, though some of their works have gone to South America.

II. CHARACTER OF THE TRANSFER

The character of the transfer of art objects to America can be illustrated by a selection of representative examples, chosen mainly from those which have found their way into public collections and each standing for many of its kind.

Egyptian.—The Boston Museum has been steadily receiving a portion of the discoveries made by Dr. Reisner. In this way it has acquired a very rich collection of the art of the Old Kingdom. The sculpture from the pyramid of Mycerinus includes an unrivalled series of portraits. The Metropolitan Museum, New York, on the other hand, has acquired more by purchase than it has from its own excavations in Egypt. Thus the tomb of Perneb, from Sakkara, though of secondary artistic importance, the most imposing monument that has come to any museum from Egypt, was purchased on behalf of the museum from the Egyptian Govt. in 1913. Another important purchase was that of a large part of the treasure of Lahun, discovered by Flinders Petrie in 1914. This jewellery was found in almost perfect condition in the tomb of the Princess Sat-hathor-iunut, probably the daughter of Senusert II of the 12th Dynasty. The same dynasty, which is the most important for our knowledge of the Middle Kingdom, is represented also by the Metropolitan Museum's acquisition, in 1919, of the large sphinx of Senusert III.

Another of Flinders Petrie's discoveries which has come to America is the sphinx of Rameses II found in the temple of Ptah at Memphis in 1912 and now in the University Museum, Philadelphia. This brings us to the New Empire, in the art of which the Metropolitan Museum has become particularly rich. A striking acquisition of the sculpture of this period was that of seven colossal seated statues of the lioness-headed goddess Sekhmet in diorite. These came from the temple of Mut at Karnak, were taken to England about 1830, and had been in the possession of Lord Amherst before they were bought by the Metropolitan Museum in 1919. The same museum has an extensive and growing collection of Coptic art, particularly textiles; in 1910 it bought 116 stone fragments, including inscriptions, sculpture and architectural decoration. About three-quarters of these were sold by the Egyptian Govt. and came chiefly from the monastery of St. Jeremias at Sakkara, excavated by Quibbell.

Classical.—The Museum of Fine Arts, Boston, acquired in 1914 a gold and ivory statuette of the Minoan Snake Goddess. Though the type is not unfamiliar, the materials and quality make the statuette unique. Another important acquisition of the same museum was the head of a Greek goddess from Chios, which came to the museum from England in 1910. This head is said to have been discovered in 1853. It was seen on Chios by Studniczka in 1887 and his mention of it in an article the following year led to its removal to England. There it was exhibited

at the Burlington Fine Arts Club in 1904. It is of Parian marble and is regarded as Praxitelean. From England, too, came the fragments of the largest known grave stele of the Greek archaic period, since 1911 in the Metropolitan Museum. The total height is 13 ft. 5⅛ inches. It is incomplete, and a head and hand from it are in Berlin. The Metropolitan Museum has secured a number of fine bronzes, including a life-size head of Agrippa, 1914; a statue of a boy 4½ ft. high, probably of the first century B.C., 1914; a statuette of an athlete, 1921; and, most prized of all, a statuette of a horse dating about 470 B.C., 1923. The magnificent bronze statue of Eros in the Morgan Library should be remembered in this connection. It was found at Boscoreale. The late Mr. Morgan lent it for a time to the South Kensington Museum and then in 1910 to the Metropolitan Museum, where it used to form the centre-piece in the museum's frescoed room from a villa at Boscoreale. There is a steady flow of Roman sculpture in stone to America, chiefly portrait heads, sarcophagi reliefs and architectural carvings.

Italian.—There has been more general interest in America in Italian art than in any other. As a result, nearly all the older private, or originally private, collections (*e.g.*, Frick, Gardner, Ryerson, Walters, Widener) are well stocked with Italian pictures. This makes the museum collections, except those of Harvard and Yale, seem proportionately meagre. The Metropolitan Museum secured at Paris in 1914 a ceiling by Pinturicchio, which would not appear extraordinary in Italy but has considerable illustrative value in America. It consists of 22 panels, in fresco now transferred to canvas, from the Palazzo del Magnifico at Siena; these are now used for the ceiling of one of the museum rooms. A ceiling by Tiepolo from the Palazzo Barbaro, Venice, acquired by the museum in 1923, is used for another room. One of the most important pictures purchased by the Metropolitan Museum in recent years is the "Meditation on the Passion" by Carpaccio, from the Abdy sale in London, 1911. Another important Carpaccio is the "Knight in Armour," sold at Christie's in 1919 and now in the Kahn collection, New York. The landscape of the former picture shows points of analogy with the large landscape of "St. Francis Receiving the Stigmata," by Giovanni Bellini, in the Frick collection and it has been suggested that Bellini might have finished the design for Carpaccio's picture. From the Abdy sale came the "Three Miracles of St. Zenobius" by Botticelli, now in the Metropolitan Museum. They are part of a well-documented series of which others are in the National Gallery, London, and the Dresden Gallery.

Of the half-dozen greatest names of the High Renaissance America must, in the nature of the case, have a very limited representation. Raphael's portrait of Giuliano de Medici came from Germany in 1925. Various portraits by Titian have come, including a well-known one from the Giovanelli Palace. Tintoretto too is variously represented in recent importations. A "Doge in Prayer before the Redeemer," acquired by the Metropolitan Museum in 1910, is of interest because it was bought in 1852 by Ruskin. More important as a picture is the "Miracle of Loaves and Fishes," a large picture acquired in 1913 from an English collection. Of Correggio two pictures may be mentioned; a large painting of "Four Saints," bought by the Metropolitan Museum in 1912 and formerly in the Ashburton collection, and a "Mystic Marriage of St. Catherine" bought by the Detroit Museum at the Castiglione sale in Amsterdam, 1925. Of the *Quattrocento* painters Fra Angelico is a favourite among American collectors, possibly because he is somewhat like the Sienese in spirit. The jewel-like little octagonal "Madonna and Child with Angels, Saints and a Donor" which was formerly in the Aynard collection, Lyons, and has been in the Boston Museum since 1914, overshadows the "Nativity" which came to the Metropolitan Museum in 1924. Because of its large size, brilliance and fine preservation, the "Annunciation" by Fra Angelico's contemporary, Masolino, in the Goldman collection since 1916, demands notice.

There is less Italian sculpture of good quality on the market than there is painting. Most of it that comes to America goes into the private collections (*e.g.*, Mackay and Widener). Outstanding exceptions are the "Angel Annunciate" by Matteo Civitale and the "Nativity" by Antonio Rossellino, both in painted terracotta and acquired by the Metropolitan Museum in 1911. The same museum secured in 1910 and 1921 fragments, formerly in Ruskin's possession, that are thought to be from Giovanni Pisano's pulpit for the cathedral of Pisa, two trumpeting angels and an angel with ox and lion.

Spanish.—The most remarkable work of Spanish art which has been brought to America is the mural decoration of the apse of S. Maria de Mur, in Catalonia. This came in 1921 and was purchased by the Museum of Fine Arts, Boston. As set up in a special room built for it with the intention of giving a setting like its original one, it transports the museum visitor effectively into the Spanish Middle Ages. Works attributed to El Greco or to Velasquez are to be found in most of the larger collections, but the greatest migration of Spanish paintings to America has consisted of the works of contemporaries. The various exhibitions of Zuloaga have tended to domesticate him in America, and Sorolla is extensively represented, particularly by the decorations of the Sorolla room opened in 1925 at the Hispanic Society of America. This institution is for the United States the focus of interest in things Spanish.

French.—The enthusiasm at the end of the 19th century for French painting has not been entirely sustained. The increasing interest in primitives has rather less to feed upon in France than in Italy or Spain. One of the private collections, the Friedsam collection, has made a speciality of early French works. In this field the museums have mainly contented themselves with small portraits of the general style of Corneille de Lyon. Examples were added to the Boston Museum in 1919 and 1924. Two kinds of French sculpture have been eagerly sought by American collectors—Gothic fragments and works of Rodin and his followers. Of the former, good examples are the "Virgin and Child" of the Amiens School, bought by the Metropolitan Museum in 1918; the 14th century great altarpiece from Pau, bought by the Boston Museum in 1924; and the five very early Gothic statues given to Yale University (1925). These last are transitional and are sometimes described as late Romanesque. Of the Romanesque proper, the series of capitals in the Fogg Museum at Harvard University is an important acquisition. Although private collectors, such as Mr. Pitcairn, are interested in medieval sculpture, America is considerably behind Europe in this branch of collecting. Of Rodin and his school, nearly every American museum has something to show, and there seems to be no decrease of interest, for the followers of Rodin continue year after year to have successful New York exhibitions.

Dutch and Flemish.—Almost none of the contemporary paintings of Belgium and Holland find an American market. On the other hand, the works of the 17th century and earlier are as popular here as elsewhere. A writer in 1921 was able to list eight examples of Gerard David in America. Others, for example the "Entombment," lent to the Art Institute of Chicago in 1913, can now be added to the list. Bosch, Patinir and the Antwerp School of about 1525 are likewise well represented in recent importations. But it is primarily the great figure painters of the 17th century—Rembrandt, Hals, etc.—whose names are attached with varying plausibility to pictures arriving in the American market.

British.—The traditions of the Homeland are strong enough in the United States to give the portrait painters of Great Britain a special prestige. This extends even to painters, like Holbein and Van Dyck, who are not British but have social position in Great Britain. Thus, while the German school is not popular in America, a number of paintings by Holbein have recently come into American collections. These include a portrait identified as "Jean de Dinteville," in the Goldman collection; a miniature portrait of "Thomas Cromwell," in the Morgan collection; and another portrait of "Thomas Cromwell," in the Frick collection. Before 1915, when it came into the Frick collection, the last-named picture was at Tyttenhanger Park. Mr. Goldman's picture, which is usually regarded as the finest

of the three, came from the collection of Sir John Ramsden, of Bulstrode Park, Buckinghamshire.

The greatest publicity has been given to the purchase for Henry E. Huntington of the "Blue Boy," by Gainsborough, and "Mrs. Siddons as the Tragic Muse," by Reynolds, pictures formerly belonging to the Duke of Westminster. But the recently published catalogue of paintings of the British School in Mr. Huntington's collection shows 32 other pictures of almost equal importance. The Taft collection at Cincinnati has likewise been enriched at the expense of English country houses. In contrast, the American museums have not, in view of the great competition, acquired many important works of the British School.

Restitution of Art Treasures.—Although this article is chiefly concerned with the transfer of art treasures to America, it should not be forgotten that there have been, especially since the World War, important transfers elsewhere. Among other restitutions to Belgium are the panels of the Ghent altarpiece which have been returned from the Kaiser Friedrich Museum. One hundred and eighty pictures, which had been removed from Italy to Austria between 1808 and 1866, were returned to Italy, likewise as a result of the War. Most of these had historic associations as decorations of the halls of the ducal palace, the offices of the old republic, the churches and the confraternities of Venice. Besides pictures restored to Venice, nine magnificent Raphaelesque tapestries were returned to the ducal palace at Mantua. In general, however, Germany and Austria have not lost any considerable amount of their artistic treasures as a result of the War. The cession of Alsace-Lorraine meant of course the loss of works in those provinces, including one altarpiece very dear to the Germans, the Isenheim altarpiece by Matthias Grünewald at Colmar. The financial crisis in these countries did not lead to extensive exportation of works of art. During the War, however, one truly famous picture left Germany, "The Legend of St. Eligius," by Petrus Christus, now in the Lehman collection in New York.

BIBLIOGRAPHY.—For the transfer of art objects, the current periodicals give fairly complete information. The bulletins which are published by practically all the American museums note briefly current accessions. The accounts in the newspapers are necessarily incomplete and untrustworthy. A few books such as *Venetian Paintings in America*, by Bernhard Berenson, and *Greek and Roman Sculpture in American Collections*, by George H. Chase, are useful.

(J. SH.)

ASBESTOS (*see* 2.714).—An incombustible, fibrous material usually found in serpentine formation in many parts of the world, with numerous varieties which are known or described as mountain flax, leather or cork, amianthus, tremolite, crocidolite, and by other names.

Deposits in Italy.—The asbestos from the Val Malenco or Val Tellina in northern Italy, occasionally found in the form of thread from 3 to 20 ft. in length, is strong, tough, saponaceous, incombustible and free from objectionable impurities, and was first used commercially in 1871, when an asbestos factory was established in Glasgow. A few years later another factory was established in Turin.

Canada.—Meanwhile other deposits of asbestos were discovered in the province of Quebec. While the chemical properties of this Canadian, or "chrysotile," variety are similar to those of the Italian fibre, there is a marked difference in their physical characteristics; the Canadian material, having a finer texture and being easier to obtain and to manipulate by machinery, came rapidly into extensive demand, although for some purposes Italian asbestos was, and is still, considered more suitable; on analysis it is shown to contain:—

	Per Cent
Lime and Magnesia	37·84
Silica	41·69
Oxide of Iron	3·01
Potash	0·85
Soda	1·41
Alumina	2·57
Moisture evaporated at 100° C.	3·04
Loss on heating to white heat, water of hydration and organic matter	9·59
	100·00

Other Sources.—Three other principal sources of supply were afterwards discovered and developed (*a*) in South Africa, blue in colour and containing, when compared with Italian and Canadian asbestos, a much larger percentage (from 30 to 40%) of oxide of iron and a correspondingly smaller percentage of magnesia; (*b*) in the Ural Mountains, similar to the Canadian but a little darker in colour and slightly less pliable; and (*c*) in Rhodesia. As this latter variety satisfactorily meets the requirements of manufacturers, its use is fast increasing.

Asbestos is now manufactured in England, in the United States, France, Germany, Austria, Russia, Italy, Spain, Belgium, Canada and Australia. The production of the raw material has sprung from about 200 tons (Italian) about 1868 to a total from all sources of over 250,000 tons in 1924. The United States are the largest consumers, and it is believed that the asbestos factories there absorb over 70% of the output of the raw material from the Canadian mines.

Uses.—Asbestos is now made into a great variety of articles, used in practically every branch of trade, and in laboratories, surgical, medical and hospital equipment, no department of industry or scientific research to-day being complete without asbestos in one form or another. Probably the most important development in the use of asbestos in recent years has been in connection with building operations. Tiles for roofs, flat sheets for partitions, ceilings, etc., corrugated sheets for factory and other buildings, in which asbestos in combination with Portland cement, and marketed in Great Britain and abroad under various trade names such as "Poilite," "Everite," "T.T.," "Eternit," etc., has come into large and rapidly increasing demand in nearly all parts of the world.

As the economic value of asbestos depends, not only on its power to withstand high temperatures, but also on its low thermal conductivity, and its partial resistance to the attacks of acids, its field of usefulness is practically unlimited.

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(J. A. FI.)

ASHANTI (*see* 2.724), a dependency of the Gold Coast Colony, is divided into two provinces, the Eastern with headquarters at Kumasi, the capital, and the Western with headquarters at Sunyani. Its area is 24,560 sq. m. and its population 406,594. King Prempeh, who in 1896 resisted the establishment of a British Resident at Kumasi and was sent as a political prisoner to the Seychelles, was allowed to return to Ashanti at the end of 1924, although without special powers. The golden stool on which he was crowned was hidden in Ashanti, and was only rediscovered in 1921.

Ashanti is administered by a chief commissioner, assisted by provincial and district commissioners. Although it is constitutionally separate and distinct from the Gold Coast Colony and the Northern Territories, all three are treated, so far as finance is concerned, as a single unit. No satisfactory estimate can be made, therefore, as to the revenue and expenditure, except those for purely local purposes. Similarly it is impossible to state the actual trade statistics and the only satisfactory test is supplied by the tonnage figures of the railway, which show that 61,176 tons of cocoa, 2,983 tons of kola and 4,085 tons of other produce were railed to the ports in the year 1923–4.

As in the Gold Coast Colony proper, cocoa forms the principal item of commerce, and is the foundation of the peace and prosperity of the country; practically all the plantations are owned and managed by natives. Agricultural stations have been established at Kumasi, Juaso and Ejura, and special efforts were made during 1923–5 to encourage the planting of oil palms and the cultivation of coffee. Gold-mining is of importance, although only two mines were producing in 1924. Excellent motor roads, 721½ m. in length, have been constructed, including

one between Sunyani and Kumasi; the Great North Road from Kumasi to Ejura is the finest and carries a heavy traffic to and from the north. A second railway from the Gold Coast to Ashanti, linking up Accra and Kumasi, was completed in Aug. 1923. The Govt. maintains a fleet of motor vehicles at Kumasi.

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(P. E. L.)

ASHFIELD, ALBERT HENRY STANLEY, 1ST BARON (1874–), British business man, was born at Derby Nov. 8 1874. He spent his early years in the United States, and was educated at American technical schools and colleges. He entered the service of the Detroit City Street Railways and had a successful business career, becoming general manager of the company and subsequently of the Public Service Corporation of New Jersey. In 1907 he returned to England, and took up the position of general manager of the Metropolitan District Railway and soon after became managing director of the traffic combine which included the London Underground Electric Railway Companies and the London General Omnibus Company. In 1914 he was knighted. On the formation of Mr. Lloyd George's Govt. in 1916 Sir Albert Stanley was elected to Parliament as a Coalition Unionist for Ashton-under-Lyne, being included in the Cabinet as President of the Board of Trade. He was a notable instance of a minister selected as a "business man" and not for any of the usual political considerations. He resigned from his office in May 1919, and in Jan. 1920 was raised to the peerage.

ASIAGO, BATTLE OF, 1916.—The Asiago plateau was the scene of various battles on the Italian front during the World War (*see* ITALIAN CAMPAIGNS); but the name of the battle of Asiago was given to the fighting which took place on the Trentino front during the Austrian offensive of 1916.

An attack from the Trentino with the object of cutting the Italian communications with the Julian front, and so bottling Cadorna's main force in what Krauss (in his book *Die Ursachen unserer Niederlage*) calls "the Venetian sack," was an operation which could not but commend itself to the Austrian general staff. Even Falkenhayn, who refused his co-operation to the proposal made by Conrad von Hötzendorff in Dec. 1915, admits that "it was very inviting." He did not, however, agree with Conrad and with Krauss, then chief of the staff to the Archduke Eugene, that a completely successful attack would have a decisive effect. He doubted the possibility of collecting the force he considered necessary for the enterprise (25 divisions), and did not think that the railway communications were adequate to supply such a force. He was, moreover, anxious about the Russian front. Conrad's plan was to attack through the Asiago and Arsiero uplands, in the direction of Vicenza and Bassano, and when he failed to convince Falkenhayn that the effort should be a joint one, he determined to attack independently.

Cadorna's Plans.—Cadorna's line of argument, when rumours of attack began to arrive, resembled that of Falkenhayn. He

did not think that Conrad could spare troops for an offensive on the grand scale, and he was of opinion that the railway communications in the Trentino were insufficient for such an offensive. He concluded that the reported movements in the Trentino signified a limited attack, to be undertaken with the object of hampering his own offensive action towards the east. He had continually urged upon Brusati, who commanded the I. Army, that his rôle was strictly defensive, now that his first duty, that of reducing the length of the Trentino front and occupying strong defensive positions previously selected, had been successfully performed. On various occasions Cadorna had emphasised the necessity of strengthening the positions chosen by him for defence, but his instructions had been insufficiently regarded.

When Cadorna went to visit the lines in person, at the end of April, he found that while the front lines, in many cases unsuitable for prolonged resistance, had been elaborately fortified, in various sectors the reserve lines which he had indicated as the "battle positions" were almost untouched. Cadorna ordered the positions to be modified, and the work of preparation was hastened on; but the enemy attack seemed imminent, and it was impossible to set about a complete re-organisation under the immediate threat. On May 8 Brusati was replaced by Gen. Pecori-Giraldi, the commander of the VII. Corps (III. Army), and within a week the Austrian offensive was launched.

Disposition of the Forces.—The Austrian attacking force was arranged in two armies, one behind the other, Dankl's XI. Army in front with 9 divisions, Koevess's III. Army in support, with 5 divisions. The troops in the Val Lagarina and Val Sugana were not included in this force, which was to make its offensive between the two valleys, where only supporting attacks were to be carried out. Krauss, as chief of the staff to the Archduke Eugene, was opposed to the disposition of the two armies and to the limitation of the attack to the hill country. He urged that the front of attack should from the outset be divided between Dankl and Koevess, and pressed for the concentration of attacking masses in the valleys, especially in the Val Sugana. But the original plan, prepared in all its details by Conrad and his staff, was not modified; it would seem that the Archduke and his chief of the staff had little freedom of action. The tactical direction of the attack was entrusted to Dankl, who had at his disposal some 180 battalions.

To meet the attack, Pecori-Giraldi had in line and immediate reserve, between Lake Garda and the Val Cismon (north of the Val Sugana), 130 regular battalions, 7 battalions of Customs Guards and 45 battalions of Territorial Militia, the latter at very low strength and of small fighting value. But his centre was weak, for 28 battalions of regular troops were in the Val Sugana sector, and on the actual front of attack he had only 90 regular battalions. Another division was concentrating at Desenzano, and 5 more were on the Tagliamento ready to be sent in support in case of need. The artillery strength consisted of 851 guns, of which 348 were of heavy or medium calibre and 259 were light guns of position. Dankl had, initially, a big superiority in infantry, but his great advantage lay in his preponderance of artillery strength. Between the Val Lagarina and the Val Sugana were concentrated some 2,000 guns, of which nearly half were of heavy or medium calibre, including 40 305-mm. howitzers, four 380's and two or three German 420's.

The Austrian Attack.—The offensive opened on May 14 with a very heavy bombardment along the whole line from the Val Lagarina to the Val Sugana, but the concentration of fire was most intense between the Vallarsa and the Upper Astico, and against this sector, the following day, the main infantry attack was launched. The plan was to attack first with the right wing of the XI. Army, commanded by the Archduke Charles, supported not only by its own artillery, but by flanking fire from the massed guns on the Lavarone plateau. When the right wing had made sufficient ground the left wing was to come into action against the Italian line north of the Upper Astico.

For a time everything went well with the attack. The Italians were driven back from their ill-chosen front lines, losing many prisoners and guns, and by May 19 their position was very grave all along the line from the Vallarsa to the Astico. The retiring troops had failed to make a prolonged stand on the insufficiently prepared battle positions. On the left Monte Pasubio, the key position, was only lightly held by reserves, which had been hurried up in the nick of time, and in the centre the Austrians had driven the defenders off the main line of defence, which ran from Monte Maggio by Campomolon to Spitz Tonezza. The 37th Div., which had held this line, had been forced back beyond the Posina and the Astico, and there were gaps both to right and left of it. The Austrian right was pressing hard on the Italian main positions west of the Vallarsa (Coni Zugna and Passo Buole), and was collecting forces to attack Pasubio. There was breathing space for a moment in the centre, but the Austrian left now came into action, Krautwald von Annan's III. (Graz) Corps being launched against the Italian 34th Division. Ample Italian reserves were now on the move, but it was a race. Krauss blames the Archduke Charles for waiting with his XX. Corps until the guns could be brought up to support a new attack, instead of driving through at once to Arsiero with all available troops. The risk was not taken, and the short respite gave time to close the door in the face of the invader.

The course of the battle, with the necessity of bringing up reserve divisions, led to a reorganisation of the attacking forces, Koevess taking command of the left wing and Dankl of the right. In the Vallarsa and Pasubio sector the attack developed strongly, but without success. Farther north the Archduke Charles was waiting for his guns and reserves, and between his left and the III. Corps, Kirchbach's I. Corps was coming into action. The III. Corps was hammering against the Italian 34th Div., which was not to resist for long.

The situation in the centre was critical, and Cadorna considered that if the Austrians were able to concentrate on the weak spot and keep up the impetus of their attack they might succeed in breaking through to the plain. On May 20 he went to Udine, and after consultation with the Duke of Aosta and Frugoni gave orders for the concentration of a reserve army in the Venetian plain. The first four corps of this reserve army (the V.), which were made up of units drawn from the II. and III. Armies, were ready on June 2.

Meanwhile the Austrians were continuing their advance in the centre, but they could gain no ground against the Italian left. By May 22 Bertotti's 44th Div., sent up from Desenzano, was in solid possession of both sides of the Vallarsa road and of Pasubio, and in touch with Ricci-Armani's 37th Div. on his left. It was in this sector that the Austrian offensive met its fate. Owing to the steadfast resistance of the troops under Ricci-Armani and Bertotti, Dankl could never secure a sufficient width of front for his advance. If the Zugna ridge had fallen, the effect upon the Pasubio position, already a salient, would have been more than serious, and upon the holding of the Pasubio lines depended the maintenance of the positions to the eastward. If Pasubio went, the line south of the Posina was turned, and the Austrians had a new route to the plain by the Valli dei Signori, as well as the opening they were now making for, by the Lower Astico. Till May 30 the attacks on the Zugna ridge were continuous, but no progress was made. The attempts upon Pasubio were as incessant, and lasted longer. The Austrian infantry advanced along the great ridge from Col Santo; they came up from Anghebeni and Chiesa in the Vallarsa and from the Val Terragnolo by the Borcola Pass. All efforts were in vain.

Northeast of Pasubio, along all the rest of the mountain front to the rim of the Val Sugana, the Austrians gained notable successes. Koevess drove back the Italians across the Val d'Assa, and thence still farther east, across the parallel valleys of Nos and Campomolon. To the southwest Dankl's left crossed the Astico, and after heavy fighting pushed the Italians back across the Val Canaglia, while his centre gained ground across the Posina, south of Arsiero. At the end of May the Italian position still seemed critical, and Cadorna gave orders for the withdrawal of stores and heavy guns from the Isonzo front to beyond

the Sile, south of Treviso. He believed he had the measure of the Austrians, but he omitted no precautions. His confidence, in fact, was justified. The impetus of the Austrian attack was dwindling. Losses had been very heavy; the attacking divisions were beginning to lose their offensive value, and the reserves were insufficient. Already on May 27 Conrad had been compelled to ask Falkenhayn to send a division of the Austrian XII. Corps, which belonged to Prince Leopold's Army Group. And Cadorna's V. Army was practically ready in the plain.

On June 4 Brusilov broke through at Leeck. The first news of the Russian attack did not perturb Austrian headquarters, for Conrad thought that his line in the east was firmly held. In a few days the situation was changed altogether. But even before the news of the disaster had reached Bozen it was clear that the offensive against Italy had failed. Koevess was to gain a little more ground. By June 8 the Austrians were only three miles from Valstagna, low down in the Brenta Valley, but they had shot their bolt. South of Asiago and south of the Posina the attack was continued for 10 more days. Here were the shortest routes to the plain and here the Austrians had been able to bring up their guns in sufficient numbers. Kirchbach made a great effort against the Monte Lemerle-Monte Magnaboschi line, while the Archduke Charles strove hard to win room south of Arsiero by incessant attacks in the Novegno sector. No further ground was gained.

Retreat of the Austrians.—By the middle of the month Cadorna had begun the first move of a counter-attack, but the Austrians were now getting ready to go out of the salient and back to a strong line which they had already selected. Attacking on May 25, all along the line, the Italians found the invaders in retreat. It was too late to develop the counter-offensive which was to have been directed against the two sides of the Austrian salient, and Cadorna relinquished the idea of a big attack as soon as he found a resistance which could only be overcome by long preparation and the use of artillery in mass.

Casualties on both sides were very heavy, and indicate the severity of the fighting. The Austrian losses were estimated at over 100,000; the Italian figures, up to the end of the counter-movement, were 35,000 killed and 75,000 wounded, with 45,000 prisoners, many of whom should be reckoned among the wounded. The Austrian attempt to break through ended in definite failure but the attack was well planned and conducted with skill and determination. Failure was due to the fact that Conrad met with a resistance which went beyond his calculation. Falkenhayn and Cadorna had summed up the situation rightly.

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ASIA MINOR (*see* 2.757), a geographical term used both in a wider and a narrower sense. In the wider usage it covers Asiatic Turkey within the pre-War frontiers, excluding the Arabian Peninsula. In its narrower sense it means the Anatolian Peninsula, together with a vague zone extending eastwards along the roots of the peninsula into Armenia and Kurdistan.

As a result of the World War, Asia Minor in the wider sense has been broken up politically into the Turkish Republic and the three territories of Syria, Palestine and 'Iraq, under "A" mandates, the first being mandated to France, and the two others to Great Britain. Asia Minor in the narrower sense has still been left entirely inside the Turkish frontiers by the Treaty of Lausanne. On the other hand, the abortive Treaty of Sèvres provided for the partitioning of the narrower area also. A district round Smyrna was to be placed under Greek administration, while the remainder of the southern half of the region was divided between a French and an Italian zone of special influence, under an Anglo-Franco-Italian convention, signed simultaneously with the treaty. Owing to the decisive Turkish victory in the Greco-Turkish War of 1919–22, all these arrangements fell to the ground, so that the present area of Turkey in Asia practically coincides with Asia Minor in the narrower sense. (*See* 'IRAQ; LAUSANNE, TREATY OF; MOSUL; PALESTINE; SÈVRES TREATY OF; SYRIA; TURKEY.) (A. J. T.)

ASQUITH, HERBERT HENRY: *see* OXFORD AND ASQUITH, EARL OF.

ASTHMA: *see* RESPIRATORY SYSTEM, DISEASES OF THE.

ASTON, FRANCIS WILLIAM (1877–), British scientist, was born at Harborne, Birmingham, Sept. 1 1877, and educated at Malvern College and the universities of Birmingham and Cambridge. He was elected to a fellowship at Trinity College, Cambridge, and was made assistant lecturer in physics at Birmingham University in 1909. In 1920 he received the Mackenzie Davidson Medal of the Röntgen Society, and in 1922 the Hughes Medal of the Royal Society. He received the Nobel Prize for chemistry in 1922 for his work in connection with isotopes and also the John Scott Medal, Philadelphia, and the Paterno Medal, Rome, both in 1923. He has written *Isotopes* (1922) and numerous papers in scientific periodicals on electric discharge in gases, mass-spectra, isotopes, etc.

ASTOR, JOHN JACOB (1886–), younger son of the 1st Viscount Astor, was born May 20 1886. Educated at Eton and New College, Oxford, in 1906 he joined the 1st Life Guards, and, from 1911 to 1914, was A.D.C. to the Viceroy of India. In 1916 Major Astor married Lady Violet Mary, daughter of the 4th Earl of Minto and widow of Lord Charles Mercer-Nairne. On the outbreak of the World War he went to France with the Household Cavalry and served there four years. He was wounded at the first battle of Ypres and again severely in Sept. 1918. In 1922, Major Astor purchased the holding of the late Viscount Northcliffe in *The Times* Publishing Co., and became chairman of it and chief proprietor of *The Times*. Shortly afterwards he caused to be established a body of trustees consisting of the holders of certain important non-political offices, whose consent he made necessary to any future transfer of the control of that journal. He was elected Conservative member for the Dover Division of Kent in Nov. 1922 and re-elected in 1923 and 1925. In 1925, as treasurer of the Empire Press Union, he attended the Press Conference in Australia.

ASTOR, NANCY WITCHER, VISCOUNTESS (1879–), daughter of Chiswell Dabney Langhorne, was born May 19 1879 in Virginia. She married in 1897 Robert Gould Shaw of Boston, from whom she obtained a divorce in 1903, and in 1906 she married Waldorf Astor. When her husband succeeded to the viscountcy, Lady Astor, who had shown much interest in the affairs of his constituency at Plymouth, was adopted as Conservative candidate, and was elected by a substantial majority on Nov. 28 1919, thus becoming the first woman to sit in the British House of Commons.[1] She was re-elected at the General Elections of 1922, 1923 and 1924. She spoke frequently in debate and was specially active in the cause of temperance, bringing forward a bill to prohibit the serving of liquor to young persons under 18 except at meal-times, which became law in 1923.

ASTOR, WALDORF ASTOR, 2nd VISCOUNT, British politician, was born in New York May 19 1879, and educated at Eton and New College, Oxford. He represented Plymouth as a Unionist 1910–8, and the Sutton Division of Plymouth 1918–9, when he vacated his seat on succeeding to his father's peerage. He was chairman of the Government Committee on Tuberculosis and of the State Medical Research Committee. During the World War, he was inspector of quartermaster-general services, and in 1918 became private secretary to the Prime Minister, Mr. Lloyd George. He acted as Parliamentary Secretary to the Ministry of Food, 1918–9, and to the Local Government Board in 1919, retaining the same position on the formation of the Ministry of Health up to 1921. Since 1915 he has been the proprietor of *The Observer* and active on behalf of many causes of social progress, especially temperance reform. At the same time he was one of the leading British owners and breeders of race horses.

His father, WILLIAM WALDORF ASTOR (*see* 2.794), became a naturalised British subject, and was created a peer in 1916, assuming the title of Baron Astor of Hever Castle. He was made a viscount in 1917, and died in England Oct. 18 1919.

[1] In 1918 Countess Markievicz had been elected by an Irish Constituency in the Sinn Fein interest, but she did not take her seat.

ASTRONOMY[1] (*see* 2.800).—In the present century the centre of interest in astronomy has shifted from the solar system to the vaster domain of the stars and nebulae, and most of the progress in the years 1910–26 to be recorded relates to the stars. Knowledge of the sun as a particular star has also advanced.

The article STAR (*see* 25.784) was written at a time when statistical methods of research were in their zenith. Accumulated data as to proper motions, magnitudes, types, etc., for large numbers of stars were analysed and conclusions drawn as to the scale and structure of the stellar universe. After some further years of fruitful activity, this kind of study seems to have given place to more intensive study of individual stars. A feature of recent work is the application of modern atomic physics and the quantum theory of radiation to stellar problems; and the study of the stars has become closely linked with the study of the atom. It is now realised that the light despatched to us by the stars and nebulae contains elaborate messages in a code to which atomic physics provides the key, and not only the condition of the radiating layers but the internal mechanism of the star can be inferred with some confidence. We divide the article into (1) The solar system; (2) the stars; (3) clusters and nebulae.

I. THE SOLAR SYSTEM

The Sun (*see* 26.85).—By means of the spectroheliograph it is possible to obtain photographs of the sun in light of a single wave-length; we thus obtain a picture of the distribution of the matter which emits this wave-length or a negative of the matter which absorbs it. In practice either calcium or hydrogen light is used, since these elements furnish spectral lines sufficiently isolated to give good results. The emission of a particular spectral line depends on favourable conditions of temperature and density, and these will vary with the level in the sun's atmosphere. Thus the function of the spectroheliograph is not so much to separate particular elements as to isolate different *levels* in the sun's atmosphere and provide separate photographs of what is occurring at each level.

The highest level is given by photographs in the red light of hydrogen Hα, and examples of the remarkable structure revealed by the spectroheliograph at the Mt. Wilson Observatory are shown in the plate (figs. 5 and 7). In fig. 7 we see clearly the vortices whirling round the dark sun spots which occupy their troughs, and we can make out that the direction of whirl is opposite in the large spot and in the smaller spot to the left of it. If the whirling matter is electrically charged it should act like a solenoid and produce a field of magnetic force; and this idea led G. E. Hale (1) to test whether a magnetic field could be detected in sun spots. By the Zeeman effect a spectral line absorbed or emitted in a magnetic field is broken up into two or more components; in particular for light travelling along the axis of the solenoid the line becomes a doublet with its two components circularly polarised in opposite directions. Applying the optical test for circular polarisation clear evidence of the magnetic field in sun spots was obtained, the strength being generally of the order 2,000 to 3,000 gausses. A large proportion of the sun-spot lines are observed to be slightly broadened, and the Zeeman effect is at least partly responsible for this.

It was pointed out many years ago by Carrington that sun spots very frequently occur in pairs, the line joining them being approximately parallel to the sun's equator. In these pairs the two spots are found to have opposite polarity, that is to say, if the magnetic field is upwards in the leading spot it is downwards in the following spot. Even when the spot group is more complex a similar bipolarity is observed; Hale estimates that in 90% of the spot groups the disturbed area shows this bipolar structure. The polarity follows a regular law. With rare exceptions the preceding spots in the Northern Hemisphere all have magnetic fields of one sign, and those in the Southern Hemisphere all have the opposite sign; after a sun spot minimum the signs in the two hemispheres are interchanged. This last reversal has been observed through two minima in 1912 and 1923 (2).

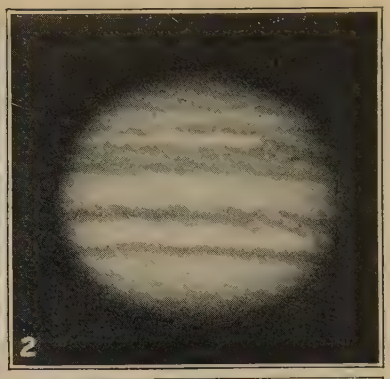
[1] The figures in parentheses appearing throughout the text of this article, refer to the references at the end.

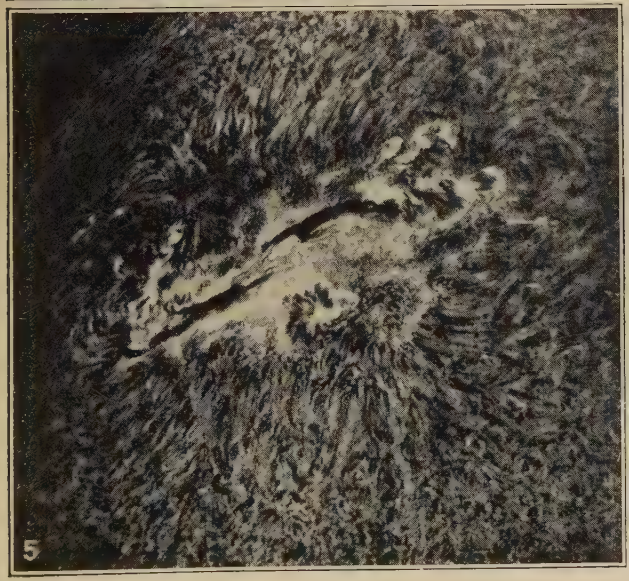
Strangely enough there is no regular relation between the polarity of the spot and the direction of the whirl above it, and the vortices shown in the hydrogen photographs obey no such uniform laws as regards Northern and Southern hemispheres. This leads us to think that the origin of the sun spot and its magnetic field is down below. The spot may be caused by a vortex—formed by currents circulating in the interior of the sun—which rises to the surface and has a free end there. It is suggested by Bjerknes that this internal vortex joins the following spot of one group to the leader of the next group, so that a spot group corresponds to a break in a permanent vortex in the form of a circle round the sun's axis. This vortex travels from high to low latitude during the sun-spot cycle, and the sun spots follow it (as observation shows); it then descends into the interior of the sun and at the same time a second permanent vortex of opposite rotation rises to the surface in high latitude and a new sun-spot cycle begins. The theory, though speculative and crudely developed at present, seems to have much to commend it. In any case it would seem that we have to do with a lower vortex—a whirl*pool*—formed according to uniform laws, and an upper vortex—a whirl*wind*—sucked in by it.

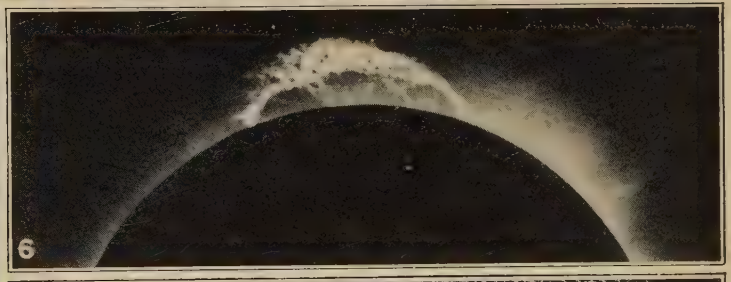
Hale has also found a general magnetic field of the sun, *i.e.*, not associated with exceptionally disturbed regions such as sun spots, which is roughly equivalent to the field of a uniformly magnetised sphere and analogous to the earth's magnetism (3). It is found that the magnetic axis of the sun deviates from the rotation axis, though not so widely as happens on the earth, the inclination being 6 degrees. The synodic period of rotation of the magnetic axis is 31·44 days. If we could assume that the source of this field is the permanent magnetisation of the interior material this would give the real period of rotation of the sun—a quantity otherwise unknown. Our knowledge of the sun's rotation has hitherto been based entirely on surface markings which revolve at different rates according to their latitude. The magnetic period of 31·5 days agrees with that of surface markings in latitude 55 degrees. The strength of this general magnetic field is of order 20 gauss and the whole observation is one of exceptional difficulty, so that perhaps the foregoing determinations of the axis and period should not be accepted too hastily.

The accepted value of the constant of solar radiation is that determined by C. G. Abbot, viz.: the amount of solar energy passing across 1 sq. cm. outside the earth's atmosphere is 1·93 gram-calories per minute. This is the same as if the sun were a "black body" with a temperature 5,740° C. (absolute), which is accordingly defined to be the effective temperature of the photosphere. The sun's total radiation is $3{\cdot}8\times10^{33}$ ergs per second. There appears to be satisfactory evidence that the sun's radiation varies a little according to the stage of the sun-spot cycle, being least when the sun's surface is quiescent. Abbot also claims that irregular changes varying according to the state of the surface have been established. Since the same changes were measured simultaneously at two widely separated stations, terrestrial causes seemed to be ruled out (4). His earlier estimates of these irregular variations were undoubtedly excessive, and according to the more recent results they are restricted to very small range. Another method of testing the variability of the sun has been carried out by Guthnick and Prager by photoelectric measurements of the brightness of Saturn; the planet, being illuminated by the sun, would reflect any changes in the intensity of the sun's light. The measures showed that the light is nearly steady, and excluded the large fluctuations originally suspected. Looking at the problem theoretically, there is no special difficulty in admitting a small regular change in the rate of radiation according to the phase of the sun-spot cycle, but an irregular holding up and release of considerable quantities of radiant energy seems unlikely.

The photosphere is the name given to the region from which most of the sun's light comes. Although no definite limits can be assigned to it, its thickness may be taken to be of the order 100 km. or perhaps less. The whole of this region is rarefied gas of density about $\frac{1}{10,000}$ of that of our own atmosphere; but the coefficient of viscosity in these conditions is probably high, and hydrodynamically it may be compared to a slightly sticky







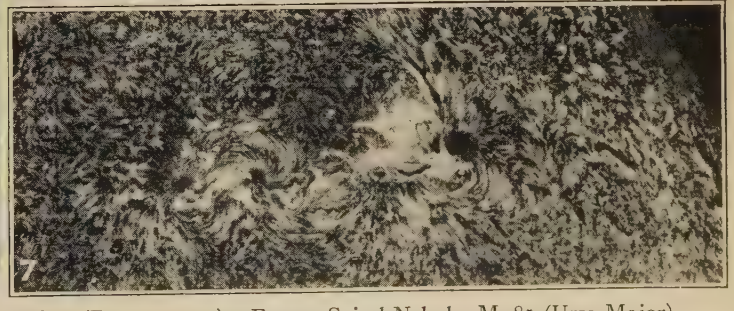


FIG. 1. Monochromatic Images of Ring Nebula. FIG. 2. Jupiter (Dec. 19 1917). FIG. 3. Spiral Nebula, M. 81 (Ursa Major). FIG. 4. Globular Cluster, M. 3 (Canes Venatici). FIG. 5. Spectroheliogram (Hα light). FIG. 6. Solar Prominence (May 29 1919). FIG. 7. Sunspot vortices.

liquid. The temperature ranges from not less than 4,650°C. at the top to about 7,000°C. at the bottom.

The upper part of this region is called the reversing layer; this is where the great majority of the Fraunhofer lines of the sun's spectrum are imprinted on the light. The pressure here is about 0·0001 atmospheres. Above this rises the chromosphere, extending to a height of over 10,000 km., which, it is now believed, is supported by radiation-pressure. General radiation-pressure is not very powerful on the sun, and the chromosphere is composed of a few elements (notably calcium) which by reason of strong line-absorption in the most intense part of the solar spectrum gain more momentum than the others. A detailed theory of the equilibrium of the calcium chromosphere due to E. A. Milne (5) has proved remarkably successful. Not only does it account satisfactorily for the height of the distribution, but it gives a purely astrophysical determination of an atomic constant of calcium—the life of an excited $ca+$ atom—which there is every reason to regard as correct. By special eruptions matter can be carried to much greater height; fig. 6 (on plate) shows a prominence 100,000 m. high photographed by the British Eclipse expedition at Principe on May 29 1919.

Mars (*see* 17.761).—We shall review the problem of the physical and climatic conditions of this planet in the light of recent investigations, including those made at the favourable opposition of 1924 (6). Few astronomers have the opportunity of examining for themselves the phenomena reported to be observed at specially favourable stations, since Mars is never well placed for observation in England and similar northern latitudes. Consequently there is much doubt as to what should or should not be accepted as trustworthy; but recent great advances in the photography of the planet, especially at the Lowell Observatory, have removed scepticism on some points. The geometrical network of narrow rectilinear "canals" supposed by Lowell and some other visual observers to cover the surface is still regarded with suspicion; most authorities explain it away as a mistaken impression of faint markings—of curious form perhaps, but not distinctively artificial. On the other hand some of the broader canals are shown on the photographs; and although the appearance does not particularly suggest artificial regularity, they are unlike any natural features on our own planet.

Seasonal changes of the surface markings are now conclusively established; a regular cycle of change with the Martian season is repeated at each opposition. The dark markings appear in regular succession, deepen in intensity and increase in area as the spring and summer advance, the polar snow melting meanwhile. It is difficult to resist the impression that we are viewing the annual growth of areas of vegetation on red desert soil. It is rash to accept so speculative a conclusion without more direct confirmation, but there seems to be no alternative explanation of the seasonal changes that is equally plausible. If life of any kind is admitted, can we restrict it to the vegetable kingdom? But that line of thought leads to guesses for which the astronomer accepts no responsibility.

There is now strong evidence that Mars has an efficient atmosphere, though it is considerably more rarefied than our own. Photographs occasionally show clouds which blot out the surface features for a time and pass away. There is usually a white fog over the polar region turned away from the sun, very different in appearance from the sharply outlined white snow cap covering the summer pole. A general haziness of the Martian atmosphere is evidenced in a manner pointed out by W. H. Wright. A terrestrial landscape can be photographed by infra-red light through a mist so thick that nothing can be seen visually; the longer the wave-length, the less is the scattering and consequent blurring of the picture. Photographs of Mars in light of different wave-lengths behave just as though the surface-detail were being seen through a hazy atmosphere; ordinary photographic light of short wave-length gives little more than a general blur, photographs in yellow visual light show more detail and those in infra-red light are the sharpest of all.

Determinations of the surface temperature of Mars by radiometric measurement of the heat coming to us from various parts of the surface have been made by Coblentz and Lampland and by Pettit and Nicholson. The former obtained an average temperature of +15° C. and the latter +13° C. (Other estimates arrived at on various assumptions are also given by the authors, but we prefer the foregoing based on Stefan's Law.) Evidently we are still left in considerable uncertainty as to the climatic conditions, but even the lower estimate is not inordinately cold when we remember that the polar snow cap is included in the average; the higher estimate makes the day temperature quite genial. According to Coblentz the dark regions (indicating vegetation or moisture?) are warmer than the red desert regions.

Other Planets (*see* 25.357).—A ninth satellite of Jupiter was discovered by S. B. Nicholson at the Lick Observatory in 1914. Like the eighth satellite it revolves round the planet in the opposite direction to the other seven. The periods of satellites 8 and 9 are about 739 and 745 days respectively, and the two bodies are revolving in almost equal interlocked orbits in planes inclined at about 10 degrees. Satellites 6 and 7 form a somewhat similar interlocked pair, their periods being 251 and 260 days respectively; but their motions are in the "direct" sense. The photograph of Jupiter (taken at the Lowell Observatory) shown on the plate (fig. 2), illustrates the great advance in planetary photography in recent years.

Much interest has been taken in the Trojan group of minor planets. These illustrate a special case of the problem of three bodies discussed by Lagrange, viz.: that in which the three bodies are situated at the vertices of an equilateral triangle. The Trojan planets have the same mean distance and revolution period as Jupiter, and the equilateral condition is roughly fulfilled. The problem of the small librations of such a planet about the triangular point of equilibrium has been discussed by E. W. Brown; the condition of stability is that the mass of Jupiter must be less than ·0385 times that of the sun—a condition which is easily satisfied—and the period of the libration is about 140 years. Actually the Trojan planets are at some considerable distance from the triangular points, and the problem of determining the finite librations (as opposed to infinitely small librations) has provided much exercise for mathematicians (7). Six members of the group are now known, Nos. 588 Achilles, 617 Patroclus, 624 Hector, 659 Nestor, 884 Priam and 911 Agamemnon; of these Patroclus and Priam are near the triangular point 60° behind Jupiter, and the others 60° ahead of Jupiter.

The period of rotation of Uranus round its axis has been determined by V. M. Slipher from measures of the line of sight velocity of the advancing and receding limbs. The result is 10^h56^m and the direction of rotation agrees with that of revolution of the satellites. Leon Campbell subsequently found that the light of the planet is variable with the same period, presumably owing to unequal brightness of different parts of the surface. The rotation period of Venus still remains a mystery; and there are advocates of the long period of 224 days as well as various estimates of a short period (one to three days).

Latitude Variation (*see* 16.267).—The study of the small periodic motion of the earth's axis of rotation (relatively to the earth) which gives rise to "variation of latitude" has been continued at the six international stations (reduced in number during and after the World War). The effect is made up of (*a*) the free precession of a spheroid rotating about an axis which does not coincide with its axis of figure; the period of this precession determined from the observations is 432¼ days; (*b*) an annual term, which is a forced oscillation due to meteorological and seasonal causes. Owing to interference of these two terms, there is an effect analogous to "beats" in sound waves, the amplitude of the motion alternately rising to a maximum of about $0''{\cdot}3$ (30 ft.) and dying out in about six years' period. The annual term appears to be nearly circular and of amplitude $0''{\cdot}085$; the possible causes contributory to this, such as seasonal circulation of the atmosphere and ocean, snowfall and vegetation have been investigated by H. Jeffreys, who finds a fair agreement between predicted and observed values. A mysterious Kimura or z term, which appears in these international results, would, if interpreted literally, indicate an annual approach to the pole and recession

by all stations on the same latitude simultaneously—or a shifting of the earth's centre of gravity to and fro along its axis. It is, however, now believed that the term arises from a small systematic error in the observations; independent observations made at Greenwich and Pulkovo (not belonging to the international chain) show either a reduced or zero Kimura term.

Gravitation.—The epoch-making theory of gravitation, put forward by Einstein in 1915, is described in the article RELATIVITY (*q.v.*). We refer to it here because the new law of gravitation, required by his theory, removes the most outstanding divergence between theory and observation in the solar system—viz., the progression of the perihelion of Mercury. There is still some discrepancy between theory and observation for the motion of the node of Venus; but this is a much smaller residual, and may perhaps even be attributable to accidental errors. Einstein's predicted deflection of light by the sun's gravitational field was verified by the British Eclipse expeditions in 1919 and further confirmed by the Lick expedition in 1922. His third crucial test—a general displacement of spectral lines to the red in the sun as compared with terrestrial sources—was for some years a subject of controversy, as it is difficult to eliminate other causes of shift of the lines; but it now seems to be generally agreed among investigators that the effect is confirmed.

E. W. Brown's lunar theory, developed according to the methods of G. W. Hill, was completed by the publication in 1920 of full *Tables of the Moon's Motion.* It seems safe to say that no term of appreciable significance has been omitted; nevertheless the moon deviates unmistakably from its theoretical place in an irregular manner. An investigation by H. Glauert ([8]) seems to show that the irregularities are at least partly due to variations in the rate of our standard timekeeper, viz., the earth's rotation; for the longitudes of the sun, Mercury and Venus exhibit similar irregularities, and the curves closely resemble one another. Besides these irregular changes, there is a general secular acceleration of the moon, which, being cumulative, leads to large changes in the circumstances of ancient eclipses. The historical evidence of all kinds has been rediscussed by J. K. Fotheringham ([9]) who arrives finally at the values 10″·5 for the moon's secular acceleration[1] and 1″·0 for the sun's secular acceleration. These quantities are presumably attributable to tidal friction, which causes a direct acceleration of the moon's orbital motion, as well as a spurious acceleration through the increase in the length of the standard of time.

It is now believed that the bodily tides in the earth have little effect and that the most effective retardation is due to tides in land-locked and shallow seas. According to G. I. Taylor the Irish Sea alone contributes $^1/_{60}$ of the total dissipation of energy.

II. THE STARS

Progress in our knowledge must depend largely on the patient accumulation of accurate statistics as to the parallaxes, motions, magnitudes, spectra, etc., of large numbers of stars; we therefore review the great advance in these data that has taken place in recent years.

The first photographic determinations of stellar parallaxes reaching a modern standard of accuracy were made by H. N. Russell and A. R. Hinks at Cambridge and F. Schlesinger at Yerkes in 1903–7; earlier results are now superseded except for a few of the best heliometer measures made chiefly by Gill. Extensive programmes have since been carried out with large telescopes, and the latest compilation (1924) by the parallax committee of the International Astronomical Union contains results for about 1,870 stars. Although the probable error is generally below ± 0″·01, this unfortunately does not give us the distances of 1,870 stars, for many of the parallaxes are inappreciable. Very few of the stars are near enough for the trigonometrical method to give a close measure of their distance, and a large proportion of the measures can only be of interest in statistical discussions of distribution. We cannot resist the impression that stellar parallax determination is reaching its limit with present instruments; and perhaps for that reason special interest is attached to a new method of finding the distances of stars described below under "Spectroscopic Parallaxes."

Lewis Boss's *Preliminary General Catalogue of 6,188 Stars* published in 1910 has been an invaluable aid to research with regard to proper motions. It comprises all the brighter stars and the proper motions constitute a great improvement on data previously available. The first really extensive lists of radial velocities were published by the Lick Observatory in 1911. Over 2,000 had been determined by 1921 when a catalogue was formed by J. Voûte. Progress would have been more rapid but for the large proportion of spectroscopic binaries which makes it necessary to repeat the measures at suitable intervals in order to discriminate between orbital motion and the steady secular motion which is looked for. The latest compilation ([10]) records 1,054 spectroscopic binaries, of which 248 have well-determined orbits.

The apparent magnitudes of stars range from $-1^m{\cdot}5$ for Sirius to 20^m and upwards for stars photographed with the largest telescopes. The corresponding light ratio is more than 100,000,000 to 1, and it is no easy matter to subdivide this range accurately. For this purpose a sequence of standard stars has been chosen near the North Pole; their magnitudes stretch at short intervals from the first to the twenty-first magnitudes, and by the co-operative effort of a number of observatories definitive magnitudes on an absolute scale have been found ([11]). It is usual to determine magnitudes of other stars by differential comparison with these. Separate standards are needed for visual and photographic magnitudes; the relation of the two scales has been fixed by international convention so that they coincide for stars of spectral type AO between $5^m{\cdot}5$ and $6^m{\cdot}5$. Since the photographic plate is most sensitive to blue light and the eye to yellow light, the difference photographic *minus* visual magnitude gives a measure of the colour of the star. This is called the "colour-index." The colour-index ranges from about $-0^m{\cdot}5$ for the bluest (type B) stars to $+1^m{\cdot}9$ for the reddest (type M) stars. The sequence of colour-index corresponds closely to the sequence of temperature, and the spectral type can usually be inferred correctly from the colour-index or *vice versa.* This affords a useful method of classifying stars too faint for spectroscopic examination. Some progress has been made with direct measurement of the heat received from the stars and the corresponding "bolometric" magnitudes have been determined; considerable corrections are necessary on account of selective absorption of heat in passing through our atmosphere, and the method has been chiefly confined to the study of special stars. The bolometric magnitude is more usually inferred from the visual magnitude by applying a theoretical correction depending on the effective temperature (or spectral type) of the star.

The Draper classification of stellar spectra is now employed almost exclusively. The stages from the hottest to the coolest are denoted by the letters O, B, A, F, G, K, M; intermediate stages are estimated in tenths, *e.g.*, G5 means half-way between GO and KO. Typical stars are B, Rigel; A, Sirius; F, Procyon; G, the Sun; K, Arcturus; M, Antares. Types N and S seem to contain low temperature stars in conditions alternative to M, type M being characterised especially by the spectrum of titanium oxide, S by zirconium oxide and N by carbon compounds. A catalogue of the spectral types of 230,000 stars classified by Miss A. J. Cannon has been published by the Harvard Observatory and forms a monumental work of reference.

The absolute magnitudes of stars cover nearly as wide a range as the apparent magnitudes. The sun's absolute magnitude is 4·9, that is to say, it would have this magnitude if seen from the standard distance of 10 parsecs (parallax 0″·1). The most luminous stars have absolute magnitude about -5^m or 10,000 times brighter than the sun. The following are the four faintest stars known with their absolute visual magnitudes:—Proxima Centauri $15^m{\cdot}4$, Barnard star $13^m{\cdot}3$, Groombridge 34 *comes* 13^m, Pi 2^h 123 *comes* $12^m{\cdot}3$. These are all red stars possessing a low surface temperature.

[1] The moon goes ahead by the amount $10''{\cdot}5T^2$, where T is the time in centuries. This is the conventional definition of "secular acceleration" in this connection.

Masses of Stars.—In a double star the two components revolve round one another under their mutual attraction; it is possible to measure the gravitational force exerted by one component on the other and so determine the mass. There are not very many systems for which our knowledge is sufficiently accurate to give trustworthy masses; among the best determinations are Sirius 2·45 and 0·8, Capella 4·2 and 3·3, α Centauri 1·1 and 1·0. The mass of the sun, viz.: 1·98. 10^{33} gm., is here taken as unit. In spectroscopic binaries with known orbits of both components we can usually determine only a lower limit to the masses, because one element of the orbit, namely its inclination to the line of sight, is lacking. These give evidence that very much larger masses occasionally occur. It has been shown by J. S. Plaskett that the O-type star 6° 1,309 has components with masses not less than 86 and 72 times the sun's mass. Masses not less than 260 and 50 are attributed to the components of υ Sagitarii, but the evidence is less certain. V Puppis consists of two equal stars of mass 19; in this case the star is an eclipsing variable, and the phenomenon of eclipsis tells us that the line of sight must be nearly in the plane of the orbit. At the other end of the scale masses from ¼ to ½ the sun's mass are common; the smallest known mass is that of the fainter component of Krueger 60, which is probably about one-sixth.

According to the theory of stellar radiation to be described presently, the absolute brightness of a star affords a close indication of its mass. This theory is fairly well checked by the direct determinations of mass; and, if it is accepted, we can apply it to find the masses of the numerous stars for which no other determination exists. It appears that the stars are for the most part closely similar in mass; a range from ⅓ to 3 would include at least 90% of the stars. The larger masses mentioned above are quite exceptional; we tend to discover exceptional rather than normal masses because it is especially the brightest stars which attract attention.

Advantage is taken of this uniformity of stellar mass to determine the "dynamical parallaxes" of double stars. If a is the semi-axis of the orbit in astronomical units, P the period in years, and m_1+m_2 the mass of the system in terms of the sun, we have by the law of gravitation

$$m_1+m_2=a^3/P^2$$

Thus a can be found if m_1+m_2 is known or guessed. We may assume with fair probability that $m_1+m_2=2$, the probable deviation being comparatively unimportant because a is proportional to the *cube root* of m_1+m_2. But the value of a in angular measure is found from the apparent orbit in the sky; comparing the angular measure with the linear measure given by the above calculation, we at once find the distance or parallax of the star.

It is possible to modify the procedure so that it can be used when a small arc of the orbit has been observed insufficient for a complete determination of the orbital elements. Dynamical parallaxes of 556 double stars have been published by J. Jackson and H. H. Furner ([12]); from these the absolute magnitudes and linear velocities (transverse to the line of sight) were calculated. The linear velocities were combined to give a determination of the sun's motion through the stellar system, the result being a velocity of 19·1 km. per sec. towards the Apex R.A. 273°, Dec.+34 degrees. This agrees remarkably well with the values generally accepted; and in particular the accordance of the speed with the value 19·5 km. per sec., obtained from the discussion of spectroscopic radial velocities, shows that the assumed mass 2·0 × sun must be almost exactly the average mass of a double star system.

Densities of Stars.—The sun has an average density greater than water, viz.: 1·41. This is fairly typical of a majority of the stars; but in recent years we have learnt that there exist numerous stars of a much lower density. We have to enlarge our ideas to include "giant" balloon-like objects with density so rarefied as to be comparable with air or even with a moderately high vacuum. These giant stars are especially conspicuous because, being swollen to great bulk, they have great light-power. Except for this high luminosity there is nothing very obvious about the appearance of the rarefied stars to distinguish them; the ordinary spectral classification is no guide. For instance the three eclipsing variables W Crucis, RZ Ophiuchi, SX Cassiopeiae have densities less than ·001, but they are classed in type G along with the sun. It is now known that there are certain telltale features in the spectrum which can be used to distinguish them; but these are only found by minute inspection and were not noticed until after the giant stars had been found and studied by other methods. Some information as to stellar densities can be obtained from eclipsing variables; it happens that a study of the eclipses gives sufficient data as to the relative dimensions of the two components and their orbit to solve the problem. But the most useful and universal clue is the absolute magnitude. The three stars above mentioned show practically the same spectrum as the sun, and it seems fair therefore to conclude that their surfaces are in the same radiating condition and will give the same amount of light per unit area within reasonable approximation. Thus if a star of the same spectral type as the sun gives 100 times as much light (5 magnitudes brighter) its surface must be 100 times greater; its radius is accordingly 10 times greater and its volume 1,000 times greater. The inference can be extended to other spectral types, accepting the principle that if the quality of the radiation as shown by its spectral distribution corresponds to a particular temperature the *quantity* of radiation must also correspond to that temperature at least to a rough approximation. Whenever we know the absolute magnitude and spectral type of a star we can give a good estimate of its size.

Until recently this was our only means of determining the size of the stars (except for some meagre information from eclipsing variables), because the stars are so distant that no appreciable disk can be seen even in the largest telescopes. But in Dec. 1920 the interferometer method developed by Michelson was successfully applied to the problem; although the star disk could not be seen, yet its angular diameter could be measured by observing the disappearance of a system of interference fringes ([13]). Pease and Anderson working with a 20-ft. interferometer at Mt. Wilson Observatory measured the angular diameter of Betelgeuse, the result being 0″·045. The parallax of this star is too small to be determined with much accuracy, and the conversion from angular to linear measure is a little uncertain; but it turns out that Betelgeuse is certainly large enough for the whole of the earth's orbit to be fitted inside it. A few other stars have since been measured, but most star disks are far too small to be within reach even of this powerful method. Whilst it is valuable to have a proof by actual measurement that some stars have diameters 200 times greater than the sun, the importance of these interferometer results is that they confirm closely the diameters already deduced from the absolute magnitude and spectral type.

As already explained there is not a great deal of range in the masses of the stars, and the huge bulk of Betelgeuse and similar stars indicates low density rather than great quantity of material. We have, of course, no actual measurement of the mass of Betelgeuse, but we infer from analogy with other stars or from the theory of stellar radiation that it is not more than 50 times the mass of the sun. In any case it is certain that its density must be very low, because Einstein's theory shows that a star of the bulk of Betelgeuse and density comparable to that of the sun would have extraordinary properties; in particular there would be a great shift to the red of the whole spectrum. According to the usual view the stars are formed by aggregation of primordial nebula, and it is therefore not surprising that we should find some stars in an early stage of low density.

Giant and Dwarf Stars.—Arranged in order of temperature from the hottest to the coolest, the spectral types fall into the sequence O,B,A,F,G,K,M. Until about 1913 it was generally assumed that this represented the course of evolution of a star, which started (presumably catastrophically) at high temperature and gradually cooled. We have, however, just seen that Betelgeuse and some similar stars which are cool red stars of type M are in an extremely diffuse state, and therefore represent the earliest stage in the condensation of a star from a nebula, We must not jump to the conclusion that all type M stars are

to be placed in the earliest stage of evolution. Closer examination shows that type M is heterogeneous and contains two quite distinct groups, the one consisting of giant diffuse objects and the other of small dense stars (red dwarfs) apparently in the last stage before extinction. This and other features of the spectra, luminosities and densities of the stars are brought into order by the giant and dwarf theory of evolution put forward independently by E. Hertzsprung and H. N. Russell, which has dominated research in stellar astronomy from 1914 to 1924. There is now strong reason to think that the theory cannot be sustained in its present form; but since it undoubtedly contains a great deal of truth and the necessary reconstruction has not as yet made much progress we shall give the usual form of the theory and later point out where it fails.

We must go back to Homer Lane's theory of the evolution of gaseous masses (*see* 25.788). Starting with a very diffuse globe of gas held together by its own gravitational contraction, the conditions of mechanical equilibrium require that its temperature must rise as it contracts. This rise of temperature continues so long as the material is rare enough to behave as a perfect gas. The gases with which we are familiar cease to follow the laws of a perfect gas when the density approaches that of the liquid state; it may therefore be anticipated that in the sun (density 1·4) the material is behaving more like a liquid and the star is cooling in the ordinary way. Accordingly the idea is that a star starts as a cool diffuse mass of perfect gas; it condenses and rises in temperature until the deviations from the gas laws check the rise of temperature; it then cools like a liquid and finally becomes extinct. It follows that a star passes through any particular temperature and spectral type twice, once ascending as a diffuse giant and once descending as a condensed dwarf. In any spectral class we shall have two groups of stars alike in surface temperature but wide apart in all other respects; in particular the two groups differ in density and in stage of evolution. The most conspicuous outward characteristic is the great difference of luminosity due to the larger surface area in the giant stage.

Instead of having a single evolutionary sequence of spectral types, the star must start as a giant of type M, ascend toward type B and then descend as a dwarf to type M again. It depends on its mass how far up the series it climbs, and probably a star must be three or four times as massive as the sun in order to reach the high temperature of type B. Smaller stars will turn at A, F or even lower. As Russell has put it, a star of small mass is a poor self-heating affair. The division of giants and dwarfs is most conspicuous for the lowest temperatures K and M since the corresponding stages are then at opposite ends of the evolutionary sequence; for types F and A the two groups begin to merge into one another and the division is less easy to recognise.

The observational confirmation drawn from many sources is now extremely favourable. For stars of known parallax the absolute luminosity can be calculated directly; and when these are grouped according to spectral type the bifurcation of the luminosities is evident. The luminosities of the giant stars depend very little on the spectral type since the rising temperature compensates for the decreasing surface area; their absolute magnitudes cluster closely about a mean value $+1^{m}\cdot0$. For the dwarfs the decreasing temperature and decreasing surface co-operate to give a rapid fall of brightness through successive types, and the absolute magnitude fades to about $+10^{m}\cdot0$ at type M. By the spectroscopic method of determining absolute brightness, Adams and Joy have been able to give striking statistics; of 58 stars of type M examined, they found that 48 were giants with magnitudes between $-1^{m}\cdot0$ and $+3^{m}\cdot4$, and 10 were dwarfs between $+9^{m}\cdot8$ and $+10^{m}\cdot7$; there was thus a gap of six magnitudes separating the groups. (It is possible that the sharpness of the separation is exaggerated by the circumstances of selection of the stars for examination, but we do not think the influence of selection is so great as to make the result misleading.) Ascending to types K and G the groups draw closer together and begin to commingle, but even in type F the frequency curve shows the two maxima. The bifurcation into giants and dwarfs is also well shown in Shapley's investigation of the densities of eclipsing variables and in Jackson and Furner's study of dynamical parallaxes.

Before leaving the observational evidence we must refer to a point which becomes especially significant now that Russell and Hertzsprung's theory of evolution is under suspicion. The giants apparently do not link on continuously to the dwarfs at type A. We trace the regular giant series from type M to G, and then there seems to be a gap with scarcely any normal giants of type F—as though this stage were rushed through rapidly. Such giants as do occur in type F are of higher luminosity and mass. We are now more inclined to divide the stars into a "Main Series" running down in temperature continuously from intensely luminous stars of type O to faint stars of type M, together with a side group of giants chiefly limited to types G, K and M. The latter is presumably a temporary halt in the early stages of evolution; when the halt is over the star proceeds rapidly to join the main series at a point depending on its mass.

The shock to the giant and dwarf theory comes from a result reached in 1924. Both from astronomical observation and purely physical theory it seems that stellar matter will continue to behave as a perfect gas up to densities exceeding that of platinum. Thus there is no explanation of the turning point from the giant to the dwarf series, and the descent along the dwarf series (if it occurs at all) must be due to some entirely different cause.

Radiative Equilibrium of the Stars.—The discovery that many of the stars are of very low density has given a stimulus to investigations of their internal conditions of equilibrium; for the material, being practically a perfect gas, will obey comparatively simple and definite laws. The distribution of temperature and density in a sphere of gas in equilibrium under its own gravitational attraction is a classical problem studied by Lane, Ritter, Kelvin, Emden and others. For the most part the mathematical analysis developed in these earlier researches is used in the modern theory, but three new features have been introduced:—

(*a*) It used to be supposed that the equilibrium was adiabatic—that is to say, the material was kept stirred by convection currents, hot gases ascending to replace the continually cooling material at the surface. But it is now clear that the heat passes to the surface not by material transfer but by radiation, and the condition of equilibrium is that each region will settle down to the temperature at which it radiates an amount of heat equal to that which it absorbs from the radiant heat flowing through it. This was first suggested as probable by R. A. Sampson in 1894, and the theory of radiative equilibrium was developed by K. Schwarzschild in 1906 for the atmosphere of the sun. It was taken by the writer as the basis of the theory of the stellar interior in 1916. One simplification resulting from this change is that a physical constant of stellar material, viz., the ratio of specific heats, which was difficult to estimate, is no longer required to be known.

(*b*) The pressure of radiation is sufficient to have an important effect on the condition of equilibrium especially in the more massive stars, and is taken into account in the new theory.

(*c*) It is recognised that at the high temperature in the stellar interior the atoms will be strongly ionised. Most of the electrons which circulate round the nucleus of an atom will have broken loose; and these, moving freely and exerting their own partial pressure, must count as separate "molecules" in determining the average molecular weight. All numerical results depend on the adopted value of the molecular weight; and it is essential that this should be known rather accurately since it is raised to a high power in several of the most important formulae. Owing to the ionisation we adopt a much smaller molecular weight than in the earlier investigations. Moreover we are no longer seriously troubled by uncertainty as to the chemical composition of the stellar interior, because *whatever the chemical composition* (provided only that there is not an excessive proportion of hydrogen) the molecular weight will be close to two. This is a consequence of the fact that the number of electrons surrounding the nucleus of an atom is approximately half the atomic weight, so that when all have broken loose there will be one free particle for every two units of weight. In stellar conditions the stripping of the atom

is not quite complete, but the modification of the molecular weight can be calculated and allowed for.

Since it is believed that the star's heat is maintained by liberation of subatomic energy, another unknown condition enters into the problem, viz.: the relative distribution of the subatomic source through the interior. This, however, has no very important effect on the results, and the margin of uncertainty due to our ignorance of the distribution has been calculated by considering the extreme cases of a source entirely concentrated at the centre and a source fairly evenly distributed through the star. All the difficulties and uncertainties attending the calculation of the internal temperatures of the stars seem to have eliminated themselves, and it is believed that we have trustworthy knowledge for all stars in the condition of a perfect gas.

The effective temperatures of a few thousand degrees represent only the marginal heat of the stellar furnaces, and the greater part of the material of a star is at a temperature of several million degrees. In a typical giant star Capella the central temperature is 10,000,000° and the average temperature is about $\frac{2}{3}$ of this. In the sun the central temperature is about 40,000,000°. (We shall see later that the theory applies to the sun in spite of its high density.) All stars on the main series have nearly the same internal temperature as the sun. It should be realised that from the standpoint of the expert in atomic physics these temperatures are not at all high. Temperature is a measure of the average speed of the molecules. At 40,000,000° the speed of the free electrons is still low compared with that ordinarily imparted to them in electrical experiments, and far less than that of the β particles shot out in radioactive disintegration. We cannot anticipate any disintegration of the nucleus, such as Rutherford has found in the laboratory by employing incomparably more powerful agency. The difference is that, whereas qualitatively the atomic processes in a star are by no means out of the ordinary, the intensity or rapid succession of the individual processes is not reproducible in laboratory experiments. It helps us a great deal that in studying the stellar interior we have not to envisage unfamiliar atomic processes but to calculate the cumulative effect of a great multiplication of familiar processes.

The temperature-gradient in the interior tends to cause a flow of radiation outwards, which is hindered by the opacity of the stellar material, the opacity being a measure of the amount of obstruction offered by a substance to the flow of light or other radiation through it. Thus the total outflow of heat from the star depends on the internal temperature distribution (calculated by the theory already discussed) and on the opacity. If L is the radiation of the star (ergs per sec.), we find

$$L = 4\pi c GM(1-\beta)/k$$

where c is the velocity of light, G the constant of gravitation, M the mass of the star (in grammes), k the coefficient of opacity, and $1-\beta$ the ratio of radiation pressure to the whole pressure found by solving the quartic equation

$$1-\beta = 0{\cdot}0031\, M^2 \mu^4 \beta^4$$

where M is now expressed in terms of the sun's mass and μ is the average molecular weight. Knowing L and M for any star we can now calculate k; for instance in Capella we find $k = 120$ C.G.S. units; this means that radiation passing through a screen of stellar material containing 1/120 grammes per sq. cm. (equivalent to about 6 cm. of air) would be reduced to one-third (strictly $1/e$) of its original intensity. This is a very high opacity. We see that the old difficulty as to how heat is brought up from the interior of a star to replace that radiated by the surface material has vanished; there is no need for convection currents; our problem is rather to explain how the material offers so much obstruction and dams back the internal heat, allowing it to escape no faster than it does. The high opacity is not so surprising when we realise that the radiation in the interior of a star consists of X-rays chiefly of wave-length 1 to 10 Ångstrom units, and the opacity determined astronomically is of the same order as the opacity of ordinary material to these X-rays as measured in the laboratory. The stellar opacity is in fact less than the terrestrial opacity because the high ionisation of the material throws a great part of the absorbing mechanism out of order.

The Mass Luminosity Relation.—Application of the modern physical theories of X-ray absorption to stellar conditions indicates that the coefficient of opacity will be directly proportional to the density and inversely proportional approximately to the $\frac{7}{2}$ power of the temperature ($k \propto T^{\frac{7}{2}}$). By the use of this law we eliminate k and obtain a relation between L and M. The density of the star nearly disappears from the relation; so that the total radiation or absolute bolometric magnitude of a star is a function of the mass, subject only to a trifling correction depending on its stage of evolution as indicated by density or by spectral type—provided always that the star is sufficiently diffuse to behave as a perfect gas. We call this predicted relation the mass-luminosity relation. So far as it can be tested with the not too abundant observational data available it appears to be strongly confirmed. The physical theory has not been so successful in predicting the absolute scale of luminosity of the stars; at present the position is that whilst the stars agree among themselves, they are all apparently about $2\frac{1}{2}$ magnitudes too faint. The cause of this discrepancy remains a mystery; but so long as we confine attention to differential comparisons it does not trouble us.

The startling result appears that not only do the giant stars confirm the mass-luminosity relation but the dense dwarf stars also agree with it, and the sun, for example, falls into line on the mass-luminosity curve (14). Taken at face value this unlooked-for agreement indicates that the material of the sun must be behaving as a perfect gas. This would be quite opposed to the giant and dwarf theory of evolution which attributes the low luminosity of the sun at its present stage (compared with that of the diffuse stars) to the deviation from a perfect gas. Nevertheless we seem bound to accept the new conclusion not only on account of the argument by which it was first reached, but because consideration of the physical conditions of material at a temperature of some millons of degrees clearly shows that it will remain a nearly perfect gas up to extremely high densities. Terrestrial material ceases to behave as a perfect gas at densities approaching that of water, because the atoms, which behave as rigid spheres with radii of the order 10^{-8} cm., are becoming jammed together. But in the stars atoms of this description do not exist; there are only the small fragments of atoms (ions) with radii of order 10^{-10} cm., and these do not jam until a density some thousands of times higher is reached. Our expectation that there would be a change in stellar conditions at a density between say 0·1 and 1 rests on a false analogy, which proves to be baseless as soon as attention is called to it.

Detailed investigation, taking account of the electrical forces between the ions, shows that there will be no appreciable failure of the gas-laws in any ordinary stars—except that in stars of small mass the material will be *superperfect* gas causing these stars to be about $\frac{1}{2}$ a magnitude brighter than at first predicted. There is some slight observational confirmation of this excess. The theory becomes extended to include all ordinary stars (*i.e.*, excluding "white dwarfs") and differences of absolute brightness are now attributed almost entirely to differences of mass. This fundamental change of view was only reached in 1924, and there has scarcely been time fully to reconstruct our ideas of stellar evolution in accordance with it.

The Companion of Sirius.—If matter at the density of platinum is still behaving as a perfect gas the limit of compressibility must be at far greater density. Thus it is possible that stellar matter may exist having a high density transcending terrestrial experience. Conversely if definite evidence of such matter can be found it will be the strongest possible confirmation of the views to which we have been led. It happens that there already existed evidence of the existence of stars of extravagantly high density—evidence which would probably have been accepted as fairly convincing if the conclusion had not been thought too absurd to be taken seriously. These stars are called *white dwarfs*. Only three are definitely known; but they are probably rather numerous in space because as a rule they are not detected unless they are close to us. The most famous is the companion of Sirius which has $\frac{2}{3}$ the mass of the sun but gives only 1/360th of the

sun's light. This would not surprise us if it were a red star of feeble surface luminosity, but it was shown by W. S. Adams in 1919 that it was a white star of spectrum F and therefore should have a surface-luminosity greater than that of the sun. The radius calculated in the ordinary way from the luminosity and type is 19,000 km.—not so large as Uranus—and the corresponding mean density is 60,000 grammes per cubic centimetre. When it was realised that these results were not necessarily nonsensical, a further test was applied by means of Einstein's theory.

The red-shift of the spectral lines—the third Einstein effect—is proportional to the mass divided by the radius and according to the above figures would be 30 times as great on the compañion of Sirius as on the sun. It would be equivalent to a Doppler effect of 20 km. per second. (The true Doppler effect can be separated from the Einstein effect because the motion in the line of sight is known from observation of Sirius itself.) Although the observation was difficult on account of the faintness of the object and its proximity to Sirius, Adams was able to show in 1925 that an Einstein effect of 21 km. per sec. existed, agreeing with the prediction [15]. The companion of Sirius has been famous in the history of astronomy as a body whose existence was known and accepted unreservedly 18 years before it was first discovered with a telescope, Bessel having shown in 1844 that Sirius was revolving under the attraction of an unseen mass; it now comes into prominence again as revealing that stellar matter can be compressed to a density of a ton to the cubic inch. There is no reason to think that this matter consists of other than the familiar elements; it is simply a case of tighter packing of the smashed atoms.

Radiation Pressure.—At any point in a star gas-pressure and radiation-pressure together support the weight of the material above. The proportion supported by radiation-pressure $(1-\beta)$ is to a first approximation the same in all parts of the star and, if the molecular weight is given, depends only on the mass. We might expect something significant in the range of mass for which radiation-pressure increases from minor to major importance, say $1-\beta$ increases from 0·1 to 0·5. The masses corresponding to these limits are 1·6 to 11·5 times the sun's mass (for molecular weight 2·1). This seems to give a clue to the remarkable phenomenon that the masses of the stars are so nearly uniform. Apparently the matter of the universe has aggregated primarily into lumps whose size is determined by this critical range of radiation-pressure. We know that a gaseous mass without radiation-pressure is stable unless it is in extremely rapid rotation; we do not know the conditions of stability of a mass subject to radiation-pressure. It is a plausible hypothesis that high radiation-pressure endangers the stability of a star; in that case the aggregation of matter to form stars will be put a stop to at limits of mass generally in the range indicated. In considering how accurate this coincidence is we must notice that there is now a wide-spread belief that the star radiates a considerable part of its mass during its lifetime. If so we must take for comparison the original masses, or the masses of stars observed in the most diffuse state. The range 1·6 to 11·5 agrees excellently with the known range of mass of the K and M giants.

Saha's Theory of Stellar Spectra.—After the first use of spectroscopy to identify the chemical elements in the atmosphere of a star, the most important advance was the discrimination of "enhanced lines," *i.e.*, lines strengthened in the spark spectrum as compared with the arc. This gives a criterion as to the physical condition of the star's reversing layer, because it depends on the temperature and density whether the arc or the spark spectrum predominates. Much of the earlier progress in this development is due to Sir J. N. Lockyer and A. Fowler. In general the arc lines are absorbed by the neutral atom and the spark lines by the atom with one electron missing (singly ionised atoms). Sometimes the distinction can be carried further; and for example, Fowler has identified the separate spectra of singly, doubly and trebly ionised silicon in the laboratory and in the stars. The modern thermodynamical theory of ionisation was brought to bear on the astronomical observations by M. N. Saha in 1920 and his method of interpretation of spectra has dominated all recent progress [16]. Consider the element calcium. In a red star the temperature of the reversing layer is low and the atoms will not be ionised, so that only the arc lines appear. At somewhat higher temperature ionisation begins, and the H and K lines of ionised calcium are shown. In the sun both spectra are prominent. Passing to higher temperatures the arc lines disappear since no atoms are left in the neutral state; and in the hottest stars the atoms become doubly ionised so that the H and K spectrum fades out.

If the pressure in the reversing layer is known we can calculate by theory how the state of ionisation progresses with temperature and so determine the temperatures corresponding to the spectral types in which the various spectra are observed to appear, disappear or reach maximum intensity. Lines absorbed by *excited* atoms (ionised or not) are especially useful, since the abundance of excitation is sensitive to small changes of temperature. By connecting together the data for different elements and controlling the results by reference to the best determinations of stellar temperature by other methods, a fairly consistent temperature-scale for the various types has been found. It appears that the pressure in the reversing layer is between 10^{-3} and 10^{-4} atmospheres—much lower than used to be supposed. A few lines are found to correspond to a still lower pressure; these are probably chromospheric lines absorbed by ions which experience strong selective radiation pressure which maintains them at a high level above the ordinary reversing layer. A number of the improvements in the detailed applications of the theory are due to R. H. Fowler and E. A. Milne.

Spectroscopic Parallaxes.—Although giant and dwarf stars of the same temperature have, broadly speaking, the same spectrum, a detailed examination of particular lines reveals distinctive differences. It was early shown by E. Hertzsprung that those spectra marked by Miss Maury as having "*c*-characteristic" belonged exclusively to giant stars. More precise criteria were found by W. S. Adams and A. Kohlschütter in 1914; and the method has been developed by Adams into a means not only of distinguishing the two classes but of determining quantitatively the absolute luminosities of stars. For example, the "enhanced lines" of strontium 4,077 and 4,215 are relatively strong in stars of high luminosity and weak in those of low luminosity; whereas the "furnace lines" of strontium 4,607 and calcium 4,455 behave in the reverse manner. Thus measures of the relative intensities of these lines give an indication of the luminosity of the star.

At present the procedure is purely empirical; the curve connecting absolute magnitude with differential intensity of the selected lines is deduced from and tested by stars of known trigonometrical parallax; it is then applied to deduce the luminosities and hence the parallaxes of other stars. Parallaxes determined by this method for 1,650 stars have been announced [17]. The existence of this criterion of absolute magnitude is explained in a general way by Saha's theory. The state of the outer layers of a star, and hence the spectrum, is controlled by two factors, viz.: the value of gravity at the surface and the intensity of the stream of radiation poured through them from below; the latter factor is equivalent to the effective temperature. Take two stars of high and low luminosity respectively, *e.g.*, a giant and dwarf of the same effective temperature; the former being a diffuse star has a much lower value of gravity, and this has the consequence that the reversing layer occupies a level of lower pressure. With lower pressure the same stages of ionisation occur at reduced temperature; and it is in fact confirmed that the same spectral type corresponds to lower temperature in a giant than in a dwarf. But a change of pressure does not simply shift the temperature scale for the whole spectrum; actually the shift is different for each element and each phase of the atom—normal, ionised or excited—so that differential comparisons of particular lines betray the alteration of pressure.

Variable Stars.—The three leading classes of variable stars are (*a*) eclipsing variables, (*b*) Cepheid variables, (*c*) long-period variables. Rather more than 200 eclipsing variables are known; in these one component wholly or partly hides the other during

part of the revolution so that there is a decrease of brightness. Intensive study of the light-curves of particular stars gives important information as to the radii of the components, densities, surface brightness, etc. In a number of systems a "reflection effect" has been observed and measured; that is to say the two hemispheres of the faint component are of unequal brightness, and the star goes through phases like the moon owing to illumination by the bright component. It has been shown theoretically that a star must be a perfect reflector of heat (heat-albedo = 1); but since our actual measurements are not in heat units but in light units this cannot be immediately checked by observation. In some systems the two components are so close that they distort one another, and the prolate form of the stars gives rise to observable features in the light-curve. It would seem that eclipsing variables will afford a quite exceptional opportunity of studying details of stellar constitution, but progress at present is difficult.

The explanation of the Cepheid variables is more uncertain. The first question is: Is the Cepheid a binary star? The spectroscope *apparently* answers in the affirmative for it shows a radial velocity increasing and decreasing in the period of the light variation, as though the star were revolving round an unseen body. But the change of light is not due to eclipses because the minimum brightness occurs when the star is receding most rapidly—at a time when the other component could not be between us and it. There must be an actual variation in the rate of radiation by the star, and this has been confirmed by H. Shapley who showed that the spectral type and therefore the surface conditions change during the period. For example, δ Cephei changes from type FO at maximum to G2 at minimum. This periodic heating and cooling is the main cause of the change of brightness.

One suggested explanation is that the orbital motion occurs in a resisting medium, so that the front side of the star is brighter than the rear side on account of the impact of the medium; this would explain why minimum brightness always occurs when the star is retreating. But opinion is now tending towards a pulsatory theory proposed by H. Shapley [18] which rejects the binary hypothesis altogether. The fact is that there is literally no room for the supposed second component required by the binary hypothesis. The Cepheids are giant stars filling a large volume, and the "orbit" is always small compared with the dimensions of the star itself. When we calculate the size of the orbit of the supposed companion (which we can do, knowing the period and approximate mass of the system) we find that it would graze or even lie inside the principal star—a *reductio ad absurdum* of the binary hypothesis. Further, a relation has been found between period and density in these stars, which points to the period being determined by intrinsic conditions; such a relation is quite unintelligible if the period is provoked by an external cause, viz.: the revolution of a companion. Accordingly Shapley suggests that the variable is a *single star which dilates and contracts with a regular pulsation;* and the observed motion of approach and recession refers, not to the star as a whole, but to the upheaval and subsidence of the part of the surface presented towards us.

The radius of δ Cephei may be taken as about 20,000,000 km.; the semi-amplitude of the oscillation, according to the observed radial velocities is 1,270,000 km. or about 6% of the radius. For 15 other fully observed Cepheids the semi-amplitude of the pulsation ranges from 3 to 8% of the radius; this seems an amount of compression and expansion suitable to produce the rather large changes of temperature required. Within narrow limits the period is inversely proportional to the square root of the star's mean density, a relation which seems significant in view of the fact that the pulsations of a gravitating sphere follow this law. Moreover the constant of proportionality is of the order of magnitude predicted by theory: we can calculate that a globe of gas having the mass and density of δ Cephei will vibrate in a period between 4 and 10 days (varying between these limits according to the adiabatic constant of the material of which it is composed); the observed period is 5·37 days. [19] The most serious objection urged against the pulsation theory of Cepheids is that it requires a broadening of the spectral lines at minimum and maximum, because all parts of the disk would not be moving with the same speed in the line of sight; this has not yet been observed. It is to be hoped that this crucial but rather difficult effect will be thoroughly sought for in the near future.

A question arises as to how the pulsations are maintained. There is very little dissipation of energy from viscosity and the main cause of decay of the pulsations would be the leakage of heat between different parts of the star. We have in any case to admit that a supply of energy (sub-atomic energy) is continually being released in the stars, and if certain thermodynamical conditions are satisfied this may supply the mechanical energy required to maintain the pulsations. The simplest theory is that this energy is released more rapidly when the star is compressed and at maximum temperature; the star then receives excess heat at high temperature which it radiates at low temperature and so acts as the working substance of a heat-engine. This explanation is perhaps too powerful, as it makes it difficult to understand why every star is not set in pulsation. An alternative theory is that the heat supply is constant but the varying opacity (acting like the valves of an engine) governs its flow in such a way that mechanical work is performed.

It now seems probable that the long-period variables link on continuously to the Cepheid variables, the differences being only skin-deep. It is, however, the skin which we observe, and in the long-period variables, which are stars of very low density and low photospheric temperature, a great surface eruption occurs at a certain stage of the pulsation. At the height of the eruption the star is usually at least 100 times as bright as at minimum; but it has recently been discovered that the increase of heat radiation is not nearly so great. By direct radiometric measurements, the variation of heat is found to be about 1 magnitude—just as in the Cepheids. The theoretical relation between period and density obeyed by the Cepheids is found to apply also to these low density stars, and the fact that the long-period variables are all of type M (or the other red types N and S) agrees with the rule found for the Cepheids that the type becomes redder with increasing period.

Novae.—Two "new stars" of unusual brilliance have appeared in recent years. Nova Aquilae III. was discovered independently by a great many observers on June 8 1918 when it was already a first-magnitude star. Its earlier history has been supplied from an examination of photographic records of the sky. From 1888 onwards it remained steady at $10^{m}\cdot5$ and a photograph taken by Max Wolf three days before discovery showed that it was still normal. Incidentally we may note that it cannot have been a red star (types K or M) or it would have appeared in visual catalogues. On June 7 it had reached $6^{m}\cdot$ according to a Harvard photograph. The next day (when it was discovered) it had brightened to $0^{m}\cdot8$; and on June 9 it was only slightly inferior to Sirius. Then followed the usual slow decline with occasional fluctuations; and it had faded to $5^{m}\cdot5$ by the end of October. W. F. Denning discovered a Nova in Cygnus on Aug. 20 1920 which reached the second magnitude. Its earlier history is unknown, but it must have been fainter than $15^{m}\cdot$ in 1908.

Broadly speaking each Nova reproduces the same sequence of phenomena with remarkable faithfulness. If caught early enough before maximum brightness is reached, the spectrum is that of an A or B type star with the absorption lines displaced to the violet. This appears to indicate that the outer layers of the star are being propelled upwards; the velocity varies from day to day. A few days later bright emission lines appear on the red side of the corresponding absorption lines. The absorption lines become doubled and trebled as though there were several jets of uprushing gas with different speeds. The bright lines broaden into bands and show complicated structure. The light is now declining owing to the continuous spectrum fading away, and the spectrum becomes mainly an emission spectrum. About a fortnight after maximum bright nebular lines (*i.e.*, lines of unidentified origin but characteristic of gaseous nebulae) appear. The great speed of upward rush of the absorbing gases is very remarkable, velocities of the order 2,000 km. per sec. being observed; there is no reason to doubt that these velocities are

genuine for the star does actually expand and in the later stages shows a nebulous disk visible in large telescopes. The observed rate of spreading appears to agree with the speeds indicated by the shift of the absorption lines. After the outbreak has subsided the star becomes of spectral type O surrounded by a nebulous disk—like a planetary nebula. For this reason it is sometimes thought that the ordinary planetary nebulae originate from novae; but this seems unlikely, because, so far as can be ascertained, there is a big difference in scale of the two kinds of objects.

Of the many theories advanced to account for the outbreak, a collision of two stars seems unlikely on account of its statistical improbability; and moreover the regular sequence of changes could scarcely be started by a haphazard impact. An eruption from within, whether occurring spontaneously at a certain stage of evolution or precipitated by the entry of a star into a nebula, may be more likely; but this theory also presents difficulties. J. H. Moore has shown that the extended nebulous disk shows differential motions of rotation in different parts. In any case, it seems likely from the very rapid sequence of changes that the main outbreak is only skin-deep. Novae always occur within the limits of the Milky Way (or in spiral nebulae); but this may perhaps be due to the greater depth of the stellar universe in this direction. So far as can be judged the Nova before the outbreak is a dwarf star; and at least in the case of Nova Aquilae it cannot have been a very red star. (The long-period variables, whose violent outbreaks are rather suggestive of the explosion of a Nova, are giant red stars.) We may meditate on the fact that the stars subject to these catastrophes are probably in about the same stage of evolution as that through which the sun is now passing.

Motions of the Stars.—Many researches have confirmed Kapteyn's discovery that the stars (or at least those near enough for investigation) move preferentially in two favoured directions. Since the article STAR (*see* 25.784) was written, the spectroscopic radial velocities have become available for testing the theory and they confirm it decisively. Relatively to the sun the favoured directions are inclined at about 120° (the apices being at R.A. 96° Dec.+8°, and R.A. 290°, Dec.−54°); but referred to the mean of the stars they are necessarily two opposite directions along a straight line. The extremities of this axis of preferential motion are called the *vertices*. The following appear to be the most accurate determinations of the vertex by the two independent methods [20]:—

From proper motions (Boss's catalogue) R.A. 94°·2, Dec.+11°·9.
From radial velocities (Lick catalogues) R.A. 94°·6, Dec.+12°·5.

We should rather expect this star streaming to be a local phenomenon in the stellar universe, but up to the present no sensible change in the velocities or relative abundance of the two streams has been found in the region surveyed. Photographic determinations of the direction of motion of faint stars of small proper motion made a Cambridge Observatory show that the phenomenon occurs without detectable alteration up to distances of 500 parsecs from the sun. It is significant that the line of preferential motion lies in the galactic plane. The phenomenon may be due to two star clouds passing through one another; or it may represent some dynamical property of a single system. The latter view has often been favoured owing to the very elegant mathematical specification of the corresponding velocity distribution given by K. Schwarzschild's ellipsoidal theory [21].

The more detailed study of the systematic motions of the stars leads to results of great complexity. We have to recognise a third drift, pointed out by J. Halm, which is nearly at rest relative to the mean of the stars. The type B stars appear to belong to this third drift and show no sign of the preferential motion towards Kapteyn's vertices; but the drift also comprises stars of other types. Another important phenomenon is the asymmetry of the motions of high velocity stars. We shall here follow the conclusions of J. Oort [22] with regard to this phenomenon; G. Strömberg, who has also investigated it, holds somewhat different views. According to Oort stars with velocities above a certain limit (probably about 60–80 km. per sec.) are moving almost exclusively towards one hemisphere of the sky. This is an additional effect, apparently having nothing to do with the two main star-streams. Tentatively we suppose that these high velocity stars are intruders into our local star cloud, having come into it from another cluster situated on one side. Regarding our star cloud as a semi-permanent system, there will be a certain velocity of escape. Stars with velocities below this limit are permanent members of the system describing orbits under its attraction, and there cannot well be one-sided asymmetry in the distribution of such orbital motions; but stars with speeds greater than the velocity of escape must be intruders which pass through the system once only, and preserve more or less the direction of motion with which they entered. Whatever the true explanation, these high velocity stars all moving one way affect considerably the various statistical discussions of the relation of stellar motions to other characteristics such as type and luminosity, because the asymmetric stream appears to include a larger proportion of stars of low luminosity and reddish type.

In 1910 J. C. Kapteyn and W. W. Campbell announced independently that (after allowing for the solar motion) the average speeds of the stars increase continuously from type B to type M. According to Campbell the average radial speeds are—type B, 6·5; A, 10·9; F, 14·4; G, 15·0; K, 16·8; M, 17·1 km. per second. In this investigation the K and M stars were almost all giants; but it has been found that the dwarf K and M stars have still higher speeds averaging about 40 km. per sec. for one component. There is also a general progression of velocity with brightness, the faintest stars having the highest average speed; and this is very much mixed up with the above dependence of speed on spectral type. To add to the confusion it has been found by Plaskett that stars of type O instead of having still smaller speeds than type B have moderately high speeds; and this is confirmed by the high speeds of planetary nebulae which usually contain a type O star as nucleus.

It seems likely that the correlation of speed both with spectral type and luminosity results from a more fundamental dependence of speed on mass—the smaller the mass, the higher the velocity. It is tempting to suppose that there is equipartition of energy as among the molecules of a gas, the average value of $\frac{1}{2}mv^2$ being the same for all classes of stars. Although the observations confirm this to a certain extent, it is difficult to suppose that there is any theoretical basis for such a law. The mutual perturbations of the stars tend to bring about equipartition, but the process is too slow to be effective within the lifetime of the stars concerned. Moreover, the empirical connection of mass and speed must not be pressed too far, because the O type stars which have very large masses have rather high speeds. The whole problem of stellar velocities is very mysterious. There must, we think, be a number of causes involved, and it seems clear that the stellar system has not yet reached anything like a steady and permanent distribution.

Moving Clusters.—Many years ago R. A. Proctor pointed out a group of stars in the neighbourhood of the Hyades with practically equal proper motions; the researches of L. Boss [23] have thrown new light on the nature of this association. He recognised as belonging to the group 39 stars spread over an area 15° square; the motions appear to converge towards a certain point in the sky—a perspective effect which would naturally occur if the actual motions in three dimensions are parallel; the direction of the convergent point gives the direction of the common motion of the group relative to the sun.

Knowing the spectroscopic radial velocity of one or more members, we can by an easy geometrical construction find the whole linear velocity and also locate each star separately in space. We thus obtain exceptionally full and exact information as to the distances and luminosities of this group of stars. The cluster is roughly spherical with a diameter of 10 parsecs; there must be many non-associated stars—accidental interlopers in so large a region—and perhaps the most significant conclusion is that the casual attractions of these stars have not been able during the lifetime of the cluster to disturb appreciably the parallelism of the motions and so scatter the cluster. Another remarkable "moving cluster" is formed of five stars of the Plough together with stars widely separated in the sky, including Sirius, α Coronae and β Eridani. Similar associations are specially frequent among the stars of the B type of spectrum, one of the most distinct being a chain of stars crossing the constellation Perseus.

Number and Distribution of Stars.—Important statistics of the number of stars down to various limits of magnitude have been obtained by Chapman and Melotte and by P. J. Van Rhijn. We give some results of the latter investigation which is the more recent (24).

The total number of stars down to photographic magnitude $16^m{\cdot}0$ is 33,000,000; by a somewhat risky extrapolation it is estimated that the total number of stars in the system is between three and four thousand millions, and to reach half this number it would be necessary to go as far as magnitude $25^m{\cdot}5$. (Exactly what is meant by the "system" in the foregoing sentence is somewhat difficult to define; there may, of course, be exterior galaxies or extensions which are not reckoned in these counts.) An important point is the well-known flattened distribution of the stars; up to magnitude 16^m the stars are distributed in the galactic plane $5\frac{1}{2}$ times as thickly as at the galactic poles. This is an increase compared with the concentration of the brighter stars; up to magnitude 5^m, the corresponding ratio is $2\frac{1}{2}$. We can easily understand this greater concentration of the faint stars, since on the average they carry us to greater distances, at which the oblate shape of the stellar system has more pronounced effect.

Taking a lower limit of luminosity 1/200 × sun, it is estimated that there are 30 stars within a sphere of five parsecs radius round the sun; about 20 of these have actually been identified. If this star density persisted, a sphere of 1,500 parsecs radius would contain 800,000,000 stars, besides an unknown but probably rather large number of extinct stars and of stars giving less than 1/200th of the sun's light. This gives some idea of the possible extent of the star cloud to which we belong; there can be little doubt that the density must fall off very considerably within a distance of 1,500 parsecs, more especially in the directions of the galactic poles.

The following table based on an investigation by Kapteyn, Van Rhijn and Weersma shows the average parallax of stars of different magnitudes:—

Mag.	Mean Parallax	Mag.	Mean Parallax
$1^m{\cdot}0$	·060″	$7^m{\cdot}0$	·0090″
$2^m{\cdot}0$	·044″	$8^m{\cdot}0$	·0065″
$3^m{\cdot}0$	·032″	$9^m{\cdot}0$	·0047″
$4^m{\cdot}0$	·023″	$10^m{\cdot}0$	·0034″
$5^m{\cdot}0$	·017″	$11^m{\cdot}0$	·0025″
$6^m{\cdot}0$	·012″	$12^m{\cdot}0$	·0018″

It is an even chance that a particular star has a parallax between 0·83 and 1·13 times the average parallax for its magnitude.

Evolution of Rotating Masses.—The figures of equilibrium and the final disruption of rotating fluid masses have been studied in great detail by J. H. Jeans. In agreement with Liapounoff he has found that the so-called "pear-shaped" figure of equilibrium, which succeeds the Jacobi ellipsoidal form, is unstable. For a full account of his conclusions as to the evolution of double stars, spiral nebulae and clusters reference must be made to his book *Problems of Cosmogony and Stellar Dynamics* (1919). With regard to the solar system, he finds himself unable to account for the formation of the planets by rotation alone; and he attributes them to a tidal disruption of the sun having occurred at some distant epoch in the past. If this view is correct the system of the planets is a "freak of nature," owing its existence to a chance encounter of some larger star (which approached within less than the sun's diameter from its surface). Comparatively few other systems of this kind would be formed; and the common view that the stars in general are attended each by a system of planets may be entirely mistaken.

Age of the Stars.—According to the Helmholtz-Kelvin theory, which supposes that a star's heat is supplied by gravitational energy converted owing to contraction of the star, the age of the sun is not more than 30,000,000 years. Physical, geological and biological arguments all agree that this time is far too short. An astronomical argument against the contraction theory is derived from the Cepheid variables. Like other giant stars δ Cephei would need to condense very rapidly if the heat which it squanders were derived from contraction; the increase of density must in fact amount to 1% in 40 years. Since the period of the light variation is intrinsic, this must also change as the density changes; calculation shows that the period should decrease 40 seconds annually. Now δ Cephei has been under careful observation since 1785 and the decrease of period is only just detectable—about 0·08 seconds per annum. Thus in the present stage evolution is proceeding at no more than $^1/_{500}$ of the rate required by the contraction hypothesis. In casting about for some other source of stellar energy, it is necessary to realise that no source is of any avail unless it liberates heat in the deep interior of a star. The temperature gradient between the centre and the surface has to be maintained (otherwise the star would collapse to the white dwarf state) and it is impossible to maintain a temperature gradient by supplying heat at the bottom end. This seems to rule out all suggestions that a star picks up its energy from outside.

Granting then that the energy required for future radiation must be already within the star, we can at once set an upper limit to the amount. All kinds of energy possess mass, and the mass of the sun is equivalent to $1{\cdot}8 \cdot 10^{54}$ ergs of energy. This is the total store, and at the present rate of radiation it is sufficient for $15 \cdot 10^{12}$ years; actually it would last considerably longer since the rate of radiation would decrease as the sun's mass decreased. To put the argument in another form, the mass of the sun's radiation amounts to 130 million million tons per year; and the sun cannot go on losing this mass for more than the period stated because by that time there would be no mass left. With insignificant exception the store consists of energy of constitution of atomic nuclei and electrons, *i.e.*, *subatomic energy;* the whole amount can only be released if there is some process of annihilation of the electrons and protons which constitute matter. A less radical suggestion is that only transmutation of the elements occurs. In that case not more than $^1/_{100}$ of the mass can be released as free energy; and to obtain even that much the mass must consist initially of hydrogen, since the main release of energy occurs when hydrogen is transmuted into helium as a first step towards the synthesis of higher elements. The energy emitted in ordinary radio-active changes is insignificant from the cosmical standpoint.

Although the theory of annihilation of matter presents grave difficulties, it is attractive (1) because it is doubtful if the less radical hypothesis can give an adequate time-scale, (2) because stars observed in the earliest diffuse stage have on the average masses two or three times greater than the average mass of the more condensed stars, (3) because if a star does not change mass considerably all previous ideas of evolution of faint stars from bright stars collapse. A star might also change mass by picking up or losing matter from its surface, but calculations indicate that this effect must be small compared with the loss of mass by radiation. The sun's chromosphere would have to move outwards at 500 km. per sec. continually in order to carry off as much mass as is lost by radiation.

One difficulty is the co-existence of giant and dwarf stars in clusters. The larger the mass the faster is the rate of loss of mass; and however big the stars may be to start with, at the end of a million million years there can be no more than twice the sun's mass left. In moving clusters such as the Taurus cluster and Praesepe we find stars of more than twice the sun's mass (judging from their luminosity) and therefore conclude that the age of these groups cannot be more than 10^{12} years. But the loss of mass of a dwarf star in that time is almost negligible, so that the dwarf stars in these clusters must have been born with practically their present masses. If we have to admit that the cluster dwarfs have undergone no evolution of mass, is there any point in assuming that dwarfs in general have been evolved from more massive stars? On the other hand, it may be significant that these clusters appear not to have their full quota of dwarfs, there being few if any below absolute magnitude about 7^m.

Very little progress has been made in unravelling the dependence of the rate of liberation of subatomic energy on temperature and density; but it seems to be established that the rate must increase with temperature or with density or both, since otherwise the stars would be unstable. It is also clear that there must be exhaustion effects, the older stars having used up their more prolific supplies. Thus the sun liberates only 1·9 ergs per gr. per sec. as compared with 58 by Capella, in spite of the fact that the sun is hotter and denser. A remarkable feature pointed out by H. N. Russell is that stars on the Main Series have nearly the same internal temperature. Thus V Puppis which requires a supply of 700 ergs per gr. per sec., and Krueger 60 which requires 0·08, both have to rise to a central temperature of about 40,000,000° to obtain their requirements. It looks as though 40,000,000° is a critical temperature at which subatomic energy becomes

available practically *ad libitum;* but this is scarcely credible as a physical hypothesis.

According to Kohlhörster and Millikan an extremely penetrating radiation found in our upper atmosphere comes to us from outside the earth. If their experimental results are accepted there can be little doubt that this radiation originates in the nebulae or in the diffuse matter pervading space, and the great penetrating power points to subatomic processes as the cause of it. This indicates an evolution of the elements prior to the condensation of matter into stars; and indeed astronomical evidence of the presence of complex elements in the most diffuse stars seems to require such an advance. But it baffles imagination to conceive how the four protons and two electrons required to form a helium atom can be brought together in a diffuse nebula.

The whole problem of stellar evolution is now in a most chaotic state because it has become involved with questions of the laws of liberation of subatomic energy which as yet have proved to be too difficult for us. It should be understood that these attempts to form a theory of the subatomic generation of energy from astronomical studies, although unsuccessful, are not speculative in the ordinary sense of the term. When once it is admitted that the stars' radiation is provided by subatomic energy, it follows that the measurement of the liberation of this energy is one of the commonest astronomical observations; the attempt to co-ordinate the results of these measurements, and to discover the laws connecting the rate of liberation with the physical conditions and age of the material is not airy speculation but a pressing problem of practical research.

III. CLUSTERS AND NEBULAE

Globular Clusters.—About 70 globular clusters are known. (*See* 19.332.) They are distinguishable from the loose irregular clusters by their symmetrical and condensed appearance. A typical example, Messier 3 (Canes Venatici), is shown in the plate, fig. 4, from a photograph taken at Mt. Wilson.

The Cepheid variables contained in some of these clusters have been used by H. Shapley ([25]) to gauge their distances, relying on the fact that the absolute magnitude of a Cepheid of given period is a known constant. In Messier 3 the mean magnitude of 110 Cepheids is $15^m{\cdot}50$, the individual stars deviating as a rule no more than $0^m{\cdot}1$ from this mean. In the cluster ω Centauri 76 Cepheids concentrate with similar closeness about a mean magnitude $13^m{\cdot}57$. It is clear that the difference $1^m{\cdot}93$ must correspond to the greater distance of Messier 3; and it is easily deduced that the ratio of the distances is 2·43, this ratio being very accurately determined provided that absorption of light in interstellar space is negligible.

We are not quite so certain of the absolute distances of the two clusters; but the evidence seems to indicate that the absolute magnitude of Cepheids with periods less than a day is $-0^m{\cdot}2$, which gives the following distances—ω Centauri, 5,800 parsecs; Messier 3, 14,000 parsecs. When it is recalled that the usual trigonometrical method can scarcely be applied to determining distances greater than 50 parsecs, the extraordinary power of this method of plumbing space will be realised. The method was first used by E. Hertzsprung to determine the distance of the Lesser Magellanic Cloud.

By this method, and by supplementary devices, Shapley has been able to plot the distribution of the globular clusters in space and to form an idea of the extent of the system which they outline. Even in this vaster system the galactic plane is still a plane of symmetry and of flattening, though the clusters extend to great distances above and below, the average distance from the plane being eight kiloparsecs. In plan the system is elongated with its axis in galactic longitude 325°—nearly the direction of star streaming; the greatest diameter is at least 60 kiloparsecs, and the sun is near one end of it, so that practically all the globular clusters are found in one hemisphere of the sky. The most remote cluster known is distant 67 kiloparsecs or 200,000 light years. We have to recognise that the "stellar system," dealt with in the researches described previously, is but a small star cloud in this greater galactic system. Roughly speaking those researches may be considered to relate to a domain of about 800 parsecs radius; the sun seems to be fairly centrally placed in the local star cloud (about 90 parsecs from the centre according to Charlier), but this is on the outskirts of a greater system whose centre is 20,000 parsecs away.

Spiral Nebulae.—The idea that there may exist "island universes" independent of and co-equal with our own galactic system of stars has appealed to many astronomers from time to time. If any known celestial objects deserve this name it must be the spiral nebulae, and after many vicissitudes this theory of their nature is now most favoured. It is natural to suppose that our flattened system of stars with the clusters and obscuring clouds of the Milky Way coiled round, would if seen from a distant point, look rather like a spiral nebula such as that shown in the plate, fig. 3 (M. 81, Ursa Major). The spiral nebulae show no tendency to crowd towards the galactic plane. Most of them have very large velocities of recession of the order 1,000 km. per sec., which seems to argue a lack of dynamical association with the galactic system. The great difficulty has been to know how far away we must place them. Rude estimates of distance based on the brightness of the novae which have sometimes been discovered in them suggested that they were extremely remote. On the other hand A. van Maanen believed he had measured comparatively large proper motions of points of the nebulae, which showed that they were not so remote as the globular clusters; but it was impossible to reconcile these results with any consistent scheme of mass and dimensions of the nebulae, and moreover the rotation shown by the supposed proper motions was in the opposite direction to that shown by the radial velocities. In 1924 E. P. Hubble discovered and observed a number of Cepheid variables in the great Andromeda nebula, and using these as a gauge, he deduced a distance of 300,000 parsecs (a million light years). Presumably the smaller spirals are still more remote. This seems to settle the question of distance and size of these nebulae. Accepting Hubble's result, the Andromeda nebula is still inferior in size to the galactic system of stars and globular clusters, but it is at any rate an object of comparable class, and is fairly entitled to be regarded as an island universe.

The theory of relativity suggests an explanation of the observed high receding velocities of the spirals. According to De Sitter's theory of a curved space-time remote objects would be expected to show a displacement of their spectral lines to the red, partly owing to a "slowing down of natural processes" in remote regions and partly owing to genuine receding velocities acquired under the cosmical repulsion which exists in a world of De Sitter's type. This explanation is, however, very much weakened by the fact that we know of two spirals (the Andromeda nebula being one of them) *approaching* with speeds of 300 and 260 km. per second.

Gaseous Nebulae.—Other classes of nebulae are comparatively near objects within the ordinary limits of the stellar system. The diffuse nebulae are of gaseous constitution or possibly a mixture of gaseous and meteoric matter. Since they occupy great tracts of space their densities must be extremely low, otherwise they would have large masses which would have conspicuous effect upon the distribution of stellar velocities. Besides the bright diffuse nebulae we recognise dark nebulae or obscuring patches, which cut off the light of the stars behind and cause apparently void regions in the sky. It is not always possible to tell whether a void region is due to one of these patches or is a genuine lacuna in stellar distribution, but there are many cases where the existence of dark nebulosity is undoubted. It is believed that bright and dark nebulae are of the same nature, the luminescence of the former being due to stimulation by the radiation from the stars present in them. Thus the Orion nebula is caused to shine by the numerous hot B type stars in that constellation; a similar nebulosity in Taurus is dark because there are no B type stars present. The connection of nebular light with stellar stimulation is well seen in Hubble's variable nebula; here there is one principal star which is a variable, and the nebula also varies. Owing to the low density and the effect of ultra-

violet radiation from the stars the material of the bright nebulae is rather highly ionised; this probably accounts for the fact that most of the lines of the nebular spectrum are unidentified, the conditions being difficult to reproduce in the laboratory. Of the identified lines, hydrogen, helium, ionised helium and probably carbon are found.

Planetary nebulae are disk- or ring-shaped clouds which surround a single central star. The star is always found to be extremely rich in ultra-violet light, and is probably to be classed as type O. It is sometimes thought that this aureole consists of atoms expelled and sustained by radiation pressure; but on closer examination we find it difficult to see how radiation pressure can have much to do with the phenomenon. These nebulae are found by spectroscopic observation to be rotating, and there can be little doubt that rotation plays a fundamental part in the equilibrium. Fig. 1 on plate, due to W. H. Wright, shows a photograph of the Ring nebula in Lyra taken through a prism, so that monochromatic images are shown for each of the chief emission lines. It will be seen that the different wave-lengths give rings of different sizes, and the great difference of distribution is well shown by the bright images on the extreme left and right (both corresponding to unidentified spectral lines). This may be due either to actual differences in distribution of the gases giving these lines, or more probably to differences in the conditions of ionisation.

Calcium Cloud in Space.—In certain spectroscopic double stars the phenomenon of "fixed calcium lines" is observed. Whereas the other spectral lines shift to and fro as the star approaches and recedes in its orbit, the H and K lines of ionised calcium remain stationary. It is clear that somewhere between us and the star's photosphere there must be an absorbing cloud of calcium vapour which does not follow the star in its orbit. The phenomenon was first pointed out by Hartmann in 1904 for the star δ Orionis. Later Miss Heger discovered that the D lines of sodium also remain fixed in δ Orionis. The same behaviour has now been observed in a large number of stars, but no other "fixed" spectral lines have been found. The important question to decide is whether the cloud belongs to the double star or whether it is a continuous cloud filling interstellar space. J.S. Plaskett ([26]) has shown that the latter alternative is correct; the motion of the calcium cloud is often different from that of the centre of mass of the star. After removing the solar motion the velocity of the cloud relative to the mean of the stars is found to be small. Just as there are lines in the solar spectrum which do not share in the sun's rotation and are accordingly to be attributed to absorption during the passage of the light through the earth's atmosphere, so we have fixed lines of calcium and sodium which do not share in the orbital or individual motion of the star and are to be attributed to absorption in an interstellar "atmosphere." The fixed lines only appear in the spectra of the hottest stars, but that is perhaps due to the fact that cooler stars have strong H and K lines of their own, masking the lines of the cloud. It has been suggested that the presence of the hot star is necessary in order to ionise the calcium vapour and render it capable of absorbing H and K light, so that although the absorption is performed by the interstellar cloud only the parts of the cloud stimulated by the star are effective. But this explanation would not hold good for the D lines of sodium which are absorbed by un-ionised unexcited atoms. There can be little doubt that the absorption occurs equally along the whole track of the light through space, and the intensity of the lines should be an indication of the length of track, that is the distance of the star.

In order to avoid a huge mass of the stellar system inconsistent with the observed velocities of the stars, it must be postulated that this interstellar cloud is of very low density. About one atom per cubic centimetre is the maximum that can be allowed. It is calculated that matter so diffuse as this would take up a high temperature not much lower than the photospheric temperatures of the stars; although a black body in interstellar space would sink to a temperature of 3° absolute. The density is too small to give any appreciable scattering or absorption of light in space other than the special line-absorption of calcium and sodium.

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For astrophysical problems two up-to-date books are available—F. J. M. Stratton, *Astronomical Physics* (1925) and H. Dingle, *Modern Astrophysics* (1926). Other books relating to various branches of the subject that may be found useful are: A. S. Eddington, *Stellar Movements and the Structure of the Universe* (1914); R. G. Aitken, *The Binary Stars* (1918); J. H. Jeans, *Problems of Cosmogony and Stellar Dynamics* (1919); S. Newcomb and R. Engelmann, *Populäre Astronomie* (6th German ed., 1921); H. S. Jones, *General Astronomy* (1922); C. H. Payne, *Stellar Atmospheres* (1925); A. S. Eddington, *Internal Constitution of the Stars* (1926). For technical information as to the nebulae, *Lick Obs. Pub.*, vol. 13 (1918) should be consulted. (A. S. E.)

ATHENS (*see* 2.831).—In spite of continual war between 1912 and 1922, Athens has progressed in every way since 1910. As the seat of government, it is also the focus of society, politics and trade. Its port, Piraeus, the best equipped and principal harbour of Greece, is the terminus of the railway and steamship lines, and the mart for all imports and exports. As new quarters have been laid out to accommodate the rapid growth of population, and the refugees from Asia Minor, Athens now extends all round the base of Mount Lycabettus. Outlying parts, such as Patēsia and Pangrati, have enormously increased, and suburbs such as Kēphisia, Marousi, Phalēron and Kallithea have much expanded.

New Discoveries.—Its museums make Athens an art centre of the first rank, and its monuments always provide fresh material for our knowledge of Hellenic culture. The constant study, which scholars of all nations devote to the Acropolis, takes practical shape in such work as the re-erection of fallen portions of the Erechtheum, Propylaea and Parthenon. Recent discoveries show that the Odeum of Pericles was a rectangular hypostyle building and not circular, as formerly supposed, and that the seats of the Theatre of Dionysus in its earliest form were in straight lines. An accident revealed two archaic sculptured bases built into a later wall, perhaps that of Themistocles, not far from the Dipylon. These, which still retain some of their original colouring, are sculptured with chariot groups and athletic scenes. In their freshness and simplicity they are charming examples of archaic Attic art.

So the excavation of the Agora, now planned by the Americans, may well lead to most important results. The area to be cleared, which is bounded on the west by the Temple of Hephaestus, on the east by the Horologium of Andronicus, and on the north by the Stoa of Attalus and the Library of Hadrian, is now covered by narrow streets and small houses, many of which date from Turkish times. When Greece became free, Ross, the first head of the Department of Antiquities, proposed that this should be reserved, and, when excavated, become a public park. Round the Agora were colonnades, the Stoa Basileios and the Painted Stoa which had frescoes of the battle of Marathon, the Temple of the Mother of the Gods and other shrines.

Public buildings here were the Bouleuterion, or Senate House, the Prytaneion, the centre of state hospitality, and the Tholos,

or round building. Monuments and statues of all kinds, commemorating distinguished citizens or foreigners and great events, were erected among them, and also inscriptions with official records and accounts. The discovery of one of these buildings, with its art treasures and original documents, for Greek history would be an event of first-rate importance.

(A. J. B. W.)

ATHLETICS (*see* 2.846).—The London Olympiad of 1908 may well be regarded as marking the commencement of a fresh athletic era throughout the world. It is worthy of note that the United States, in pursuit of a progressive policy, has always at once included in the Amateur Athletic Union and Inter-Collegiate championship programmes any new event which might be added to the Olympic syllabus. The English Amateur Athletic Assn. (A.A.A.), on the other hand, for many years ignored such events as Throwing the Javelin, Discus and 56 lb. Weight and the Hop, Step and Jump, and allowed to fall into disuse, through lack of encouragement and competition, such excellent exercises as Pole Vaulting, Shot Putting and Hammer Throwing, and gave but little more attention to High and Long Jumping and Hurdling.

In 1910 the English Amateur Field Events Assn. (A.F.E.A.) was formed and authorised by the A.A.A. to hold championships. By 1914 the purpose of the A.F.E.A. had been fulfilled, for in that year the A.A.A. incorporated in its championship programme the Javelin, Discus, Hop, Step and Jump and the 440 Yards Low Hurdles, but even then these events were not taken as seriously as the others.

Fifth Olympiad.—Meanwhile the holding of the Fifth Olympiad (1912) had been allotted to Stockholm and the Swedes had recalled from America that great athletic coach, Ernie Hjertberg, to make ready a national team. Finland, also, had produced a great distance runner in Hannes Kolehmainen, and a set of magnificent heavy weight field events men, such as Saaristo, Taipale and Niklander, while France had come into prominence with Jean Bouin, a world's record holder, who was, however, beaten by Kolehmainen in both the 5,000 and 10,000 Metres races. Germany, too, gained prominence with Rau, the sprinter, and Braun, the middle distance runner.

It is significant that at the Stockholm Olympiad the United States finished first with a total of 85 points, Finland second with 29 points, Sweden third with 27 points and Great Britain fourth with 15 points. American athletes were again in the ascendant, but with their supremacy challenged by Finland and Sweden. Finland, Sweden, Norway and Denmark had now become definitely athletic countries, while France, Germany and the lesser European nations, such as Italy, Belgium and Holland, were all showing steady progress toward national athletic efficiency.

More International Matches.—About this time, too, the custom of holding international athletic matches became popular. Most notable of all these, perhaps, is the Scandinavian Landskamp, in which Norway, Sweden and Denmark meet annually at Oslo, Copenhagen and Stockholm in rotation. France, too, entered the international arena with matches with Sweden and Belgium, and Great Britain began to hold a triangular international in which England, Ireland and Scotland met annually. The other European nations in meeting each other contest practically the whole of the Olympic programme, whereas from England's match with France are excluded such important events as Javelin Throwing, Pole Vaulting and the Low Hurdles, and in the case of the British triangular international the Discus is also omitted. In any comparison of international prowess in field events it is only fair to note that neither Discus nor Javelin Throwing is practised at Oxford and Cambridge, and the Hammer Throwing event has been abandoned, while these events are regular features at all American and foreign schools, colleges and universities.

The War Period.—After Stockholm came the World War, which prevented the Sixth Olympiad, although a vast stadium had been built to house it at the Grunewald, Berlin. Many doubtless thought that in those strenuous years all sport must come to an end. This was not to be. Alva Kranzlein, the American sprinter-hurdler-jumper, had returned to Germany, the land of his forefathers, to make ready the German Olympic team, and in Germany or Holland he stayed throughout the War, laying the foundations of a great athletic future for those nations. He was probably the first person to discover, in the internment camp at Gravenhaag, Holland, the potentialities of H. F. V. Edward, the West Indian, who won so many A.A.A. championship titles.

In England championships were abandoned from 1914 to 1919. Athletic meetings of a sort continued to be held under an unofficial general amnesty, which allowed pure amateurs and those soldiers who had forfeited their amateur status to compete together. In Great Britain the London Athletic Club contrived to carry on the Public Schools Sports Meeting right through the War, thus assuring for Great Britain the nucleus of a fine supply of athletes of international standing when the days of war should be ended.

Education of Athletes.—Here, one may pause to draw attention to the splendid movement now in progress all over the world for the better athletic education of boys at school. In the United States the universities and colleges, as well as every school of any standing, have their properly qualified athletic coach. Inter-university, inter-collegiate and inter-school athletic meets are exceptionally popular, and the same may be said of the Scandinavian and many other European nations. France, in particular, has established a Ministry of Sport. In Scotland inter-scholastic championships have long been in vogue. In England the Public Schools Sports Meeting and also the Public Schools Relay Meeting, the latter under the auspices of the Achilles Club, are both established fixtures, and there is now an Inter-Schools Athletic Assn., which, for the first time, held championships in 1925. The Public School Athletic League of New York, organised in 1906, annually has between 7 and 8 thousand boys compete in its championships, all on one day. It is a usual thing to have between 2,500 and 3,000 boys compete in the indoor elementary championships each year. But in no country, save possibly the United States, is there to be found anything approaching the Swedish Schoolboys Athletic Week, held annually in Stockholm, to which city school teams journey from every part of Sweden.

The War Period Again.—To revert, however, to the War period. The United States, unaffected by the struggle in its early stages, and Sweden, Norway and Denmark, which countries maintained their neutrality throughout this time of strife, forged rapidly ahead. In 1915 at Cambridge, Mass., Norman S. Taber placed upon the books a new amateur mile world's record of 4 min. 12⅜ sec., which, at last, eclipsed the professional mile time of W. G. George, who, in 1866, covered the distance, in his match with W. Cummings at Lilly Bridge, in 4 min. 12¼ seconds. Taber's race was the forerunner of a great many record-breaking performances.

In 1916 at Evanston, U.S.A., R. I. Simpson brought the 120 Yards High Hurdles record down to 14⅗ sec., owing to certain modifications he made in the, then, accredited style of hurdling, and in 1920 a young Canadian, Earl Thomson, who had served in the Royal Air Force, still further reduced the record time to 14⅗ seconds. Two of the most noteworthy achievements of the War period were the performances accomplished in 1916 by J. E. Meredith (U.S.A.), who set up new world's records for the Quarter Mile, which he ran in 47⅗ sec., and the Half Mile run in 1 min. 52⅕ seconds. At Magdeburg in 1913, incidentally, A. R. Taipale (Finland) threw the Discus 158 ft. 11 inches. This performance is duly recognised in Scandinavia, but has never been passed by the International Amateur Athletic Federation; otherwise it would stand as the world's record.

Shortly after the signing of the Armistice a great Inter-Allied Military Athletic Meeting took place in the Pershing Stadium at Paris. Of signal importance at this time was the step taken by the authorities of the British services, who decided that the pre-War custom of rewarding athletic proficiency among soldiers and sailors by money prizes must forthwith cease. An inter-

services meeting was held in 1919, at which some of Great Britain's Dominion soldiers, not yet demobilised, proved clearly that the Dominions themselves would hold a strong hand at the next celebration of the Olympic Games. It is interesting to note that even after the United States had entered the World War, the National A.A.U. championships were not abandoned, whereas, in Great Britain, no championship meetings took place between 1914 and 1919.

Peace Conditions Return.—In the year of the restoration of the A.A.A. championships the governing body again elected to omit certain of the field events from the programme; nor have they since insisted upon the inclusion of these events, which score, equally with the track events at the Olympic Games, in such important contests as the triangular international between England, Scotland and Ireland, the annual match between England and France, and the inter-county championships. The governing body in 1925 decided to abandon the English National Championships, after they had been held for only three years, and were just beginning to produce a really satisfactory crop of fine young English exponents of these field events. The A.A.A. championships are open to the whole world and hitherto Great Britain has always been outclassed at the A.A.A. championships proper in the majority of field events

In Great Britain the sterling post-War work of the Oxonians, A. N. S. Jackson and B. G. D. Rudd, coupled with the exertions of the Cambridge men, P. J. Baker, G. M. Butler, R. S. Woods and W. R. Seagrove, was responsible for inducing university athletes to take a healthy interest in open competitions generally, and championship meetings in particular, outside the limited scope of their own university Sports.

In 1919 the Inter-University Athletic Board of Great Britain and Ireland was constituted, comprising the universities and university colleges of Aberystwith, Bangor, Birmingham, Bristol, Cardiff, Durham, Leeds, Liverpool, Manchester, Nottingham and Sheffield; other universities have since joined the movement. At these provincial universities the whole of the Olympic events are practised, and year by year the records, especially in the field events, improve.

Seventh Olympiad.—It was decided to hold the Seventh Olympiad at Antwerp in 1920, partly as a tribute to the Belgian people for the part they had played in the War, but principally in order that the true Olympic cycle might not be interrupted. There was a great outcry that the war-worn nations were not yet sufficiently recovered to participate in such a festival. P. J. Baker, Cambridge University, was appointed captain of Great Britain's athletic team; the whole Olympic side came under the control of Brig.-Gen. R. J. Kentish, C.M.G., D.S.O., and the British team won golden opinions in Antwerp. Great Britain did better in actual competition at this Olympiad than she had ever done at any previous celebration of the Games. Notable victories were gained by A. G. Hill in the 800 and 1,500 Metres, by B. G. D. Rudd, the Oxonian, representing South Africa, who won the 400 Metres, and by Percy Hodge, who broke the world's record in the 3,000 Metres Steeplechase. The British team succeeded also on this occasion in winning the 1,600 Metres Relay Race.

At the conclusion of the Antwerp Games the United States was first, Finland second, Sweden third and the British Isles fourth, the same order as appertained at the conclusion of the Stockholm Games, but in the other positions there was a marked difference. France, for example, eighth at Stockholm, was now fifth, while Italy had moved up from the eleventh to the sixth place. America's strength lay in the sprints, hurdles, relay races and jumps. Finland gained honours across country, in the middle distance races and the throwing events. Sweden scored heavily through the magnificent team work of her men, and Italy came into prominence by the fine walking of Ugo Frigerio.

Further proof of the taste which the public was acquiring for international competition was exemplified immediately after the Games by the match between France, Sweden and the United States, which took place in Paris, and that even greater match at Queen's Club, London, between the United States and the British Empire. This match has evidently come to stay, since it was repeated in London in 1924, after the celebration of the Eighth Olympiad at Paris. In 1921 the International Amateur Athletic Federation held an important congress at Geneva. New rules for international competitions were passed and the Olympic programme at last standardised. The years that followed the Antwerp Olympiad were years of wonderful progress. This is conclusively proved by the existing world's records

Running.—In 1906 the 100 Yards record of 9⅗ sec. was established. This record was equalled in 1922 by the Canadian, C. Coaffee, while C. W. Paddock, U.S.A., has also, upon several occasions, covered the distance in that time. Paddock has also, in 1921 and 1924, run 220 yards in 20⅘ sec., thereby establishing himself as the greatest sprinter the world has ever seen. Taber's mile record, to which reference has already been made, was, in 1923, quite eclipsed by the Finnish phenomenon, P. Nurmi, who, in a race at Stockholm, beat the great Swede, Edvin Wide, in a mile race run in 4 min. 10⅖ seconds. From one mile up to 10 miles the records are about evenly divided between Nurmi and Alfred Shrubb. Earl Thomson still holds the palm among high hurdlers, but the 220 Yards Low Hurdles record of 23⅕ sec. was made by C. E. Brookins (U.S.A.) in 1923, and that of 53⅘ sec. for the 440 Yards Low Hurdles by F. H. Taylor in 1925.

Jumping.—In jumping the most marvellous improvements have been made. Old-time sportsmen still remember the amazement that was felt when, in 1876, M. J. Brooks of Oxford University accomplished a high jump of 6 ft. 2½ in., and again in 1893 when that other great Oxonian, C. B. Fry, created a world's long jump record of 23 ft. 6½ inches. The latter performance was totally eclipsed by the Irishman, P. J. O'Connor, who, in 1901, cleared 24 ft. 11¾ inches.

Credit for the subsequent improvement in jumping belongs to America. Taking the High Jump first, it must be remembered that in 1895 M. J. Sweeney (U.S.A.) cleared 6 ft. 5⅝ in., and that by 1921 an Englishman, B. Howard Baker, had cleared 6 ft. 5 inches. In the meantime, however, George Horine, a young undergraduate of Leland Stanford University, California, had evolved an entirely new method of jumping, styled the "western roll," by which, in 1912, he cleared the height of 6 ft. 7 inches. In 1914, however, Edward Beeson, another American, reached 6 ft. 7 15/16 in., and even this has been exceeded by yet another American, H. M. Osborne, who, in 1925, jumped 6 ft. 8¼ in.; this was no fluke performance, for he has, time and again, gone within an ace of beating even this stupendous record.

From the beginning of the present century, when O'Connor set the world's Long Jump record at a quarter of an inch short of 25 ft., it was a fruitful source of discussion as to whether such a jump could be made again and even 25 ft. possibly be beaten. At Stockholm in 1912 Albert Gutterson (U.S.A.) only just failed to reach O'Connor's mark, his actual jump measuring 24 ft. 11⅕ inches. Early in 1920 the United States began to produce a crop of most amazing negro jumpers. Sol Butler is said to have beaten 25 ft., but the record never went on the books. In 1921, however, E. O. Gourdin, Harvard University, actually jumped 25 ft. 3 inches. Shortly after this, yet another negro, de Hart Hubbard, repeatedly beat 25 ft. and in exhibitions cleared 25 ft. 4 in.; being exhibitions, however, these jumps did not stand as records. At the Paris Olympiad de Hart Hubbard pulled a muscle and, although winning the competition at 24 ft. 5 15/16 in., was far below his best form, and it was left to R. Legendre, a white American, who was competing in the Pentathlon, to carry the world's record on to 25 ft. 5⅝ inches. Since then de Hart Hubbard has attained his ambition by clearing 25 ft. 10⅞ inches.

For many years it was believed impossible that a pole vaulter would ever beat 13 feet. At Antwerp in 1920, however, F. Foss (U.S.A.) accomplished 13 ft. 5 in. in a downpour of rain, and in 1922 Charles Hoff, of Norway, at Copenhagen cleared 13 ft. 6 inches. Again at Copenhagen, a year later, the same athlete cleared 13 ft. 9¾ inches. It was confidently anticipated that Hoff would beat 14 ft. at the Paris Games, but just prior to the Olympiad of 1924 he broke his ankle and so could not compete. In 1924 it was reported that R. E. Spearrow (U.S.A.) had, at Tokio,

cleared the amazing height of 13 ft. 10½ inches. This record has not yet been accepted, but at Abo in 1925 Hoff, the Norwegian champion, actually cleared 13 ft. 11 $\frac{13}{16}$ inches.

It is significant that nations that have hitherto been considered non-athletically disposed, such as the South American peoples and the Japanese, are really taking seriously to sport. At the Olympic Games at Paris in 1924, for instance, when A. W. Winter, New Zealand, set up a new world's Hop, Step and Jump record of 50 ft. 11 $\frac{3}{16}$ in., L. Bruneto, of Argentina, was second at 50 ft. 7¼ in., which easily beat the previous Olympic record, while M. Oda, Japan, was sixth at 46 ft. 9 inches.

Weight Putting.—The world's record for Putting the 16 lb. Shot has stood at 51 ft. to the credit of Ralph Rose (U.S.A.), since 1909, but has since been closely approached, both by other Americans and by Finnish and Swedish men. The record of 189 ft. 6½ in. for Throwing the 16 lb. Hammer was created in 1913 by P. Ryan (U.S.A.) and has never since been seriously challenged. It is interesting to note, however, that the Javelin Throwing record which, in 1908, stood to the credit of E. V. Lemming, Sweden, at 179 ft. 10½ in., was raised to 216 ft. 10⅜ in. by J. Myrra, Finland, in 1919, and again eclipsed, with a throw of 218 ft. 7¼ in., by H. Lindstrom, Sweden, in 1924; this thrower has since done 221 ft., which record has not, however, been accepted by the International Amateur Athletic Federation. Still more interesting is it to note that, in 1924, the British thrower, J. Dalrymple, accomplished 186 ft. 5 in., while a number of Americans have exceeded 200 ft. and the Frenchman, Degland, has beaten 190 feet. From 1912 until 1925, the world's official Discus Throwing record of 156 ft. 1⅜ in. was held by J. Duncan (U.S.A.). In Sept. 1924 Thomas J. Lieb (U.S.A.) broke this record with a throw of 156 ft. 2½ inches. Clarence "Bud" Houser (U.S.A.), the Olympic shot and discus champion, has bettered 158 ft. twice in 1925. This performance was closely approached upon several occasions by the two Finnish throwers, Taipale and Niittymaa, and has been eclipsed by Glenn Hartranft (U.S.A.), who, on May 2 1925, reached 157 ft. 1⅝ inches.

Marathon Running.—Marathon running, at the official distance of 26 m. 385 yd., is an event competed for but once or twice annually in any country, by reason of the strain imposed upon the runners. But here again a great improvement has taken place during the decade 1915–25. In 1908 Dorando Pietri, the little Italian waiter, ran from Windsor to London in 2 hr. 54 min. 46⅗ seconds. At Stockholm in 1912 the course was only about 25 m. and the time taken by the winner, K. K. McArthur, South Africa, was 2 hr. 36 min. 54⅘ seconds. At Antwerp, however, the full course was covered and the race won by H. Kolehmainen, Finland, in 2 hr., 32 min. 35⅘ seconds. In 1924 numerous Olympic trials were held in the United States and one of these was won by Clarence de Mar, in what must be considered world's record time of 2 hr. 29 min. 40⅘ seconds. The actual Paris Marathon was won by A. O. Stenroos of Finland in 2 hr. 41 min. 22⅗ sec., R. Bertini, Italy, being second, and Clarence de Mar, United States, third.

Cross Country—It has been said that the home of cross country running is England and to this form of recreation the country owes the long-continued successes of so many of her men in the middle distances upon the track. Englishmen have, however, to-day found serious rivals in this branch of sport in the French teams that annually visit the country, in the Finns who have always beaten them at the Olympic Games, and also in the United States, where the cult of cross-country running has obtained a firm hold. Switzerland, too, is becoming a recognised force in international competition. At the Paris Olympiad in 1924 J. Imbach for a brief space held a new world's 400 Metres record, while P. Martin, Switzerland, finished second to D. G. A. Lowe, Great Britain, in the 800 Metres, and W. Scharer, Switzerland, was second to P. Nurmi, Finland, in the 1,500 Metres.

Walking.—Walking is a sport which has had a certain vogue in Great Britain, America and Canada, but which is more enthusiastically practised in Italy than elsewhere. The great days of walking in England were those in which G. E. Larner, a Brighton policeman, and G. J. Webb, who had been both sailor and soldier, were completely unbeatable at the 1908 Olympiad, in which they took first places in both the 3,500 Metres and the 10 Miles walking events. Before the Stockholm Olympiad, Larner had retired and it fell to Webb to uphold England's honour at 10,000 Metres, the only walk included in the programme. Webb, however, was beaten by G. H. Goulding of Canada, but finished ahead of E. L. Altimani, of Italy. At Antwerp in 1920 the Britishers were completely outclassed by Ugo Frigerio, who won both the 3,000 and 10,000 Metres events, and also by the two men from the dominions, G. L. Parker (Australia) and C. C. McMaster (South Africa), as well as by the two Americans, R. F. Remer and J. B. Pearman. At Paris, in 1924, England again suffered defeat, Frigerio finishing first in the 10,000 Metres Walk, followed by G. R. Goodwin (Great Britain), C. C. McMaster (South Africa) and his fellow Italian, D. Pavesi. The world's walking records are as follows: G. E. Larner (Great Britain), 2 to 6 Miles and 8 and 9 Miles, and G. H. Goulding (Canada), Half Mile, 1 Mile and 7 Miles. All other records from 11 to 25 m. are held by British walkers.

At the Eighth Olympiad held in Paris in 1924, at which nearly 2,000 athletes representing 45 different nations took part in the track and field events, the United States, in 27 events, scored 12 first places, made 5 of the 9 new world's records and established 2 of the 5 new Olympic records, while one of the two marks, equalling previous Olympic records, was also established by an American. Of the other countries Finland scored 9 first places, Great Britain 3, New Zealand 1 and Italy 1.

Athletics in Great Britain.—In America, Scandinavia, on the European continent and even among the coloured races of the world, athletic progress of an amazing kind is taking place from year to year, but up to 1925 it seemed certain that Great Britain must fall so far behind as to be at last forced to abandon the struggle altogether. The difficulty, however, was overcome when it was realised that hitherto British athletic sport had been too individualistic to appeal to the British sporting spirit. The decentralisation of authority was decided upon and county amateur athletic associations began to come into being throughout the country.

The essence of the county administrative scheme is found in the internal management of the sport by counties within their own areas, inter-county contests being an essential adjunct to the movement. At present Bedfordshire, which county held matches in 1925 with the London Athletic Club and the University of London A.C., has probably achieved the most signal progress. In this connection it may be stated that England has for years past been divided into northern, midland and southern areas for administrative purposes, and that the furtherance of the county scheme lies at present entirely in the hands of the south, a circumstance strongly resented by the northern and midland districts.

In 1925 the first English Inter-County Relay and Team Athletic Championship, for the trophy presented by the Achilles Club, was held at Stamford Bridge, London; and Middlesex proved the winner. The position, however, was an entirely unsatisfactory one. The fatal policy of booming certain events at the expense of others was once again fully in evidence, such events as Hammer, Discus and Javelin Throwing, the Pole Vault, Hop, Step and Jump, and the 440 Yards Low Hurdles being excluded from the programme. The result was that Bedfordshire, exceptionally strong in the field events and hurdles and several other counties refused to take part in championships which were not considered fully representative of English athletic sport. A pronouncement was made subsequently that the championship programme would not be in any way augmented in 1926. Consequently the midland counties, comprising Bedfordshire, Gloucestershire, Leicestershire, Shropshire and Staffordshire, for the time being, abandoned all thought of taking part in the inter-county championships. The north also, although possibly from different motives, refused to have anything to do with the county scheme. In deference to the views of the counties, however, it was finally agreed to include Pole Vault and

Throwing the Discus, but this still leaves Hammer and Javelin Throwing outside the scheme.

The essential fact is that, up to 1906, the Amateur Athletic Assn., which is the governing body of the sport in England, has been unable to establish any liaison with the English Public Schools, which should prove the great recruiting ground for future Olympic Teams. On the other hand, the counties, by reason of their more personal local contact, have in one year begun to till this field, as is witnessed by the number of schoolboys who gained their county athletic colours during 1925, and the far greater number of school authorities who sought the advice and assistance for coaching schools for the annual sports, of old champions and other experts.

Women as Athletes.—One aspect of international athletics still remains. It is the surprising degree of efficiency which women are attaining in this particular phase of sport. Long before the War women's colleges in the United States recognised and practised track and field athletics keenly and also kept records; but it was only during, and to a greater extent since, the War that British, French, Czechoslovakian and Belgian girl athletes took up athletics seriously.

Mrs. Sophie Eliott-Lynn, whose sporting record ranges from big game hunting to aviation, and Mrs. V. Cambridge, have been the prime movers in Great Britain and their efforts have been ably seconded by Messrs. Lyons' Ladies' A.C., the London Olympiades and the Middlesex Ladies' Athletic Club. It may be said, indeed, that the women's athletic movement started in England and has spread outwards. As was natural, the records remained chiefly in the hands of English girls during the first years following upon the inception of the scheme. Championships, international matches and a great international festival, akin to the men's Olympic Games, are now held annually; performances are improving and records being broken week by week. In 1924 a team of Czechoslovakian girls met and was defeated by an English team. In 1925 the interest of this international match was greatly enhanced by the arrival in London of a team of Canadian girls.

Before the triangular international meeting in 1925 between Great Britain, Canada and Czechoslovakia the world's records stood as follows: 100 Yards, Rose Thompson (England) 11⅘ sec.; 250 Metres, E. Edwards (England) 34 sec.; 100 Yards Hurdles, G. Sabie and F. Batson (America) 14⅖ sec.; 440 Yards, V. Palmer (England) 161⅖ sec.; 880 Yards, M. Lines and E. Trickey (England) 2 min. 26⅗ seconds.

Records in the throwing events represent the best right and left hand throws added together and are as follows: Putting the 8 lb. Shot, V. Morris (France) 68 ft. 11 in.; Throwing the Javelin, Mlle. Vidlakova (Czechoslovakia) 161 ft. 2½ in.; Throwing the 3½ lb. Discus (best hand only), V. Morris (France) 98 ft.; High Jump, Phyllis Green (England) 5 ft.; Long Jump, Mlle. Mejzlikova (Czechoslovakia) 17 ft. 4½ inches.

At the women's international held at Stamford Bridge, London, on Aug. 1 1925, Miss E. Trickey (England) set up a new half mile women's world record of 2 min. 24 sec., while Miss V. Palmer, also of the English team, beat the world's record in the 250 Metres, which distance she ran in 33⅕ seconds.

This movement, which was almost purely British in its original conception, is now gaining a true international vogue, and, towards the end of 1925, a team of British girl athletes journeyed to Scandinavia for the purpose of assisting at the inauguration of a Swedish Women's Amateur Athletic Assn. and also took part in an international meeting at Stockholm. (*See* OLYMPIC GAMES.)

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ATLANTA, Ga., U.S.A. (*see* 2.853), the commercial capital of the southeast, had a population of 200,616 in 1920, an increase of 29·6% over 1910, of whom 62,796 were negroes and 4,738 foreign born; in 1925 (local estimate) it was 253,783. Its area was increased from 17·3 sq. m. in 1910 to 31·6 sq. m. in 1924. The value of its manufactured products was $33,083,000 in 1909; $113,992,000 in 1919; $122,284,262 in 1923. Leading industries within the corporate limits (1923) were printing and publishing, and the making of confectionery and ice cream, mattresses and bed springs, furniture, lumber and planing-mill products. Cotton-mills, fertiliser plants and numerous other industries were located near the city. Hydro electric power to the amount of 236,936,695 kilowatt hours was used in 1923. A steam heating plant, serving the central part of the business district through underground mains, evaporated 315,000,000 lb. of water in 1924.

Atlanta has easily kept its position as the principal distributing point and financial centre of the southeast. The seat of a Federal Reserve Bank, it ranked 16th in bank clearings in 1924 ($2,895,571,945) and 21st in postal receipts ($3,408,368). In 1925 an average of 400 cars of merchandise and package freight left the city daily. By 1925 large hotels and sky-scraper office buildings gave it a metropolitan appearance. The streets were overcrowded, and projects for widening some of them were under consideration. A city-planning commission, established in 1920, secured the adoption of a zoning ordinance in 1922. In 1921–2 a comprehensive survey of the public-school system was made, and plans were mapped out to meet anticipated needs as far ahead as 1940. Emory University, founded in 1914, and Oglethorpe University, originally located at Midway, but destroyed during the Civil War, and re-opened at Atlanta in 1916, are notable additions to the surrounding circle of educational institutions. On Stone Mountain, 16 m. east of Atlanta, a magnificent memorial to the Southern Confederacy was under construction in 1926. When completed a procession of over 700 gigantic figures carved in the bare granite will sweep across the precipitous mountain side for 1,300 feet. Under the central group will be quarried out a vast memorial hall, to serve as a depositary for records and relics of the Confederacy.

ATLANTIC CITY, N.J., U.S.A. (*see* 2.855).—Growing slowly in permanent population and the normal occupations of an American city, Atlantic City continues to develop its unique position as an all-the-year-round playground for the nation and a favourite meeting-place for conventions. The permanent population in 1920 was 50,707, of whom 10,946 were negroes and 7,009 foreign born; in 1925, according to the estimate of the census bureau, it was 53,287. This is increased to 300,000 in Aug. and it is estimated that there are 15,000,000 visitors in the course of a year. In 1925 there were about 1,000 hotels. The Atlantic City airport, dedicated in May 1919, was the first in the world. During the summer there is an aeroplane passenger service to New York. The Boardwalk, built of steel and concrete with a board flooring, 60 ft. wide in the central portion and extending 8 m. along the ocean front, is connected with six great recreation piers reaching out over the ocean for 1,000–2,500 ft. and lined with sumptuous hotels, shops and places of diversified amusement. The city issued bonds to the amount of $1,734,000 in 1924 for the purchase of a Convention Hall site bordering on the Boardwalk. In 1912 the commission form of government was adopted.

ATMOSPHERIC ELECTRICITY (*see* 2.860).—Our knowledge of atmospheric electricity at the earth's surface depends on data from comparatively few stations. Of the air we have only scanty information from balloon observations. Thus any mean results put forward are exposed to much uncertainty. In the article in vol. ii., page 864, 125 volts per metre was accepted as a mean value $\overline{P}$ of the potential gradient at ground level. This implies the presence on the ground of a negative charge whose surface density Σ in electrostatic units (E.S.u.) is given by

$$-4\pi\sigma = \overline{P} = 1{\cdot}25/300 = 0{\cdot}00416$$

Taking the earth as a sphere of radius 64 x 10^7 cm., its entire negative charge is -0·00416 x 4 x 10^{17} E.S.u. or -56×10^4 coulombs. The inference drawn (2.867) from the rapid fall in the potential gradient with increased height above the ground shown in balloon ascents was that an equal positive charge exists in the atmosphere, most of it in the lowest 4 kilometres. The charge at any spot on the earth is undergoing constant change. A vertical air-earth current is continually passing. This has been observed

at only a few stations, and at most of them only during fine weather, and at one or two hours of the day.

From these observations it has been inferred that the fine-weather current is directed downward, and averages about $2 \cdot 10^{-16}$ amp. per cm^2. Under a uniform current of this magnitude, the earth would receive in one second about 1,030 coulombs of positive electricity, and its entire negative charge, if unreplenished, would disappear in about nine minutes.

A limited area on the earth may experience uninterrupted fine weather for weeks, and if it were an electricity tight unit, we should assume that it also received a liberal allowance of some very penetrating radiation which ordinary instruments do not record. We know, however, that the earth is a conductor. Thus the phenomena might be accounted for if regions experiencing bad weather (during which potential gradient is often negative) received an excess of negative electricity. During bad weather, electricity passes between the air and the earth in at least three ways. There is an air-earth current, carried as in fine weather by ions; there is electricity brought down by rain or snow and there is lightning. Our information as to these supplies will be discussed presently.

Besides the large rapid changes of local earth charge, associated with rain and lightning and the passing overhead of charged clouds, there are slower regular changes depending on the time of day and the season of the year. In Britain, potential gradient is higher in the evening than in the early morning, and higher in winter than in summer. If this held good everywhere, the charge on the earth as a whole might remain invariable (fine weather and bad weather effects balancing out), electricity passing between areas in which it is early morning and areas in which it is evening, and between areas where it is summer and areas where it is winter. But doubts are entertained as to whether the phenomena in the southern and northern hemispheres are complementary, a maximum potential gradient having been observed in summer in some southern stations. The view has also been put forward that the diurnal variation at sea, of which our observational knowledge is very scanty, is mainly dependent on universal, not local time. Again results from some stations have been supposed to show an increase in potential gradient with increasing sun-spot frequency. If these conclusions are correct, the charge on the earth as a whole would seem to have a diurnal, a seasonal and an 11-year period.

A knowledge of the mean value of the potential gradient, therefore, is of fundamental importance, and here a serious difficulty at once presents itself. The earth's surface is not in general, an unbroken level plain. In the hollows or in the immediate neighbourhood of trees, the potential gradient is inevitably lower than elsewhere. The surface charge is not uniformly distributed. There is more of it on ridges than in hollows, and it exists on tree tops rather than on the ground underneath. But over an area of many square miles, under normal conditions, the charge should be at least approximately the same as if the surface were flat. What we really require to know is the potential gradient over a flat area making as close an approach as possible to an infinite plane. Also the potential must be measured in such a way that the presence of apparatus and observer is without effect. A suitable spot is hard to find near many stations, and the factor for reducing observed values to the infinite plane is seldom a quantity wholly above suspicion. In the case of many of the older data, no factor was applied, and the results are only of relative value. A factor is known to have been applied in the case of the following selection of more recent values of potential gradient P:—

TABLE I.—*Mean Potential Gradient for the Year*

Station	Latitude	Period	P (volts per metre)
Eskdalemuir	55° N.	1912–22	256
Potsdam	52° N.	1904–23	203
Kew	51° N.	1913–23	333
Davos	47° N.	1909–10	64
Tortosa	41° N.	1911–23	108
Samoa	14° S.	1913–8	115
Cape Evans	78° S.	1911–2	87

The above value for Potsdam is lower, and that for Kew higher than the older values given in 2.861 and 862. This is mainly, if not wholly, due to a revision of the reduction factors. The exceptionally low value at Davos, it is suspected, may arise partly from the position of the site of the absolute observations in a narrow valley. But, as a rule, we should expect imperfections in the site or in the method adopted to lead to too low a factor, and so to an underestimate of potential gradient. On the other hand, potential gradient data are mostly from fine weather days. An attempt to estimate the effect of this restriction at Kew was made for 1922. On the average day, means from the whole 24 hours and from the four hours 3h., 9h., 15h. and 21h., are closely alike. The electrograms were measured at these four hours on all days of complete trace, and the means so obtained were as follows: all days 271 volts per metre, occasions free from negative potential 293 volts per metre. The corresponding all day mean from selected fine days was 318 volts per metre.

This suggests a reduction of some 15% if mean annual values at Kew were derived from all days instead of from selected fine days. At Kew during 1923, a fairly normal year, negative potential was recorded on 190 days, but its longest duration on any one day was 12·5 hours, and its total duration for the year only about 350 hours. Potential gradient seldom remains continuously negative for long. During rainfall, alternations of sign often occur, and during thunderstorms they are too large and rapid for the ordinary apparatus to follow accurately. Thus disturbed weather results are affected by considerable uncertainties.

There are other sources of uncertainty. Few observatories are in sparsely peopled areas. Many are in or near large towns, where the atmospheric conditions suffer from by-products of civilisation, which unfortunately influence atmospheric electricity. The breaking up of water, whether by natural or artificial means, leads to a separation of electricity. Condensed steam usually carries a positive charge, and steam trains may exert a considerable influence on potential gradient. But there is another more widely spread influence, atmospheric pollution mainly due to smoke. In a smoky atmosphere (for example in Dublin, where special observations have been taken) light, mobile ions diminish, and heavy, slow-moving ions largely increase in number. The conductivity of the air tends to fall, and the potential gradient to rise. The practice at Kew Observatory is to derive mean values and diurnal inequalities of potential gradient from 10 selected fine weather days a month. The 10 selected days of each month of the two years 1921 and 1922 were divided into a more dirty 5 and a less dirty 5. The mean amount of pollution in the atmosphere, as measured by the Owens pollution recorder, and the mean potential gradient, were calculated from the two groups of days separately, for the year as a whole, summer (May to Aug.) and winter (Nov. to Feb). Table II. gives the results, the pollution being in milligrammes per cubic metre and the potential gradient in volts per metre.

TABLE II.—*Potential Gradient on Days of Greater and Less Atmospheric Pollution*

Class of Days	Year		Summer		Winter	
	Pollut.	Potent.	Pollut.	Potent.	Pollut.	Potent.
More dirty	0·491	343	0·252	201	0·726	486
Less dirty	0·254	252	0·139	161	0·331	319
Ideal (clean)	..	155	..	112	..	179

The results for the ideal clean day were calculated on the hypothesis that the increase of potential gradient due to pollution varies directly as the amount measured by the Owens recorder. The atmospheric conditions which promote air pollution at Kew, would possibly lead to enhanced values of potential gradient even if the atmosphere were pure. But it is hardly open to doubt that pollution has a direct effect. In 1921 when a prolonged coal strike led to an exceptionally clear atmosphere in England for several months, the mean value of the potential gradient at Kew was the lowest recorded for many years, being only 281 volts per metre, as against 315 volts per metre in 1920 and 318 volts per metre in 1922.

Sunspot influence, such as is prominent in the diurnal range of the magnetic elements, has been supposed by some to apply to the mean annual value as well as to the diurnal range of the potential gradient. A priori the result is probable enough, in view of the increased conductivity of the upper atmosphere which auroral and magnetic phenomena suggest at sunspot maximum. The normal way of investigating the existence of a sunspot influence on the mean yearly value Q of any quantity, is to apply Wolf's formula

$$Q = a + bS,$$

where S is the sunspot frequency, or area, and a, and b constants, to be determined from the observed values of Q by least squares. a is the value of Q when S vanishes, as it nearly does at sunspot minimum; b is positive or negative according as Q is greatest or least at sunspot maximum. In the average 11-year period the extreme value of S approaches 100; thus 100 b/a is a convenient measure of the importance of the sunspot influence. Any haphazard collection of figures will naturally give a finite value for b. To determine whether the sunspot influence is real or imaginary, we consider the size of the correlation coefficient r (regarded here as an essentially positive quantity, the sign of the correlation being shown by b). For perfect correlation r is unity, and unless r is a substantial fraction the correlation is unlikely to be real. Table III. gives some data obtained for recent periods of years.

The only case in Table III. where r is as large as is usual in the case of the magnetic daily range, is that of the mean yearly value at Eskdalemuir. The values of 100 b/a are all small compared with those encountered in Terrestrial Magnetism, (*q.v.*). On the whole, the results for 1911–21 at the three stations favour a small 11-year variation in the mean annual value of potential gradient, with a maximum at sunspot maximum and a fourth station, Tortosa, not included in Table III. also favours this view. The small values generally obtained for r throw, however, doubt on the reality of the sunspot influence. If it is real and universal, as in the case of magnetism, it is clear from the Potsdam results that it may be masked at individual stations by other causes. The verdict perhaps most in accordance with the facts is "not proven."

2.861 contained a good many data for the annual variation of the potential gradient. Table IV. gives some more recent data in absolute measure. Under W/S is given the ratio bourne by the mean value of the four winter months (Nov. to Feb. in the Northern Hemisphere, May to Aug. in the Southern Hemisphere) to the mean value of the four summer months.

All the five stations in the Northern Hemisphere show the maximum in winter, the minimum in summer. This is equally true of older data from these and a number of other northern stations. But the opposite phenomenon, according to B. Chauveau, has presented itself at one exceptionally high level station in France (Pic du Midi, 2,860 metres); though this is strongly opposed by the results at Davos, the phenomena on mountain summits want further investigation. For the Southern Hemisphere, results are conflicting. Only one year's data are available for Buenos Aires, but unless it was an altogether exceptional year, winter is clearly the period of maximum. At Samoa, earlier data from 1906–8 placed the maximum clearly in winter, but these are now under suspicion. The Samoa data in Table IV. though derived from 6 years, depend really on only 40 months, there being many breaks in the record. The annual variation they suggest is very trifling and uncertain, a result not improbable in itself in view of the low latitude. The observer at Cape Evans, Dr. G. C. Simpson, pointed out that the maximum appears in summer in all the observations taken in high southern latitudes, including Hut Point (78° south), Belgica Station (71° south), Port Charcot (65° south) and Petermann I. (65° south), and expressed the opinion that "the potential gradient in the Antarctic is higher in the summer than in the winter." Some authorities have gone further, claiming that a maximum in summer is characteristic of the whole Southern Hemisphere. This seems, however, to be supported by results from only two stations outside the Antarctic, viz.: Cape Horn and Batavia. The observations at Cape Horn were of very limited duration, and at Batavia results for different periods, from different levels, appear about as conflicting as at Samoa. Older observations at Melbourne agree with those at Buenos Aires in placing the maximum in winter.

The conclusion that the seasons influence the potential gradient in different directions in the two hemispheres, the maximum appearing in both near northern mid-winter, cannot be accepted as proved on existing evidence. It is a question obviously of fundamental importance.

The diurnal variation of potential gradient at a number of stations is considered in detail in recent works by Chauveau and Mathias. The former, who has made a special study of the subject, thinks that the normal type of the diurnal variation makes a close approach to a single 24-hour wave, the maximum appearing in the evening, the minimum in the early morning. The double oscillation generally encountered, with minima in the early morning and early afternoon, he regards as largely the product of local disturbing causes, such as atmospheric pollution, trees, heating of the ground by the sun. The expediency of reserving judgment will appear on considering figs. 1 and 2. Results for Kew (1913–23) and Eskdalemuir (1912–22) appear side by side in fig. 1. Winter includes the four months Nov. to Feb., summer the four months May to August. The heavy horizontal lines answer to the mean values for winter, the whole year and summer. The Eskdalemuir winter curve suggests Chauveau's ideal station. Its afternoon minimum and forenoon maximum are inconspicuous as compared with those at Kew. But the Eskdalemuir summer curve is of quite a different type. The morning minimum is hardly represented, and the afternoon minimum is more prominent even than the Kew one. Eskdalemuir is in an upland valley with pure air and few trees. Fig. 2 illustrates the effects of atmospheric pollution in an actual case. The curves show the diurnal variations for the year as a whole of potential gradient and atmospheric pollution at Kew. They are based on the two groups of more dirty and less dirty days of the two years 1921 and 1922, already described. The unbroken lines refer to the more dirty, the broken lines to the less dirty days. The line oo represents zero potential and zero pollution. The

TABLE III.—*Values of Constants in Wolf's Formula*

Nature of Q	Station	Period	a	b	100 b/a	r
			v/m	v/m		
Mean value of potential gradient	Potsdam	1904–23	211	−0·216	−0·102	·34
	Kew	1904–23	309	+0·303	+0·098	·37
	Eskdalemuir	1911–21	236	+0·440	+0·186	·83
Range diurnal inequality for year	Potsdam	1911–21	205	−0·143	−0·069	·46
	Kew	1911–21	312	+0·444	+0·142	·56
	Eskdalemuir	1912–21	110	+0·115	+0·105	·25
	Kew	1911–21	152	−0·114	−0·075	·23

TABLE IV.—*Annual Variation of the Potential Gradient (volts per metre)*

Station	Period	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean	W/S
Eskdalemuir	1912–22	323	338	271	234	200	177	183	199	234	268	328	320	256	1·72
Potsdam	1904–23	278	270	218	186	166	151	151	154	169	190	226	272	203	1·68
Kew	1913–23	482	438	405	354	272	200	196	201	249	321	426	454	333	2·07
Davos	1908–10	93	101	82	71	51	33	42	47	45	49	67	87	64	2·01
Tortosa	1918–23	133	96	112	91	92	80	84	93	92	100	112	116	102	1·31
Samoa	1913–8	118	121	113	106	105	117	118	125	115	103	117	119	115	0·98
Buenos Aires	1911–2	96	57	59	138	154	149	174	153	165	116	147	102	126	1·57
Cape Evans	1911–2	96	89	75	79	67	80	85	78	105	90	88	107	87	0·82

scales were so chosen that the horizontal lines representing the mean values for the more dirty group of days (viz., 343 v/m and 0.490 milligrams/metre ^{3}) come at the same level. The mean values for the less dirty group (252 v/m and 0.252 milligrams/metre ^{3}) are also shewn by horizontal lines. With increased pollution there goes increased potential, and the diurnal variations of the two elements are of very similar type. But while the afternoon maximum and minimum of pollution become

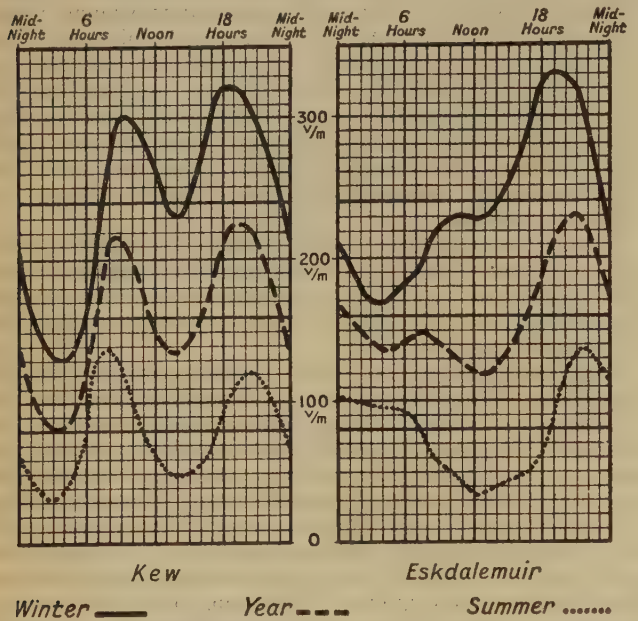


FIG. 1.—Graph comparing the Diurnal Variation of Potential Gradient at Kew and Eskdalemuir.

relatively less important as pollution diminishes, this is not true of potential gradient.

The electricity brought down by rain or snow has been measured by the following amongst others: G. C. Simpson (Simla 1908–9), K. Kähler (Potsdam 1908), Schindelhauer (Potsdam 1909–11), A. Baldit (Puy-en-Velay 1910–11), McClelland and Nolan (Dublin 1911–2). Simpson obtained a complete record during the rainy seasons of two years. Kähler and

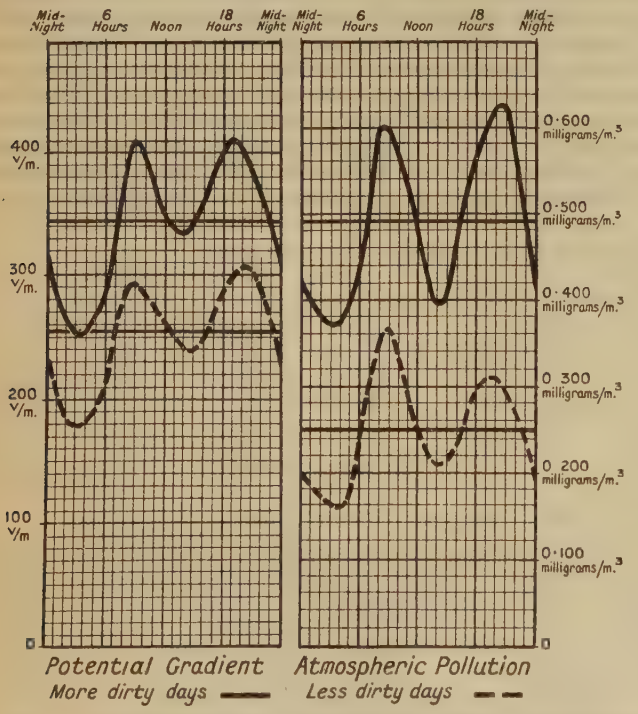


FIG. 2.—Graph illustrating the diurnal variations of potential Gradient and Atmospheric Pollution for a Year, at Kew.

Schindelhauer had also continuous records. These three observers measured the results of two-minute falls. Baldit took 15-second falls, but his observations being taken by eye, are in one way less complete, while giving more minute details of individual cases. On some occasions, as observed at Dublin, the charge brought down by rain, especially by fine rain, may be of one sign for a considerable time. But in general, there are frequent changes of sign and continual changes of intensity. Thus even short intervals of time tend to give too low maximum rates. In Table V., A denotes the ratio of the duration of positively charged rain to the duration of negative, B the ratio of the total quantity of rain charged + to the total quantity charged −, C the ratio of the total positive charge brought down by rain to the total negative, D is the excess of positive over negative charge calculated for a total rainfall of 100 centimetres.

TABLE V.—*Rainfall Electricity Data*

Place	Period	Kind of Rain	A	B	C	D(E.S.U.)
Simla . .	1908–9	all	2·5	..	3·2	17·5
Potsdam .	1908	"	..	..	..	5·6
" .	1909–11	"	2·2	..	1·4	2·8
Dublin . .	1911–12	"	3·1	4·8	..	..
Puy-en-Velay	1911	"	2·9	..	1·4	..
" .	1911	ordinary	5·3	4·3	2·3	..
" .	1911	storms	1·7	1·5	1·2	..
" .	1911	squalls	1·1	1·2	1·1	..

At Dublin, little if any of the rain that fell was accompanied by thunder. The observers at Potsdam and Puy-en-Velay drew a distinction between ordinary rain, with which they found a marked excess of positive charge, and thunderstorm or squall rain for which the excess of positive was trifling. Much of the rain at Simla was storm rain, and it was generally heavier than elsewhere, but it gave as marked an excess of positive as did ordinary rain. All the observers found the charge per cm^3 of rain to be greatest in the lightest rains. In one 15-second fall at Puy-en-Velay, the charge per cm^3 was −43.6 E.S.U. This formed part of a 5-minute fall for which as a whole the charge per cm^3 was −37.7 E.S.U. Negative charges exceeding 40 E.S.U. per cm^3 were observed at Potsdam on one or two occasions. The greatest positive charge per cm^3 observed was +26.7 E.S.U. at Puy-en-Velay.

While the charge per cm^3 tended to be greatest in light rains, the quantities of rain then occurring were so trifling that the largest vertical currents due to rain occurred during the heavy storm rain. At Puy-en-Velay, currents were measured of $-1{\cdot}10\times10^{-12}$ and $+1{\cdot}05\times10^{-12}$ amp./cm^2, and currents nearly, if not quite, as large were also observed at Simla. The figures supplied by Simpson give as the average current in amps. per cm^2 for the positively charged and the negatively charged rain, the respective values $+41\times10^{-15}$ and -31×10^{-15}. The corresponding figures for Puy-en-Velay are $+20\times10^{-15}$ and -42×10^{-15}. No charge was recorded during some 40 per cent of the time of sensible rainfall at Simla. Allowing for this, the average current during sensible rainfall was at least 2×10^{-14} amp./cm^2, or 100 times the ordinary ion-carried current in fine weather. The excess of positive charge observed at Simla was +15·1 E.S.U. per annum. This is sufficient to maintain the fair weather current, estimated at 2×10^{-16} amp./cm^2, for 290 days. The excesses of positive electricity observed at Potsdam and Puy-en-Velay are much less, and considerable differences were observed at these stations at different seasons of the year. Also, while snow on the few occasions when it was observed at Simla brought with it a considerably larger positive charge than the corresponding amount of rain, the charges accompanying snow at Potsdam appeared to be small and predominatingly negative.

No simple explanation of thunder and lightning can be accepted without reserve. But there appears a general consensus of opinion that the theory proposed by Dr. G. C. Simpson is less open to criticism than any other. It depends essentially on the following facts: 1. The velocity of raindrops falling through still air, increases with the size of the drop only up to a certain diameter. Drops of larger size tend to flatten and break up into smaller drops. 2. The breaking up is accompanied by the separation of electricity. 3. During thunderstorms there are in limited areas rapidly ascending air currents. It is inferred that when a larger drop falling through an ascending air current breaks up, the drops into which it breaks receive a positive

charge, the negative going to the air, and are carried up. They may unite and increase in size, fall and get broken up again. In this way a continual separation of charge may go on, until the potential is locally raised to the point at which a lightning stroke becomes possible.

For information as to the changes of potential gradient during thunderstorms, we are indebted mainly to the work of C. T. R. Wilson at Cambridge and H. Norinder at Uppsala. Wilson's method consists essentially in measuring the alterations in the charge on a plate representing part of the earth's surface. Norinder measures the potential difference between two insulated horizontal wires at different heights. Accompanying a flash of lightning there is a very rapid, if not quite instantaneous, change of potential gradient. Out of 864 flashes observed by Wilson 528, or 61%, were accompanied by a rise of potential gradient. Wilson supposes a thundercloud to consist essentially of a lower and an upper part, oppositely charged, the sign of the upper charge being usually positive. Supposing then a charge $+Q_2$ to be concentrated at a height H_2, and a charge $-Q$, at smaller height H, on the same vertical, we can calculate the potential from these charges and the image charges $+Q_2$ and $-Q$, at depths H_2 and H. From this potential, we easily obtain the following expression for the downwardly directed vertical force at ground level

$$2Q_2H_2(H_2^2+L^2)^{-\frac{3}{2}}-2Q_1H_1(H_1^2+L^2)^{-\frac{3}{2}}$$

where L is the horizontal distance of the spot where the force is measured from the vertical line on which the charges are supposed collected. Immediately under the charges L vanishes and the force is given by

$$-2(Q_1H_1^{-2}-Q_2H_2^{-2})$$

As H_2 considerably exceeds H_1 this is negative—implying a positive charge on the ground—unless Q_2 is much larger than Q_1. At a distance L, large compared with H_2, the expression for the force becomes approximately

$$2(Q_2H_2-Q_1H_1)L^{-3}$$

This is positive unless Q_1 is considerably larger than Q_2. Thus at a large distance, the sign of the vertical force and the sign of the earth's charge are the opposite of what they are immediately under the cloud. Supposing Q_2 positive, when lightning passes discharging the cloud, potential gradient will suddenly rise under the cloud, while at a large horizontal distance it will fall, the fall varying inversely as the cube of the distance. According to Wilson's observations, the change of potential gradient does follow roughly the law of the inverse cube. Wilson's theory does not give Q directly, but QH, where H is a sort of centre of gravity of the thunder cloud. Assuming H to be 2 km Wilson found Q to be on the average, about 20 coulombs. Supposing the value correct, the initial value of the current recharging the cloud must usually amount to several amperes. For a spark to pass in ordinary air at atmospheric pressure, a voltage of 30,000 v/cm is requisite. This would actually be found at the surface of an isolated sphere of 250 m. radius charged with 20 coulombs.

The presence of the earth and the supposed bi-polarity of the cloud, of course complicate matters. Wilson observed changes of potential gradient of the order 1,000 v/m for flashes at 10 km distance, and inferred they might be of the order 100,000 v/m under the centre of the cloud. Norinder has actually observed changes of potential gradient of 200,000 v/m. Under exceptionally high potential gradients, air tends to become ionised, and the presence of pointed objects like grass and leaves promotes discharge. Thus even when no lightning is passing or rain falling, the air-earth current may be abnormally large under thunderclouds. Recently C. E. P. Brooks, from a summary of thunderstorms at different parts of the earth, has calculated that over the earth as a whole, about 100 lightning strokes occur per second. If these were all of one sign, and each brought 20 coulombs to the earth, this would be equivalent to a vertical current of about 4×10^{-16} amp./cm^2. Many lightning strokes pass, however, between clouds, and a large minority according to Wilson bring down positive electricity. Thus lightning cannot safely be treated any more than rain as a negligible factor in the problem presented by the earth's negative charge in fine weather.

As to the other atmospheric electricity elements, in addition to the ions caught by the Ebert apparatus which have values of the order 1·5 cm/sec. for their mobilities (*i.e.*, their velocities under a potential gradient of 1 v/cm), there are "heavy" ions. These, having a mobility of only about $\frac{1}{3000}$ of that of the light ions, are practically negligible so far as concerns the conductivity of the air and the air-earth current, unless their numbers much exceed those of the light ions. In or near large towns, judging by the large average number—16,000 per cm^3—found in Dublin by McClelland and Kennedy, heavy ions may play an important part. But in country districts, they seem no more numerous than light ions. Thus the ordinary calculations of conductivity based on light ions alone should not be much in error. For the mean numbers n_1 n_2 of light positive and negative ions per cm^3, as observed at a number of land stations, Chauveau gives 750 and 630 respectively. For the corresponding figures from sea observations—mostly by the surveying ship of the Carnegie Institution of Washington, Chauveau gives $n_1=730$, $n_2=580$. The areas represented are so comparatively few that we can only say that there is little if any difference between land and sea. If we take the value now accepted for the ionic charge $4{\cdot}8\times10^{-10}$, we obtain from Chauveau's mean land values as the free ionic charges positive and negative per cubic metre.

$$E_1=0{\cdot}36 \text{ E.S.U.} \qquad E_2=0{\cdot}30 \text{ E.S.U.}$$

If k_1 and k_2 are the mobilities, the air-earth current, assuming the air without vertical velocity, is given by

$$i=(k_1\ n_1+k_2\ n_2)\ eP$$

where e is the ionic charge, P the potential gradient per cm. This may be written $i=\lambda P$, where λ the conductivity is given by $\lambda=\lambda_1+\lambda_2$ with $\lambda_1=k_1n_1e_n\lambda_2=k_2n_2e$.

λ_1 and λ_2 the so-called conductivities for positive and negative ions are usually measured separately. If we suppose, as an example, $n_1=n_2=500$, and $k_1=k_2=1{\cdot}5$ v/cm$=450$ E.S.U., we have $\lambda=\lambda_1+\lambda_2=2\times500\times450\times4{\cdot}8\times10^{-10}=2{\cdot}2\times10^{-4}$ E.S.U. There are only a few stations where regular observations are made of λ, and these are mostly at only one or two hours of the day.

The following mean yearly values have been obtained for λ and i

			λ(E.S.U.)	i(amp/cm^2)
Davos:				
Hrly. Obs.	1909–10	1 yr.	2·68	1·71
Potsdam:				
Hrly. Obs.	1910–1	1 yr.	$0{\cdot}95\times10^{-4}$	$2{\cdot}37\times10^{-16}$
Tortosa:				
Obs. near 11 h.	1918–23	6 yrs.	1·80	2·03
Val Joyeux:				
Obs. at 9h., 13h., 17h.	1924	1 yr.	1·43	1·57

Speaking generally, the diurnal and annual variations of λ are in the opposite direction to those of potential gradient. At all the stations mentioned above λ is largest in summer, and at Potsdam and Davos it is largest in the early morning, when P is least. The vertical fine weather current would seem to be a less variable element than the others.

The ionisation of the atmosphere has several possible sources, including γ rays from radium and thorium in the ground, radioactive emanation in the air, photo-electric effects at the ground, ultra-violet light especially at higher levels, and penetrating radiation. The last-mentioned source has been demonstrated by experiments with closed vessels. Near the earth's surface it is less over sea than over land, but still sensible. Over land, as we ascend, it diminishes at first according to the observations of Hess and Kolhorster, but after attaining a minimum at a height of 500 metres or a little over, it increases again, attaining much higher values than near ground level. More recent observations made by R. A. Millikan confirm this increase, though making it considerably less than Kilhorster supposed. Millikan has found the radiation to include rays of different penetrating power, some much more penetrating than the hardest γ rays. The source of this radiation is still problematical.

For references the reader is referred to the treatises by Chauveau and Mathias described below. Chauveau's vol. I. is entirely historical. The volume edited by Mathias has an elaborate bibliography at the end of each chapter, as well as a very full name index. L. A. Bauer, *Terrestrial Magnetism*, vol. 29, p. 23, etc.; B. Chauveau, *Electricité Atmosphérique*, in 3 vol.; G. C. Simpson, *British Antarctic Expedition* 1910–3 *Meteorology*, vol. 1, p. 312; E. Mathias *Traité d'electricité atmosphérique et tellurique*; G. C. Simpson, *Phil. Trans.* A. vol. 209, p. 405; C. T. R. Wilson, *Phil. Trans.* A. vol. 221, p. 73. (C. Ch.)

ATOM (*see* 2.870), *Structural Units.*—Through the experimental discoveries of the second half of the 19th century it became gradually clear that the atoms of the elements, far from being indivisible entities, had to be thought of as aggregates built up of separate particles. Thus from experiments on electrical discharges in rarified gases and especially from a closer study of the so-called cathode rays, one was led to recognise the existence of small negatively charged particles the mass of which was found to be about 2,000 times as small as the mass of the lightest atom, the hydrogen atom. These small particles, which may be regarded as atoms of negative electricity are now, following Johnstone Stoney, generally called electrons. Through the investigations of J. J. Thomson and others convincing evidence was obtained that these electrons are a constituent of every atom. On this basis a number of the general properties of matter, especially as regards the interaction between matter and radiation, receive a probable explanation.

In fact the assumption that electrons are vibrating around positions of stable equilibrium in the atom offered a simple picture of the origin of spectral lines which allowed the phenomena of selective absorption and dispersion to be accounted for in a natural way. Even the characteristic effect of magnetic fields on spectral lines discovered by Zeeman could, as was shown by Lorentz, be simply understood on this assumption. The origin of the forces which kept the electrons in their positions remained for a time unknown, as well as the way in which the positive electrification was distributed within the atom. From experiments on the passage through matter of the high speed particles expelled from radioactive substances, however, Rutherford was in 1911 led to the so-called nuclear model of the atom. According to this the positive electricity is concentrated within a nucleus of dimensions very small compared with the total space occupied by an atom. This nucleus is also responsible for practically the whole of the atomic mass.

True Properties of the Elements.—The nuclear theory of the atom has afforded a new insight into the origin of the properties of the elements. These properties can be divided into two sharply distinguished classes. To the first class belong most of the ordinary physical and chemical properties. These depend on the constitution of the electron cluster round the nucleus and on the way in which it is influenced by external agencies. This, however, will depend on the attractive force due to the nucleus which keeps the cluster together. On account of the small size of the nucleus compared with the distance apart of the electrons in the cluster, this force will to a high approximation be determined solely by the total electric charge of the nucleus. The mass of the nucleus and the way in which the charges and masses are distributed among the particles making up the nucleus itself will only have an exceedingly small influence on the behaviour of the electronic cluster.

To the second class belong such properties as the radioactivity of the substance. These are determined by the actual internal structure of the nucleus. In the radioactive processes we witness, in fact, explosions of the nucleus in which positive or negative particles, the so-called α and β particles, are expelled with very great velocities. The complete independence of the two classes of properties is most strikingly shown by the existence of substances which are indistinguishable from one another by any of the ordinary physical and chemical tests, but of which the atomic weights are not the same, and whose radioactive properties are completely different. Any group of two or more such substances are called isotopes (*q.v.*), since they occupy the same position in the classification of the elements according to ordinary physical and chemical properties. The first evidence of their existence was found in the work of Soddy and other investigators on the chemical properties of the radioactive elements. It has been shown that isotopes are found not only among the radioactive elements, but that many of the ordinary stable elements consist of isotopes, for a large number of the latter that were previously supposed to consist of atoms all alike have been shown by Aston's investigations to be a mixture of isotopes with different atomic weights. Moreover the atomic weights of these isotopes are whole numbers, and it is because the so-called chemically pure substances are really mixtures of isotopes, that the atomic weights are not integers.

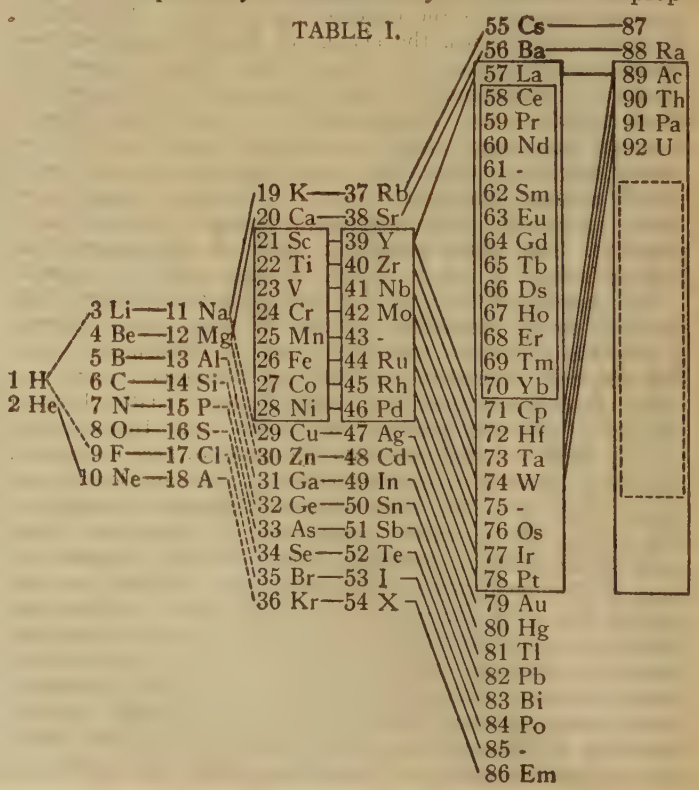
Inner Structure.—The inner structure of the nucleus is still but little understood, although a method of attack is afforded by Rutherford's experiments on the disintegration of atomic nuclei by bombardment with α particles. Indeed, these experiments may be said to have started a new epoch in natural philosophy in that for the first time the artificial transformation of one element into another has been accomplished (*see* Transmutation of Elements). In what follows, however, we shall confine ourselves to a consideration of the ordinary physical and chemical properties of the elements and the attempts which have been made to explain them on the basis of the concepts just outlined.

The Relationships Between the Elements

Periodicity of Elements.—It was recognised by Mendelejeff that when the elements are arranged in an order which is practically that of their atomic weights, their chemical and physical properties show a pronounced periodicity. A diagrammatic representation of this so-called periodic table is given in Table I., which represents in a slightly modified form an arrangement first proposed by Julius Thomsen. In the table the elements are denoted by their usual chemical symbols, and the different vertical columns indicate the so-called periods. The elements in successive columns which possess homologous chemical and physical properties are connected by lines. The meaning of the square brackets around certain series of elements in the later periods, the properties of which exhibit typical deviations from the simple periodicity in the first periods, will be mentioned below.

Radiation.—The discovery of the relationship between the elements was primarily based on a study of their chemical prop-

TABLE I.



erties. Later it was recognised that this relationship appears also very clearly in the constitution of the radiation which the elements emit or absorb in suitable circumstances. In 1883 Balmer showed that the spectrum of hydrogen, the first element in the table, could be expressed by an extremely simple mathematical law. This so-called Balmer formula states that the frequencies ν of the lines in the spectrum are given to a close approximation by

$$\nu = R\left(\frac{1}{(n'')^2} - \frac{1}{(n')^2}\right) \quad (1)$$

where R is a constant, and where n' and n'' are whole numbers. If n'' is put equal to 2 and n' is given successively the values 3, 4, . . . the formula gives the frequencies of the series of lines in the visible part of the hydrogen spectrum. If n'' is put equal to 1 and n' equal to 2, 3, 4, . . . a series of ultra-violet lines is obtained which was discovered by Lyman in 1914. To $n''=3$, 4, . . . , correspond series of infra-red hydrogen lines which also have been observed.

Rydberg in his famous investigation of line spectra more than 30 years ago was able to analyse in a similar way many spectra of other elements. Just as in the case of hydrogen he found that the frequencies of a line-spectrum (such as that of sodium) could be represented by a formula of the type

$$\nu = T'' - T' \quad (2)$$

where T'', T' can be approximately represented by

$$T = \frac{R}{(n-a_K)^2} \quad (3)$$

a_K is a constant for any one series, but takes different values a_1, a_2 . . . for the different series, while n takes a set of successive integral values. R is constant throughout for all spectra, and is the same constant as that appearing in (1); it is generally called the "Rydberg number." In many spectra the terms of most series are multiple, *i.e.*, the terms which we consider as forming a series do actually form two, three or more series corresponding to two, three or more slightly different values of a_K. Rydberg also discovered that the spectra of elements occupying homologous positions in the periodic table were very similar to each other, a similarity which is especially pronounced as regards the multiplicity of the terms.

Moseley's Discovery.—The study of X-ray spectra made possible by the work of Laue and Bragg brought out relations of a still simpler kind between different elements. Thus Moseley (*q.v.*) in 1913 made the fundamental discovery that the X-ray spectra of all elements show a striking similarity in their structure, and that the frequencies of corresponding lines depend in a very simple way on the ordinal number of the element in the periodic table. Moreover the structure of these spectra was very like that of the hydrogen spectrum. The frequency of one of the strongest X-ray lines for the various elements could for instance be given approximately by

$$\nu = N^2 R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) \quad (4)$$

and that of another line by

$$\nu = N^2 R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) \quad (5)$$

where R is again the Rydberg constant and N the ordinal number of the element in the periodic table. The extreme simplicity of these formulae enabled Moseley to settle any previous uncertainty as to the order of the elements in the periodic table, and also to state definitely the empty places in the table to be filled up by elements not yet discovered.

Atomic Numbers.—In the nuclear model of the atom, the ordinal number of an element in the periodic table receives an extraordinarily simple interpretation. In fact, if the numerical value of the charge on an electron is taken as unity, this ordinal number, which is often called the "atomic number" (*q.v.*), can simply be identified with the magnitude of the nuclear charge. This law which was foreshadowed by J. J. Thomson's investigations of the number of electrons in the atom as well as by Rutherford's original estimate of the charge on the atomic nucleus, was first suggested by van den Broek. It has since been established by refined measurements of the nuclear charge, and it has proved itself an unerring guide in the study of the relationship between the physical and chemical properties of the elements. This law also offers an immediate explanation of the simple rules governing the changes in the chemical properties of radioactive elements following the expulsion of α or β particles.

The Quantum Theory

The discovery of the electron and of the nucleus was based on experiments, the interpretation of which rested on applications of the classical laws of electrodynamics. As soon, however, as an attempt is made to apply these laws to the interaction of the particles within the atom, in order to account for the physical and chemical properties of the elements, we are confronted with serious difficulties. Consider the case of an atom containing one electron: it is evident that an electrodynamical system consisting of a positive nucleus and a single electron will not exhibit the peculiar stability of an actual atom. Even if the electron might be assumed to describe an elliptical orbit with the nucleus in one of the foci, there would be nothing to fix the dimensions of the orbit, so that the magnitude of the atom would be an undetermined quantity. Moreover, according to the classical theory the revolving electron would continually radiate energy in the form of electromagnetic waves of changing frequency and the electron would finally fall into the nucleus. In short, all the promising results of the classical electronic theory of matter would seem at first sight to have become illusory. It has nevertheless been possible to develop a coherent atomic theory based on this picture of the atom by the introduction of the concepts which formed the basis of the famous theory of temperature radiation developed by Planck in 1900.

This theory marked a complete departure from the ideas which had hitherto been applied to the explanation of natural phenomena, in that it ascribed to the atomic processes a certain element of discontinuity of a kind quite foreign to the laws of classical physics. One of its outstanding features is the appearance in the formulation of physical laws of a new universal constant, the so-called Planck's constant, which has the dimensions of energy multiplied by time, and which is often called the "elementary quantum of action." We shall not enter upon the form which the quantum theory exhibited in Planck's original investigations, or on the important theories developed by Einstein in 1905, in which the fertility of Planck's ideas in explaining various physical phenomena was shown in an ingenious way. We shall proceed at once to explain the form in which it has been possible to apply the quantum theory to the problem of atomic constitution. This rests upon the following two postulates:—

1. An atomic system is stable only in a certain set of states, the "stationary states," which in general corresponds to a discrete sequence of values of the energy of the atom. Every change in this energy is associated with a complete "transition" of the atom from one stationary state to another.

2. The power of the atom to absorb and emit radiation is governed by the law that the radiation associated with a transition must be monochromatic and of frequency ν such that

$$h\nu = E_1 - E_2 \quad (6)$$

where h is Planck's constant and E_1 and E_2 are the energies in the two stationary states concerned.

The first of these postulates aims at a definition of the inherent stability of atomic structures, manifested so clearly in a great number of chemical and physical phenomena. The second postulate, which is closely related to Einstein's law of the photo-electric effect, offers a basis for the interpretation of line spectra; it explains directly the fundamental spectral law expressed by relation (2). We see in fact that the spectral terms appearing in this relation can be identified with the energy values of the stationary states divided by h. This view of the origin of spectra has been found to agree with the experimental results obtained in the excitation of radiation. This is shown especially in the discovery of Franck and Hertz relating to impacts between free

electrons and atoms. They found that an energy transfer from the electron to the atom can take place only in amounts which correspond with the energy differences of the stationary states as computed from the spectral terms.

The Hydrogen Spectrum.—From the Balmer formula (1) and the quantum theory postulates, it follows that the hydrogen atom has a single sequence of stationary states, the numerical value of the energy in the n^{th} state being Rh/n^2. Applying this result to the nuclear model of the hydrogen atom, we may assume that this expression represents the work necessary to remove the electron from the nth state to an infinite distance from the nucleus. If the interaction of the atomic particles is to be explained upon the laws of classical mechanics, the electron in any one of the stationary states must move in an elliptical orbit about the nucleus as focus, with a major axis whose length is proportional to n^2. The state for which n is equal to 1 may be considered as the normal state of the atom, the energy then being a minimum. For this state the major axis is found to be approximately 10^{-8} *centimetres*. It is satisfactory that this is of the same order of magnitude as the atomic dimensions derived from experiments of various kinds. It is clear, however, from the nature of the postulates, that such a mechanical picture of the stationary states can have only a symbolic character. This is, perhaps most clearly manifested by the fact that the frequencies of the orbital revolution in these pictures have no direct connection with the frequencies of the radiation emitted by the atom. Nevertheless, the attempts at visualising the stationary states by mechanical pictures have brought to light a far-reaching analogy between the quantum theory and the classical theory. This analogy was traced by examining the radiation processes in the limit where successive stationary states differ comparatively little from each other. Here it was found that the frequencies associated with the transition from any state to the next succeeding one tend to coincide with the frequencies of revolution in these states, if the Rydberg constant appearing in the Balmer formula (1) is given by the following expression:

$$R=\frac{2\pi^2e^4m}{h^3} \qquad (7)$$

where e and m are the charge and mass of the electron and h is Planck's constant. This relation is actually found to be fulfilled within the limits of the experimental errors involved in the measurements of e, m and h, and may be considered to establish a definite relation between the spectrum and the atomic model of hydrogen.

Correspondence Principle.—The considerations just mentioned constitute an example of the application of the so-called "correspondence principle" which has played an important part in the development of the theory. This principle gives expression to the endeavour, in the laws of the atom, to trace the analogy with classical electrodynamics as far as the peculiar character of the quantum theory postulates permits. On this line much work has been done in the last few years, and quite recently in the hands of Heisenberg has resulted in the formulation of a rational quantum kinematics and mechanics. In this theory the concepts of the classical theories are from the outset transcribed in a way appropriate to the fundamental postulates and every direct reference to mechanical pictures is discarded. Heisenberg's theory constitutes a bold departure from the classical way of describing natural phenomena but may count as a merit that it deals only with quantities open to direct observation. This theory has already given rise to various interesting and important results, and it has in particular allowed the Balmer formula to be derived without any arbitrary assumptions as to the nature of the stationary states. However, the methods of quantum mechanics have not yet been applied to the problem of the constitution of atoms containing several electrons, and in what follows we are reduced to a discussion of results which have been derived by using mechanical pictures of the stationary states. Although in this way a rigorous quantitative treatment is not obtainable it has nevertheless been possible, with the guidance of the correspondence principle, to obtain a general insight into the problem of atomic constitution.

The Spectra of Elements of Higher Atomic Number

The hydrogen spectrum may be considered as evidence of a step-like process in which an electron is captured and bound increasingly strongly in the field surrounding the nucleus, the stages of this process being the stationary states of the atom. Simple arguments lead to the conclusion that the stages corresponding to the binding of an electron by a nucleus of any given charge will be represented by a similar sequence of stationary states and that the energy W_n necessary to remove the electron from the n^{th} state will be given by the expression:

$$W_n=N^2\frac{Rh}{n^2} \qquad (8)$$

where N is the atomic number of the elements under consideration. These states may be visualised as mechanical orbits of the electron in which the major axis is N times as small as the major axis in the corresponding orbit in the hydrogen atom. The spectrum associated with the binding process under consideration is represented by the formula:

$$\nu=N^2R\left(\frac{1}{(n'')^2}-\frac{1}{(n')^2}\right) \qquad (9)$$

For $N=2$, this formula actually represents the spectrum which is emitted by a singly ionised helium atom, *i.e.*, a helium atom, which has lost one of its electrons. Spectra of this type have not yet been observed for values of N larger than 2, but it will be seen that formula (9) includes the approximate formulae (4) and (5) representing the frequencies of the strongest lines in the X-ray spectra of the elements. This may be understood if we assume that an X-ray spectrum is associated which changes in the state of binding of one of the electrons in the inner region of the atom, where, at least when the atomic number is large, the force on the electron due to the nucleus will far outweigh the forces due to the other electrons, and where consequently the presence of these electrons will have a comparatively small influence on the strength of the binding.

Influence of Electrons.—In general the mutual influence of the electrons is very considerable. Consider the stages by which an electron is captured by an atom of which the nucleus already has s electrons circulating round it. In the initial stages of this process while the orbits may be supposed to have dimensions which are large compared with the orbital dimensions of the electrons previously bound, the repulsive forces from these latter electrons may be assumed to neutralise s units of the nuclear charge, and the resultant force will be approximately the same as when an electron is circulating round a nucleus of atomic number N-S. In the later stages, when the dimensions of the orbit of the new electron are smaller, the other electrons can no longer be considered to act as a single central charge, and their repulsion cannot be easily determined. Thus the conditions become more complicated, and the stationary states can no longer be treated by picturing the motion of the new electron as following a Keplerian ellipse. It has been found, however, that many features of the resulting spectra would be explained by assuming the added electron to move in a plane central orbit consisting of a sequence of quasi-elliptic loops. In contrast to a Keplerian orbit, however, the single loops are not closed but the successive maximum radii will be placed at constant angular intervals on a circle with the nucleus at the centre. For such central orbits it is possible, as was first shown by Sommerfeld, to select from the continuous multitude of possible orbits a set of orbits which may be taken as representing stationary states in the sense of the quantum theory. These states are labelled with two integral numbers; the one, denoted by n, corresponds to the integer appearing in the Balmer formula and is called the principal quantum number. The other, denoted by k, may be called the subordinate quantum number. For any given value of n, the number k can take the values 1, 2, 3 . . . n, corresponding to a set of orbits with increasing minimum distance from the nucleus. For a given value of k increasing values of n correspond to orbits which exhibit an increasing maximum distance from the nucleus, but which are similar in size and shape in the region where the electron comes nearest to the nucleus.

For the work necessary to remove an electron in an n_k orbit completely from the nucleus, the theory leads to the following approximate expression

$$W_{n,k} = (N-s)^2 \frac{Rh}{(n-a_k)^2} \qquad (10)$$

where a_k depends only on the subordinate quantum number k, and approaches zero for increasing k.

If s is equal to N-1, we see that the $W_{n,k}$ when divided by h coincide exactly with Rydberg's expressions (3) for the spectral terms of the ordinary series spectra of the elements. These spectra may therefore be considered as evidence of processes, representing the last stage in the formation of a neutral atom, in which a nucleus of charge Ne, which holds already N-1 electrons bound in its field, is capturing an N^{th} electron. In recent years it has been found that many elements under suitable conditions besides their ordinary spectra also emit spectra for which the terms can be represented by

$$T = p^2 \frac{R}{(n-a_k)^2} \qquad (11)$$

where p may take the integral values 2, 3, 4. . . . Comparing (11) with formula (10) we see that these spectra must be ascribed to atoms, which after having lost p electrons are rebinding an electron in the field of the remaining atomic ion.

This interpretation of series spectra allows also the rules governing the possible combinations of spectral terms to be explained. In fact, it has been found that only those lines appear in the spectrum for which the k-values of the spectral terms involved differ by one unit. From an investigation of the constitution of the radiation which on classical electrodynamics would be emitted from an electron performing a central motion, this rule can be shown to be a simple consequence of the correspondence principle.

Multiplet Structure.—The multiplet structure exhibited by the terms of most series spectra makes it necessary to assume that the motion of the electron involved in the emission of these spectra is somewhat more complicated than the simple central motion described above. An analysis based on the correspondence principle indicates that this motion may be described as a central motion on which is superposed a uniform precession of the orbital plane round an invariable axis in space. For a time, however, it seemed very difficult to obtain any closer connection between the observed structures and the above hypothesis of the constitution of the atom. In particular the remarkable analogy between the finer structures of the optical spectra the X-ray spectra, which had been brought out by the experiments, was very puzzling. The study of the strange anomalies exhibited by the effect of a magnetic field on the components of the optical multiplets has, however, quite recently led to the view that the electron itself carries besides its electric charge, also a magnetic moment which may be associated with a swift rotation round an axis through its centre. This new assumption allows not only the anomalous Zeeman effect to be accounted for, but affords at the same time a natural explanation for the empirical rules governing the dependency of the widths of the multiplet structures on the atomic number.

Atomic Constitution and the Periodic Table

Soon after the discovery of the electron it was recognised that the relationships between the physical and chemical properties of the elements expressed in the periodic table point towards a group-structure of the electronic distribution in the atom. Fundamental work on these lines was done by J. J. Thomson in 1904. After the discovery of the nucleus and the simple interpretation of the atomic number given above, his work has been followed up with great success especially by Kossel and Lewis.

Valency Properties.—It is suggested that the electrons within the atom possess a tendency to form stable groups, each containing a definite number of electrons, which in the neutral state of the atom surround the centre of the atom like successive shells or layers. An explanation of the simple valency properties holding for the second and third period of the periodic table was for instance obtained by assuming that there was a tendency to form completed shells each containing eight electrons. The single valency of sodium and the double valency of magnesium are ascribed to the facility with which the neutral atoms of these elements can loose one or two electrons respectively, as the atomic ions remaining would then contain completed shells only. On the other hand the double negative valency of sulphur and the single negative valency of chlorine are ascribed to the tendency of their outermost shells to take up two or one additional electron respectively in order to form a complete shell of eight electrons, like that contained in the neutral atom of the inactive gas argon.

Statical Arrangement of Electrons.—Attempts have been made to associate the existence of such groups with statical configurations of electrons possessing a high degree of symmetry. The presence of groups of eight electrons for instance has been explained as an arrangement of electrons at the corners of a cube. However suggestive these ideas have been in affording pictures of the constitution of chemical compounds, they do not allow a direct connection with other properties of the atom to be established; the main difficulty being that stable statical arrangements of the electrons are incompatible with the nuclear theory of the atom. In the meantime, however, it has been possible to connect the group structure of the electronic cluster in the atom with the quantum-theory interpretation of spectra. Thus the constitution of the neutral atom in its normal state can be investigated by imagining a process by which N electrons one after one are captured and bound in the field of force surrounding a nucleus of charge Ne.

To each step there corresponds a multitude of stages, *i.e.*, stationary states, in which the electron is more and more firmly bound to the atom. The final state, in which binding is strongest, corresponds to the normal state of the atomic ion. A definite connection between the spectra and the group structure was now established by assuming that in the normal atom only a limited number of electrons can be bound in states visualised as orbits characterised by definite values of the quantum numbers n and k. The electrons bound in orbits corresponding to a given value of n are said to form an n-quantum group, which in its finally completed stage will contain n subgroups, corresponding to the possible values 1, 2 . . . n which k may take. For a sufficiently large nuclear charge, the strength with which the electrons in the different subgroups belonging to one and the same group are bound will be nearly equal. In the gradual building up of the groups in atoms with increasing nuclear charge, it is, however, to be noted that when an n_k orbit appears for the first time in the neutral atom, the strength of the binding will depend very considerably on the value of k.

This is due to the circumstance that this quantum number fixes the closest distance to which the electron may approach the nucleus. The screening of the nuclear charge by the other electrons in the atom may therefore be very different for orbits corresponding to different values of k, and the effect on the strength of the binding can be so large that an orbit characterised by certain values of n and k may correspond to a stronger binding than an orbit for which n is smaller but k larger. This offers a natural explanation of one feature of the periodic table, namely that the periods grow gradually larger, while there appear sequences of elements which differ comparatively little in their chemical and physical properties. Such a sequence marks a stage in the development of an n-quantum group, which consists in the addition of a subgroup corresponding to a value of k which was previously not yet represented in that group, and which takes place after the building up of a group corresponding to a higher value of n has already begun. In fact, during the addition of the subgroup a temporary standstill will occur in the development of the latter group, the constitution of which will primarily determine the chemical affinity of the atom, since it contains the most loosely bound electrons.

In the accompanying table (Table II.) is given a summary of the structure of the normal state of the neutral atoms of the elements. The figures before the different elements are the

TABLE II.

	1_1	2_1	2_2	3_1	3_2	3_3	4_1	4_2	4_3	4_4	5_1	5_2	5_3	5_4	5_5	6_1	6_2	6_3	6_4	6_5	6_6	7_1	7_2
1 H	1																						
2 He	2																						
3 Li	2	1																					
4 Be	2	2																					
5 B	2	2	1																				
⋮																							
10 Ne	2	2	6																				
11 Na	2	2	6	1																			
12 Mg	2	2	6	2																			
13 Al	2	2	6	2	1																		
⋮																							
18 A	2	2	6	2	6																		
19 K	2	2	6	2	6		1																
20 Ca	2	2	6	2	6		2																
21 Sc	2	2	6	2	6	1	2																
22 Ti	2	2	6	2	6	2	2																
⋮																							
29 Cu	2	2	6	2	6	10	1																
30 Zn	2	2	6	2	6	10	2																
31 Ga	2	2	6	2	6	10	2	1															
⋮																							
36 Kr	2	2	6	2	6	10	2	6															
37 Rb	2	2	6	2	6	10	2	6			1												
38 Sr	2	2	6	2	6	10	2	6			2												
39 Y	2	2	6	2	6	10	2	6	1		2												
40 Zr	2	2	6	2	6	10	2	6	2		2												
47 Ag	2	2	6	2	6	10	2	6	10		1												
48 Cd	2	2	6	2	6	10	2	6	10		2												
49 In	2	2	6	2	6	10	2	6	10		2	1											
⋮																							
54 Xe	2	2	6	2	6	10	2	6	10		2	6											
55 Cs	2	2	6	2	6	10	2	6	10		2	6				1							
56 Ba	2	2	6	2	6	10	2	6	10		2	6				2							
57 La	2	2	6	2	6	10	2	6	10		2	6	1			2							
58 Ce	2	2	6	2	6	10	2	6	10	1	2	6	1			2							
59 Pr	2	2	6	2	6	10	2	6	10	2	2	6	1			2							
⋮																							
71 Gp	2	2	6	2	6	10	2	6	10	14	2	6	1			2							
72 Hf	2	2	6	2	6	10	2	6	10	14	2	6	2			2							
⋮																							
79 Au	2	2	6	2	6	10	2	6	10	14	2	6	10			1							
80 Hg	2	2	6	2	6	10	2	6	10	14	2	6	10			2							
81 Tl	2	2	6	2	6	10	2	6	10	14	2	6	10			2	1						
⋮																							
86 Em	2	2	6	2	6	10	2	6	10	14	2	6	10			2	6						
87 —	2	2	6	2	6	10	2	6	10	14	2	6	10			2	6					1	
88 Ra	2	2	6	2	6	10	2	6	10	14	2	6	10			2	6					2	
89 Ac	2	2	6	2	6	10	2	6	10	14	2	6	10			2	6					2	1

atomic numbers, which give the total number of electrons in the neutral atom. The figures in the different columns give number of electrons in orbits corresponding to values of the principal and subordinate quantum numbers standing at the top. A comparison with the periodic table (Table I.) will show that those elements, which in chemical respect are homologous will have the same number of electrons in the electronic groups most loosely bound, containing the so-called valence-electrons. The atoms of elements which in Table I. are enclosed in brackets possess electronic configurations in which a subgroup is being added to a group, whose principal number is less than the group containing the typical valence-electrons. An especially conspicuous example of such a completion of an inner group is offered by the elements forming the family of the rare earths. Here we witness the addition of the fourth subgroup to the 4-quantum group, which begins first in Ce (58) while the addition of the third subgroup was already finished in Ag (47).

Table II. is in general agreement not only with the optical spectral evidence but also with that in the region of X-rays. As mentioned earlier, we see in X-ray spectra a change in the binding of an electron in the interior of the atom. This takes place when, for instance, by the impact of a swiftly moving particle on the atom, an electron is removed from one of the electronic groups, and its place is taken by an electron belonging to a group for which the binding energy is smaller. As an example it may be stated that the strong X-ray whose frequency is approximately represented by formula (4) is emitted when an electron has been removed from the 1-quantum group, and one of the 2_2 electrons performs a transition so as to occupy the empty place. The line represented approximately by formula (5) originates from a transition by which a 3_3 electron takes the place left open upon the removal of a 2_2 electron.

The question how many electrons there are in the various groups and subgroups has been subject to much discussion in the last few years. Table II. is the temporary result of this discussion and seems to give an adequate description of the spectral as well as the chemical evidence. It is clear that a full theoretical treatment of the problem cannot be obtained from considerations based only on the simple picture of central orbits. Such a treatment will essentially involve an examination of those features of the binding of the electrons, which appear in the multiplet structure of spectral lines. Indeed it is very probable that the idea that the electron itself has magnetic properties may give the clue to the interpretation of the empirical rules governing the number of electrons in the group structure of the atom.

In this article we have tried to give an idea of the fertility of the use of mechanical pictures visualising stationary states in

the analysis of the properties of the elements. Notwithstanding the valuable suggestiveness of such an hypothesis it must once more be emphasised that such pictures do not allow the atomic phenomena to be interpreted quite rationally within the frame of the postulates of the quantum theory. For the adequate description of the properties of atoms it seems impossible to rely directly upon any concept of classical electrodynamics. On the contrary it appears imperative that any such concept should from the outset be transcribed in accordance with the methods of the new quantum mechanics, alluded to above. (*See* also ATOMIC WEIGHTS; CHEMISTRY; GASES, ELECTRICAL PROPERTIES OF; ISOTOPES; QUANTUM THEORY.)

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(N. Bo.)

ATOMIC ENERGY.—By this expression is generally meant energy associated with the inner nuclei of atoms, in contradistinction to energy of translation or thermal agitation possessed by the atoms moving as units, or chemical energy which is associated with their outer systems of electrons. Soon after the discovery of radioactive elements it was demonstrated that their radiations were entirely unaffected by temperature or chemical combination, and that therefore they must be supplied by a source of energy more deeply seated than any hitherto suspected. On Rutherford's theory of the atom, this source could only be the nucleus itself which in the process of spontaneous disintegration liberated energy in the form of radiations. Measurements showed that one gramme of radium gave out heat at the rate of 100-gramme calories per hour, and would continue to do so at a hardly diminished rate for many centuries.

This radioactive energy was, atom for atom, so vastly greater than that liberated in the most violent chemical reactions that it aroused great interest, and was hailed as the source of the sun's heat. Misled by the idea that radioactivity could be "induced" in otherwise non-radioactive elements, radioactive energy was eagerly seized by speculative writers (see H. G. Wells, *The World Set Free*, 1914) as the energy of the future. Further investigation failed, however, to support these claims. It was calculated that even if the sun were composed entirely of radioactive matter, the energy produced would still be quite inadequate to meet the demands of science. Experiments supposed to prove the existence of "induced" radioactivity were found to bear in reality a different interpretation and the excessive rarity of the radio elements removed any hope of using these as a source of terrestrial energy on a practical scale.

With the coming of Relativity (*see* RELATIVITY) and the discovery of Isotopes (*see* ISOTOPES) the matter took a new aspect. The whole number rule removed the last obstacle in the way of the electrical theory of matter, that all atoms are composed of protons and electrons, the atoms of positive and negative electricity. According to Rutherford's nucleus atom theory, in the atom of a normal element all the protons and about half the electrons are packed together to form a central positively charged nucleus, which is surrounded by the remaining electrons. It can be shown that if we bring two charges of opposite sign as close together as they are in the nucleus, their fields will affect each other in such a way that the mass of the system will be reduced. This reduction is called the packing effect. In the atom of hydrogen with a nucleus of a single proton there can be no packing effect, so that it will be abnormally heavy. Measurements by means of the mass-spectrograph demonstrate conclusively that the mass of a hydrogen atom, consisting of one proton and one electron, is that accepted by chemists, namely 1·0077, whereas that of the helium atom, consisting of a nucleus of four protons and two electrons and two exterior electrons, is 4·00. Hence, whatever the explanation, it is certain that if it were possible to transmute hydrogen into helium, mass would be lost, and therefore, by the theory of relativity, energy liberated. On the latter theory, mass and energy are interchangeable, and the energy associated with a mass m is mc^2 where c is the velocity of light. For quantities of matter in ordinary experience this quantity of energy is prodigious. Take the case of one gramme atom of hydrogen, that is to say, the quantity of hydrogen in 9 cu.-cm. of water. If this is entirely transformed into helium the energy liberated will be

$$\cdot0077\times9\times10^{20}=6\cdot93\times10^{18}\text{ ergs.}$$

Expressed in terms of heat this is $1\cdot66\times10^{11}$ calories or in terms of work 200,000 kilowatt hours. Within a tumbler of water lies sufficient energy to propel the "Mauretania" across the Atlantic and back at full speed. Here we have a supply equal even to the demands of astronomers. Eddington remarks that if only ten per cent of the hydrogen in the sun were transformed into helium, enough energy would be liberated to maintain its present radiation for a thousand million years. There can be little doubt that the vast energy of the stars is kept up by the loss of an insignificant fraction of their mass. Whether this process is a degradation of hydrogen, or simple annihilation of matter by the coalescence of protons and electrons, is unknown. How long it will be before man can release and control this energy, and to what uses he will put such vast potentialities, are subjects for the philosopher. The first step has already been taken, for Sir Ernest Rutherford has succeeded in causing transmutation in several elements, only, of course, in inconceivably small quantities, by bombardment with swift alpha rays. If scientific knowledge maintains its present rate of progress, the balance of probability is in favour of ultimate success, but this appears so far off that almost any speculation is permissible. It may be that the operation, once started, is uncontrollable and that the new stars which flare out from time to time are but the notification of successful large-scale experiments on far distant worlds. It may be that the highest form of life on our planet will one day discover supreme material power, or cataclysmic annihilation, in the same ocean wherein, we are told, its lowest forms originally evolved.

BIBLIOGRAPHY.—*Phases of Modern Science*, a collective work (1925); "Atomic Theory and Mechanics," Niels Bohr, suppl. to *Nature* (Dec. 5 1925). (F. W. A.)

ATOMIC WEIGHTS.—Atomic weights have been defined as "the relative weights of the atoms of chemical elements referred to a common standard." This statement still serves as the simplest indication of the fundamental idea involved, although it now needs amplification. The concrete development of the idea was first effected in 1803 by John Dalton, an English chemist, when he converted the vague atomistic theory of the ancient Greeks into a highly valuable scientific asset by means of the concept of atomic weights. The chemical atomic theory thus initiated has been strengthened by modern investigation, and is to-day entrenched in a well-nigh impregnable position.

Practical and Scientific Interest.—Atomic weights are quantities of great practical and theoretical importance. They record the operation of the chemical law of definite combining proportions; hence they are the basis of quantitative chemical analysis, and are in everyday use throughout the world. Because of the parallelism between gravitational effect and inertia, they record also the relative masses of the atoms of the elements. They possess an extraordinary degree of definiteness, since the law of combining proportions is one of the few known precise laws of the universe. Far deeper in meaning than the accidental astronomical "constants," such as the length of the day or the length of the year, the atomic weights of the simple elements and of the individual isotopes (*see* ISOTOPES) stand out as among the peculiar and basic attributes of those 92 elementary substances of which everything is composed. Their interpretation is closely concerned with our inferences concerning the nature of things.

Dalton's Views.—Simple as the original concept of atomic weights seems to be, it nevertheless presents problems which are rather complex. For example, 22·997 grammes of sodium combine with 126·932 grammes of iodine to form sodium iodide. This ratio of the combining weights of these elements appears to be invariable. As Dalton pointed out, these weights must depend on the relative weights of the respective atoms; no other simple explanation is conceivable. There is in the experimental result,

however, nothing which shows whether the sodium and iodine combine atom for atom, or whether one atom of sodium combines (for example) with two of iodine. Dalton himself perceived that this latter happening might in many cases occur; indeed it is the essence of his Law of Multiple Proportions. There is now every reason to believe that in this particular case of sodium and iodine the atoms actually combine one to one, and that the numbers given above represent really the relative weights of the atoms of sodium and iodine; but there are many less simple cases. For instance, 126·932 grammes of iodine combine with 20·035 grammes of calcium; here the latter number represents only half the atomic weight of calcium; because every molecule of calcium iodide is believed on excellent evidence to contain two atoms of iodine for every atom of calcium. Such a decision was beyond the reach of Dalton. It is based chiefly upon three subsequent discoveries to be briefly described.

Avogadro's Hypothesis.—In 1811 Count Amedeo Avogadro di Quaregna advanced the hypothesis, based upon Gay Lussac's Law of Volumes, that equal volumes of gases under like conditions of temperature and pressure contain the same number of molecules, a molecule being defined as consisting usually of two or more atoms. This hypothesis (which has since been so amply confirmed as to become, in many minds, a statement of fact) furnishes the most important means of deciding between the multiples or sub-multiples of the combining proportions which are to be taken as the atomic weights, because it fixes the molecular weights and formulas of volatile elements and compounds (*see* CHEMISTRY).

Dulong and Petit's Constant.—The second important means of deciding between possible multiples and sub-multiples of atomic weights was the discovery of Dulong and Petit (1818) that the atomic weight of an element is about equal to a constant number (6·3) divided by the specific heat. To be sure, this rule is not exact; but its inexactness is not usually great enough to affect it in its office of deciding the multiple or sub-multiple of the chemical combining proportion to be taken as the atomic weight. For example, the specific heat of calcium is about 0·16; therefore its atomic weight is shown to be about 39·4, whereas the exact value found by chemical means is 40·07.

Crystalline Similarity.—A third method of answering the question exists in the similarity of the crystal forms of similar salts of allied elements, discovered by E. Mitscherlich in 1821. If the atomic weight of one element entering into such isomorphous crystals is unknown, that multiple of the combining proportion of this element which corresponds to the formula indicated by the known salt may be taken as the true atomic weight.

The full significance and essential consistency of these three methods of solving Dalton's unsolved problem were not realised until 1858, when a table of atomic weights identical in principle with that used today was published by S. Cannizzaro. Previous doubts concerning the criteria just described had caused many chemists to reject wholly the term "atomic weights," and to call the arbitrarily selected multiples merely by some such name as "proportion numbers" or "chemical equivalents." But the numbers now used (as regards the multiples chosen) inevitably involve the atomic theory, hence the adjective "atomic" is fitting. "Weight" also is fitting, since the values are determined by means of the gravitational balance. The term "atomic mass" applies consistently only when inertia is the basis of measurement. The term "chemical equivalent" is now used to signify the atomic weight divided by the valence.

Standard of Atomic Weights.—The choice of the standard of atomic weights has varied. Dalton chose the smallest atomic weight, that of hydrogen, as his standard. Berzelius temporarily selected Oxygen = 100 as the standard of his system. Later the chemical world returned to Dalton's practice, especially because (according to early work) it was believed that the atomic weight of oxygen is nearly the whole number 16, if hydrogen is taken as 1. Finally, after it had been shown by E. W. Morley and others that the ratio of the atomic weights of oxygen and hydrogen is in fact 15·878 to 1, it was decided, by general consent, in 1905, to abandon the standard H = 1·000, retaining the standard O = 16·000. The decision was based upon convenience. The permanent choice of O = 15·878 would have changed by nearly one per cent almost every other accepted value, and would have caused much confusion in previous quantitative statements. Besides, more atomic weights approach whole numbers when oxygen is taken as exactly 16·000 than when any other usual standard is chosen.

A more weighty reason lay in the fact that most of the values are experimentally determined by relation to oxygen, and are referred to hydrogen only through that element. Hence any subsequent change in the accepted ratio H : O (one of the most difficult to determine of all such ratios) would affect all the atomic weights, if hydrogen were chosen as the standard substance. The present unit of the system of atomic weights is therefore exactly the sixteenth part of the atomic weight of oxygen. The atomic weight of hydrogen thus becomes 1·0077. The choice, on the whole, was a wise one; it has been justified by modern research, and has proved to be peculiarly fortunate, because probably all atoms of oxygen are alike in weight (*see* ISOTOPES).

Atomic Numbers and Actual Weights.—Atomic weights are *numbers;* that is to say, they represent ratios and are therefore devoid of physical dimensions. They are, however, very different from the quantities designated by J. A. R. Newlands and H. G. J. Moseley as "atomic numbers," which record the serial order of the places in the periodic classification of the chemical elements. No immediate knowledge of the actual weights of individual atoms is afforded by "atomic weights," unless the number of atoms in a given gross weight of some elementary substance is known. Various researches have shown that 16 grammes of oxygen contain about 606×10^{21} atoms; hence a single atom of oxygen must weigh 0·000,000,000,000,000,000,000,026,4 gramme. The actual weights of other kinds of atoms must be in due proportion.

Experimental Determination.—The exact values of the chemical combining proportions which form the basis of the table of atomic weights are found only by experimental work. Therefore, before the table is given, the necessary experimental methods may well be briefly described. The first and most generally useful method employed for the purpose has as its object the determination of the precise amount of one element which is necessary exactly to combine with a given amount of some other element of known atomic weight. The experimental technique is that of the most refined quantitative chemical analysis. Early extensive and careful investigations of this kind were conducted by J. Berzelius, C. de Marignac, J. B. A. Dumas, J. S. Stas and many others. Recently most of the work in this direction has been conducted in the United States (E. W. Morley, W. A. Noyes, T. W. Richards, G. P. Baxter and others), although European investigators (especially B. Brauner and O. Hönigschmid) have made important contributions.

Experimental work of this kind naturally involves the observance of a number of essential conditions. Comparatively few compounds of any given element are fit to serve as a means of determining its atomic weight, for the reason that comparatively few substances may be prepared in a perfectly pure state. The choice of the compounds to be employed is in some ways the most crucial part of the whole process, for with some compounds no result worthy of consideration could be obtained, even using the greatest care possible.

Having chosen wisely, the experimenter must prepare the needful substances, whatever they may be, in a state of very great purity. He must never forget that every precipitate carries down with it contaminating impurities absorbed or included by the substance as it separates from the solution. He must remember always that no receptacle necessary to contain the substance is free from the possibility of being attacked or dissolved, thus affecting the result. Moreover, precipitates are never wholly insoluble; and most substances will volatilise if heated to an excessive temperature. These complicating circumstances combine often in unexpected ways to introduce impurity, and the experimenter must not only guard against these dangers, but must prove by adequate tests that no such complication has

occurred. Moreover, above all, he must not forget that oxygen, nitrogen and water are almost omnipresent; and continual care must be exercised lest in some way one of these impurities may affect the substance which is serving as the basis of the work.

These difficulties are greatly augmented during the latter part of the work; because after the beginning of the quantitative experiment, not only must the substance be kept in a pure state, but also it must be collected to the last trace and brought on to the balance pan—a stern condition not imposed by the preliminary preparation of material. If any escapes collection, the loss must be estimated by careful experiments, so that its exact amount may be known. All the weights used must be carefully standardised, and correction must be made for the buoyancy of the air on the bodies weighed. For further statement of these and other precautions and for a brief description of apparatus suitable for avoiding many pitfalls, together with the details of an especially instructive complex case, the reader is referred to *Carnegie Institution of Washington, Publication No. 125.* A critical summary by F. W. Clarke of all investigations up to 1920 is to be found in the third Memoir of Volume 16 of the *Memoirs of the National Academy of Sciences* (Washington).

A Typical Experiment.—A simple case may best exemplify the method. In one of many experiments, 7·59712 grammes of ferric oxide (Fe_2O_3) prepared with the greatest care, were found to yield on reduction (by means of hydrogen at a high temperature) 5·31364 grammes of metallic iron. The loss of weight (2·28348 grammes) represents the oxygen present in the oxide. Hence, from the proportion $(2{\cdot}28348) : (5{\cdot}31364) = O_3 : Fe_2 = 3(16{\cdot}000) : 2x$, the atomic weight of iron is found to be 55·848. (G. P. Baxter and C. R. Hoover.) The analysis was repeated many times in order to eliminate accidental errors.

Silver is often used as an intermediary standard of reference, because its chloride, bromide and iodide are particularly susceptible to exact treatment. For example: in 11 concordant experiments an aggregate of 60·6479 grammes of exceedingly pure ferrous bromide ($FeBr_2$) were found to require 60·6731 grammes of the purest silver to precipitate all the bromine present. (Baxter and Thorvaldson.) The accepted atomic weight of silver being 107·88, we have the proportion:—$(60{\cdot}6731) : (60{\cdot}6479) = 2\,Ag : FeBr_2 = (2[107{\cdot}88]) : y$, giving $y = 215{\cdot}670 = FeBr_2$. Since Br = 79·916 (found by converting a known weight of silver into silver bromide), the atomic weight of iron is thus found to be 55·838, a value only slightly less than that found from the oxide. The rounded average of the two values (55·84) is taken as the true value.

Alternative Method.—Another general method of determining atomic weights (applicable only to gases or vapours) depends upon Avogadro's Rule, and resolves itself into the weighing of like volumes of different gases under like conditions of temperature and pressure. This is the only gravimetric method applicable to the six inert gases (helium, etc.) which do not form chemical compounds. The method determines molecular weights, not atomic weights; but the number of atoms in a molecule may be inferred in other ways, and therefore the atomic weights calculated from the data. The method involves experimental difficulties. The globe containing a gas inevitably weighs much more than the gas itself and is peculiarly subject to changes of buoyancy of the air. The exact measurement of temperature and pressure is not always easy, nor is the perfect purity of the gas to be weighed a condition readily secured. Moreover, Avogadro's Rule holds only for perfect gases; no actual gas fulfils exactly its requirements, because of the bulk occupied by the molecules themselves and their mutual attraction. On the whole, making allowance for these difficulties, the method of determining molecular (and therefore atomic weights) by comparison of the densities of gases agrees remarkably well with the results obtained from chemical analysis (Lord Rayleigh, E. W. Morley, P. A. Guye, A. Leduc, E. Moles, G. P. Baxter).

Third Method.—A third method of determining atomic weights (like the last, a purely physical method) is that which determines the mass (or rather the ratio of mass to electric charge) of rapidly moving charged atoms or molecules by means of their deflection by electric and magnetic fields. It appraises with moderate precision (by means of impressions on a photographic plate of the positions of impact of the deflected particles) the relative atomic masses pertaining to selected groups of atoms. In its original form it furnished the first experimental evidence not only that in some elements the atoms are all alike in weight, but also that in other elements this is not the case (Sir J. J. Thomson, 1912). Different varieties of a single chemical element, similar in every respect except as regards the weights and masses of their atoms, and apparently inseparable by natural agencies when once mixed, are called isotopes (F. Soddy). Under that head will be found a full description of this method of evaluating them, which was greatly improved by F. W. Aston, in his "mass-spectrograph" (*see* ISOTOPES).

Isotopes.—Many but not all of the elementary substances have been found by this third method to be isotopic or "complex." Hence elements may be divided into two classes: simple elements, probably possessing only one variety of atom, and isotopic elements, containing two or more varieties. The relative proportions of the several isotopes in a given elementary substance are shown roughly by the relative intensities of the "photographic" records; they can be shown exactly only by quantitative analysis, and then only when no more than two isotopes are present. Thus ordinary terrestrial chlorine (Cl = 35·46) must consist of a mixture of about 30 atoms of (Cl = 37) to every 100 atoms of (Cl = 35).

Although the term "atomic weight" referred originally to the elementary substances (whether simple or isotopic) which actually occur on the earth's surface, it is applicable with even greater fitness to each isotope alone. Of all the isotopic elements only one, namely lead, has had the atomic weight of any individual isotope accurately determined by chemical analysis (Richards, Soddy, Hönigschmid). The individual isotopes of this metal are unique, because, so far as we can tell, they are end-products of the spontaneous disintegration of uranium, and other radioactive elements, in which the atoms of lead were segregated at the moment of their terrestrial birth and confined in the minerals producing them. Their abnormal atomic weights (determined by chemical methods of unquestioned trustworthiness) constitute the most convincing evidence of the existence of isotopes. For the determination of the atomic weights of the isotopes of all the other isotopic elements, some form of "mass-spectrograph" is needed because complete separation of mixed isotopes is at present unattainable in any other way.

Table of Atomic Weights.—The following table of atomic weights of the chemical elementary substances as they exist on the surface of the earth is essentially the table issued in 1925 by the International Committee on Elements and Atomic Weights, but includes the newly discovered element hafnium, as well as two of the individual isotopes of lead which have been experimentally investigated by chemical methods. "Atomic numbers" are also given. Usually, the larger the atomic weight, the larger the atomic number; but all isotopes of a given element have the same atomic number. Except in the case of hydrogen, the atomic number is never more and usually somewhat less than half of the atomic weight.

The following table records quantities of outstanding practical importance; it is the *vade mecum* of the analytical chemist. Its value to theory also is very great.

Redefinition of Term.—The discovery of the spontaneous disintegration of radioactive elements and the finding of isotopes have modified our theoretical interpretation of the atomic weights. Because of these discoveries, two *a priori* premises (of a more or less philosophical nature), namely, first, the assumption that the atoms are indivisible (the elementary substances being absolutely permanent) and, second, the assumption that the atoms of a given chemical element are all alike in weight, must to-day be abandoned, but the premises are seen on close scrutiny to be by no means an essential part of the chemical atomic theory. Nevertheless, the old definition of atomic weights must be altered in order to correspond exactly to modern knowledge.

Table of Atomic Weights of the Chemical Elements

	Symbol	At. No.	At. Wt.
Aluminium	Al	13	26·97
Antimony	Sb	51	121·77
Argon	A	18	39·91
Arsenic	As	33	74·96
Barium	Ba	56	137·37
Beryllium (Glucinum)	Be	4	9·02
Bismuth	Bi	83	209·00
Boron	B	5	10·82
Bromine	Br	35	79·916
Cadmium	Cd	48	112·41
Calcium	Ca	20	40·07
Carbon	C	6	12·000
Cerium	Ce	58	140·25
Cesium (Caesium)	Cs	55	132·81
Chlorine	Cl	17	35·457
Chromium	Cr	24	52·01
Cobalt	Co	27	58·94
Columbium (Niobium)	Cb	41	93·1
Copper	Cu	29	63·57
Dysprosium	Dy	66	162·52
Erbium	Er	68	167·7
Europium	Eu	63	152·0
Fluorine	F	9	19·00
Gadolinium	Gd	64	157·26
Gallium	Ga	31	69·72
Germanium	Ge	32	72·60
Gold	Au	79	197·2
Hafnium (Celtium)	Hf	72	180·
Helium	He	2	4·00
Holmium	Ho	67	163·4
Hydrogen	H	1	1·008
Indium	In	49	114·8
Iodine	I	53	126·932
Iridium	Ir	77	193·1
Iron	Fe	26	55·84
Krypton	Kr	36	82·9
Lanthanum	La	57	138·90
Lead (ordinary)	Pb	82	207·20
" (from U)	"	82	206·06
" (from Th)	"	82	208·
Lithium	Li	3	6·940
Lutecium	Lu	71	175·00
Magnesium	Mg	12	24·32
Manganese	Mn	25	54·93
Mercury	Hg	80	200·61
Molybdenum	Mo	42	96·0
Neodymium	Nd	60	144·27
Neon	Ne	10	20·2
Nickel	Ni	28	58·69
Nitrogen (Azote)	N	7	14·008
Osmium	Os	76	190·8
Oxygen	O	8	16·000
Palladium	Pd	46	106·7
Phosphorus	P	15	31·027
Platinum	Pt	78	195·23
Potassium (Kalium)	K	19	39·096
Praseodymium	Pr	59	140·92
Radium	Ra	88	225·95
Radon (Niton)	Rn	86	222·
Rhodium	Rh	45	102·91
Rubidium	Rb	37	85·44
Ruthenium	Ru	44	101·7
Samarium	Sm	62	150·43
Scandium	Sc	21	45·10
Selenium	Se	34	79·2
Silicon	Si	14	28·06
Silver	Ag	47	107·880
Sodium (Natrium)	Na	11	22·997
Strontium	Sr	38	87·63
Sulphur	S	16	32·064
Tantalum	Ta	73	181·5
Tellurium	Te	52	127·5
Terbium	Tb	65	159·2
Thallium	Tl	81	204·39
Thorium	Th	90	232·15
Thulium	Tm	69	169·4
Tin	Sn	50	118·70
Titanium	Ti	22	48·1
Tungsten (Wolfram)	W	74	184·0
Uranium	U	92	238·17
Vanadium	V	23	50·96
Xenon	Xe	54	130·2
Ytterbium	Yb	70	173·6
Yttrium	Y	39	88·9
Zinc	Zn	30	65·38
Zirconium	Zr	40	91·

A more complete and precise definition may be worded as follows: " Primarily, atomic weights are appropriate simple multiples (decided by theory) of the relative combining proportions or relative gas-densities of elementary substances calculated on a consistent basis. They represent the relative average weights of the atoms of given specimens of elementary substances referred to a common standard." Any such definition involves other definitions. An elementary substance is a substance which is not disintegrated into other elementary substances by ordinary chemical reactions. This definition avoids the implication that such a substance is incapable of disintegration by extra-chemical means. " Element " and " chemical element " are sometimes used synonymously. " Atoms " are postulated as the smallest particles of such a substance under ordinary conditions. They are not necessarily incapable of disintegration under extreme conditions. Hence their name (from ἄ privative and τομός " divided, cut ") is not now appropriate, but it will doubtless be retained; the term " chemical atom " would perhaps be better. The qualification involved in the word " average " above is necessary because of the discovery of isotopes. The weighted average of the atomic weights of the isotopes in any particular isotopic or " complex " elementary substance is that which is recorded as its atomic weight.

Constancy of Atomic Weights.—That the atomic weights are constant in different compounds is shown by the analysis of many pure substances containing the same element and also by H. Landolt's experiments (1907), which proved that there is no loss or gain of gravitational effect in ordinary chemical reactions within one part in ten million. Moreover, specimens of various elementary substances (*e.g.*, sodium, calcium, copper, silver, iron, nickel, cobalt, etc.) found in different parts of the earth or even in meteorites, have been found by careful research to have constant atomic weights independent of geographical occurrence. All the samples of terrestrial lead even, except those found in uranium or thorium minerals, show similar uniformity. That each native terrestrial mixture of isotopes is thus unvarying seems to show that each was commingled when the earth was still fluid, or else that some unknown law determines the proportion in which the isotopes are formed. If it were not for the consistency indicated in this paragraph, the table of atomic weights would be much less useful than it is. The atomic weights are precisely consistent also with the electro-chemical equivalents indicated by Faraday's Law (Faraday, Rayleigh, Richards), affording thus further evidence of their fundamental nature.

Hydrogen and Other Elements.—The hypothesis of Prout (1815) that all the elements are aggregates of hydrogen has been greatly strengthened by the discovery of isotopes; for it appears that the fractions in the table above are due chiefly to isotopic mixtures, in which each isotope taken separately has nearly a whole number for its individual atomic weight. The atomic weights of uranium, radium, thorium, the isotopes of lead, and helium furnish an argument in favour of the theory of the

atomic disintegration in which they are concerned, and therefore support the postulate maintaining the composite nature of the elements. Nevertheless, all the simple elements and individual isotopes have atomic weights somewhat less than the appropriate multiples of that of hydrogen, as has been shown in the case of oxygen. Many theorists believe that this common deficiency is due to the actual loss of mass during the atomic coalescence of hydrogen nuclei, the expelled mass being transformed into energy. If this is true, the exact values of the simple atomic weights (and those of individual isotopes) even to the third decimal place, possess great theoretical interest, since they must furnish an essential clue to the amount of energy expended. Modern hypotheses concerning the structure of the atom (Sir E. Rutherford, Sir J. J. Thomson, N. Bohr, G. N. Lewis, I. Langmuir) assume that practically all the weight and mass of the atom (fixing, of course, its atomic weight) are concentrated in an exceedingly small nucleus in its centre.

Concord with Atomic Numbers.—For fifty years the atomic weights decided the arrangement of the periodic system of the elements. Recently X-ray spectra have more certainly evaluated the atomic numbers which place the elements in this system (Moseley); but the agreement between the two methods is close enough to indicate a fundamental if sometimes complex relation between them.

Atomic Weights and Cosmogony.—The sun and stars appear spectroscopically to be made largely of the elements existing on earth. It is therefore no mere flight of fancy to infer that the vast gravitational forces which regulate the motions of the heavenly bodies are due to the collective action of countless myriads of atoms, whose individual shares in the process are recorded in the table of atomic weights. The foregoing considerations concerning atomic weights suggest many other cosmological inferences, which are, however, beyond the scope of this article (*see* "Atomic Weights and Isotopes," *Chemical Review*, 1, 1; 1924). It is not too much to say that these unique numbers, the atomic weights, probably bear a very close relation to the unknown fundamental processes which determined the nature and evolution of the universe. (T. W. R.)

AUCKLAND, New Zealand (*see* 2.894), increased largely in area, and the population rose from 82,101 in 1906 to 172,935 in 1924. From 1913 to 1926 seven outlying boroughs were incorporated in the city boundaries, making the area 7,844 acres. Many streets have been paved and the traffic routes widened and improved. The Grafton Bridge was erected in 1910, a town hall in 1911 and a new building for the State Maternity Hospital in 1923. In 1913 the Art Gallery was enlarged, and an Old Colonists Museum, with objects illustrating the history of New Zealand and of Auckland in particular, was installed therein in 1916. A number of parks and reserves have been acquired by the municipality, which now controls 8,000 ac. of open spaces. In the Wakefield Street Reserve is a memorial of the early wars in New Zealand, unveiled in 1920, and the foundation-stone of the World War Memorial was laid in 1925 in Auckland Domain, which has been improved through the use of the profits from the industrial exhibition held there in 1913–4. A winter garden has been built and a statue of Robert Burns was unveiled in the park in 1921. A large dam was constructed at Nikotupu in 1925 to augment the water supply. Before the World War several wharves and a western breakwater were built in the harbour and land was reclaimed in Freeman's Bay. Since 1919 further work has been carried out, and parts of the harbour have been deepened. There are 14,925 ft. of wharfage.

AUCTION BRIDGE: *see* BRIDGE.

AUFFENBERG-KOMAROW, MORITZ, RITTER VON (1852–), Austrian general, was born May 22 1852 at Troppau. A most able soldier, Auffenberg was one of the leaders of the Austrian military party, which centred round the Archduke Franz Ferdinand. Owing to the latter's influence he became Minister of War in Sept. 1911 until Dec. 1912, when he resigned owing to the opposition of the Emperor and the Magyars. In 1914 he commanded the Austrian IV. Army and won a remarkable victory at Komarów, Aug. 26—Sept. 3 1914, but was suspended for alleged irregularities in April 1915. He published an autobiography, *Aus Oesterreichs Höhe und Niedergang* (1921).

AUSTIN, ALFRED (1835–1913), British poet (*see* 2.938), died June 2 1913 at Swinford Old Manor, near Ashford, Kent.

AUSTIN, MARY HUNTER (1868–), American author, was born in Carlinville, Ill., Sept. 9 1868. After graduating from Blackburn University in 1888, she went to California for reasons of health, marrying there Stafford W. Austin of Bakersville, Cal., May 19 1891. For some years she resided at Independence, Cal., and her first book, *The Land of Little Rain* (1903), dealt with outdoor life in California, as did many of her succeeding works. She made a special study of the Indians of the southwest, embodying the results in many articles and addresses. Among her best known works are *The Flock* (1906); *Lost Borders* (1909); *The Arrow Maker*, a play produced at the New Theatre, N.Y., 1911; *The Man Jesus* (1915; revised edition, 1925, entitled *A Small Town Man*); and *The American Rhythm* (1923). She also wrote the chapter on "Aboriginal Literature" in *The Cambridge History of American Literature* (1919).

AUSTRALIA (*see* 2.941).—The area of the Australian Commonwealth is 2,974,581 sq. m., exclusive of its Papuan Territory. Its population at the census of 1921 was 5,435,734.

I. POLITICAL HISTORY

The second decade in the history of the Commonwealth was a period of national development. The first 10 years of the century had seen the birth of the constitution, the gradual evolution of parties and political creeds and the slow education of the people to think in terms of a single Commonwealth rather than of a group of states. In the second 10 years the process of education was completed, and if the lesson was learned in the hard school of war it was all the more deeply engraved on that account. It is very important to note the immediate and far-reaching effect which the World War exercised on the internal politics of the Commonwealth. The growth of national sentiment is difficult to measure, yet each achievement of Australian arms—whether it was the sinking of the "Emden," the landing at Anzac Cove or the advance at Bullecourt—struck another blow, not only for the Allied cause but for Australian unity as well.

The War gave a common aim and a single purpose which the years of peace could never have afforded. The six states forgot their rivalries and their jealousies and, whether it was a case of reinforcements or of Red Cross funds, the national effort was all directed towards the one united purpose. For the time, interstate boundaries disappeared. There was, in addition, the exceedingly practical factor of men from all the states meeting each other and mixing with each other in camps and billets and in the front line itself. From Brisbane to Perth is more than a week's journey by train, and in normal times the Queenslander has few chances of meeting his fellow-Australian from the West. In varying degree the same fact holds good even of intercourse between states that adjoin each other and it is difficult to overestimate the effect of the mutual knowledge and sympathy that was acquired between 1914 and the Armistice.

Although the War was immeasurably the greatest factor in welding the national character of the Commonwealth it was by no means the sole cause. The effort towards unity found expression in a variety of ways, and many signs in Australian political history of the period 1910–25 suggest that war merely hastened what peace would have attained in the end. There was no doubt, for instance, that in 1925 popular interest in Federal politics far transcended interest in the comparatively narrow arena of state affairs, and that that interest was steadily increasing. Again, measures of a distinctively national character, such as the construction of the transcontinental railway, the creation of the Australian Navy and the provision of compulsory military training in time of peace, were all products of the years before the War. Even the attitude towards the erection of a Federal capital at Canberra had changed, and if there was no great enthusiasm for the scheme, at least it did not arouse the mingled feelings of jealousy and derision with which it was greeted when first proposed.

Pre-War Period.—The purely political history of this period was marked by several distinctive features. In the first place, there was the definite commitment of the people to certain political doctrines—notably Protection and the maintenance of the "White Australia" ideal—which may be described as part of the national policy irrespective of party. In the second place, the dividing lines on questions of tariff and taxation, which in the first few years of the Commonwealth Parliament separated the parties, gradually disappeared and were replaced by the far wider cleavage between political Labour and the forces which oppose it. The rise of Labour was the outstanding development in Australian party politics after 1910. In the early days of the Commonwealth the place of Labour in politics was that of a noisy but relatively unimportant section of the opposition. At the end of 1925, not only was it the sole force in opposition to the Federal Govt., but it actually held office in every state except Victoria. It is not easy to account for this ascendancy without embarking on controversial subjects, but the broad lines of the movement may be said to have run along the ever-increasing education of the working classes to political power; the application of the efficient machinery of the great unions towards party ends, and the determination of the Labour leaders that their influence should extend far beyond the industrial—as distinct from the political—life of the community.

The year 1910 saw the end of the third Deakin administration, and in Feb. the House was dissolved. The elections which followed resulted in a substantial victory for the Labour party under Mr. Fisher, who had previously been Prime Minister from Nov. 1908 to June 1909, and who now returned to office with a working majority both in the Senate and in the House of Representatives. But there were clear indications that his victory had been gained not so much because the country approved of his policy as because it was thoroughly tired of coalitions. In May 1911 he submitted to a referendum certain amendments of the Federal Constitution, without which the Government could not carry out its avowed programme. These amendments sought to give to the Commonwealth Parliament:—

(*a*) full power to legislate with respect to trade and commerce instead of the limited power it had under the constitution;
(*b*) full power over all trading corporations;
(*c*) specific power to deal with the wages and conditions of labour and with labour disputes;
(*d*) power to deal with all combinations and monopolies;
(*e*) power to declare that any business was a "monopoly" and following such declaration, to acquire it, paying on just terms for any property used in connection with it.

The Australian people have always been reluctant to alter the Constitution, which was framed after many years of deliberation and controversy, and Mr. Fisher's amendments were defeated by a majority of about 250,000 votes. Thus his Government found itself holding office without the power to carry out its policy.

Nevertheless, Labour carried on for two more years, and actually brought into effect important schemes for national defence. The credit for the inception of these schemes was due to the Deakin administration, which in 1909 had not only brought in a Bill enforcing military training on the young men of the Commonwealth, the first instance of compulsory service in an English-speaking community, but also decided to give practical effect to the sweeping recommendations of the Imperial Defence Committee of the same year. But Labour had offered no serious opposition to these measures, and when it succeeded to office it spared no effort in giving them the fullest possible effect. Among other legislation of this period was the transfer of the Northern Territory from South Australia to the Commonwealth, and the grant of a "maternity bonus" of £5 on the birth of each child.

Australia During the World War.—In May 1913 another General Election was held in the Commonwealth. It had a singularly unsatisfactory result in so far as Mr. Deakin's successor, Mr., afterwards Sir, Joseph Cook, obtained a majority in the House of Representatives but was unsuccessful in the Senate. In these precarious circumstances he managed to survive until July 30 1914 when a dissolution of both Houses was granted. Five days later, war broke out. There was an immediate outcry for the abandonment of the elections, but the writs were already out, and an attempt to arrange an allotment of seats and form a National Govt. signally failed. For nearly two months Mr. Cook and his colleagues conducted Australia's war effort, and it is to them that the credit for the initial organisation of the Australian Imperial Force belongs.

The election came on Sept. 17. Again Mr. Fisher triumphed, and he at once proved that Labour was no less ready and eager than its opponents to put every effort into the war. "The last man and the last shilling" was Mr. Fisher's promise, and the change of government certainly brought no slackening in the Commonwealth's contribution to the Empire's cause. For more than a year Mr. Fisher remained at the head of affairs. Then, in Oct. 1915, he accepted the appointment of High Commissioner in London and was succeeded by the Attorney-General, Mr. W. Morris Hughes.

For the next seven years the political history of the Commonwealth was dominated by the personality of Mr. Hughes. His services to Australia and to the Empire may have been somewhat over-estimated when he was in power, but there is as little doubt that, in the reaction that followed his fall, they came dangerously near to being forgotten altogether. This much is certain: that he proved himself a leader at a time when his country stood most in need of leadership, that he was whole-hearted in the sincerity of his feelings towards the Empire, and that he was gifted to an exceptional degree with the power of infecting others with his own enthusiasm. He spared neither his health nor his frail physique in the incredible amount of work which he performed each day, and the very faults which ultimately helped to bring about his downfall—his impatience of criticism, and his intolerance alike of the feelings of his colleagues and the trammels of constitutional precedent—were not altogether bad qualities in a crisis when prompt action was emphatically the need of the moment.

In 1916 he travelled to Great Britain, and the remarkable success he achieved with his hard-hitting speeches all over the country was reflected in the increased prestige which accrued to him in Australia. But with his return to the Commonwealth there came an anticlimax. The tide of recruiting had begun to fall, the best of Australia's manhood had already left for the front, and the nation waited for Mr. Hughes to declare for the measures of conscription which he had advocated so wholeheartedly abroad. He hesitated, and finally decided to submit the question of conscription to a referendum. Never in the history of the Commonwealth had so bitter a campaign been waged. Arrayed against Mr. Hughes was a public opinion which included all the leaders of advanced Labour, the Industrial Workers of the World, the Bolshevists, the Pacifists and many Irish. The referendum was held and conscription was decisively rejected by the people.

The immediate result was the break-up of the Labour party. A second referendum and a second defeat made it impossible for Mr. Hughes to remain leader of a party which had officially rejected the most vital clause of his policy, and in 1917 he crossed the floor of the House and formed the Australian National War Government. The new Ministry was recruited mainly from the ranks of the former opposition and included only three of the Prime Minister's former colleagues. So came into being the National party which was to hold office for the next eight years and which at the end of 1925 seemed more firmly established than ever. The Armistice came a year after the reshuffle and once again Mr. Hughes visited England. Once again he returned to his own country with an increased reputation, for his vigorous assertion of Australian claims, not only in London but at the Peace Conference at Versailles, had to a great extent re-established his popularity.

The War Effort.—The sacrifices of the nation are shown by the following figures: Australia sent 329,883 troops overseas. The casualties of this force reached the extraordinarily high proportionate total of 314,078, of which 59,302 were deaths from wounds or disease. Other casualties from wounds or gas totalled

166,819, and there were 87,957 cases of sickness. The financial drain of the War on a young nation of less than 6,000,000 inhabitants was appalling. The following table gives the estimated war expenditure between 1914 and 1920:—

1914–5	£15,111,335	1917– 8	£66,958,360
1915–6	41,201,946	1918– 9	83,447,990
1916–7	61,541,566	1919–20	70,137,319

It is estimated that the total war expenditure in which pensions and allowances played a large part, were well over £600,000,000.

Australia has made generous provision for ex-service men. Pensions payable for total disability range from £2 to £3 a week, with extra provision for a wife and all children under 16 years of age. Ex-soldiers and sailors were liberally helped to re-establish themselves in civil life and, co-operating with the state governments, the Commonwealth Government has provided farming lands, grants and loans for houses, working capital, etc. Up to 1924 the Repatriation Commission had spent £13,717,000 in gifts or loans to ex-service men, and £34,145,000 had been advanced on account of ex-soldier settlement on the land. There is also a scheme to provide education for war orphans and the children of incapacitated ex-soldiers.

Post-War Problems.—It was to the solution of the enormous problems following the War that Mr. Hughes applied himself when he returned to Australia after the Peace Conference. But, triumphant as was his return, there is little doubt that his decline in power began at this stage of his career. Labour had been badly beaten at a " khaki " election in 1919, and he was branded as a traitor to the cause by his old associates. The Nationalists themselves were not a happy family, for the " Country party," which, as avowedly representing agricultural interests, had sprung into being at the election, was already disposed towards mild flirtations with the Opposition. There were personal considerations as well, and although Mr. Hughes paid a successful visit to the Imperial Conference of 1921 his success was coldly received by his own countrymen.

The eighth Parliament of the Commonwealth came to an end at the close of 1922. The elections, held in Dec., were marked by the most violent personal bitterness, and although Labour again suffered defeat, it was evident that no alliance of Nationalists and the Country party was possible under the leadership of Mr. Hughes. An acceptable successor was found in Mr. Stanley Melbourne Bruce. His first task was to form a coalition with the strongly reinforced Country party. Dr. Page, its leader, became Treasurer, and the administration was known as the Bruce-Page ministry. But Mr. Bruce was the real leader. He rapidly consolidated his position, and by the time he came to visit London for the Imperial Conference of 1923 his position was firmly established.

The chief business of the Conference was concerned with Imperial Preference. Mutual preference, which promised considerable help to Australia's primary industries, was agreed to between Great Britain and Australia. These arrangements, entered into on behalf of Great Britain by Mr. Baldwin's first government, were not carried out by the succeeding government of Mr. Ramsay MacDonald. The proceedings of the Australian Parliament in 1924 reflected the results of the change of Government in Great Britain: because Mr. MacDonald in the Imperial Parliament refused to accept the agreement for an Imperial naval base at Singapore, the Australian Prime Minister brought forward a new naval programme; and because the new British Government refused to endorse the preference agreement, the Australian Prime Minister proposed a scheme to assist exporters to obtain markets overseas, and also a series of Bounty Bills, designed to help the primary producer. Acts were passed by Parliament providing for export bounties on beef, and on fencing wire, galvanised iron, traction engines and wire netting manufactured in Australia; the bounty on shale oil produced locally was increased. A reciprocal trade treaty with Canada was also sanctioned.

A long series of shipping strikes culminated in the crisis of 1925. Shipping in Australian ports was held up and trade production seriously affected. Many local labour organisations sympathised with the strikers, and the political Labour party was, in the opinion of the Australian Government, responsible for aiding a strike movement which had a strong revolutionary aspect. The Commonwealth Government took measures to deport the strike leaders who were alien to Australia, but political Labour, which was in power in the majority of the state governments, openly resisted this and other measures dealing with the strike situation. Mr. Bruce finally decided to appeal to the country for authority to take measures which he deemed necessary for its safety, and a general election was held in Nov. 1925. The election resulted in the heavy defeat of the Labour party. The Nationalists obtained 38 of the 75 seats in the House of Representatives, the Country party 14 and the Labour party 23. In the Senate there were 22 seats to fill. Labour already held 11 seats in the section not due to retire, and it was therefore necessary for the party to win eight seats in order to have a majority in that House. The electors, however, made a clean sweep of the Labour candidates and returned 22 members of the Nationalist and Country parties. Voting at this election was compulsory under a penalty of £2.

Bibliography.—*Oxford Survey of the British Empire*, vol. 5, *Australasia* (1914); Viscount Bryce, *Modern Democracies* (1921); A. W. Jose, *History of Australasia* (1921); C. E. W. Bean and H. S. Gullett, *Official History of Australia in the War of 1914–18* (1923); V. G. Childe, *How Labour Governs: a Study of Workers' Representation in Australia* (1923). (F. Pe.*)

Constitutional Questions

Experience has demonstrated the marked rigidity of the Australian Constitution. Between 1908 and 1925 only one amendment was carried in accordance with the procedure outlined in section 128. The situation foreseen by certain critics, in which proposed amendments would be carried by sweeping popular majorities, but lost to an opposition strong enough to control three small states, did not occur, but the submission of proposed alterations to a referendum proved a sufficient barrier. Proposals which obtained the necessary statutory majorities in both Houses of Parliament were generally lost when they were referred to the people.

Proposed Amendments.—In 1910, simultaneously with the general election of April 13, electors were asked to decide on two constitutional amendments. One of these was accepted by a majority; it enlarged the power of the Commonwealth to take over the debts of the states, which by section 105 of the Constitution was limited to debts already existing at the date of the Commonwealth's establishment. By the amendment state public debts incurred later could also be taken over. The other proposal related to the allocation of the customs and excise revenue between the Commonwealth and the states. Under section 87, the Commonwealth's share was limited to one-fourth of its total. This arrangement was to continue for a period of ten years and thereafter until the Commonwealth Parliament otherwise provided. Parliament resolved, however, to diminish the proportion left to the states to an amount representing £1.5.0. for each unit of population—and to do so, not by statute, a course which was open under section 87, but by constitutional amendment, in order to give the states a somewhat more stable claim on the proportion left to them. The amending measure was passed in Parliament but was rejected at the referendum of 1910. At a slightly later date, an ordinary statute to the same effect was passed. The effect of this was greatly to enhance the financial importance of the Federal Government, while the corresponding reduction of the states' share in customs and excise revenue, by approximately 50 %, initiated a period of considerable financial stringency in their finances.

A further unsuccessful effort to amend the constitution was initiated in 1910 and submitted to the people in a referendum of April 26 1911. The object of this was to give to the Commonwealth Parliament power to deal with the following matters:—

(*a*) Trade and commerce, without any limitations, instead of " trade and commerce with other countries, and among the states " only.

(*b*) The control and regulation of corporations of all kinds, except those formed not for the acquisition of gain. (Only " foreign cor-

porations and trading and financial corporations formed within the limits of the Commonwealth" came under the jurisdiction of the Federal Parliament.)

(*c*) Labour and employment, including wages and conditions of labour and the settlement of industrial disputes generally, including disputes in relation to employment on state railways. (Conciliation and arbitration by the Commonwealth operate only in the case of any industrial dispute extending beyond the limits of any one state.)

(*d*) Combinations and monopolies in relation to the production, manufacture or supply of goods or services.

This proposal was rejected by a majority and also by a majority in every state except Western Australia. On the same occasion and as an outcome of the same legislation, it was proposed to insert in the constitution the following sub-section:—

When each House of Parliament, in the same session, has by resolution declared that the industry or business of producing, manufacturing or supplying goods, or of supplying any specified services, is the subject of any monopoly, the Parliament shall have power to make laws for carrying on the industry or business by or under the control of the Commonwealth, and acquiring for that purpose on just terms any property used in connection with the industry or business.

This proposal was also rejected by closely similar voting. In 1913 the same proposed alterations of the constitution, with certain minor changes, were again submitted in the form of six separate amendments. They were again rejected, although on this occasion a majority for them was obtained in Queensland, South Australia and Western Australia, while New South Wales, Victoria and Tasmania were hostile. In 1919 proposals were again submitted to a referendum for extending the legislative powers of the Commonwealth relating to industrial disputes and the nationalisation of monopolies. Both proposals were rejected. On this occasion South Australia was hostile, but Victoria gave a majority for the proposals, as did Queensland and Western Australia.

Decisions of the High Court.—Apart from action of a legislative character directly altering the nature of the constitution, there must be noted, within the period 1900 to 1925 certain constitutional changes due to the activity of the High Court, which, under the terms of the constitution, is made its final interpreter. In a series of early cases the doctrine of immunity had been applied to both Commonwealth and State instrumentalities. Under this doctrine, the officers, institutions and other machinery of the one government are not to be fettered, controlled, hampered or interfered with by the legislation of the other government. The instrumentalities of the Commonwealth are thus immune from any such legislation of the state, which, even if it contains no explicit exceptions in their favour, automatically exempts them. The principle had also been applied conversely, and it had been held that state instrumentalities were similarly exempt from the incidence of Federal legislation. The High Court later enunciated, in connection with cases of overlapping of state and federal powers, what amounted in the circumstances to a new principle, stated by the majority of the Court in the following terms:—

That section (sec. 109) which says "When a law of a State is inconsistent with a law of the Commonwealth, the latter shall prevail, and the former shall, to the extent of the inconsistency, be invalid," gives supremacy, not to any particular class of Commonwealth Acts, but to every Commonwealth Act, over not merely State Acts passed under concurrent powers but all State Acts, though passed under an exclusive power, if any provisions of the two conflict; as they may. (The *Amal. Soc. of Eng. v. the Adelaide S.S.Co.*—*28 C.L.R.* 129.)

This important determination has obviously affected the independence and dignity of the states. The total disbursements, *e.g.*, to be made to its railway or other industrial servants by any state, may now depend not on the decision of the taxpayers of the state, but on that of an organ of the Federal Govt. (the Court of Conciliation and Arbitration). This would appear to be a substantial derogation of the states' financial autonomy, which in other portions of the constitution is carefully safeguarded. The high court also decided the true meaning of section 92 of the constitution, the important part of which is as follows:—

On the uniform duties of customs, trade, commerce and intercourse among the States, whether by means of internal carriage or ocean navigation, shall be absolutely free.

The attempts of various states to maintain control over some commodity whose place of origin was within their territory met with varying degrees of success.

Two Important Points.—In the case of New South Wales the state had, by appropriate legislation, taken over the whole of the wheat in the state, and refused to sell it in other states except upon its own terms. The Court held that this constituted no violation of section 92. The ownership had passed to the King. If his advisers wished to export it to another state they were free to do so. Later a New South Wales statute purported to make public property of pigs. Here, however, the Legislature had provided that the ownership should pass only upon a proclamation, and that in the interim no holder should export except in certain conditions. This additional provision was regarded as infringing the prohibition of section 92 and therefore invalid.

When a similar question arose in Queensland over the position created by statute which had been modelled upon the New South Wales statute, and in which the operative words were equivalent, the Court changed its attitude and, on fuller consideration, came to the conclusion that in the interval preceding the actual transfer of stock, or meat, to the King, an intermediate type of property interest, not previously known to the law, had been created, and that it was within the province of the state Legislatures to create such new forms of property. Confronted later with the somewhat different problem presented by the action of the Queensland Parliament in endeavouring to make it unlawful for the trader to sell commodities within Queensland at anything above an officially proclaimed price, the Court held that so far as it sought to impose this prohibition upon traders of other states this Act was invalid. (McArthur v. Queensland 28 C.L.R. 530.)

This decision also has affected the standing of the constituent states of the Commonwealth, by imposing a definite limitation upon their legislative powers. Whether the same limitation would apply to the legislation of the Commonwealth was, of course, not a matter to be decided. But the majority of the Court indicated clearly that they considered it would not. The net result of the judgment would thus appear to be to exclude a whole field of legislation from the jurisdiction of the states and leave it, subject to any further decision of the High Court, to the Commonwealth.

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Defences of the Commonwealth

The Defence Acts of 1909 and 1911 provided for the compulsory enrolment and military training of all males between the ages of 12 and 18 as cadets, and then between 18 and 26 as citizen soldiers. The Acts compel the boy and the young man to attend so many statutory parades each year and to spend several days actually in camp—the number in each case varying according to circumstances. The total number of boys at cadet age at the census of 1921 was approximately 300,000. There were 353,000 men of citizen soldier age. By an Act of 1921 the Australian Army system was reorganised on the model of the Australian Imperial Force in the World War. The organisation is territorial, each area providing a battalion of infantry and a proportion of other troops. After training, the citizen soldier passes into the reserve.

As a result of the Washington Conference on Disarmament it was decided by the Commonwealth in 1922 that the universal training law should be continued, but that its operation should be restricted to the more populous centres and to certain quotas only. As from July 1 1925 senior cadet training was confined to one quota instead of four quotas, beginning on July 1 of the year in which persons liable for service reach the age of 17 years. Citizen force training was confined to three instead of seven quotas, beginning on July 1 of the year in which persons liable

reach the age of 18 years, and continuing until June 30 of the year in which they reach the age of 21 years. Notwithstanding these reductions in training, the liability to register at the age of 12 years and to serve for the full period prescribed by the Defence Act remained. The Divisional Organisation of the Field Force is retained in skeleton form, units being maintained at considerably below war strength. The total strength of the permanent military forces in 1925 was approximately 38,889.

An important section of the reserve is formed by the rifle clubs. In 1925 these clubs, which are officially recognised, numbered 1,383 with a membership of over 80,000. The Royal Military College at Duntroon was established in 1911 for the purpose of training officers for the permanent forces. Over 158 staff cadets graduated between that year and 1918 and saw service during the War. The activities of the college suffered as a result of post-war retrenchments.

Naval Policy.—In 1909 Australia, which had previously contributed a subsidy to the British Navy, agreed at an Imperial Defence Conference to a proposal for the building of an independent Australian fleet unit. Under this scheme Australia provided a fleet unit of one battle cruiser, three light cruisers, six destroyers and three submarines, which, placed unreservedly at the disposal of the British Admiralty at the outbreak of the World War, did notable service. Additions to the navy, by purchase and gift, were gradually made, and when peace arrived the fleet consisted of one battle cruiser, six light cruisers, twelve destroyers, six submarines and various auxiliaries, sloops and depôt ships.

The Washington Conference greatly affected Australian naval policy. In acceptance of its decisions the battle cruiser "Australia" was sunk and 19 other ships paid off. In 1925 the number of ships actually in commission was less than in 1914. A vigorous programme of development was begun, including the construction of two new cruisers, the maintenance of ships out of commission and the establishment of submarine bases and oil depôts. Australia has a naval college at Jervis Bay for the education of naval officers; the system closely follows that of naval colleges in England, and all expenses of the cadets are met by the Commonwealth Government. There is also a training ship at Sydney for other ranks.

In 1912 approval was given for the establishment, as part of the army organisation, of a Central Flying School for the training of aeroplane pilots. Training commenced at Point Cook in June 1914 and continued actively throughout the War. An Air Adviser to the Navy Department was appointed in 1918. In 1920 the Australian Air Force was constituted by proclamation as part of the military forces. On March 31 1921 this force became the Royal Australian Air Force. The approved establishment is 71 officers and 300 other ranks; the units are a headquarters at Point Cook, an aircraft depôt and training school and an experimental section. Over 120 aerodromes and landing grounds had been prepared by the end of 1925.

II. ECONOMIC AND FINANCIAL HISTORY

Area and Population.—The following table gives the areas and population of the States and Territories of the Australian Commonwealth:—

State	Area in sq. m.	Population 1921
New South Wales	309,432	2,100,371
Victoria	87,884	1,531,280
Queensland	670,500	755,972
South Australia	380,070	495,160
Western Australia	975,920	332,732
Tasmania	26,215	213,780
Northern Territory	523,620	3,867
Federal Capital	940	2,572
The Commonwealth	2,974,581	5,435,734

In 1909 the Commonwealth and the State of New South Wales entered into an agreement for the surrender to and acceptance by the Commonwealth of an area of 912 sq. m. as the seat of the Government of the Commonwealth. This area was constituted a Federal Territory on Jan. 1 1911. By the Jervis Bay Territory Acceptance Act 1915, an area of 28 sq. m. at Jervis Bay was surrendered by New South Wales and accepted by the Commonwealth as a port for the Federal Territory. On Jan. 1 1911, the Northern Territory was transferred by proclamation from the State of South Australia to the Commonwealth, and constituted a Federal Territory. On July 1 1914 Norfolk Island, a Crown Colony administered by the Government of New South Wales, was taken over by the Federal Parliament as a territory of the Commonwealth. In 1920 the former German possessions of Kaiser Wilhelms Land, the Bismarck Archipelago and the Solomon Islands were entrusted under mandate from the League of Nations to the Government of the Commonwealth of Australia, and administered as the Territory of New Guinea.

The natural increase of births over deaths per 1,000 of the population in the period 1906 to 1910 was 15·93. The population at the census of 1911, exclusive of full-blood aboriginals, was 4,455,005. As a consequence of the World War the rate of increase fell, and for the period 1919 to 1923 the figure was 14·07 per 1,000. At the census of 1921 the population was 5,435,734. The average annual increase for the period 1921 to 1924 was 117,000. Of this number, 68·5% was due to natural increase and 31·5% to immigration. The increase for 1925 was 110,000, of which 65% was natural increase and 35% immigration. At the end of 1925 the total population approximated 6,000,000.

Aboriginal reserves totalling 30,231 sq. m. have been set aside for the native population, and all possible help is given to this primitive people; their number however constantly declines. The 1921 census showed 1,597 in New South Wales, 144 in Victoria, 1,609 in South Australia, and an estimate of 15,587 in Western Australia. The number in the Northern Territory is variously estimated from 20,000 to 50,000, the weight of evidence favouring the former rather than the latter number. In Tasmania the aborigines have been extinct for many years.

Growth of Urban Population.—A feature of Australian social life is the preponderance of the urban over the rural population. In South Australia and Victoria more than one-half of the total population of the states is concentrated in Adelaide and Melbourne respectively, while over 45% of the population is contained within six towns. The following table shows the population of these towns on Dec. 31 1924, both in numbers and as percentages of the populations of the respective states. The total is also given as a percentage of the total population of the Commonwealth.

	Year	Population	%
Sydney (N.S.W.)	31st Dec. 1924	1,012,070	44·89
Melbourne (Vic.)		885,700	53·45
Brisbane (Qld.)		245,015	29·35
Adelaide (S.A.)		289,914	53·84
Perth (W.A.)		176,467	48·46
Hobart (Tas.)		56,507	25·74
Total		2,665,673	45·44

The states and the Commonwealth strive to counterbalance the call of the cities by cheap railway rates for farmers' goods, by increasing as much as possible such of the conveniences of civilisation as are under state control, by encouraging manufactures in country centres and by other means: all effort seems to be in vain, and the proportion of the urban to the total population is growing. The settlement of the great empty spaces of the Northern Territory still presents an apparently insoluble problem, and successive commissions of inquiry have failed to suggest any adequate remedy for what is generally recognised as a national danger.

Immigration.—In regard to immigration, Australian public opinion has undergone a marked change, due chiefly to a fuller appreciation of the danger of a small white population. There was, for many years, a desire on the part of the exceedingly prosperous working-people of Australia to keep out immigrants as much as possible, lest an increase in the population should

result in lower wage rates and a fall in the standard of material welfare of the workers. That desire survived in some quarters in 1925 and was still a force to be reckoned with; but it was gradually being recognised that a much larger population was necessary to the safety of the country, and need not affect the individual prosperity of the inhabitants of a continent which has room at a low estimate for 100,000,000 people. In 1906 the policy of state-aided immigration was re-established and, though interrupted by the War, was later revived under Commonwealth direction.

In 1920 an arrangement was made between the Commonwealth and state governments, under which the Commonwealth is responsible for the recruiting of immigrants abroad, whilst the state governments advise the Commonwealth as to the numbers and classes of immigrants they are prepared to receive. The Commonwealth selects the immigrant according to the requirements of the state concerned and brings him to Australia; on his arrival the state takes the responsibility for placing him in employment or on the land. Under an amending Immigration Act (1920) the entry was prohibited:—

(*a*) of any person advocating the overthrow by force or violence of the established Government of the Commonwealth or of any state or of any other civilised country, or of all forms of law, etc.

(*b*) for a period of five years, of any person of German, Austro-German, Bulgarian or Hungarian parentage and nationality, or of Turk or Ottoman race.

By a proclamation issued on Dec. 2 1925, the latter restriction was removed as from that date, except in so far as it affected persons of Turk or Ottoman race. Between 1914 and 1923, 914,436 persons were assisted to migrate to Australia.

British immigration was still far from satisfactory in 1925. The following table gives the figures for the years before the War and the period 1921–4.

	Grand Total	British Immigrants		Grand Total	British Immigrants
1910 . .	94,543	81,457	1921 . .	87,938	73,015
1911 . .	139,020	124,061	1922 .	93,513	82,028
1912 . .	163,990	146,602	1923 . .	92,859	83,200
1913 . .	140,251	122,443	1924 . .	103,667	86,614

The Empire Settlement Act of 1922, by the terms of which the British Government entered into partnership with the Dominions for the encouragement of assisted immigration, failed to realise the expectations of its sponsors. The hostility of organised labour in Australia, the high standard demanded by the Commonwealth authorities in London, and the fact that Crown Lands are owned by the states, all tended to restrict the flow of immigration from the mother country. In May 1925 an important agreement with the British Government to encourage migration to Australia was announced. The British Government offered to make a loan to the Australian Government of £34,000,000, provided that, within a period of 10 years, 450,000 British emigrants were settled in Australia. The British Government would meet one-half of the interest charges on this loan during the first five years and one-third during the second five years; it also undertook to bear a proportion of the cost of maintenance of training farms in connection with the scheme, and made certain guarantees against loss. This agreement has to be accepted by all the states of the Commonwealth before it can be given practical effect. Up to the end of 1925, only Victoria and Western Australia had accepted. (F. Pe.*)

Production, Industry and Trade

During the years 1910–25, the pastoral and agricultural industries have continued to be the most important in Australia, though a considerable growth of manufacturing has taken place. The mining industry has, however, declined both in quantity and in value. In the following table the average annual value of the output of the various classes of production are compared.

Class of Production	Period 1911–3	Period 1921–2 to 1923–4
	£	£
[1]Agricultural	43,563,000	83,399,000
[1]Pastoral	53,402,000	87,808,000
Forests and fisheries . . .	6,166,000	11,169,000
Dairy, poultry and bee farming . .	19,909,000	43,357,000
Mining	24,790,000	20,841,000
Manufactures	59,873,000	131,556,000
Total	207,703,000	378,130,000

[1]Period 1911–2 to 1913–4.

Allowance should be made for the alteration of price levels between 1911 and 1924. It is officially estimated that on 1911 price levels the value of the annual average production for the period 1921–2 to 1923–4 of the agricultural industry was £59,341,000; the pastoral industry, £44,032,000, and the dairying, poultry and bee-keeping industries, £24,479,000.

Pastoral Production.—During the period 1910–3 wool represented 13·3% of the total Australian production and 35·0% of the total exports, and for 1921–2 to 1923–4, 12·9% of the total production and 45·5% of the total exports. Before 1914 Australia annually produced twice as large a quantity of wool as any other country. Her output in 1912–3 amounted to approximately 700,000,000 lb. out of a world total of some 3,157,000,000 lb., *i.e.*, 22·6%. In 1921–2 the world production had sunk to 2,697,000,000 lb., of which total Australia was responsible for 631,000,000 lb. or 23·5%. The breeding of sheep for wool is carried on in every state of the Commonwealth, particularly in New South Wales. Owing to climatic conditions, the sheep population of Australia fluctuates considerably. During the period 1910–25 the lowest number of sheep, 69,000,000, was recorded in 1915 and the highest, 93,000,000, in 1911. In 1923 the number was 80,110,461; a considerable increase occurred in 1924, there being 4,000,000 more in Victoria and Queensland alone.

During the period 1885–1925 careful attention to breeding developed a much more valuable type of sheep. Between 1890 and 1920 the average yield of wool per sheep has risen by about 2 lb. or 40%. In 1913 the average value of merino wool was 10d per pound. In 1915–6, owing to war conditions, wool clips accumulated in Australia. The Imperial Wool Purchase Scheme was then established and the Imperial Government purchased, during the remainder of the War period, the Australian clips on a flat rate basis of 1/3½d per lb. plus one-half share of any profits realised on sales for civilian purposes. By agreement the price of 1/3½d for Australian wool was maintained for the 1919 season, but world prices for wool were rising rapidly. In April 1920 the high water mark was reached, but a heavy slump followed, which was intensified by the termination of the Imperial Wool Purchase Scheme in June 1920, after which the price per lb. fell still further, the lowest point being touched in March 1921. On Jan. 27 1921 the British-Australian Wool Realisation Association, Ltd., was formed to take over the balance of stocks held by the British Government, and it undertook the marketing of the stocks of Australian wool on behalf of the Imperial Government and of the producers. The concluding sale of the B.A.W.R.A. wool took place on May 2 1924.

The total number of cattle in Australia in 1913 was 11,483,882, and in 1923 the number had increased to 13,357,508. In considering the beef industry, from this total must be deducted dairy cattle, numbering 2,035,717 in 1913 and 2,304,644 in 1923. The raising of cattle for beef is the main industry of the northern districts of Western Australia, the Northern Territory and the northwest of Queensland. The War conditions gave a great impetus to the Australian beef industry. The British Government bought the available supplies of Australian beef at fixed prices until 1921, when the price level on the British market was so low that the export of beef from Australia was unprofitable. From 1922 till 1924 the Australian Government was forced to subsidise the export of frozen and canned beef, and of live cattle for slaughter.

The year 1925 saw a rise in price which was sufficient to cover the cost of production and marketing, but which was not sufficient to encourage any large increase in production. Australian beef is at a serious disadvantage in comparison with that of

South America. The best Argentine meat is brought to Great Britain in a chilled state, whereas Australia, being much farther away, has to send her beef in a frozen condition. The further development of the industry is largely dependent on whether scientific research can remove this disadvantage. The importance of the beef industry in Australia is not confined to its own intrinsic value. Cattle, as opposed to sheep, can be travelled large distances and can flourish without elaborate fencing. For these reasons the development of a large portion of Northern Australia is dependent upon cattle.

The production of sheep for mutton and lamb has, in Australia, always been subsidiary to wool production, and for this reason less progress has been made in Australia than in New Zealand in this branch of the pastoral industry. The export trade in mutton and lamb is confined to the southern coastal areas of Victoria, New South Wales and South Australia; the average annual exports for the period 1911–3 amounted to 149,957,686 lb. and for 1921–2 to 1923–4 to 99,710,969 pounds. Australia consumes about four-fifths of her production. Experience in the use of superphosphates and clovers on lands within the heavier rainfall areas in South Australia indicates that very considerable developments of mutton and lamb production will occur in the near future.

Agricultural Products.—Great progress has been made in improvement of the methods of production and in the varieties of wheat grown. These improvements have led to an increased yield per acre which is the more noteworthy when it is realised that the production of wheat has been extending into drier areas. The results which have been obtained in the drier areas make it evident that the area under wheat in 1925 could be trebled without substantially lowering the average yield per acre. The progress made in wheat production in the Commonwealth is indicated in the table given below:—

	Annual Average	
	1911–2 to 1913–4	1921–2 to 1923–4
Area under wheat	8,018,294 ac.	9,674,445 ac.
Total yield	88,987,183 bu.	121,178,973 bu.
Average yield per acre	11·1 bu.	12·53 bu.
Value per acre	£2. 0. 6	£3. 4. 6

The production of cereals other than wheat is developed on a much more limited scale. The oat crop, mainly produced in Victoria, is used for feeding purposes. Maize is grown to a considerable extent in New South Wales and Queensland, and barley growing is concentrated in South Australia. Very large areas in Australia are suitable for the growing of barley and maize, but the production is conditioned by markets for these cereals. If an export market could be found for Australian pig products, a large extension of production of both barley and maize will take place.

Sugar cane is grown in Queensland and New South Wales, Queensland producing over 90% of the total output. The annual average production of cane in the period 1911–2 to 1913–4 was 1,696,000 tons; for 1921–2 to 1923–4 it was 2,309,000 tons, from which an average output of 297,457 tons of sugar were obtained. The "White Australia" policy has led the Commonwealth Government to assist the cane farmers in various ways. In 1915 the Government agreed to purchase the sugar output at the price of £30 6s. 8d. per ton. In 1923 this agreement was terminated, and a competent tribunal was formed which fixed the price at £27 per ton. The embargo on importation was continued until 1925, but special concessions were granted to manufacturers using sugar in goods for export.

Cotton production in Queensland dates from 1919. In that year 72 ac. were planted and 37,238 lb. of unginned cotton produced. In 1923–4, 75,000 ac. of land under cotton in Queensland produced 12,614,000 lb. of unginned cotton. In order to encourage the development of this crop, the Commonwealth Government, in conjunction with the Queensland Government, guaranteed the price of 5d. per lb. to cotton of less than $1\frac{1}{4}$ in. staple and $5\frac{1}{2}$ per lb. to cotton of a longer staple. The reason for the encouragement from government sources of this experimental development has been the idea that the production of cotton in Australia is particularly suitable for the small farmer, and, if successful, will lead to a rapid extension of land settlement.

Dairying.—Dairying, as shown by the following table, has expanded considerably during the period 1911–24:—

	Annual Average	
	1911–3	1921–2 to 1923–4
Dairy cattle (milking)	1,547,016	1,654,268
Milk produced for all purposes	578,012,226 gal.	704,370,465 gal.
Butter production	199,508,714 lb.	242,910,734 lb.

The most important product of the dairying industry is butter; 40% of the production was exported during the period 1911–3 and 37% during 1921–2 to 1923–4. The season 1924–5 witnessed a largely increased export, amounting to 145,281,000 lb. or 79,000,000 lb. more than in 1923–4. The co-operative production of butter from milk has made more progress in Australia than any other branch of agricultural production; 70% of the total output is manufactured in co-operatively owned butter factories. The Australian dairying industry has been extensive rather than intensive, but the present tendency is to attach an increasing importance to intensive methods. Attention is being directed towards the improvement of the breeding of dairy cattle and to the progressive improvement of pastures.

Forestry.—A post-War revival of interest in forestry resulted in state encouragement of the educational side. The annual average amount of local timber sawn or hewn in the Commonwealth during the period 1911–3 was 649,110,000 super. ft., and for 1921–2 to 1923–4, 615,986,000 super. feet. The exports of dressed and undressed timbers (hardwood) show a distinct decline between the annual average for 1911–3 and the annual average for 1921–2 to 1923–4 from 134,078,000 super. ft. in the earlier period to 96,866,000 super. ft. in the later period.

Fruit.—Fruit production in Australia may be classified under the five main heads of apples and pears, soft deciduous fruits, dried fruits, citrus fruits and tropical fruits. In 1913, the apple crop amounted to 4,691,836 bu., valued at £1,086,702. The annual average of 1921–2 to 1923–4 shows an increased yield of 2,000,000 bu. over the 1913 figure, the value being £1,962,836. The area under apples amounted in 1923–4 to 81,000 ac., and of this total Tasmania contained 32%. The increase in pear production is not so noticeable, the yield in 1913 being 1,100,114 bu. and the average for 1921–2 to 1923–4, 1,388,713 bu. The export of apples in 1913 was 49,000,000 lb. and in 1923–4 65,000,000 pounds. The production of apricots, peaches and berry fruits is either consumed locally or exported as canned or pulped fruit. The export of canned fruit increased from an annual average value of £15,000 in the period 1911–3 to £471,000 in 1921–2 to 1923–4. Dried fruit production is concentrated mainly in the Murray basin. The progress in this industry has been remarkable: The annual production of dried fruits averaged 243,000 cwt. for the years 1911–3, but during the period 1921–2 to 1923–4 the output averaged 682,000 cwt., currants and raisins accounting for 637,000 hundredweight. Pre-War figures indicate that only 20% of the production was exported, but since the War the export has increased to 80%.

The citrus industry flourishes in the Murray irrigation settlements, New South Wales, Queensland and Western Australia. In 1923–4, 2,820,000 bu. of oranges were produced. The export trade has as yet hardly passed the experimental stage: in 1923–4 approximately 26,560 bu. of oranges were exported to Great Britain. Queensland is the main source of tropical fruits. An expanding production of bananas and pineapples has coincided with ex-soldier settlement in that state. The wine industry is rapidly increasing. The area under vineyards in 1912–3 was 62,388 ac., South Australia and Victoria accounting for 80% of this total. By 1923–4 the acreage had increased to 112,965 acres. The annual production of wine increased from an

average of 5,262,948 gal. for the period 1911–3 to 11,551,415 gal. for the period 1921–2 to 1923–4.

Mining.—The following figures indicate the relative importance, as far as value of output is concerned, of the mineral products of Australia:—

	Annual Average	
	1911–3	1921–3
	£	£
Gold	9,936,041	3,571,757
Coal	4,324,004	10,645,710
Silver lead ore and concentrates	3,347,321	1,930,569
Copper ore, ingot and matte	3,025,783	964,639
Zinc and concentrates	1,576,538	950,855
Tin and tin ore	1,323,239	462,071
Lead	328,288	430,771
Iron	154,125	531,970
Silver	309,760	307,973

Hard coal mining activities are concentrated in New South Wales whose output amounts to 83% of the total. Australia's gold output, 64·5% of which comes from Western Australia, only represented 5% of the world production in 1922, in comparison with her 10% share before 1914. The decadence of mining in Australia may be regarded as of a temporary nature. Large metalliferous areas are reported in Central Australia, but the existing lack of transport facilities renders development too costly to be undertaken.

Manufactures.—The two most important branches of secondary production are the iron and steel and the woolen industries. Large supplies of high-grade iron ore occur in South Australia; these are shipped to the coalfields at Newcastle, New South Wales, where an iron and steel industry has been established. Articles of apparel and boots and shoes are now largely manufactured and there has been a considerable development of engineering activity, especially in the production of railway rolling stock. The average annual value added to products by process of manufacture was £59,873,000 for the period 1911–3 and £131,556,000 for 1921–2 to 1923–4. Of the latter total about £48,682,000 was due to such branches of secondary production as the preparation of foodstuffs for consumption, the provision of heat, light and power and brick and tile production.

Heat, Light and Power.—The supplying of heat, light and power in 1912 cost £4,901,975 and in 1923–4 cost £14,750,000. The development in Tasmania of hydroelectric schemes has led to the establishment in that State of a number of new industries. In Victoria large brown coal deposits occur. The Victorian Electricity Commissioners were set up in 1918 to consider the possibilities of establishing a scheme for electrical generation from the lignite mined at Morwell. The supply of electricity from this source of cheap power is becoming a factor of great importance to the factories in and around Melbourne.

Irrigation.—Irrigation in Australia is concentrated mainly in the Murray valley. The Murray River Agreement, entered into in 1914 by the Commonwealth Government and the Governments of South Australia and Victoria, was brought into operation in 1917. The agreement provides for the construction of the Hume dam on the upper Murray, the Lake Victorian storage schemes, the Burrunjuck dam in New South Wales and the Sugar Loaf dam in Victoria. The work is supervised by the River Murray Commission and it is estimated that when these works are finished, the water impounded will irrigate 1,500,000 acres: 26 locks and weirs are to be constructed on the Murray and Darling rivers which, when completed, will allow of 1,000 m. of navigation on the Murray, 600 m. on the Murrumbidgee and 1,000 m. on the Darling. The special importance of these irrigation works is to be found in the opportunities which they provide for close settlement, which has been found the most satisfactory form of land settlement for British immigrants.

Overseas Trade.—The annual average value of Australian imports for the period 1911–3 was £74,958,000 and for the period 1921–2 to 1923–4, £125,147,000. The domestic exports for these periods had an average annual value of £79,033,000 and £121,734,000 respectively. Australian tariff policy has for many years been governed by two desires: firstly, to protect and encourage home manufactures, and secondly, to assure to the British manufacturer the chief share of the import trade. Under the Tariff Act of 1920 additional protection was afforded to many Australian industries and the average preference on British goods was increased from 5% to 12%.

In 1921 the Industries Preservation Act was passed to protect both the Australian and the British manufacturer from the competition of countries with depreciated exchanges. The Tariff Board, composed of a government representative, two business men and a representative of primary producers, was also set up in 1921 to administer the Industries Preservation Act and to investigate the effect of the tariff upon primary production and upon the cost of living. Later tariff measures carried on the two policies of industrial protection and imperial preference. The general trend of Australian overseas trade is shown in the following table:—

Imports

Country of Origin	Annual Average 1911–3	Per Cent	Annual Average 1921–2 to 1923–4	Per Cent
	£		£	
United Kingdom	37,661,000	50·3	61,677,000	49·4
United States	10,226,000	13·6	26,076,000	20·8
Germany	6,851,000	9·1	682,000	·5
Other countries	20,220,000	27·0	36,712,000	29·3
Total	74,958,000	100·0	125,147,000	100·0

Exports

Country of Destination	Annual Average 1911–3	Per Cent	Annual Average 1921–2 to 1923–4	Per Cent
	£		£	
United Kingdom	33,841,000	43·0	51,741,000	42·6
France	8,628,000	10·9	11,961,000	9·8
Belgium	6,720,000	8·5	5,279,000	4·3
United States	2,046,000	2·6	8,351,000	6·9
Other countries	27,798,000	35·0	44,402,000	36·4
Total	79,033,000	100·0	121,734,000	100·0

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Banking and Finance

Banking in Australia, linked as it is with the economic development of that continent, presents in its history since 1908 features of exceptional interest. The pre-War period was marked by the continued recovery from the effects of the financial crisis in Australia in 1893, by the realisation of immobile assets, chiefly unproductive or partly productive lands, and the steady conversion of the proceeds into commercial or other similar assets of a more or less liquid form and by the general strengthening and consolidation of the banking position.

Of the 30 banks in existence before 1893, 13 were either absorbed by other institutions or disappeared, while several of the older banks, still struggling in 1908 to carry through their reconstruction obligations of 1893, have successfully met them, and regained positions of undoubted strength. Their recovery in earning power and dividends and the increased market value of their shares are indicative of the general trend towards the more stable and prosperous banking conditions which prevailed throughout Australia in 1925. Evidence of this change is reflected in the net profits of the trading banks, which increased from £908,000 in 1899 to £2,423,000 in 1908, while dividends in the same period went up from £660,000 to £1,378,000. Of the 14 older banks forming the main body of the 19 institutions trading in Australia in 1925, some of them emerged from the crisis of 1893 not only untouched by its effects but with

added strength. None of the 14 banks, it may be mentioned, has been in existence for less than 40 years. Five additional banks have been added since 1908 to the number operating in Australia; of these three are foreign institutions each with a single agency, mainly for exchange purposes, and two are locally domiciled, one being the central institution—the Commonwealth Bank of Australia.

State Regulation.—For a number of years two of the aims of the Labour Party in Australia were a State note issue and a State bank: these aims were ultimately achieved, although not precisely on the lines nor with the results contemplated. The Australian banks, from their foundation, had enjoyed the right to issue their own notes. In 1866, the Queensland Govt., in order to facilitate their own financial operations, decided to make an issue of Treasury notes as an auxiliary to the issues of the banks. But the banks, wishing to protect their own circulation, presented for payment every government note as it came into their hands for credit or collection, thus rendering abortive the government scheme, which was withdrawn a couple of years later. After a majority of the banks had suspended payment in 1893, the Queensland Govt., in order to stabilise the currency and provide funds for their own commitments in London, abolished the bank-note issues in Queensland by imposing a prohibitive tax and circulated their own Treasury notes. The latter continued as a monopoly from 1893 until 1911, when all other issues were superseded by the Federal Govt. notes now circulating throughout Australia. The Queensland Govt. circulation averaged £1,500,000 during the 18 years of its existence, against a gold backing of about one-third, the maximum circulation reaching £1,692,506.

Under the Australian Notes Act of 1910 the sole right to issue and re-issue notes became vested in the Commonwealth Government. The private issues of the banks, which had reached a maximum of £3,800,000 in 1910, therefore lapsed and were redeemed on presentation. On Sept. 30 1925 notes were still outstanding to the amount of £202,588, including all lost or destroyed. The Federal issue at close of 1910 was £3,389,476 and in Dec. 1911 reached £10,156,358. It amounted to £56,890,226 in Dec. 1924, falling on June 30 1925 to £53,890,226. The latter comprised £23,930,437 notes held by the public and £29,959,789 by banks, the reserves being £25,841,027 of gold coin and bullion, Australian Govt. securities valued at £27,574,106 and other assets. The management of the issue was handed over to the Commonwealth Bank of Australia when a Note Board was created in 1920. The net profit from the Note Issue Department is paid by the bank direct to the Treasury, the amount for the half year ending June 30 1925 being £578,577.

The Commonwealth Bank.—After much contention in the Australian Parliament, the Commonwealth Bank Act received assent on Dec. 22 1911 and steps were taken to bring the measure into operation without delay. The first governor, Mr. (afterwards Sir) Denison Miller, was appointed on May 14 1912, and to his organising capacity, energy and prudent conduct of the affairs of the bank its success was largely due. Branches were opened in London and throughout Australia in Jan. 1913, and senior officials were selected for the management from other Australian banks. From London a system of agents and correspondents, first in the British Isles and then throughout the world, was arranged, and a bank created to handle in London not only banking in all its phases but the organisation required for the loan flotations in England of the Commonwealth Govt. as well as of several of the state governments and municipal and other bodies. The preliminary expenses of the bank were provided from a loan of £10,000 from the Treasury to the governor; this was quickly repaid, a remunerative business was formed and large profits, aggregating £4,696,608, were made in less than 12 years from its inception. The institution was started without capital, other than the temporary loan of £10,000, but it was backed by the guarantee of the state for all its obligations.

After the death of Sir Denison Miller in 1923, the intention to alter the constitution of the bank by appointing a Board of Control of eight Directors was given effect, and the amending Act was passed on Aug. 20 1924. A capital of £20,000,000 was also provided for the bank, £4,000,000 of which was obtained by transfer from accumulated profits, £6,000,000 is to be granted from government funds, and the balance to be raised by the sale of debentures. Up to Dec. 1925 the £4,000,000 from reserves had been deemed sufficient, and £696,608 from profits still remained at reserve account. A Board of Advice in London of three members was also provided for, but no appointments had been made before the end of 1925.

The War Period.—After the outbreak of the World War the British Govt. entered into contracts through the Australian Govt. for supplies at pre-War prices, and the cost of these was paid from time to time to the Commonwealth Bank in London, for distribution through the other banks to the producers. Wool, wheat, meat, butter, cheese, etc., thus paid for aggregated a value of over £200,000,000. All the primary producing industries were, as a necessity of the War, assisted in their financing and practically controlled by the Commonwealth Govt., their products being taken over in bulk or dealt with in "pools." The total amount thus paid to primary producers under the compulsory and voluntary pooling arrangements exceeded £437,000,000.

In Australia loans for War purposes were floated through the state bank for a total sum of £210,000,000; subscriptions for the 10 local war issues exceeding £250,000,000. The private banks loyally co-operated in all these War measures and shared in the related exchange transactions. The financing of the Australian troops was carried through by the Commonwealth Bank. Branches were opened in army camps throughout Australia and in England, for the purpose of facilitating soldiers' payments, and some millions of transactions were undertaken without charge, including private cable transfers to England, France, Egypt, Palestine, etc. Australian state notes were cashed for Australian soldiers and travellers at the chief centres throughout the world at par of exchange. Bank of England notes, to a large aggregate, were cashed for returned soldiers in Australia free of charge, under an arrangement by which the Commonwealth Bank was periodically reimbursed in London on receipt of advice of the amounts cashed; the notes themselves, owing to submarine activities, were retained in Australia until after the World War.

Post-War Developments.—The course of Australian finance throughout the War and during the post-War period ran without hitch or difficulty. The Commonwealth Bank—which operated in effect if not in name as a central bank from its formation—displayed in its management in Australia and in London a helpful attitude of co-ordination and co-operation towards the private banks. Its strong leadership was willingly followed, and even if the necessity for assistance by way of advances or discounts or otherwise did not materially arise, the fact that the state bank, as the instrument of the government and with its reserves including its note issue and gold holdings, stood behind the whole of the banks, contributed towards dispelling any unrest or uncertainty which might otherwise have arisen. As a special measure after the outbreak of War, the Australian states were assisted temporarily from the Notes Fund to the extent of £20,000,000, but the gold reserve never fell below 40%, although the statutory reserve is 25%. Money in Australia was easy during and after the War, and exchange with London more or less stabilised. This was assisted by the arrangements with the British Govt. for purchase of all wool and wheat, etc. The ease of money, especially in the later post-War period, resulted partly from the bountiful seasons, and partly the good prices realised from wool and wheat. In 1925 the value of the wool shipments from Australia alone reached £55,000,000, as against £25,000,000 in 1914 from Australia and New Zealand together, although the weight of wool despatched abroad had not increased.

Another factor in the monetary ease has been the somewhat liberal expenditure of borrowed money. In addition to the distribution from war loans, the expenditure and the purchase of

properties for returned soldiers and their settlement has aggregated £100,000,000, and new loans raised by the various states between 1915 and 1924 totalled £250,000,000. The distribution of these borrowed moneys has stimulated certain classes of employment and trade, and doubtless has re-acted on some forms of land values. From 1915 to 1924 the Commonwealth public debt increased from £37,000,000 to £415,000,000 and the State debts from £348,000,000 to £595,000,000. After deducting debt counted twice the net total public debt in 1924 was £955,579,000. Thrift, as evidenced by the larger deposits in the state governments' and Commonwealth Bank's savings bank departments, has certainly been accelerated, the total balances having grown from £46,147,472 in 1908 to £176,871,147 in 1925. The assets held against the state savings bank deposits of £140,000,000 comprise government stocks £74,000,000, municipal loans £7,000,000, land mortgages and other investments £39,000,000, and cash items £20,000,000.

Land banks, mostly formed since 1918, operate in every state. Through the medium of these institutions, funds for short or long term credits to farmers and other land settlers are readily found. They are all state organisations, variously styled the Rural Bank Department of New South Wales, the State Bank of South Australia, the Agricultural Bank of West Australia, etc. The respective states are responsible for the obligations of these bodies, and the amounts of loans on mortgage granted by them and the state savings banks to settlers aggregated £58,338,995 in 1923. A rural credits department of the Commonwealth Bank, to be kept distinct from its general banking business, was formed under an Act dated Sept. 14 1925, for the purpose of financing the orderly marketing of primary produce by means of loans for periods not exceeding one year. The department may have advances from the Treasury up to £3,000,000 at any time, may issue debentures and shall have allocated to it 25% of the net annual profits of the note issue department until the amount so paid reaches a total of £2,000,000. (The profits of the note issue department exceed £1,000,000 per annum.) The advances of the rural credits department may be made to the banks or co-operative associations or such other bodies as may be specified by proclamation.

Exchange Problems.—Before the return to the gold standard in 1925 the value of the Australian pound since 1914 had been linked throughout with that of the British pound sterling. Subject to ordinary seasonable trade fluctuations, the Australian exchange on London was maintained on a fairly stable basis except on two occasions. One was when, after the end of the War, goods overdue and in anticipation of requirements were rushed out too hurriedly and payment for these shipments exhausted the banks' London funds, which could not be immediately replenished from Australia owing to the embargo on gold shipments. The converse of this position was created in 1924, when, owing to heavy shipments of wool and wheat at high values, the currency available in Australia proved inadequate to finance the purchases, even against credits established by the chief English banks. In the view of the Note Board any increase in the note issue, even against gold offered by the associated banks or against cash ear-marked in London, would have created unjustifiable inflation.

But the new directors of the Commonwealth Bank, when appointed in Oct. 1924, took, under the wise leadership of the Prime Minister, the practical rather than the doctrinaire view, and for the seasonal requirements made notes temporarily available to the associated banks against London cash cover, readjustment to be effected on the marketing of the produce in London. Notes were only applied for to the extent of 25% of what was at first thought necessary; repayment was duly made by the banks, and the exchange impasse, during which premiums of 5% and over were paid for telegraphic remittances for the purchase of wheat, wool and other Australian produce, was removed. Gold was imported to the value of £10,000,000 and the gold standard was soon after adopted in Australia, simultaneously with the return to the gold basis in England, thus placing the exchange position on a permanent and stable basis.

The following statement shows the position of the various cheque-paying banks in Australia:—

Capital, Reserves and Dividends of Australian Banks to June 30 1924 (excluding three foreign banks each with a single exchange agency)

	£
Capital Paid up	30,466,275
Reserved and Undivided Profits	26,496,857
Dividends for year	3,353,356

Assets and Liabilities in Australia for quarter ended Sept. 30 1925. (*Sworn averages*)

	Liabilities		Assets
	£		£
Notes of Old Issues, unpresented	202,588	Gold and Silver coin and bullion	33,235,455
Bills in circulation	2,727,868	Australian Notes and cash with Commonwealth Bank	37,162,790
Balances due to other banks	7,950,938	Landed Property	7,255,407
Deposits	316,763,543	Notes and Bills of other banks	2,726,341
		Balances due from other banks	5,900,786
		All debts due to the banks	264,790,564
Total liabilities	£327,644,937	Total assets	£351,071,343

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TRANSPORT AND COMMUNICATIONS

Railways.—The great majority of the railways are owned and controlled by the Federal and State Governments. Between 1910 and 1925 the total mileage open for traffic increased from 18,012 m. to 27,644 m. On Oct. 22 1917, the Trans-Australian Railway from Kalgoorlie in Western Australia to Port Augusta in South Australia was opened for traffic; the line is controlled by the Federal Government. With the transfer of the Northern Territory by the South Australian Govt. to the Commonwealth Govt. on Jan. 1 1911, the railways in the Northern Territory from Darwin to Pine Creek, and in South Australia from Port Augusta to Oodnadatta came under Federal control.

The Northern Territory Acceptance Act 1910 provided for a transcontinental line from South Australia to the Northern Territory. The extension of the existing line southwards from Pine Creek to Emungalan was completed in 1917. There are four different gauges in use on the main lines in the various states. A Royal Commission (1921) recommended the conversion of all main trunk interstate lines to a standard gauge of 4 ft. 8½ in. at a cost of £21,600,000. In 1925 the construction of a 4 ft. 8½ in. gauge railway between Grafton, New South Wales and Brisbane, Queensland, was begun. This is the first action taken towards the unification of gauges. The electrification of the Melbourne Suburban Railways (143 m.) was completed in 1923. Work on the construction of the Sydney City and Suburban Electric Railway (11·9 m.) was recommenced in 1924 after being shut down for 4½ years.

Motor traffic in Australia developed considerably between 1910 and 1925. Since 1918 the state governments and local authorities have expended considerable sums, not only in making new roads in newly settled areas, but in improving the existing trunk roads. In 1923 the Commonwealth Govt. passed the Main Roads Development Act, which provided for an annual grant to the state governments of £500,000 for the making of main roads. The grant is conditional on the respective states supplementing it on a pound for pound basis. The grant was increased to £1,000,000 in 1924, and up to the end of 1925 £3,250,000 had been expended under the arrangement.

Shipping.—Both interstate and overseas shipping is controlled by the Commonwealth Govt. under the provisions of the Navigation Act 1912–20. The Act was assented to Oct. 24 1913 and is being brought into operation in sections by proclamation. Various sections were proclaimed between July 1921 and Dec. 1925, including the coastal provisions, which provide that all shipping engaged in interstate trade must conform to the regulations under the Act in regard to wages, manning accommodation, etc. A decision of the High Court, June 23 1925, held that the provisions of the Colonial Laws Validity Act applied to the Commonwealth, and that the provisions of the Commonwealth Navigation Act concerning the engagement and discharge of seamen were invalid, being repugnant to the Imperial Merchant Shipping Act.

In 1916, owing to the scarcity of freightage due to war conditions, Mr. Hughes, then Prime Minister, bought 15 steamers for the Commonwealth, and a programme for the building of 48 vessels in Australia was announced. Owing to certain variations, the programme

resulted in the building of 21 steel cargo vessels and two five-masted schooners with auxiliary power. In addition, five steamers of 8,450 tons each were constructed in the United Kingdom, and the Commonwealth Govt. also had 18 ex-enemy steamers and one ex-enemy vessel under its control. Statutory provision for the establishment of the Australian Commonwealth Line of steamers was made in 1923, when the whole right and title to the 50 vessels then owned by the government was vested in a Board of Directors. The line was offered for sale in 1925, but only a few vessels were disposed of.

Wireless.—On March 28 1922 the Commonwealth Govt. entered into an agreement with the Amalgamated Wireless (Australasia) Ltd., whereby the company agreed to establish and maintain direct wireless communication between Australia and the United Kingdom and Canada, and to take over from the Commonwealth Govt. the existing radio stations under its control. The company is required, if desired, to hand over control of all stations to the government in time of war or public danger. Broadcasting stations have been established in all the capital cities. The agreement provided for the erection of high-powered long-distance wireless stations in the United Kingdom and Australia. Owing to refusal of British Govt. to grant licenses for erection and operation of a trunk and other stations in the United Kingdom for communication with Australia, the agreement was amended in Sept. 1924, the company undertaking to erect in Australia a "beam" station capable of providing a commercial wireless service with the United Kingdom and Canada of at least 21,600 words per day for 300 days per year.

Aviation.—An Air Navigation Act was passed in 1920, the Civil Aviation Department formed and a Controller of Civil Aviation appointed. Aerial surveys have been made in all mainland states and in the Northern Territory. Nearly 100 landing grounds have been acquired or leased. Services have been established between Perth and Derby (Western Australia), Adelaide and Cootamundra (N.S.W.) and Charleville and Camooweal (Queensland). The services are subsidised by the Government for the conveyance of mails.

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INDUSTRIAL AND SOCIAL CONDITIONS

The average weekly wage for male adults throughout Australia for all industrial groups was estimated by the Commonwealth statistician at £2 11s. 3d. in 1911, £4 14s. 6d. in 1921 and £4 14s. 3d in 1924. The printing group, with £5 8s. 3d., showed the highest average wage in 1924; the building group was next with £5 5s. 6d. and the agricultural group lowest with £4 5s. 10d. (including board and lodging). For females, the average in 1924 was £2 9s. 7d. per week compared with £1 7s. 2d. in 1914. These rates of wages are the minimum for a full week's work.

The basic weekly wage was first declared in New South Wales in 1914; the rates at March 1925 were £4 2s. for males and £2 1s. 6d. for females. A Royal Commission appointed by the Commonwealth Government in 1919 declared in its findings for a basic wage of £5 16s. per week for a man with wife and three children under 14 years. In 1920 the Commonwealth Government fixed the basic wage for male employees at £4 per week and 5s. for each dependent child. The Board of Industry of South Australia, appointed under the Industrial Code, 1920, was charged with the fixation of the living wage. The first declaration was made in April 1922, the rates for male adults being 12s. 11d. per day; this was increased to 13s. 1d. in Oct. 1923 and to 13s. 8d. in April 1924. In Queensland, the Industrial Arbitration Court declared the basic weekly wage for adult male workers at from £4 5s. to £4 15s., according to the district. These rates were operative in 1925.

A statutory 44-hour week was brought into operation in New South Wales in 1921, the 48-hour week restored in 1922 and the 44-hour week again enacted in 1925. A statutory maximum 44-hour week was brought into operation in Queensland in Oct. 1924. The average working hours for all industries throughout the Commonwealth (excluding shipping and agricultural) in 1924 were 46·66 per week for males and 46·02 for females. The conditions governing apprenticeship are clearly defined in each state.

Trade Unions.—The trade unions range from the small independent associations to the large, interstate organisation, which, in some cases, is a branch of a British or an international union. The number of separate unions and branches in 1924 was 376. The number of male members was 1,175,749, representing 54·5% of estimated total number of employees. The figures for female members were 280,664 or 31·5%. The tendency towards closer organisation is evidenced by the fact that, although membership of trade unions has increased since 1912 by 72%, the number and membership of unions having less than 2,000 members have considerably decreased. In 1924, there were 469 employers' associations, with a membership of 77,930, united for their own protection and for representation in cases before arbitration courts, wages boards and other wage-fixing tribunals. Associations of employers and employees are recognised under the Commonwealth Conciliation and Arbitration Act as well as under several State Acts, and such organisations may be registered.

Unemployment.—According to trade union returns, the average number of unemployed in Australia in 1924, exclusive of persons unemployed through strikes or lock-outs, was 35,507 or 8·9%, as compared with 16,054 or 6·5% in 1913. Very few unions pay unemployment benefit. In 1922 the Queensland Government passed the Unemployed Workers' Insurance Act, which provided for the establishment of an unemployment insurance fund from contributions by workers, employers and State in equal parts and for the payment of unemployed sustenance therefrom at the rates of from 15s. to 20s. per week for single (male or female) workers, and £1 5s. to £1 15s. per week for married workers, with 4s. or 5s. per week for each child under 16 years of age. The Unemployed Council, constituted under the Act, was empowered to order employers to proceed with works that could reasonably be proceeded with, with a view to reducing unemployment. The Act also provided for Government relief work in localities affected by unemployment, and for the establishment of labour farms for unemployables.

Regulation of Wages.—Two systems exist for the regulation of wages and terms of contracts of employment. In Victoria and Tasmania there is the wages board system, and in Western Australia an industrial court. The industrial legislation of New South Wales, Queensland and South Australia embodies both systems. Industrial courts in these states have been exercising the functions of wages boards. The New South Wales Industrial Arbitration (Amendment) Act, 1926, abolished the state court of industrial arbitration and vested its powers in an industrial commission. In Victoria, wages boards' decisions may be reviewed by the Court of Industrial Appeals. There is also the Commonwealth Court of Conciliation and Arbitration which has power to deal only with matters extending beyond the limits of a single state. The Industrial Peace Act, which was passed by the Federal Parliament in 1920, provided for the appointment of special tribunals for the prevention and settlement of industrial disputes extending beyond the limits of any one state. This is supplementary to the Court of Conciliation and Arbitration. The awards or decisions of a tribunal are binding at law and have the same effect as an award of the Arbitration Court.

Health.—Though part of Australia is within the tropics, there is practically no tropical disease. The death-rate from all causes in 1924 was 9·47 per 1,000. The infantile death-rate, which, owing to the hot summers ruling over the greater part of the Commonwealth, is the chief cause of anxiety to the public health authorities, has considerably improved. In 1901 it stood at 103·61 per 1,000, in 1924 it was only 57·08 per 1,000. The Commonwealth Government pays a maternity bonus of £5 for every child born of a white woman resident in Australia, and the states have public health organisations dealing specially with infant welfare. Apart from infant mortality, the chief foes to human life in Australia are tuberculosis, cancer and diseases of the heart. A Commonwealth Department of Health was formed on March 3 1921.

Education.—The most notable advance in the educational life of the Commonwealth between 1910 and 1925 was in the rapid development of the younger universities. In 1925 there was a university in each of the six states, and the tendency was more and more to decentralise university training instead of looking to Sydney, Melbourne and Adelaide as the natural centres. Considerable progress was made in the establishment of state secondary education, in the form of high schools and technical colleges, to continue the valuable work done in the primary institutions which, in most of the states, provide free education for children up to 14 years of age.

Art.—One of the remarkable features of Australian life during the post-War period was the rapid growth of a distinctively national school of art, and the appreciation of its work by the general public. Men like Lambert, Streeton, Heysen, Hilder and Roberts went to the Australian "bush" for their inspiration and gradually their fellow countrymen awoke to the realisation of the beauty that lay at their own doors. At the same time, Norman Lindsay was making a world-wide name for himself with his delicate etchings and his imaginative black and white work and Bertram Mackennal had established himself as a sculptor. An exhibition of Australian art held in London in 1924 attracted considerable attention.

Sport.—The War did not have the same devastating effect on sport as it had in countries nearer the scene of hostilities. The traditional love of games, born of the sunny open air life, remained unchecked, and racing, cricket, football and lawn tennis suffered little as a

result of the war years. Events particularly worthy of note are the victories of Australia over England in the post-War series of test matches; the performances of the Western Australian race-horse Eurythmic; the success of Australian crews at Henley for the first time and the consistently good showing of Australian lawn tennis players in the Davis Cup contests.

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(M. L. S.)

AUSTRALIAN LITERATURE.—During the period 1910–25 occurred the death of two writers whose books have permanent value in Australian literature. Rolfe Boldrewood (T. H. Browne), who died 1915, wrote many popular novels, such as *Robbery under Arms* (1888), *The Squatter's Dream* (1890) and *The Miner's Right* (1890), all of which possess no small measure of literary charm. Henry Lawson, who died in Sept. 1922, in his poems and short stories, described the life of the shearer, the small farmer and the swagman. His *Children of the Bush* (1910) was his culminating achievement as a story-writer.

The book which attained the largest degree of public appreciation in Australia during this period was C. J. Dennis's *The Sentimental Bloke.* Written in slang, it was pervaded by warm humour, mingled with fine feeling. Bernard O'Dowd published *The Bush* (1912), as well as an elaborate poetical rhapsody on Venus-worship and a collected edition of his poems.

Mary Gilmour's *The Passionate Heart* (1918) and *Hound of the Road* (1922) contain mature examples of this poetess' genuine art. J. B. O'Hara published *Calypso and other Poems* (1912) and a collection of his best work as a writer of verse. A posthumous book by Victor Daley, *Vine and Roses* (1911), and the *Complete Works* of William Gay (1911) should be noted. Leon Gellert's *Songs of a Campaign* (1918) and *The Isle of the Sun* (1919) fully sustained this author's poetic reputation. Archibald T. Strong published *Sonnets of Empire* (1915) and a volume of translations from Theodore de Banville (1913). Bertram Stevens's *Golden Treasury of Australian Verse* (2nd edition, 1912) and Walter Murdoch's Oxford Book of *Australasian Verse* (1918) are good anthologies. The only critical works which call for mention, published within the period under review, are the *Peradventure* (1912) of A. T. Strong, a collection of essays, and T. G Tucker's critical edition of Shakespeare's *Sonnets* (1924).

Kangaroo (1923), although written by an Englishman, D. H. Lawrence, was the most notable work of fiction dealing with Australia during this period. The best of the humorous books of " Steele Rudd " (Arthur Hoey Davis)—*On our Selection* and its several sequels—were reprinted in a uniform edition in 1913, and continued to command a well-merited popularity. Among present writers of short stories none can compare with Louis Becke and Henry Lawson. Mrs. A. Gunn's *We of the Never-Never* (1912) was a vivid description of life in the interior of the continent, and C. A. Bean's two books, *The Dreadnought of the Darling* and *On the Wool Track* (1916) were pieces of descriptive realism of photographic fidelity. Elsia Masson's *An Untamed Territory* (1915) was a charming account of life in the Northern Territory. R. L. Jack's *Northmost Australia* (1921) was the work of an eminent geologist, while Baldwin Spencer's *Across Australia* (1912) was significant both as a description of travel and as the work of a noted anthropologist. The appeal of Spencer's *Native Tribes of the Northern Territory of Australia* (1914) was more strictly scientific.

Biography and History.—In biography, Walter Murdoch's *Alfred Deakin, a Sketch* (1923) stands prominent. Prof. Ernest Scott's *Life of Captain Matthew Flinders, R.N.* (1914) and his *Life of Lapérouse* (1912) also belong to the biographical section. Miss S. Macarthur Onslow's *Early Records of the Macarthurs of Camden* (1914) was chiefly a collection of family papers. Among autobiographies Sir George Reid's *My Reminiscences* (1917) proved somewhat disappointing, but must be regarded as of some importance historically. Dr. J. M. Creed's *My Recollections of Australia and Elsewhere* (1916) and Bishop Gilbert White's *Thirty Years in Tropical Australia* (1918) may also be mentioned; and two popular books were C. A. W. Monckton's *Some Experiences of a New Guinea Magistrate* (1921) and *Further Reminiscences* (1922).

A series of well-illustrated art books appeared from the office of the attractive periodical *Art in Australia.* The most successful volumes were those devoted to the art of the painters Hilder, Arthur Streeton, Hans Heysen and George Lambert, A.R.A. Two volumes by the Sydney architect, Hardy Wilson, *Old Colonial Architecture in New South Wales and Tasmania* and *The Old Cowpastures Road,* were excellent achievements. A volume of the drawings of Norman Lindsay exhibited many phases of the craftsmanship of this accomplished artist.

Amongst historical works, B. R. Wise's *The Making of the Australian Commonwealth* (1913) is a spirited and valuable record of memorable controversies and momentous decisions. H. G. Turner's *First Decade of the Australian Commonwealth* (1911) is a useful survey. Marion Phillips's *A Colonial Autocracy* deals fully with the governorship of Macquarie in New South Wales. James Collier's *The Pastoral Age in Victoria* (1911) is written from intimate personal knowledge. R. C. Mills's *The Colonisation of Australia* (1915) traces particularly the influence of Edward Gibbon Wakefield. Dr. J. S. Battye's *History of Western Australia* (1924) is a very solid work, based on ample documentary material. J. T. Sutcliffe's *History of Trades Unionism in Australia* (1921) and M. Willard's *History of the White Australia Policy* (1923) deal with two highly important phases of historical politics. Edward Sweetman's two works on the development of responsible government, in Victoria and in Australia generally, brought together a mass of information that had been overlooked by all previous writers.

The History of State Education in Victoria by Sweetman, Long and Smyth, was a good piece of work. S. H. Roberts's *History of Australian Land Settlement* (1924) deals with a subject which is the very core of Australian history. In G. Arnold Wood's *The Discovery of Australia* (1922) many popular misconceptions were shattered. Scott's *Terre Napoléon* (1910) discussed the several French expeditions dispatched to Australian waters during the 18th and early 19th centuries. Ida Lee (Mrs. C. Bruce Marriott) added to her studies in Australian maritime history by publishing *The Log Books of the Lady Nelson* (1915), *Bligh's Second Voyage to the South Sea* (1920) and *Early Explorers in Australia* (1925). Scott's *Short History of Australia* (1916), Fitchett's *The New World of the South* (1913), T. Dundabin's *The Making of Australasia* (1922) and Sir T. A. Coghlan's four volumes on *Labour and Industry in Australia* (1918) were more general works on Australian history. Dr. MacLaurinan's *Post Mortem, Essays Historical and Medical* (1922) attempted to diagnose the maladies of a number of historical characters. The *Historical Records of Australia,* published by the Library Committee of the Commonwealth Parliament under the editorship of Dr. Frederick Watson (1913, *et seq.*) are invaluable, but unfortunately it has been determined to cease publication. For a good presentation of the physical conditions of Australia an extremely valuable book is Griffith Taylor's *Geography of Australia* (1914).

Books on sociological topics include H. L. Wilkinson's *History of the Trust Movement in Australia* (1914) and *State Regulation of Prices in Australia* (1917); C. A. Bernays' *Queensland Politics During Fifty Years* (1916); Duncan Hall's *The Commonwealth of Nations* and the book of essays by various hands edited by Meredith Atkinson under the title *Australia: Economic and Political Studies* (1920). *A New Province for Law and Order* by H. B. Higgins (1922) was an important work on the theory and working of industrial tribunals. Amongst miscellaneous books may be mentioned *14,000 Miles through the Air* (1922) by Sir Ross Smith and *An Australian Bird Book* by Dr. J. A. Leach (1911 and later editions).

Books on the War.—The official history of the part taken by Australia in the World War, edited by C. A. Bean, was planned to fill twelve volumes, one half of which had been issued by 1925. This history will form an adequate record of the achievements of the Australian armies and a worthy literary monu-

ment to the brave men whose names are inscribed within the volumes. Sir John Monash, in *The Australian Victories in France in* 1918 (1920), gave a survey of the operations leading up to Aug. 8 1918, and of the great day itself. *The Desert Mounted Corps* by R. M. P. Preston (1921) and *Australia in Palestine* by H. S. Gullett and C. Barrett were devoted chiefly to the work of the splendid cavalry force commanded by Sir Harry Chauvel. A. D. Ellis's *The Story of the Fifth Australian Division* (1920), F. M. Cutlack's *The Australians in their Final Campaign* (1918), R. Bridges's *The Immortal Dawn* (1915), and P. F. S. Schuler's *Australia in Arms* dealt with particular phases.

A few works on Australia by foreign writers should be added to this review. C. H. Northcott's *Australian Social Development* (1918) and C. D. Allin's *History of the Tariff Relations of the Australian Colonies* (1918) were by American authors. Two very interesting French books were *Sous la Croix du Sud* by P. Wenz (1910) and *L'Australie et la Pacifique* by G. M. Crivelli and Pierre Louvet (1924). R. Schachner in *Australien in Politik, Wirtschaft und Kultur* (2 vol., 1910–11) gave a German account of many aspects of Australian life. From Stockholm came G. Anderson's *Australien: Natur och Kultur* (1912). For a brief but penetrating piece of political observation by a Briton there is nothing better than Viscount Bryce's chapters on Australia in his *Modern Democracies* (1921). (E. Sc.)

AUSTRIA, REPUBLIC OF.—This state was formed in Nov. 1918 from a portion of the Austrian lands of the former Austrian Empire. Its area is 32,352 sq.m.; and the population is 6,526,661. (*See* 2.970 and 3.2.)

I. AREA AND POPULATION

The territory included in the republic consists of some of the poorest and most mountainous areas of the former Austrian Empire. Only about one-third is under cultivation; another third is covered with forest, and the remainder is largely mountainous, though well-suited in parts to grazing and dairy farming. The economic situation is completely dominated by the existence of Vienna, a highly organised financial, commercial and industrial centre containing nearly one-third of the total population of the republic in a comparatively poor state, unable to produce, under present conditions, sufficient foodstuffs to meet the needs of its people, and cut off from its former markets and sources of supply. The following table shows the areas and populations of the provinces of the republic:—

Province	Area (sq. m.)	Population
Vienna	107	1,863,783
Lower Austria	7,462	1,478,697
Upper Austria	4,628	873,702
Salzburg	2,763	222,731
Styria	6,327	977,350
Carinthia	3,684	370,432
Tirol	4,790	313,699
Vorarlberg	1,005	139,968
Burgenland	1,586	286,299
	32,352	6,526,661

Defence.—The present Austrian Federal Army (Bundesheer) originates from the "People's Army" (Volkswehr) formed by the Revolutionary Govt. simultaneously with the disbanding of the remainder of the old Imperial Army. The Treaty of St. Germain limited the strength of this army to 30,000 men and officers. At present this limit is not reached by the actual number; budgetary reasons work for a reduction of military expenses. The present force numbers 15,000 men and non-commissioned officers. The Austrian Army is formed by voluntary enlistment for a period of 12 years. All means of mobilisation are forbidden by law. The army consists of six brigades each of two infantry regiments, six squadrons of cavalry, six artillery and six technical units. There is no air force. The men and officers enjoy, during the time they serve, the full rights of citizenship.

II. CONSTITUTIONAL AND POLITICAL HISTORY

The Revolution.—Nov. 12 1918, the day after which the last Emperor of the Habsburg-Lorraine line abdicated in Vienna, is also the day from which the new Austrian Republic formally and legally dates its birth. On Oct 21 the assembly of all the German members of the Lower House (Abgeordnetenhaus) of the former Austrian Parliament had already determined to declare the German-Austrian portion of the Austrian territories, formerly under Habsburg rule, an independent state, and had constituted itself the Provisional National Assembly. The constitution of the former Monarchy afforded a legal foundation for this action, for it was based on the Emperor Charles' manifesto of Oct. 16 inviting the racial entities of the non-Hungarian half of his empire to constitute national states within the framework of the empire.

On Oct. 30 the Provisional National Assembly assumed the supreme independent authority in those Austrian territories claimed by it to be predominantly German, and appointed a State Council as executive under the leadership of the three presidents of the Assembly, who then nominated secretaries of state as heads of the administrative departments simultaneously organised for German-Austria. But the revolutionary movement, which broke out in Vienna at this moment as a consequence of the general military break-down of the Central Powers, led to the declaration of an independent German-Austrian Republic on Nov. 12. This declaration, which was in accordance with the right of self-determination, was the result of revolutionary action, and expressly repudiated any legal descent from the broken-up empire. The Czechoslovak Republic had already come into being on Oct. 28. The law promulgated by the Provisional National Assembly on Nov. 12 1918 explicitly declared in its first Article: "German-Austria is a democratic Republic," and in its second: "German-Austria is a component part of the German Republic." Thus in the proclamation itself of the new state, there was adumbrated its cessation by a future treaty uniting it with the German Reich.

Ten days later, in a special law, on Nov. 22 1918, the National Assembly defined its territory. In addition to the ancient hereditary Austrian lands (Crown Lands), with the exception of districts inhabited by the Yugoslav and Italian races, this law claimed the inclusion in its territory of a large number of predominantly German districts in Moravia and Bohemia. Simultaneously with the constitution of a German-Austrian Republic as a whole, administration was taken over in the separate provinces (the former Crown Lands), of which the republic was composed. The provincial Diets, resolving themselves into provisional assemblies, carried out corresponding changes, the presidents being entrusted with the conduct of the provisional administration and the executive power in their provinces. Thus the autonomous organisation and provincial self-government, established by the constitution of the Austrian Empire of Feb. 26 1861, was perpetuated as a real popular self-government in the separate provinces, this time on a really democratic foundation.

The history of the Austrian Republic as far as its foreign relations are concerned, can be divided into three parts: the period up to the passing of the Treaty of St. Germain, ratified on Oct. 17 1919; the period ending with the conclusion of the Geneva Pact with the League of Nations, Oct. 4 1922; and the period regulated by that agreement.

From the Constitution of the Republic to the Peace

Treaty of St. Germain.—The Treaty of St. Germain finally defined the frontiers and extent of the new republic. Austria was obliged to renounce all claim to the districts occupied by the Czechs in 1919, but inhabited by a German population. In the south, towards Yugoslavia, the frontier in the Klagenfurt district was drawn in accordance with the plebiscite (Oct. 10 1920) ordered by the treaty; in southeast Carinthia it was essentially according to the ancient frontier of that province. The treaty also laid down that the republic was in future not to bear its own chosen name, but that of Austria. The principle already laid down in the Treaty of Versailles, that the Austrian Republic must preserve her independence, and that union with Germany could only take place with the consent of the League of Nations, was also laid down in the dictated peace of St. Germain. But the treaty awarded a large part of the old German-settled territories in West Hungary to Austria; and Hungary was obliged by the Treaty of Trianon to evacuate and transfer them. The execution of these decisions of the Paris treaties was not complete until well on into the year 1921.

Burgenland.—The Austrian occupation of the West Hungarian territory called the Burgenland by the Austrian Govt. met with violent opposition in Hungary from public opinion and from the Government. Troops of free lances, organised under official pat-

ronage, prevented by force of arms the entry into the country of the Austrian officials and gendarmes to whom the occupation was entrusted, and even threatened the Austrian frontier. An appeal by Austria to the Conference of Ambassadors led to long diplomatic conversations, which culminated in a conference at Venice, Oct. 20 1921, when Italy, as self-constituted arbitrator, forced Austria[1] to accept a plebiscite in Oedenburg (Sopron), the capital of the territory in dispute. This procedure, imposed on Austria in the interests of the Magyars, led to a Magyar majority, and the town of Oedenburg and several communes were left to Hungary. Minor frontier rectifications in favour of Czechoslovakia, in accordance with the peace treaties, were carried out without incident (*see* BURGENLAND).

Difficulties of the New State.—The law of Oct. 1 1919 definitely and finally drew Austria's frontiers in accordance with the treaty. The carrying into effect of the onerous and complicated terms of the treaty became the chief task of Austria's foreign policy, which was prevented from following any independent line by the weak economic condition of the country and the ever-increasing financial difficulties of the state. In the years 1919 and 1920, it was only with the help of credits from the United States, granted largely in kind, that it was possible to maintain the town population, which had been reduced to destitution by the World War and the effects of the blockade. The most important agencies in relieving this extreme misery and suffering were the American Relief organised by Mr. Herbert Hoover, which fed the children, and the work of the Society of Friends for the starving population of Vienna and other towns. Thus at that time the whole political life of the republic was absorbed in the efforts to assure the existence of the republic under the burdens imposed on it by the consequences of the War and by the division of the great and ancient empire into independent economic and political units; in the fulfilment of Austria's obligations; and in the task of maintaining public order in the face of internal and external dangers. The Chancellor, Karl Renner, who had been at the head of the Govt. since the revolution, nevertheless succeeded in 1920 in establishing friendly relations with the Czechoslovak Republic. Numerous problems arising out of the execution of the treaty were harmoniously solved in an agreement concluded with the Prague Govt. at Brno (Brünn) (June 7 1920) and a supplementary agreement at Karlovy Vary (Carlsbad) (Aug. 23 1920).

The Law of the Constitution and Internal Policy

The Constituent Assembly.—The revolutionary decisions of Nov. and Dec. 1918 had provided for the summoning of a National Constituent Assembly, elected on the broadest democratic franchise and by proportional representation, which met at Vienna on March 4 1919. The result of the elections was again to divide political power between the three parties, which together had carried through the revolution, but in considerably altered proportions. Out of a total of 159 deputies, 69 belonged to the Social Democratic party, 63 to the Christian Socialists and 26 to the Pan-Germans, *i.e.*, to the Nationalists. In accordance with the two laws of March 14 1919, on the franchise and on the Govt., the Constituent Assembly retained for the time being the provisional Constitution of the Republic of 1918, but introduced fundamental changes. The Council of State (Staatsrat) and its three presidents were abolished.

From this date the Ministry, consisting of the State Chancellor, the Vice-Chancellor and the secretaries of state, was entrusted with full executive and administrative powers, and was henceforward to be elected on nomination of the main Committee of the National Assembly, consisting of the president, two vice-presidents and eleven deputies. Several former functions of the Council of State were now transferred to the Ministry; some of its prerogatives, such as the appointment of judges and higher officials, were, however, transferred to the president of the National Assembly acting in agreement with his vice-presidents. He became the representative of the republic abroad and treaties must be ratified by him. He represented the supreme power in the republic, although with strictly limited functions. The Constituent Assembly, elected for two years, was to be in continuous session for this period. The most important alteration in the character of the Parliament was the appointment of the Main Committee to form the permanent link between Legislature and Executive and to regulate the work of Parliament.

Centralised or Federal Government.—It was evident in the early days of the Austrian Republic, that, as in imperial Austria, the relation to the state of the historic provinces presented the great problem, indeed the problem of the political existence of the state. From the very beginning the idea of centralisation had been most strongly emphasised by the Social Democrat leaders. Opposition in the provinces increased. In the laws of March 14 1919 certain provisions were therefore inserted to meet the case of conflicts between the decisions of the provincial assemblies and the Federal laws, the central authority being empowered to challenge such decisions before the newly instituted Constitutional Court.

[1] The Venice Protocol, approved by the Council of Ambassadors, Oct. 27 1921.

Dr. Renner's Government.—The republic and its Govt. still rested on the coalition of the three parties, which included the whole population. Social Democracy remained politically the strongest factor; on the reconstitution of the Govt. which took place on March 15 1919, by election from the National Assembly, almost all the important posts were filled by Social Democrats: the Ministries of the Interior, of Foreign Affairs and of War. The first Chancellor, Dr. Renner, presided over the new Ministry, and was appointed head of the Peace Delegation to Paris.

The Social Democratic party found its main support in the trade unions and party organisations, which in Vienna and in all industrial districts included almost the whole of the working classes. The revolutionary feeling which had resulted from the downfall of the Monarchy during the War was a strong auxiliary. Part of the official class and of the lower middle class also supported it. But on the other hand, the Christian Socialist party had succeeded in winning over not only all the agricultural class, but also the overwhelming majority of the upper and middle classes in Vienna and the provincial towns. The Social Democrat leaders regarded the coalition, from which the first constitutional Govt. was formed, as a union of workers and peasants, from which a complete democratic republic would emerge through the legislation to be passed by the National Assembly. The party, under the leadership of Dr. Renner, President Seitz and Dr. Otto Bauer (Foreign Minister), was able to preserve its unity by successfully combating those activities of its own Left wing, which had been inspired by the establishment of the Bolshevist Republic in Russia and by the temporary success of Bolshevism in Hungary. They succeeded in subordinating party differences to party unity.

In the spring of 1919, when the Soviet Republic in Hungary under Bela Kun was exercising increasing pressure on Austrian social democracy, the situation became at times highly critical, but the policy and tactics of the Social Democrat leaders directed against Bolshevism were successful in restraining the population of Vienna. Thus there was never serious danger from the isolated attempts by the extremist elements to disturb by violence of any kind the quiet development of Austria's republican democracy.

These attempts were repressed by the armed police. In spite of the deep depression which the dictated peace caused in Austria, and in spite of the increasing difficulties of social and economic conditions, the Coalition Govt. succeeded in preserving public order uninterruptedly. The gradual cooling of revolutionary sentiment in the masses did not therefore lead to any change in Social Democratic policy, which was directed to the maintenance and development of the democratic republic, nor to any reactionary movement against democracy by the Christian Socialists, who represented the Conservative elements in the community. This relative stability, in a community ever more severely threatened from day to day, was further demonstrated by the united opposition from both the great parties in the country to the attempts made by the ex-Emperor Charles, on March 13 and Oct. 26 1921, to restore the dynasty by his return to Hungary. Nevertheless the second coalition, formed on Oct. 17 1919, with Dr. Renner at its head, was felt to be an undesirable hindrance to normal political developments, while the agricultural and urban middle classes, led by the Christian Socialists, began to resist the predominance of socialistic ideas in government and administration. These tendencies emerged most clearly on the question of the new army organisation.

The Proportional Government.—The Coalition was formally dissolved, and a so-called " proportional " Govt. formed, that is an administration containing representatives of the parties in proportion to their numerical strength. This Ministry was to settle the law of the constitution, which had not yet been adopted and to transact business until the elections, which were to take place at an early date. This procedure, which again showed the strong leaning of all Austrian parties to friendly compromise, was successful. The new Federal constitution, after long preparation, was completed on Oct. 1 1920 in the last days of the Constituent Assembly.

Dr. Mayr's Ministry.—The elections which followed (Oct. 17) showed a loss of nearly 200,000 Social Democrat votes, and a corresponding increase of the Christian Socialist vote, and led to the formation (Nov. 20) of the first Ministry, in which Social Democracy was not included, under Chancellor Dr. Mayr. The new National Council consisted of Christian Socialists, 82; Social Democrats, 66; German Nationalists, 20; Peasants' Party, 6; Workers' Party, 1. The German Nationalists supported the majority in most political questions, but the two non-Socialist parties formed no coalition.

The new Federal Constitution had to solve the fundamental problem whether Austria should be organised on a federal or a centralised basis. The provinces demanded the greatest possible extension of their administrative and financial independence, a claim strongly supported by the whole agricultural class and by a part of the urban middle class in the provincial capitals; but the majority of the German Nationalists and Christian Socialists of Vienna demanded the retention of the " Centralist " Constitution. The Social Democratic party directed its efforts to preserving a strong central administration so as to weaken as far as possible the political influence of the Christian Socialists on the provincial bodies.

Status of Vienna.—The main point of the compromise eventually reached was the principle of an eventual administrative reform on federal lines, the execution of which was deferred for future legislation. One consideration which carried great weight was the significant change in Social Democrat policy, which had hitherto been in favour of centralisation. The party demanded, and received, the assurance that the city of Vienna, containing little less than one-third of the total population of the state, in whose City Council Social Democracy had had an overwhelming majority since 1919, should be legally severed from the province of Lower Austria, and be declared an independent province (Bundesland). In accordance with this stipulation the City Council is at the same time the Provincial Diet, and has all the legislative and administrative powers which the constitution gives to the provinces. It became a provincial government, and the burgomaster the governor of a province. This arrangement led the Social Democrats to lose much of their interest in opposing a further federalisation of the republic. Some minor modifications of the principle were conceded to the Christian Socialists.

The Constitution of the Republic.—Austria was given a special head of the state, the Federal President, who is elected by the Federal Assembly for four years. This latter consists of the National Assembly, henceforward called the National Council, elected on the widest franchise for men and women, and of the newly created Federal Council, elected by the provincial Diets, from the inhabitants of their provinces by proportional representation. The Federal Council has a certain share in legislation, as all legislative decisions of the National Council, with the exception of the Budget, are submitted to it, and it may within eight weeks exercise its suspensive veto. In this case the National Council need only pass the legislation concerned a second time, and the veto is annulled.

The Federal President's position is a purely ceremonial one. He concludes foreign treaties, formally appoints a large number of Federal officials and army officers, and has the right to pardon, and to confer honours and distinctions. He has no real political power. All his orders have to be countersigned by the chancellor and by a member of the Federal Government. He is responsible for the constitutionality of his actions, and can be indicted before the Constitutional Court by a majority of the Federal Council. The President may only hold office for two successive periods. He may not practise any profession, but he is awarded a reasonable annual salary to meet the costs of official ceremonies and hospitality. Dr. Michael Hainisch was elected the first Federal President on Dec. 8 1920 and was re-elected on Dec. 9 1924. The Federal Ministry, presided over by the Chancellor, is composed of ministers whose numbers are not fixed by the constitution. and to whom state secretaries may be added. Their powers remain unaltered under the new constitution. The great questions of the allotment of taxes between the central government and the provinces, and of the Federalist demand that the whole internal administration be transferred to the provincial government, received no practical solution.

Austria's Serious Economic Position

Austria's internal policy was, from this time onward, dominated by the threatening conditions of the country's economic life, above all by the rapid depreciation of the Austrian exchange

in consequence of the continuous inflation of the currency. The ever-growing deficit in the federal budget and the provincial revenue necessitated the continuous output of currency notes. At the same time the yield of the taxes disappeared, and the levy on capital of 1920 remained inoperative. These events embarrassed the Mayr Govt. all the more as they had great pressure put upon them by the popular movement for union with the German Reich. This movement was instigated by the provincial governments, which had been working against Vienna since 1919, led by the Tirol. They were strongly under the influence of Bavaria, where the Conservatives and Nationalists had consolidated themselves. The Govt. under pressure of French intervention opposed the movement when its strength was evidenced in plebiscites.

In the spring of 1921, the chancellor in vain endeavoured to secure financial help in London; both there and in America all efforts were unsuccessful. Industry had begun to revive in the end of 1920, and needed foreign credit and currency to pay for imports of raw materials; the financial administration had immediate and similar needs, and this situation caused a more rapid drop in the value of the Austrian crown abroad.

The Schober Ministry.—The Christian Socialist party thought it advisable under these circumstances not to continue to bear alone the burden of unpopularity and responsibility which the conduct of government must necessarily impose in such difficult circumstances. They decided to join with the German Nationalists in electing a ministry of officials, with the respected police president of Vienna, Schober,[1] as chancellor (June 21 1921). This Ministry also had to struggle with economic and financial difficulties. With the fall in the exchange the cost of living rose terribly, especially in Vienna: between July 1 1920 and July 1 1921 prices were doubled; between Oct. 1921 and Jan. 1922 they were trebled. This and the feverish attempts to secure foreign currency were the clearest indications of the threatened collapse of the exchange. Another result was serious social unrest, which on Dec. 1 1921 led to a working-class demonstration accompanied by looting and shop-wrecking. Chancellor Schober and his Finance Minister, Dr. Gürtler, concentrated their efforts on avoiding financial ruin. A number of new taxes were imposed on the wealthy classes, and preparations were made to withdraw the state subsidies towards the cost of living, which weighed heavily on the Treasury.

Understanding with Czechoslovakia.—At the same time the Govt. endeavoured to put Austria's foreign relations on a firm foundation. The unfortunate ex-Emperor Charles' attempts at restoration had proved the success of the policy of co-operation between the Succession States, a policy developed by Dr. Beneš, the chief minister of the Czechoslovak Republic. Austria, it is true, did not join the "Little Entente," but Chancellor Schober and the Federal president visited President Masaryk, and Schober subsequently concluded at Lany (Lana) a treaty (Dec. 16 1921) with the Govt. of the Czechoslovak Republic, in which both states pledged themselves to carry out the peace treaty loyally, to support each other against all revolutionary movements and to submit all disputes to a court of arbitration. Czechoslovakia granted Austria a credit of 500,000,000 Czech crowns, and promised to support her applications for credit both in London and Paris.

This rapprochement with the Czechoslovak Republic encountered strong opposition from the Pan-Germans, who now refused their support to the Government. Their defection led to the fall of the Schober Ministry at a time when the devaluation of the crown was proceeding at headlong speed. The urgent demand for foreign currency and securities rapidly exhausted an English loan, and a catastrophe in the exchange seemed imminent. Under these circumstances, the Schober Ministry resigned (May 31 1922) and the leader of the Christian Socialist party, Monsignor Seipel, put himself at the head of a coalition Govt. based on an agreement between his party and the German Nationalists (Pan-Germans). So for the first time a united Anti-Socialist front was avowedly formed. Dr. Seipel decided to treat Austria's economic and financial helplessness not merely as her own burden, but as a problem of European policy, and on his diplomatic journeys to Prague, Berlin and Verona, he prepared the chief lines of his policy in dealing with the Western Powers, which aimed at long-date and adequate credits, with the help of which Austria might be entirely restored. The success which attended his efforts is dealt with in the section on Economic and Financial History p. 287.

Political Effects of Geneva Agreement.—The Geneva agreement for the reconstruction of Austria dominated the whole internal situation of Austria in the three years following its conclusion; in spite of the indubitably great success of Dr. Seipel's policy it has not been popular; the dismissal or pensioning off of nearly 100,000 state employees severely affected the lot of many families, and all the more harshly as the economic crisis made new occupations impossible in most cases.

The most severely affected were the middle classes, whose sons were unable to find employment in the liberal professions any more than in the Civil Service. Even the officials in employment and the thousands of pensioned officials and employees complained bitterly of their inadequate salaries and pensions. Here again it was the higher officials and judges who were most severely hit, for under party pressure the new scale of salaries and retiring pensions was so arranged that they were fixed at pre-War level for the lower classes in the service, whereas the middle, and, above all, the higher ranks only received from 60 to 30 % of the pre-War salary or pension, and even in these figures no account was taken of the diminished purchasing power of money. The working class on the other hand, supported by its strong trade unions, was able from 1920 to 1923 not only to secure its pre-War wages, but in many cases, to raise them. This favourable position has been maintained, although in the past two years the results of the economic crisis and of unemployment, in which the figures of those receiving relief reached at times 160,000, reacted more and more on wages. The political results of these conditions were that Social Democracy maintained the strength of its position; indeed its majority in the City Council of Vienna has considerably increased.

In spite of the steady opposition of the Socialist minority of the National Council to the "Geneva policy," Dr. Seipel maintained his majority in the elections of 1923, which only made small alterations in the strength of the parties. When Dr. Seipel, whose health was affected by the results of an attempt on his life, resigned in Nov. 1924, the coalition Govt., newly formed under his influence, was able to continue quietly the conduct of the affairs of state

Dr. Ramek's Ministry.—The new Ministry under the Chancellor, Dr. Ramek, continued Dr. Seipel's policy of scrupulous fulfilment of the Geneva agreements, and it was also able in the session of 1925 to complete the constitution in agreement with the Social Democrats. The essence of the reform lay in a further strengthening of the federal principle of the constitution, as the administrative authorities, formerly under the state and controlled by Federal State departments, were now attached to the provincial governments. The Ramek Ministry maintained and extended the financial reform of 1924 in favour of the provinces and communes.

The chief question in Austria's internal policy in the latter half of 1925 was the speedy removal, promised in the June session of the League of Nations Council, of the control over the finances of the republic, exercised for the past three years by the Finance Committee of the League of Nations and the Commissioner-General. The essential point in question is whether it is possible to maintain a lasting balance of the budget, although income and expenditure have long been considerably higher than was originally contemplated by the Council of the League. Moreover the question of the gradual abolition of the Restriction of Rents Act, which has been in force since the War and has, together with the fall in the value of the crown, almost entirely destroyed the value of house property in favour of the tenant, was a burning question in dispute between the majority and minority in the National Council. Financial problems such as the demands of the Civil Service for higher salaries and pensions continued to form the chief pre-occupation of the Government. Party conflicts were of a mild nature and unaccompanied by social disturbance. The demand for union with the German Reich was strongly supported by Social Democracy. (J. Re.)

[1] John Schober, born Oct. 14 1874, was appointed, by the last Imperial Govt., police president of Vienna (1918).

Social Democrat Policy.—The Austrian Social Democrat party became the most powerful force in the country in 1918. In the first of the two Coalition Governments it was the predominating, in the second an equal, partner. It thus had nearly two years in which to put its views on government into practice, although always with great reservations owing to the coalition with the Christian Socialists, and the dependence of Austria on foreign countries.

These reservations made it impossible for it to carry through the large programme of nationalisation of factories, banks, mines and large estates, which it formulated in 1919. In fact it accomplished no expropriation at all. The old state military factories were taken over for peace production on socialised or semi-socialised lines. These experiments were based on the lessons of English Guild Socialism and Russian Bolshevism; the control was in the hands of a mixed body of the producers, the consumers and the state, the workmen receiving a share in the profits. In general, these concerns suffered from shortage of capital, and few survived long. The Workmen's Council, elaborately organised parallel to Parliament, proved efficient only in preventing an open breach with the left-wing extremists; the Soldiers' Council succeeded in preventing a military reaction, if one was planned but broke down in the field. The first agrarian programme encountered the hostility of the farmers and the Church, and was never fulfilled at all. The party therefore returned to its old stronghold of the trade unions, which had expanded to embrace practically all manual and lower intellectual labour, fortified by a Soldiers' Union in the army and a very complete system of works councils (*Betriebsräte*), its active experiments on communal lines being confined to the powerful municipality of Vienna.

Social Legislation.—On the other hand the first Ministry of Social Welfare under Hainisch accomplished remarkable work in purely social legislation, including laws establishing the eight-hour day, insurance against accidents, extension of sickness insurance, state assistance for mothers and infants, a subsidy for children and numerous other measures for the protection of particular classes, especially children. Social legislation in Austria is now very complete, though no provision for old-age pensions has been made. The workmen are in a strong position and the Conciliation Boards have greatly reduced the number of strikes and lockouts. The new education laws aroused much opposition owing to their anti-clerical tendency.

At the Party Conference of 1925, Dr. Otto Bauer produced a new agrarian scheme based on the old Austrian *gemain* or common land. Its effect would be to establish a number of village communities of small-holding, dairy and cattle-farming proprietors, each largely dependent on his usufruct of the common land. Afforestation, the common land and, to some extent, even the small-holding private property would be subjected to a large amount of state and communal control. Cereals would become a state monopoly, the cheap credit required by the small holders being supplied by an extension of co-operative societies and banks. (*See* LAND TENURE.)

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III. ECONOMIC AND FINANCIAL HISTORY

In order to follow the development of the economic and financial history of Austria, it is necessary to distinguish two periods. From 1919 to 1922 Austria awaited salvation from without which it thought impossible from within; it was a period of discouragement and financial crisis, when many thought that only the steady provision of credits by foreign states, or union with Germany, could help her. From 1922 to 1925 certain Austrian politicians showed real determination to re-organise the country, and, with the help of the League of Nations, Austria reformed her finances; at the same time she worked at economic reconstruction, a more difficult task, and one of lower achievement.

THE BEGINNING OF THE CRISIS

The day after the proclamation of the republic a first preliminary budget had to be framed for the period Nov. 1 1918—June 30 1919. In theory 41% of the 3½ milliards of normal expenditure was covered by taxation; but neither frontiers, territories, nor sources of revenue were clearly indicated. The Finance Minister tried to raise a loan, and demanded the payment of taxes (old and new) for the whole financial year before the middle of 1919; otherwise, he stated, resort would have to be made to the note printing presses, which would lead to the collapse of the currency.

The Austro-Hungarian crown, which before the War was worth 1·05 fr., had fallen on the Zürich exchange to 37·75 centimes on Nov. 11 1918 and to 18 centimes in June 1919. The districts which had formerly furnished cereals and coal to Austria had been detached from the republic and had adopted a new money. The Govt. therefore had to buy in foreign exchange and to import corn and fuel; but to assure the maintenance of order, it decided to furnish them to consumers at a very low price. The difficulties were accentuated by the necessity of employing the large number of German-speaking officials dismissed by the Succession States. The increase in expenditure and the fall in the exchange made it impossible to adhere to the estimates. The tax on capital had, in the spring of 1919, provided funds which enabled the Finance Minister, Dr. J. Schumpeter, to reduce for some weeks the additions to the paper currency; yet the issue of paper money reached 9 milliards in Aug. and 12 milliards at the end of the year. Only 37% of estimated expenditure for 1919–20 (17 milliards) could, according to the budget, be covered by taxation. It was known that expenditure was increasing much more rapidly than revenue, and capital was exported on a large scale in anticipation of a period of inflation. The terms of the Peace of St. Germain, ratified in Oct. 1919, further aggravated the situation; indeterminate financial obligations weighed down the new republic, and a first claim was established on all property to guarantee the payment of reparations. The crown fell to a value of 3 Swiss centimes at the end of 1919.

Financial Catastrophe.—Immediately after the Armistice, foodstuffs were sent into Austria by the Allied Governments, supplies being granted on credit. Private relief centres, notably those of the American Relief Fund and the Society of Friends, were established in Vienna. On March 1 1919 a relief credit of $30,000,000, subsequently increased to $48,000,000, was granted to Austria for the import of food. The credits were furnished in equal amounts by France, Great Britain and Italy, certain specific Austrian public assets being assigned as security. The Austrian Govt., in May 1919, made the repayment of these relief credits a prior charge on all its revenues. The Austrian section of the Reparations Commission, sitting in Vienna under the presidency of Sir William Goode, was concerned in 1920–1 with deciding what, if any, reparations could be paid by Austria. The section decided that Austria was not in a position to pay any reparations and suggested that a loan should be granted her to enable a definite scheme of reconstruction to be carried out.

Meantime the Austrian budget for 1920–1 showed an estimated deficit of 41 milliard crowns at a time (June 1920) when the total circulation was only 17 milliards. The crown continued to depreciate. At the end of 1920 it was worth less than a Swiss centime. The printing of notes continued, from 17 to 30 milliards and then to 175 milliards. At the end of 1921, 14 paper crowns were equivalent to one Swiss centime. At first, speculators in other countries had refused to believe in the finality of such a collapse, and collected depreciated money in the hope of a rise, but Austrians, on the contrary, lost all faith in the currency, and changed it as rapidly as possible for foreign securities or for goods. The policy of subsidising food made it possible to pay very low wages and to produce goods at prices below those of the world markets. This premium on exports only disappeared when producers learned, after cruel experience, not to confound real gains with differences in rates apparent at a time of depreciation.

Proposed International Action.—At the London Conference of the Allies, Feb. 21—March 14 1921, the Austrian Chancellor, Dr. Mayr, submitted a proposal for the application of the Ter Meulen Scheme to Austria, and Great Britain, France, Italy and Japan decided to suspend the mortgages which guaranteed their credits to Austria. Dr. Mayr's proposal was referred to the League of Nations. The Financial Committee met at once, and sent to Vienna (April 15 1921) a delegation consisting of M. J. Avenol, Sir Drummond Fraser and M. Glückstadt, whose recommendations were accepted by the league and forwarded (June 3) to the Supreme Council. But the suspension of all the mortgages encumbering Austrian assets on account of repara-

tions and credits for reconstruction necessitated negotiations with 18 states. While they were proceeding, the situation became worse and the project fell through. The actual situation in Austria went from bad to worse.

Once more the Entente Powers had to come to the help of Austria and consented to advance funds, partly for the formation of a new bank of issue. The British credit of £2,250,000 was used, however, in a vain attempt to support the crown for a few weeks. After it was exhausted the depreciation of the crown was accelerated, accompanied by an immediate rise of prices. The long foreseen collapse seemed inevitable.

The food subsidies, which accounted for half the deficit on the budget, had been suppressed in Dec. 1921 and a budget with revenue to cover 60% of the 348 milliards expenditure had been drawn up for 1922; but the automatic adjustment which it had been necessary to enact between salaries and cost of living led to a rapid increase of expenditure, without any counterpart in increased revenue. In a few months all the estimates were exceeded; prices rose rapidly, and the public felt the burden of reforms more than their necessity. In Aug. 1922 the circulation exceeded 1,000 milliard crowns, and 15,000 crowns were worth one gold crown (140 crowns were equivalent to one centime).

On Aug. 7, Dr. Seipel made a despairing appeal to the Supreme Council, informing it that neither the present Govt. nor any other could continue to administer the state. On Aug. 15 1922 the Austrian question was referred a second time for "examination and report" to the League of Nations, with an indication of the possibility of a plan for making private credits available for Austria, providing such credits would not be wasted like previous ones.

The League of Nations Plan.—In Sept. 1922, thanks to preparatory work and to the atmosphere of the Assembly, of the Council and of the Committee for Austria, presided over by Lord Balfour, invaluable support was obtained, and a plan for the purpose was elaborated.

The Reparations Commission granted an exceptional moratorium, suspended all claims for 20 years, renounced the pledges of its mortgage and announced a similar decision on the part of the states which provided the relief credits, and thus created a basis for credits. The Financial Committee of the League reported that, when all possible economies and reforms had been carried out by the Austrian Govt., a loan of £30,000,000 would be required to put Austria on her feet. They estimated that the charges on the loan could be met, under strict administrative methods, from the proceeds of the customs and the tobacco monopoly. They pointed out that the process of reconstruction entailed that Austria "must endure and support an authority which must endorse reforms entailing harder conditions than those at present prevailing, knowing that in this way alone can the state avoid an even worse fate."

A complete scheme of reconstruction was adopted on Oct. 4 1922, agreed by Great Britain, France, Italy, Czechoslovakia and Austria. It was embodied in three protocols, the first reaffirming Austrian independence and sovereignty; the second stating the conditions of the loan, and the third laying down the functions of the commissioner-general of the League, charged with the administration of the scheme and the reciprocal obligations of the Austrian Government. A delegation of the council, presided over by M. Albert Janssen of the National Bank of Belgium, proceeded on Oct. 17 1922 to Vienna, and remained there until the middle of Dec. when the commissioner-general, Dr. Alfred Zimmermann, took over his duties.

The Geneva protocols put the Govt. under the immediate obligation to take steps to reduce the deficit and to present to Parliament a bill conferring on it full powers to insure within two years the balancing of the budget. The delegation supported the Govt., helped it to organise a bank of issue completely independent of the state and procure necessary financial resources by credit operations. It drew up a programme for budgeting by stages, fixing for each half year the maximum figure for expenditure, and estimated the receipts. The total charges on the state were to fall progressively from 672,000,000 gold crowns to 350,000,000 in the year 1925, so that the deficit to be covered amounted to 520,000,000 gold crowns.

Far-reaching reforms had to be carried out in order to conform with the plan: the provisional delegation and the Govt. had agreed on a scheme of reorganisation providing for the dismissal of 100,000 civil servants, the re-arrangement of departments, the putting of state undertakings on a sound basis, the increase of receipts, and the provision of financial resources for the provinces and communes. This programme was carried out from 1922 to 1925.

The Reconstruction Loan

Inflation was stopped on Nov. 18 1922, and the Govt. aided by the confidence inspired by the new scheme was able to raise short-term loans to meet the immediate needs of the situation. The Committee of Control authorised the negotiation of short-term loans amounting to $10,600,000 in Austria and £3,500,000 raised successfully abroad under the guarantee of the four guaranteeing Powers.

On April 16 1923 the assent of the Committee of Control was given to the raising of the long-term loan, to run for 20 years, redeemable by June 1943. Three trustees, M. Albert Janssen, M. Wallenberg and Mr. Jay, were appointed to watch the interests of the bondholders. The guaranteeing Powers were the four original guarantors, whose guarantee covered 94% of each *tranche*, together with Belgium, Sweden, Holland and Denmark. The following are the details of the issue:—

Market	Total (nominal)	Rate of interest, per cent	Rate of issue, per cent
London	£14,000,000	6	80
New York	$25,000,000	7	90
Stockholm	13,110,000 Swedish crowns	6	80
Amsterdam	3,000,000 guld.	6	80
Brussels	25,000,000 Belgian francs	6	80
Switzerland	25,000,000 Swiss francs	6	80
Austria	$13,000,000	7	93
Paris	170,000,000 French francs	6½	84
Rome	200,000,000 lire	6½	93
Prague	60,000,000 gold crowns	(no public	emission)

The long-term loan yielded the Austrian Govt. 585,000,000 gold crowns, *i.e.*, the sums necessary for the repayment of the obligations incurred to the Allied governments in 1922 and the repayment of the short-term loans plus new money amounting to more than 326,000,000 gold crowns. To this sum should be added a further 20,000,000 gold crowns, lent directly to the Austrian Govt. by the Swiss Govt., and 26,000,000 gold crowns, the yield of the Spanish guarantee. Thus a total sum of 372,000,000 gold crowns of new money was available, sufficient to meet the needs of the Austrian Treasury up to the end of 1924 under the programme of reform.

The New National Bank.—From Jan. 2 1923 the new National Bank of issue, with a capital of 30,000,000 gold crowns, began to function independently of the state, under the presidency of Dr. Reisch. Its cash balance in gold and securities of 93,000,000 gold crowns came in great part from the repatriation of Austrian capital, which had been going on since the initiation of the scheme, the foreign securities held by Austrian nationals being exchanged by them for crowns. The proceeds of the Reconstruction Loan and the speculative influx of capital from abroad, raised the cash balance in 1923 to 300,000,000 gold crowns, that is, to 10 times the value of the bank capital.

The New Currency.—The currency was stabilised at 14,400 paper crowns to one gold crown, this rate being strictly maintained, and the monetary reform of 1924 made the situation still more secure by establishing a new monetary unit, the schilling, on a gold basis, equal to 10,000 crowns, or 0·694 of the gold crown, *i.e.*, containing 0·2117 grammes of fine gold.

Execution of Internal Reforms.—The stipulations of the reform programme in other departments, without being rigorously followed, were carried out courageously. The dismissal of state officials and employees, which proceeded at first at the prescribed rate, became more difficult later on; 25,000 employees had been dismissed between

Oct. 1922 and Jan. 1923, according to plan; at the beginning of July 1924 the figure reached 68,000 instead of 100,000. Up to the close of 1925 the figures reached about 80,000. The high cost of pensions and increases of salary of the personnel employed have prevented the hoped for economies from materialising in full measure; nevertheless the administrative machine has been put on a much more economical footing. The re-arrangement of government departments also disappointed expectations; in April 1923 the number of ministries was reduced from 11 to 7, but the saving effected by concentration and reduction of personnel was outweighed by increases of salary to those who remained. On the other hand, the reorganisation of state undertakings has effected great improvements. Helped by the advice of foreign experts, the Austrian administration has succeeded in making current receipts cover expenses, but owing to the neglect of capital outlay during the period of confusion, the financial needs are still great. The cutting down of expenses went well at first but grew more difficult later; real economies were effected and wasteful expenditure checked, but necessary expenditure on repairs to roads and buildings, and legitimate increases of salary, as well as the service of the new public debt, have counterbalanced the saving.

Budgets of 1923–5.—Austrian experience has shown that it was useless to count on a great reduction of total expenses, but has proved how quickly revenue recovers when the currency is stabilised, and private incomes have adapted themselves to the change. From the moment that the crown was stabilised the fiscal system could work. The state levied direct taxes in the same currency in which the taxpayers received their incomes, and in the case of indirect taxation it profited by the increase in general prosperity and in consumption. Thus the gross revenue from customs and tobacco pledged for the Reconstruction Loan was estimated at 100,000,000 gold crowns a year; but the receipts for 1923 reached 190,000,000, those of 1924, 270,000,000 and those of 1925 are at the rate of more than 300,000,000. The total receipts from taxation have exceeded forecasts, showing that the Austrian state can count permanently on receipts much above 350,000,000 gold crowns per annum. The Council of the League of Nations therefore authorised the Austrian Govt. in Sept. 1924 to budget for a higher amount than that fixed originally. The figure of 495,000,000 plus 50,000,000 for capital expenditure, totalling 545,000,000 gold crowns, has been fixed for 1925. Control will be abolished if these results are maintained, but during the following 10 years it may be re-introduced if the balancing of the budget or the service of the loan should be threatened. The committee of guarantor states will continue to meet periodically until the loan is amortised in 1943.

For three years the commissioner-general has fixed the preliminary monthly budget with the Finance Minister, fixing the figures of expenditure, approving estimated receipts and using the loan to cover the difference. A year after the adoption of the scheme, when the programme estimated a deficit of about 158,000,000 gold crowns per annum, a monthly surplus was recorded. In 1924 and 1925 the total deficit on the budget was less than productive capital expenditure shown by the accounts. Thus a considerable sum remains over from the loan, and the method of its expenditure should be fixed when control will cease, as it seems not to be needed to cover current deficits, as had originally been planned.

The Economic Problem

The re-establishment of a firm financial situation convinced a growing number of Austrians that the Austrian state could carry on an autonomous existence, but hesitation and doubt reappeared with regard to economic conditions. Toward the close of 1923, the adaptation of economic life seemed to take place even more rapidly than the budgetary improvement. Thanks to a restoration of confidence there was a reversal in the movement of capital, which flowed into Austria at the beginning of the reform as quickly as it had flowed out in previous years. The result was that Austrian accounts balanced so easily that the difficulty of the economic problem was lost sight of.

In spite of Press campaigns the National Bank remained faithful to the stabilisation policy inaugurated by Dr. H. Schwarzwald; it absorbed at this time all surplus foreign exchange, buying it from the public and putting it to reserve, without letting the crown appreciate. This policy was the wiser, as the easy balancing of accounts in 1923 was not permanent. Some sources of revenue, such as the repatriation of capital invested abroad, would not recur; others, such as the influx of foreign capital for speculation on the Bourse, were but temporary, and withdrawals would shortly exceed the original investments. This is exactly what happened. Foreign capital, attracted to Austria, did not permanently remain, although the country suffered from lack of capital as a result of the losses due to monetary depreciation.

At the moment when the state realised that with its limited resources it must retrench, financial circles in Austria did not at once realise that, in private business, unhealthy elements should be eliminated. Instead of reserving the exceptional credits at the disposal of the market for productive enterprises, the banks in 1923 were tempted too often to attract foreign capital to all business on the market, whatever its nature. The result was a general speculative rise, rather than an improvement in the conditions of production of promising business.

Industrial Capital.—When the inevitable decline took place in 1924 on the Stock Exchange, the foreigner having then withdrawn his capital, the lack of floating capital was sharply felt in the country. The National Bank, in order to avoid a catastrophe, had to increase its discount business, at the same time that it supplied the foreign exchange necessary for external payments. The rise in the rate of discount, which it was obliged to adopt, stabilised the high rate of interest, to the detriment of production. This rise brought back short-term foreign capital to a certain extent, and thus enabled accounts to be balanced, but it frightened people abroad, who had been disposed to make long-term investments in Austria, by its reaction on the income of business enterprises. Productive business was left with insufficient floating capital. Industrial capital was, in gold values, much less than before the War, for during the depreciation period all reserves had depreciated or had been invested. In the first case they were non-existent; in the second, they had to be converted afresh into floating capital, which could only be done by realising a part, that is, by investing a certain percentage of shares abroad.

Meanwhile, manufacturers had to pay enormous rates to procure funds necessary for the payment of salaries and for raw materials (25 to 28% per annum to the beginning of 1925, then less); net costs and possibilities of sale abroad suffered accordingly, and the conditions of home production made a barrier to export more dangerous than any foreign customs barrier. Under these circumstances, severe unemployment developed; 200,000 unemployed (about a fifth of the working-class population) had to draw relief in the spring of 1925. Building, metal and textile industries and trade were particularly affected, and the effort to reduce costs of production increased unemployment. Owing to lack of outlets, emigration and intensified production were difficult.

The Layton-Rist Report.—This was shown in the report presented to the League of Nations in Sept. 1925 by Mr. W. T. Layton and Prof. Charles Rist. They reported a slow but sure improvement in the economic situation from 1922 to 1925. Austrian economy seemed to them to be suffering from the same evils as the rest of post-War Europe, but more acutely. The increased customs tariffs and the difficulty of commercial relations between states were especially prejudicial to a country like Austria, separated by its new frontiers from its former normal markets. (P. Q.)

Trade and Commercial Policy.—The outstanding feature of the post-War trade of Austria is the large adverse visible balance which is shown in the table below.

	1921	1922	1923	1924
	£	£	£	£
(A) Imports	70,846,000	73,219,000	80,091,500	100,515,000
(B) Exports	37,673,700	44,308,000	47,062,000	57,526,000
Excess of (A) over (B)	33,172,300	28,911,000	33,029,500	42,989,000

The chief imports are fuel, raw materials, cereals and finished goods; exports are mainly iron and magnesite, timber and wooden manufactures, textiles, leather and leather goods, machinery and chemicals.

Tariffs and Commercial Treaties.—The commercial policy of the republic is largely influenced by the situation in Central Europe. The Austrian tariff is mainly designed to provide revenue and give protection to home industries; but it is also intended as a weapon for obtaining commercial concessions from other countries and, with this end in view, the duties on imports were increased in 1925. Commercial treaties were concluded in 1924–5 with Great Britain, Czechoslovakia, Germany, France, the Belgium-Luxemburg Customs Union, Spain, Greece and Norway. These treaties, negotiated by

Dr. R. Schüller, secured appreciable advantages, and the adverse visible balance of trade, which reached 686,000,000 schillings in the first half year of 1924, was only 333,000,000 in the corresponding period of 1925; 73% of imports were covered by sales abroad. The big commercial deficit alarms the Austrian public, which forgets that many prosperous countries before the War paid with exports for a similarly small proportion of their imports (*see* BALANCE OF PAYMENTS). If, in 1913, an economic zone comprising the regions forming post-War Austria had been detached from the rest of the Austro-Hungarian Empire, it would have been seen that this region could be self-sufficing; although it produced materially much less than it consumed, it bridged the gap by other means.

The Position of Vienna.—Vienna was a great international business and financial centre, and, above all, was a reservoir for capital, which she could invest profitably and which returned with increased interest. Vienna also attracted foreigners, and the profits from services that it rendered enabled it to pay for the products which came from other parts of the empire. To-day, the regions composing new Austria remain organised materially as before the War, but monetary depreciation has destroyed a great part of the capital which assisted the provision of "invisible exports." Austria has become a country which temporarily needs capital, whilst retaining the structure of a country which invests capital, and consequently a debit commercial balance.

It is to be hoped that a general diminution of protective tariffs will allow Austrian exports to increase, but it would be foolish to expect the disappearance of the excess of imports in a country which has always imported more goods than it produced. It is normal for Austria to have a large commercial debit balance, and it would not be possible to change that state of affairs, even by devoting many years to the formation of productive machinery in the centre of Europe, already excessively industrialised. It is not normal for Vienna to lack capital, because it has an organisation which has always successfully handled and directed it. The problem with which Austria is confronted is to secure loans, and to make them yield more than they cost until she has been able, out of her national savings, to provide sufficient working capital of her own; economic stabilisation will then probably be attained by Vienna again becoming a European financial centre.

PRODUCTION AND INDUSTRY

During the years 1914–8, agriculture declined very considerably, and a disturbing feature in the new state is the slow recovery that is being made. The following table gives the yield in tons of the chief crops in 1913, 1919 and 1924:—

Crop	1913	1919	1924
Wheat	289,939	139,171	237,662
Rye	604,057	229,503	407,331
Barley	179,443	83,207	158,921
Oats	465,804	197,132	331,902
Maize	78,266	53,735	91,856
Potatoes	1,508,320	544,904	1,524,996
Sugar Beet	403,621	74,190	365,214
	3,529,450	1,321,842	3,117,882

These figures refer to the areas included in the Austrian Republic, except that the figures for 1913 and 1919 do not include the crops of the Burgenland, which represent some 10% of the 1924 yields. Cattle-raising and dairy-farming are suited to the climate and configuration of the republic, and are slowly improving. The following table gives the numbers of livestock in 1910 and 1923:—

Year	Horses	Cattle	Sheep	Goats	Pigs
1910	318,217	2,356,012	301,404	239,340	1,935,536
1923	282,484	2,163,025	597,414	382,204	1,472,821

Mineral deposits are of considerable importance: the chief are iron, magnesite, salt and graphite. The industries of Austria are well organised and equipped, and capable of producing a large surplus for export. The plentiful supplies of iron ore are more than sufficient for the needs of her important metal-working industry, and the forests ensure a constant supply of timber. The lack of coal hampers industrial progress and has resulted in the exploitation of waterpower resources; it is estimated that the total waterpower capable of being harnessed amounts to some 3,500,000 horsepower. The textile, iron, metal-working, electrical, motor vehicle, woodworking and paper-making industries are the most important. Owing, however, to the lack of working capital, the loss of pre-War markets and the post-War financial crisis, conditions in industry are very depressed and a considerable time must elapse before the pre-War prosperity can be regained.

COMMUNICATIONS

The railways of the republic have a total length of over 4,000 m., and link up every part of the country with Vienna, which is an important station on the line from western to southeastern Europe. The railways, over three-quarters of which are state owned, have been reorganised under expert commercial management, independent of the Government. Electrification is rapidly proceeding, and a programme for the electrification of the railways in the western area was laid down in the law of July 23 1920; the first part of this programme was practically completed by the middle of 1925. The river Danube is of great importance, owing to the lack of seaports, as an artery of transport; its value to Austria should greatly increase when the deep water Rhine-Main-Danube canal, under construction, is completed. Vienna has developed into an important centre for aerial services; it is a landing station on the Paris-Constantinople and Prague-Budapest air routes, and a terminus for lines running to Munich and Trieste.

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AUSTRIA-HUNGARY (*see* 3.2), the name given to the Dual Monarchy of Austria-Hungary, dissolved in 1918. Area, 264,062 sq. m.; population, 51,352,429 (1910).

With the annexation of Bosnia and the Hercegovina in Oct. 1908, the Austro-Hungarian Monarchy reached its final form. It consisted of two independent states, whose relations were governed by the Compromise of 1867: the complex in the West which may be termed Austria, consisting of numerous provinces (Kronländer) with local Diets, united by a central Parliament; and the Kingdom of Hungary, a unity affected only by the local independence, under a governor and a Diet, enjoyed by Croatia. The Emperor-King, their common ruler, reserved the unity of control over foreign affairs, the armed forces and certain other matters, in which the people had a voice only in the delegations appointed for the purpose from the respective Parliaments. The annexed provinces were to be absorbed later in the Dualist system, but no agreement could be reached on their destiny. For the moment they were administered by the common finance minister, assisted after 1910 by an elected Diet which was autonomous in internal affairs.

Population.—The last census for the Monarchy as a whole was that of 1910. It gave the total population as 51,352,429 (Austria 28,567,898; Hungary with Transylvania 18,264,533; Croatia and Slavonia 2,621,954; Bosnia and the Hercegovina 1,898,044). No figures for nationality were then given; but figures for the habitual language (Umgangsprache) were given, which must be taken with caution. Apart from the dubious nature of Magyar official statistics, Jews are only reckoned separately in the annexed provinces, while they actually form no mean proportion of the German, Magyar and Polish speakers. Austria puts Serbo-Croat under one heading, Hungary distinguishes Serbs and Croats, but puts Slovene under "other languages."

The approximate racial totals and distribution were: Germans (in the territory of the present republic, the Sudetic lands of Bohemia, Moravia and Silesia, parts of West Hungary, Transylvania and the Banat) 12,050,000; Czechs (Bohemia and Moravia) and Slovaks (north Hungary) 8,500,000; Poles (east Silesia, west Galicia) 5,070,000; Ukrainians (east Galicia, northeast Hungary) 4,000,000; Slovenes (south Styria, southeast Carinthia, Carniola, the Coastland) 1,390,000; Serbs (southeast Croatia, the annexed provinces, parts of the Banat and Bačka in south Hungary) 2,675,000; Croats (Croatia, Dalmatia, the annexed provinces) 3,000,000; Italians and Ladins (south Tirol, Trieste and district, some Dalmatian towns) 800,000; Rumanians (parts of Transylvania and the Banat), 3,250,000; Magyars (central Hungary with Székler settlements in Transylvania) 10,200,000. The official figures were as shown on the next page.

The Balkan Danger.—From the date of the annexation of Bosnia and the Hercegovina (Oct. 1908), the differences which were dividing Europe into two hostile camps centred ever more clearly round the conflict of interests between Austria-Hungary and Serbia. With the Turkish Empire again on the brink of collapse, the Balkans were the field in which any change, however trivial in itself, might develop into a trial of strength involving first Germany and Russia, then all Europe.

Nationalist Movements.—Internal conditions in the Monarchy made a pacific solution of this problem almost impossible. The extension of the franchise in Austria (1907) had not had the desired result of allaying the Nationalist agitation. The Social Democrats, Austria's one international party, emerged indeed from the first elections on the new basis as the strongest parlia-

Racial Distribution in 1910

Language	Austria	Hungary	Crotia and Slavonia	Bosnia and Hercegovina
German	9,950,678	1,903,357	134,078	22,968
Bohemian, Moravian and Slovak	6,435,532	1,946,357	21,163[1]	7,527[2]
Polish	4,965,667			10,975
Ruthenian (Ukrainian)	3,518,882	464,270	8,317	7,431
Slovene	1,253,148	(3)	(3)	3,108
Serb	783,010[4]	461,516	644,955	825,418
Croat		194,808	1,638,354	385,009[5]
	Mahommedan Serbo-Croats			612,137
Italian and Ladin	768,592			2,462
Rumanian	275,088	2,948,186	846	608
Magyar	10,899	9,944,627	105,948	6,443
Other Languages		401,412[6]	67,843[7]	13,958

[1]Slovak; Czech is included in "other languages." [2]Czech and Slovak. [3]Included in "other languages." [4]From religious figures one may deduce 110,000 Serbs, 670,000 Croats. [5]Figure arrived at by subtracting the figures for orthodox Serbs and Mahommedan Serbo-Croats from the total of Serbo-Croat language. [6]Described by the Magyar official statistics as "principally Wendisch (Slovene), Bunyewatisch, Gipsy, Czech-Moravian, Polish, Bulgar and Italian." Estimated figures for Hungary with Croatia and Slavonia on the basis of the 1890 census, 115,000 Slovenes; 200,000 Gipsies. Of the remaining contingents the largest are Czech, Polish and Bulgarian. [7]Includes 7,886 Spanish Jews; 5,419 Gipsies.

mentary party; but only to succumb themselves to disintegration, the majority of the Czech members splitting off into a separate and often hostile Nationalist group. The chief gainers from the extended franchise were the more backward Slav races particularly the Ukrainians and Slovenes. Here the change deepened and complicated the Nationalist movement, and brought its democratic character into increasing conflict with the ruling system. The neo-Slav movement gained in strength, and its political character was increasingly evident and increasingly directed against the organisation of the Monarchy. The central figure of the Russophils in Austria was Kramar, leader of the Young Czech party.

The Young Czechs, the Polish National Democrats, the Pan-Russian party among the Ukrainians and the Slovenes, who were now awakening to the sense of brotherhood with the other southern Slav races, were in violent opposition to their government's policy toward Serbia and Russia. The Austrian Slavs were now in close political connection with the Slovaks, and still more with the southern Slavs in Hungary. The dynasty had long used the Croats as a counter to the Magyars, who in turn had played off the Serbs of Hungary and Croatia against the Croats. But since the resolution of Fiume (1905) the political leaders of Serbs and Croats had united, at first to support the Magyars against the dynasty; but when the Magyars left their help unrewarded they allied themselves with Serbia against Vienna and Budapest alike.

The Slavs of the Monarchy could only have been appeased by a complete reorganisation, involving the abandonment of the Dualist system and probably of the German alliance. They were strongly supported by the Social Democrats, who advocated the transformation of the Monarchy into a "second Switzerland," with complete liberty of development for all its nationalities. Even had it been possible to carry this through peacefully in Austria, it would have led to civil war in Hungary, and probably to war with Serbia. The military party, led by Conrad von Hötzendorf, the chief of the general staff, was prepared to face the latter risk; on several occasions Conrad advocated annexing Serbia bodily. The heir to the throne, Francis Ferdinand, was in close touch with the military party, although by no means always in agreement with their views. With time he had assumed practical control over the army, and it was thanks to his influence that the army reforms, which were urgently necessary, were taken in hand seriously from 1908 onwards. But these reforms aroused almost universal opposition; among the Slavs, who feared an aggressive policy against Serbia, and still more among the Magyars. Francis Ferdinand disliked the Magyars personally and politically, and it was known that his first act on accession to the throne—before his coronation in Hungary—would be to break the Magyar supremacy, either by adopting a system of "trialism" which would elevate the southern Slavs to the position of a third partnership in the Monarchy or by some less drastic form of federalism. But while the prospect aroused the Magyars' fear and resentment, and was at the back of most of their agitation for a national army, the Archduke's ideas were too reactionary and clerical to awaken corresponding hopes among the Slavs.

Rule of the Bureaucracy.—Francis Joseph was in any case too old to change. He clung tenaciously to the German alliance and the basic principle of the Dualist system, the twin hegemony of Germans and Magyars. He had never really either understood or sympathised with the Slav national movements, and as his Slav subjects moved further from his ideas, and as constitutional government in Austria became a real impossibility—the weary Nationalist obstruction had made the proceedings of the Reichsrat and the Diets alike into a tragic farce—he restored the real authority to the hands of the old bureaucracy, which in its higher branches was still mainly German and loyal; while political control was concentrated in the hands of the Minister President alone. Beck's Ministry, which had carried through the electoral reform, fell in 1908; both Bienerth who succeeded him (Nov. 1908—June 1911), and Stürgkh, Austria's last peace minister President, from Nov. 1911 (Gautsch's Ministry, June—Oct. 1911, was only a temporary stop-gap) were absolutists at heart; and in March 1914 Stürgkh dismissed the Austrian Parliament altogether. Up till then, necessary government measures were forced through under paragraph 14 of the constitution, or the parties sold their votes for appointments in the bureaucracy—the logical reply to this policy, but one which would have had the effect, in a few years, of disintegrating the bureaucracy and even the army altogether.

Hungarian Dissensions.—In Hungary Francis Joseph had an ally in Count Tisza. The struggle in Hungary, bitter as it had been, had been to some extent unreal. The Magyar gentry and Jewish financiers who monopolised the seats in the Hungarian Parliament and the political and economic influence in the country differed only on the degree of independence which it was safe to claim; their interests were homogeneous, and none of them could afford to face an electoral reform in favour of the poorer classes and the non-Magyars. Thus the monarch's threat to introduce universal suffrage proved effective. The party of Independence split. The old Liberal party reorganised itself as the National Party of Work and entered Parliament in June 1910, with a large majority. Tisza, who became President of the Hungarian Parliament in 1912, and Hungarian Minister President in 1913, was convinced that the Magyar nation could not afford to do without the backing from Germany and Austria afforded by the Dualist system. He therefore carried the army measures in 1912 with a high hand against the Party of Independence. At the same time, he maintained the claims of his nation and his caste most ruthlessly. The electoral law of 1913, with which his name and that of Lukacs were associated, and which became law but was never applied, was a reform only in name.

In 1912 he crushed a workman's demonstration in Budapest with much bloodshed, and Cuvaj, appointed under his influence in that year to be Ban of Croatia with the powers of a Royal Commissary, suspended the Croat Constitution, and surpassed all records of corrupt despotism; the memory of his rule was not wiped out by the milder period which succeeded it. The unity of the army had been saved and a temporary stability restored in Hungary; but at the price of the final estrangement of the southern Slavs of the Monarchy and the passionate hatred of Serbia, whom the Magyar land-owners, intent on their economic interests, denied the most legitimate outlet for her aspirations.

Home and foreign policy thus moved in a vicious circle. The hegemony of the German and Magyar upper classes alone enabled the Monarchy to show a strong face to the world and to reorganise the army. But it put a peaceful solution of the Serb problem out of the question, while the discontent of the Italian

and Rumanian minorities in the Monarchy aroused the hostility and ambition of Italy and Rumania, and endangered Austria-Hungary's understandings with these countries.

War Foreseen.—From 1908 the war party was convinced that a conflict was inevitable. Its members urged a drastic solution of the Slav problem, and rapid reform in the army. Conrad was in favour of annexing Serbia in 1909, and in 1911 he advised a " defensive war " against Italy while she was engaged with Turkey in Tripoli. Francis Joseph, however, earnestly desired peace and believed that it could be maintained; partly, no doubt, because only the most optimistic reports were allowed to reach his ears. Aehrenthal also wished and worked for peace, and with some success, once the storm after the annexation had been weakened. He therefore offered Italy a free hand in Tripoli in return for non-interference with Austrian plans in the Balkans. The Allies were drawn together by the common desire to prevent Serbia's access to the Adriatic, and united in their Albanian policy; the Triple Alliance could therefore be renewed as early as Dec. 1912.

The Balkan Wars.—The Balkan wars (*q.v.*), however, put Berchtold, who became Foreign Minister on Aehrenthal's death (Feb. 17 1912), in a most difficult position. An active pro-Turkish policy was impossible in view of the feeling among the Slav populations and the danger of a conflict with Russia. Austria-Hungary remained a spectator, and carried her point as regards Albania, so that Serbia was still denied an outlet to the Adriatic. But she could not prevent Serbia from joining hands with Montenegro across the Sanjak of Novi Pazar, so that these two countries, while remaining her irreconcilable enemies, were now increased in strength. In the Eastern Balkans her prestige diminished. With Rumania allied with Serbia against Bulgaria, to intervene in Bulgaria's favour meant disappointing Rumania; not to intervene meant the loss of a potential ally against Serbia. In fact, Austria-Hungary worked for a compromise; disappointing Bulgaria, whom her efforts could not save from dismemberment, and estranging Rumania, who now showed a marked desire to join the Russian camp, with, presumably, designs on Transylvania. There was a grave danger that all Balkan states would reunite in a new Balkan League under Russian leadership against the Monarchy. To prevent this, one secure ally was necessary, and Austria-Hungary urged that Bulgaria was the most suitable, while Germany believed that Rumania should be made safe, even at the cost of sacrifices. The Viennese policy prevailed. From March 1914 on, the chief aim of the Central Powers was to secure Bulgaria as a firm ally. Meanwhile, Rumania grew more hostile, Irredentism increased in Italy and Serbia's hatred was unbounded. In June 1914 Conrad drew up a memorandum describing conditions in the Balkans as intolerable. Rumania must state her attitude clearly, Bulgaria be induced to sign a definite alliance. Berchtold hoped to unite Rumania, Bulgaria, Greece and Turkey in a new Balkan League against Serbia.

Outbreak of War.—When the news of the murder of Francis Ferdinand at Sarajevo on June 28 reached Vienna, all those in authority, except Tisza, considered the time had come for a reckoning with Serbia, to whom, in spite of the negative report of the investigators, they ascribed the guilt of the murder. It was understood that Germany would support her Ally in a conflict with Serbia; and Conrad reported that the military situation, even in a World War, would be better now than later. On July 23 an ultimatum was despatched to Serbia, containing conditions of which the rejection was inevitable. In fact, Serbia accepted nearly all the conditions, but the die once cast, the advisers of the Monarchy refused to draw back. They rejected all efforts of mediation, and declared war on Serbia on July 28. Within a week the World War had broken out; Austria-Hungary and Germany were pitted against Serbia, Montenegro, Russia, France, Belgium and Great Britain, with her daughter states (*see* EUROPE).

The Monarchy's internal dissensions were little apparent on the outbreak of the War. Among the troops, only the Czechs were partly disaffected. The civilian opposition, both Nationalist and Democratic, declared for the Govt. if without enthusiasm. In Austria, the bureaucracy and military were already in charge, Parliament having been suspended in March, and could carry through mobilisation, militarise the War industry and much of the administration and justice and establish a state of siege, without interference. This dictatorship continued in fact for nearly three years, during which censorship and courts-martial solved the complications of internal politics. In Hungary, Tisza's régime left the " nationalities " and lower classes equally helpless; the Magyar " gentry," however, still met in the Hungarian Parliament and thus, as the only vocal class in the Monarchy, acquired a dominating influence in its politics.

The effects of the nationalist discontents were, however, immediately apparent in the foreign relations of the Monarchy. Although she could conclude alliances with Turkey (Aug. 5 1914) and Bulgaria (Sept. 6 1914), her two former Allies, Italy and Rumania, not only admitted no *casus foederis*, but demanded territorial concessions as a price for their neutrality. Burian, who succeeded Berchtold on Jan. 13 1915, at last consented to surrender some districts in Austria—a step urgently advised by the German and Austrian High Commands—but was never able to concede what the Entente offered. Italy therefore concluded the Treaty of London on April 26 1915, and declared war on May 23. Rumania hesitated longer, but, as Tisza passionately refused to yield an inch of soil in Transylvania, Rumania also declared war on Aug. 27 1916.

The Polish Question.—Meanwhile the fatal difficulties of the Polish question had become acute. Russia was driven out of " Congress " Poland, Warsaw falling on Aug. 5 1916. The Central Powers administered the country provisionally by means of two provincial governments in Warsaw and Lublin respectively. But when Russia refused to take the province back at the price of leaving the Entente, neither Ally would allow the other complete control over Poland, and both were embarrassed by the ambiguous attitude of their own Polish subjects. No settlement of the question could be reached. The Poles of Austria, Germany and Russia worked together very skilfully to get the best out of any possible situation, including the defeat of the Central Powers. In the hope of securing Polish soldiers, a proclamation on Nov. 5 1916 promised the restoration of an independent Poland as an hereditary constitutional monarchy. Galicia was to receive increased autonomy within Austria.

Blockade of Austria.—This proclamation was almost the last act of Francis Joseph, and the concession was sweetened by the news of the military success in Rumania. But it was the beginning of the national concessions in Austria, while Hungary had already struck a blow at the unity of the Monarchy. Early in 1915, Tisza had closed the Hungarian frontier against the export of foodstuffs to Austria. Such small quantities as were later released were bought at the secret price of a further alteration of the " quota " in Hungary's favour. The blockade, the loss of supplies from Hungary and Galicia—ravaged in the first fighting—and the diminution of home production consequent on shortage of human and animal labour made the food situation in Austria already desperate, especially in the towns; the country districts shut themselves off, held up supplies and ran up prices in defiance of the law.

Foreign Nationalist Committees.—The Czechs and southern Slavs had established foreign committees in 1915, while the disaffection in their home provinces was growing rapidly. The latter were still hampered by mutual jealousies and by the commitments of the Entente to Italy. Only a minority favoured the " Great Serb " solution proclaimed by the Serb Govt., the majority inclining to a " Great Croatia " or a Yugoslav Union under the Habsburgs. The Czechs, too, worked still for autonomy within the Monarchy. But their troops were by now quite unreliable, and the protracted trial of the Young Czech leader Kramář proved how very widespread was this anti-Austrian and this pro-Russian feeling.

While the dominant classes of the Germans supported the dictatorship as indispensable and were even considering a new arrangement for the future Austria under which the German

hegemony should be established securely, war weariness and discontent were growing among the working classes. But they were too cowed and too lethargic to protest, until Friedrich Adler, the Socialist leader—at the time a solitary figure—did this in startling fashion by shooting Stürgkh dead on Oct. 21 1916, "as a demonstration."

When Francis Joseph died (Nov. 21), his successor Charles, a young man of undoubted good intentions but mediocre ability, thus found a very difficult situation, which he hoped to solve by a change of régime. Conrad von Hötzendorf exchanged the post of chief of the staff for an army command, and there were other important military changes. Count Czernin became (Dec. 22 1916) Foreign Minister and real head of the government.

Peace Proposal of 1917.—The March revolution in Russia gave a great impetus to the Slav national movements and to the Social Democrat agitation, which was more perceptible as the military pressure on the population was now relaxed. Charles and Czernin saw the danger and worked hard for peace. The Emperor opened up secret negotiations with the Entente through Prince Sixtus of Parma, and promised in a letter of March 24 1917 to support the "just claims" of France to Alsace-Lorraine. These negotiations broke down, however, as Italy insisted on the full measure promised her in the Treaty of London. Czernin now turned to the Germans and asked them to offer peace, renouncing Alsace-Lorraine for compensations in Poland. This Germany refused to do, although she would have taken Poland, giving Austria-Hungary compensations in the Balkans. It became clear that Germany would turn her armies on Austria if she abandoned the alliance. Czernin could not face this danger and was obliged to continue the war, and even to consent to Germany's wish for unlimited submarine activity.

Meanwhile, an attempt was made to allay discontent at home. Charles called on Tisza to introduce electoral reform with soldiers' votes in Hungary. Tisza resigned on May 22 1917 and a fresh Hungarian Cabinet was formed to carry through the reform. A general amnesty (July 2 1917) was issued for political offences and the Austrian Parliament summoned on May 31 1917.

Nationalist Claims.—But its first meeting showed how far popular ideas had moved. The Poles demanded an "independent and united Poland," declaring that the Polish question was one for international consideration; the Czechs, that the Monarchy be "transformed into a federal state of free and equal national states"; the Slovenes, that all southern Slavs of the Monarchy be united into one independent democratic state under the Habsburgs; motions which involved the end of the Dualist system. The Austrian Social Democrats supported the claims of the Slavs. Adler's trial (May 18–19 1917), during which he delivered an extraordinary indictment of prevailing methods, gave them courage and a programme.

The Poles were finally alienated a few months later. A separate peace with the leaders of Soviet Russia was signed on March 3 1918 at Brest-Litovsk. During the negotiations a Ukrainian delegation appeared, claiming autonomy. Czernin signed (Feb. 9) a separate peace with them by which he allowed the district of Kholm to be included within the frontiers of the new Ukraine, and Austria's Ukrainian districts, East Galicia and the Bukovina, to be formed into an autonomous Crownland. These concessions infuriated the Poles, who had acquired their independence from Soviet Russia. They turned their backs on Austria, and from now on were practically independent. Meanwhile, the peace with the Ukraine failed to achieve the hoped-for results. It had been dictated by the urgent need to replenish Austria's food stocks, but the armies of occupation could send few supplies into Austria owing to the breakdown of communications, and their requisitionings turned the inhabitants into enemies. The shortage continued to be terrible. It had already led to a strike in Jan. 1918 in the Austrian and Hungarian munitions districts, which almost amounted to a revolution, when the Govt. had had to make terms with the workmen's leaders.

America's entry into the War increased the hopes of the remaining Slavs, especially since the new régime[1] in Hungary proved quite powerless in the face of the opposition of Tisza's party, and the position of the non-Magyars grew no better. It was, however, impossible for the Emperor to negotiate on the basis of the Fourteen Points in face of the attitude of Germany, while the Magyars would have answered any attempt to satisfy southern Slav and Czechoslovak wishes by breaking with Austria and probably joining hands with Germany against her. This fear kept Austria true to the alliance, and temporarily restrained the nationalist and revolutionary movements while Germany was rallying for her great military effort of 1918. At the same time, Clemenceau's revelation (April 1918) of the Sixtus negotiations strained the alliance badly, and irreparably damaged the prestige of the dynasty among its German and Magyar subjects. When the great German and Austrian offensives had shot their bolt, the national movements revived. In the course of the summer the Entente recognised the Czechs as a belligerent power, and all the Slavs began to see that the break-up of Austria would give them more than her continued existence. The Slavs now based their calculations on a break-up, the Austrian Social Democrats had adapted theirs in their party conference of Oct. 1917, and the party in Hungary which demanded complete independence with democratic reforms and immediate peace grew very strong. Desertions at the front and mutinies in the hinterland grew rife; the fleet mutinied on a grand scale and hoisted the red flag (Feb. 1918).

Request for Peace.—On Sept. 15, the Bulgarian front broke. The Armistice of the 29th left Hungary unprotected. The Magyar regiments demanded to be sent home to guard their own frontiers. The Govt. was distracted between the centrifugal demands of the Slavs and the insistence of the Magyars on Hungary's integrity. On Oct. 1, the Minister President of Austria announced that Austria was to be transformed into a "federation of free States." Two days later, Austria-Hungary, with her allies, begged Wilson for an Armistice. Meanwhile, the Poles proclaimed their independence in Warsaw on Oct. 7, the Ukrainians summoned their National Council for the 19th, the Czech Govt. was formed in Paris on the 14th. On the 16th, the Emperor issued a manifesto promising that every nation should form a separate state. But the Magyars had threatened separation unless a clause were inserted that the integrity of Hungary should not be affected thereby; this stultified the whole proclamation. Meanwhile, the Hungarian peace party had the country behind it, and the Slovaks, Serbs and Rumanians of Hungary were at last able to voice their demands. The Germans of Austria prepared to erect their own state, as the Emperor's manifesto had sanctioned. Viktor Adler, speaking for the Social Democrat party, demanded that Austria should become a federal state of the German Reich; the other parties were still Monarchist.

Break-up of the Monarchy.—On the 31st, President Wilson replied that the complete satisfaction of the Slavs was a condition of the Armistice, which was now vital to Austria, since a fresh Italian offensive had commenced. First the Magyar, then the other troops—the Germans excepted—left the front for their own countries. The Austrian fleet handed itself over to the Croats. In the last days of Oct., autonomous governments were formed in Prague, Laibach, Sarajevo, Trieste, Cracow and Lemberg, and a neutral Govt. was set up in Vienna to liquidate the central administration. On Oct. 27 the Foreign Minister accepted Wilson's conditions regarding the rights of the nationalities, "especially of the Czechoslovaks and Yugoslavs." The Dualist system was officially abandoned. On the 30th a national Hungarian Govt. was formed in Budapest; on the 31st Tisza was assassinated. The provisional Govt. in Vienna declared the legislative power to rest with itself, the executive with a National Council to be elected immediately. The Socialists and German Nationalists now demanded a republic. On Nov. 2 the Emperor accepted Italy's conditions for an armistice. The Austrians ceased hostilities on the 3rd, the Italians on the 4th. On the 11th, the Emperor renounced his share in the conduct of government; on the 12th, the German-Austrian Republic was proclaimed last of the Succession States (*see* EUROPE).

[1] Count Esterhazy formed a Hungarian Cabinet in June, and was followed two months later by Wekerle.

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AUSTRIAN LITERATURE.—The literature of Austria is so closely connected with that of Germany that in order to get a correct perspective of the subject during the years between 1910 and 1926 one must bear in mind the chief phases through which German literature has passed in the same period. These may be described as (1) naturalism, not the uncompromising aggressiveness of Holz and Schlaf, but of a mitigated and domesticated species; (2) neo-romanticism, which from about 1910 was also made to suit the average public; and finally (3) expressionism, a movement that is opposed to, and yet is linked up with its predecessors.

Although Austrian literature has passed through the same stages, it has preserved its own specific and unmistakable characteristics, due before the World War to the peculiar position of the Alpine and Sudetic Germans within the Habsburg monarchy, and their close, albeit hostile relations, to so many other nations; due after the War to the revolution and other crises. But many distinctive traits of Austrian literature must be explained from causes common to pre-War and post-War conditions: from the history of the country as an autonomous body politic, geographical features, its Roman Catholicism and its various local traditions. Especially the temperament and mentality of the people of Vienna, which is, and always has been, a literary centre, have modified to a certain extent the Austrian development of German tendencies in general. The Viennese have a vivid perception of beauty as well as of sentiment and of fun; they love music, nature and everything spectacular; they are endowed with a subtle taste in art. On the other hand they take life as easily as possible, by avoiding everything unpleasant. They dislike extremes, are always glad to compromise, and usually take little interest in metaphysical phenomena and problems. Since 1914 this mentality has undergone a slight change, but it will be found faithfully expressed in a great part of pre-War and post-War Austrian literature.

Three Periods.—There are three distinct periods in modern Austrian literature. In the first period are to be found those authors (best known abroad), who in the '80s and '90s laid the foundations of the Austrian "Moderne" on the basis of realistic or neo-romantic principles. These men by now have either completed their life-work or at least are not likely to reveal any new features, although their former leader, Hermann Bahr, is a perfect Proteus in versatility. There are secondly, those writers who between 1900 and the World War, represented various aspects or combinations of realism and romanticism; and lastly, the authors of the War and post-War period: most of them, but not all, influenced by expressionism. This division is by no means arbitrary and, if applied without pedantry, it gives an adequate survey of modern Austrian literature.

These three groups are easily distinguishable, if we turn to the field of lyrical poetry. The leadership among the "old moderns," must be awarded to Hugo Hofmannsthal. He is pre-eminent in the school originated by the Rhinelander Stefan George in opposition to the crude naturalism of the early '90s. His style may best be conceived by thinking of him as a reincarnation of Swinburne, to whom he is deeply indebted. There is the same exuberance of language, the same gorgeous imagery, the same quest for subtle beauty and the same interest in complicated or abnormal psychical phenomena; Hofmannsthal's personal characteristic being an elegant weariness, an aristocratic aloofness from everyday matters.

The next group consists of lyric poets, more or less under the influence of Hofmannsthal: Wladimir Hartlieb, Hans Müller, Alfred Grünewald, Stefan Zweig, Otto Hauser, Felix Braun, Paul Wertheimer, Max Mell and the passionate Anton Wildgans. But the third group follows the banner of expressionism, and is characterised by a conscious, nay deliberate disregard of the laws of logic and of metre, and an all-embracing love of the universe and of mankind as a part of it, reminiscent of Walt Whitman and the French unanimists. Albert Ehrenstein, Franz Werfel, Georg Trakl (d. 1914), Karl Schossleitner, Friedrich Schreyvogl, the painter Uriel Birnbaum may be mentioned here; and there is a certain affinity in matter and thought between their poems and those of the powerful satirist, Karl Kraus, and of the labour poet, Alfons Petzold (d. 1923), although in age both belong to an earlier period, as well as Peter Altenberg (d. 1919), equally original in life and art, whose short "prose poems" sometimes possess an irresistible charm and a childlike wisdom.

Independent of these groups are Richard Kralik, Karl F. Ginzkey, Richard Schaukal, the religious poetess Enrica Handel-Mazzetti, Erika Spann-Rheinsch, the Tyrolese poets Arthur Wallpach, Karl Dallago, Heinrich Schullern, all belonging to the school of the old romantics rather than to the new.

Narrative Literature.—In narrative literature also the "moderns" of the '90s hold their own with their younger competitors, and in some cases are ahead of them. In the forefront are Arthur Schnitzler and Jacob Wassermann, the latter an immigrant from the German Reich. Both have mastered the technique of fiction, and have never quite lost touch with naturalism. Both deal especially with the present day and the life of great cities, Schnitzler devoting himself chiefly to personal problems, Wassermann, with no common imaginative power, to social questions too. Among Schnitzler's rivals may be mentioned: Bahr, the founder of the Austrian "Moderne", Raoul Auernheimer, Felix Salten, Hans Müller, Paul Zifferer, Robert Musil and among the younger generation, Ernst Lothar; while Otto Stoessl's measured and thoughtful style is somewhat reminiscent of Wassermann.

The next group which appeared about 1908 adopted an attitude of tacit opposition to the Schnitzler school; the scenes of their novels are laid for the most part, not in Vienna, but in the provinces, and the leader of this "Kailyard" movement is the Styrian, Rudolf Hans Bartsch, an emotional writer with a fervid imagination and a florid, sometimes ecstatic style, a master in the word painting of landscapes. He had numerous followers, who shared his power of giving speech to nature, and his sympathy with the life of the countryside and the provinces. These were Ginzkey, Karl H. Strobl, Franz Nabl, Robert Hohlbaum, Josef F. Perkonig, Hans Sterneder, Hans Hammerstein—and again a separate group of Tyrolese: Hans Hoffensthal (d. 1915), Dallago, Schullern, Albert Trentini.

The historical fiction of Austria, after having been severely boycotted by "thoroughgoing" naturalism, received a fresh impetus before the War from the philosophic writers, Josef Popper-Lynkeus, Erwin G. Kolbenbeyer, Emil Lucka, all excelling in technique, vividness of style and depth of thought. It was also influenced by the devout Handel-Mazzetti and the learned Otto Hauser—and in their wake Alma J. Koenig, Hermann Graedener, Braun and Egmont Colerus have followed. Hohlbaum, endowed with a great wealth of invention, wrote successful novels giving, if considered as a series, the development of the German "Geist." The last generation of novelists, the writers of the War and post-War period, are characterised by weary resignation, by passionate negation or assertion of the life force. Spiritualism, occultism and religion have become fashionable

again, and find expression in novels of terror and in Wellsian Utopias. Otto Soyka, Franz Spunda, Paul Busson, (d. 1924) Franz Rebiczek and Rudolf J. Kreutz, a no-more-war novelist, may all be included in this category. The eminent prose work of Kraus, begun as early as 1899, stands apart from the main stream.

Drama.—In the drama of the period under revision the modified naturalism of the Schnitzler school and the new romantic or neo-baroque style of Hofmannsthal have held their own, but the leadership is undoubtedly with the Tyrolese, Karl Schönherr. Society comedy with its graceful discussion of erotic problems continues to be cultivated in the Schnitzler manner, by Bahr, Salten, Wertheimer, Auernheimer, the Shaw apostle Siegfried Trebitsch and Kurt Frieberger; and, quite recently, by Hofmannsthal, too. On the other hand, Mell and Georg Terramare attempted to revive the mediaeval morality play, suggested by Hofmannsthal's arrangement of *Everyman* in 1912. Otherwise the neo-romantic drama shows only a poor harvest (Richard Beer-Hofmann, Braun, Zweig). Next to Schönherr's super-realistic plays are to be mentioned the dramas of Wildgans, whose style indicates clearly the transition from unrelentingly cruel naturalism to ecstatic expressionism. This reaction directed against the mere exact rendering of visual and acoustic phenomena as well as against the academic and somewhat anaemic ideals of the neo-Romantics, was begun in the pre-War Empire and eagerly followed in post-War Austria: it restored and enhanced the poet's ego and liberated the drama from all the conventions hitherto determining form and subject. The young dramatists Arnolt Bronnen, Franz Th. Csokor, Oskar M. Fontana, Hans Kaltneker (d. 1919), Walter Eidlitz, Otto Marbach and Richard Billinger are all followers of this school, but Werfel has shown the greatest creative power among his contemporaries. Hans Müller has tried his hand in diverse styles.

The Vienna Burgtheater, which formerly gave the lead to theatrical and, in some degree, to dramatic art in Germany, had already been deprived of its hegemony before 1900, and now has a dangerous rival in Max Reinhardt's *Theater in der Josefstadt*. The annual summer festivals in Salzburg are also due to Reinhardt's initiative.

See H. Naumann, *Deutsche Dichtung der Gegenwart 1885–1924* (1924); Chr. Touaillon, in *Oesterreich in Wort und Bild*, edited by C. Brockhausen (1925); J. Bab, in *Das deutsche Drama*, edited by R. F. Arnold (1925). (R. F. A.)

AUTOGIRO: *see* AIRSCREW.

AUTOMATIC MACHINERY.—The greatest single advance that has been recently made in the evolution of machine tools has been that of movements which are effected without requiring the direct interposition of the attendant.

Speeding-up.—With the rapid growth of automatic movements, general speeding up has become increasingly necessary in order that inoperative intervals shall not check the rapid sequences of tooling. A notable result has been the growth of time studies, and the functions of the route men in the shops. This also has been vastly quickened by the general substitution of tools of high speed steels for those of carbon steels, the increase in speed being approximately three to one. A consequence is that it now becomes increasingly difficult to prevent the time spent in fixing up work from lagging behind that occupied in actual tooling. A solution is reached partly by the use of fixtures to receive the work, partly by continuous methods of tooling on rotating tables, and by modifications in the details of machines, included in the vast subject of machine design.

The advances that have been made in automatic movements may be broadly classified under three heads—the supply and feeding of the work blanks, the details of tooling, and the multiplication of the tool-holding and of the work-holding equipments. Nearly all recent machine tools have been influenced by these changes in some degree.

The great compelling influence that has galvanised these swift developments has been the production of component parts in large quantities, the adoption of which is now imperative in all highly competitive manufacture. The output is vastly larger now from a modern machine than from its very recent predecessor of less than ten years since. And equally essential and remarkable is the fact that all the parts produced in almost incredibly short periods will interchange without corrections. These results, impossible of attainment in the older practice, are commonplace facts in the new designs and conditions. (*See* MASS PRODUCTION.)

Work Blanks.—The feeding of the work blanks is the first stage in an automatic scheme. It occurs in two forms—one embracing pieces of small diameter that are not rotated on centre points as in a common lathe, but which are fed through the hollow spindle of a headstock and gripped during the tooling with some form of collet chuck at the front; and the other, that of articles too large in diameter to be passed through the spindle, but which are inserted and chucked from the front. In each, intervention on the part of the attendant is frequently dispensed with. In the first, a self-acting toggle mechanism at the tail of the head-stock grips the hinder end of the stock bar and feeds it forward through the spindle immediately a piece has been tooled and severed, and the same movement grips the front end in the spindle by the automatic closing of the collet chuck, when the tooling of the succeeding piece commences.

The duty of the attendant is limited to the insertion of a new bar as often as the previous one has been used up. In the second case, that of articles too large to pass through the hole in the spindle, limited usually to about 4 in., a chuck is screwed to the nose of the spindle. When the volume and the shape of the articles permit, these also are fed automatically by sliding them by gravity down a chute, with a few exceptions the attendant has then to place the work in the chuck. But this is never the older form with gripping screws that are tightened individually on the work. In the greater number of instances this is an "adapter," designed precisely for the shape of the work, and closed instantaneously with the same mechanism that operates the smaller collet chucks used for bar work. A variant on this, the use of which is increasing, is the pneumatic chuck opened and closed with compressed air, all trouble with screw adjustments being eliminated. And where a large volume of repetitive work is in hand, the chucks are designed for that alone, or a standard chuck is adapted by fitting false jaws in iron or steel to suit it.

Grinding.—In the latest method of grinding, the articles are neither mounted between centres, nor fed by the movement of a table, nor is the grinding wheel traversed. The time commonly occupied in drilling centres and in chucking between head and tailstocks is wholly saved, with the result that grinding is accomplished in about one-third of the time that is occupied in the ordinary machines. And being centreless, the allowances left for grinding can be smaller.

The rotation and feeding of the work longitudinally are effected with one wheel, the grinding is done with another, the peripheries of the two facing each other, and revolving in opposite directions. The pieces, which are usually short, are brought through a chute to the wheels, and discharged into a box when finished, so that the cycle of movements is wholly automatic. The principle is simple. The controlling wheel rotates at the relatively slow speed at which work is run, and being in close contact with it, drives it frictionally at the same speed, while the wheel that grinds and is opposed to it, and driven independently, running at the peripheral speed of grinding wheels, from 5,000 to 6,000 ft. surface speed per minute, removes material. The exact amount ground off is controlled by the micrometric radial settings of the two wheels, which also effects the settings for pieces of different diameters within the range of capacity of the machine.

The automatic feeding is effected by the inclination of the axis of the controlling wheel in relation to the axis of the grinding wheel. If the axes were parallel, the work would be merely rotated, but the angular disposition combined with rotation compels the work to move endwise. The rate of feed is determined by the amount of angularity given to the controlling wheel, the range of which is from 0 to 6 degrees. Only in one machine is the feed imparted by giving the angularity to the rest that supports the work between the wheels. These machines work to best advantage on short pieces of moderate diameter, not exceeding about 12 in. long by 4 in. diameter, but this

embraces a vast quantity of spindle stud and pin work. The same machines will shoulder small pieces, in which case the longitudinal feed is not used, but only a radial movement.

Tooling.—The details of tooling and of tool equipments are much more highly elaborated than they have been. This work is now allotted to specialists, the tool setters, in the tool room. Arrangements may be very simple, or extensively elaborated. But always the cost of tool making has to be correlated to that of production, the controlling factor of which is the number of pieces to be tooled. If these total to many thousands, the cost of the tool equipment divided among them is negligible. The same relation holds in elaborated work—holding fixtures, and tool-controlling jigs, which now fill so large a place in manufacture. Cost is only relative, the essential being the rapid and uniform production of very large quantities. An immense number of small articles that involve several separate tooling cuts—turning, drilling, boring, threading, within fine limits—are produced in periods that are measured by one or two minutes, and at a cost of a fraction of a penny. These are triumphs of the tool designer, associated with the automatic arrangements of the machines.

All advanced tool arrangements now are based on the principle of multiple cutting. That is, several tools, or tool edges, or points, operate either at the same time, or in very rapid succession. The most familiar example of this kind is the older one afforded by the screw machines and turret lathes, with their polygonal turrets, each carrying its tool or set of tools, on the several faces, and the cross- or cut-off slide with tools supported both at front and rear. After the various tools have been set up, their action is wholly automatic under the operation of cams and stops. Some turret faces may be occupied with simple turning tools, or drills, or taps or dies, but others carry veritable batteries of tools, that perform several distinct operations, or turn several diameters.

Turning.—Invention has taken a more specialised direction, to deal with a large volume of work for which turning and facing alone are employed, and for which the extensive elaboration of the turret lathes would not be economical. For this, the turning-machines built broadly on the lathe model are designed. In these, the work is carried between the centres of head and tail-stock, and is turned with batteries of tools clamped to rests supported at front and rear of the lathe bed. The possibilities of so simple a scheme are immense. Within the limits imposed, they far exceed those which the turret lathe affords. Details differ widely in various machines, but the feature common to all is that a large number of simple tools, not forged, but severed from plain rectangular bar and suitably ground, are carried rigidly in holders clamped down to the tool base, and fed automatically, those at the front in a longitudinal direction, those at the rear radially inwards for shouldering. By the aid of suitable forms, tapered or curved outlines can be produced as readily as parallel pieces. As many as ten or a dozen separate tools can be mounted on a single bar, each having minute radial adjustments with a screw.

In addition to the multiplication of tools, there is a feature which increases economy. In many shafts and spindles having several diameters and shoulders, one portion is often much longer than others. Then the tools are set so that the time occupied in cutting this length determines the periods of all the other cuts, so that when the maximum length has been turned all the others are completed. The economy is often carried farther. If one length is very much in excess of the others, two tools are apportioned to deal with that, in tandem, the hinder finishing where the leading one had commenced.

The work of the automatic turning machines is usually limited to pieces that are carried between centres, or, which having been bored elsewhere, are mounted on arbors supported between centres. If this should appear a limited range of functions, it is not so, remembering the immense numbers of short shafts, spindles, shouldered and flanged elements that enter into motor work, and into the gear cases common now on nearly all machine tools. Lengths of pieces are generally limited to about 20 in., and diameters are moderate. But within these limits, given a constant product, they are more economical than any other lathe or turret machine. In some modifications, lengths are extended to take motor crank shafts, and cam shafts, with corresponding increases in the numbers of tools.

Work Holders.—The multiplication of work holders, and of corresponding tool-holding equipments, is an equally striking development. If the turret lathe with a single work spindle has lost ground before the invasion of new machines in one direction, the principle has made headway in others. Given a very large product, the greatest demands for which are now made by the builders of motor vehicles, the single spindle automatic lathe is being surely displaced by lathes that have from three to five work-holding spindles all having their bearings in a rotating head which is locked at each station while all the pieces in all the spindles are being subjected to simultaneous tooling operations from tools mounted on bars aligned with the spindles, and the numbers of which correspond with those of the work-holding spindles. During a single revolution of the head, an article will be completed, or if it is of a simple character, two may be produced. All the movements are automatic.

The multiple spindle automatics fall under two groups, those for bar work, and those for chuck work—the same division that exists in the single spindle automatics and turret lathes. In the first the stock bars are fed through the hollow spindles with toggles, and gripped during the tooling. In the second the work is chucked from the front by an attendant stationed there. The chucks used have jaws suited to the shapes of the work, and give an instant grip.

Continuous automatic work is done on machines with horizontal work tables that rotate constantly. Chief among these are the vertical spindle milling-machines and the grinding-machines of the same class. A circular table, or, as often, a fixture attached to it, or for some light grinding, a magnetic table rotated without intermission, receives large numbers of small parts, as races for ball bearings, levers, etc., which are all tooled in the course of a revolution, removed and replaced by others by an attendant stationed at one locality.

Lubrication.—In all these machines lubrication and cooling are amply provided for. Not infrequently as much as 15 gal. of cooling compound are pumped automatically over the tools and the work per minute. In some machines the supply is automatically cut off the instant that a series of operations is completed.

Gear Cutting.—In the extensive field of gear tooth cutting, automatic provisions have been made as nearly perfect as possible. In all the later machines, indexing is effected without interference by the attendant. In those machines where both sides of a tooth are being cut simultaneously, whether they use a hob, a rack, a pinion cutter or planer arms, movements are automatic from the setting up until the completion of the gear. In these also the indexing is performed after every cut, so that many revolutions of the blank have to be made before the teeth are finished to their correct depth and section. When opposite sides of teeth are cut alternately, risk of local heating is lessened by taking a central gashing cut all round first, using a form cutter, and finishing each side subsequently with lighter cuts.

Recording.—Automatic recording fills an essential place in many mechanisms. By means of it an inspector can read results that are plotted on a sheet of paper without watching the actual recording. It is used on gear tooth testing machines, on pyrometrically equipped furnaces and in a number of other industrial operations.

Automatic movements include services of the machine shops. Feeding chutes are supplied in increasing numbers to supply blanks to machines. Work is brought to, and carried away from machines on moving conveyors, in place of hand carrying, wheel barrows or trucks. Motors are assembled while travelling on conveyors past the workmen, each of whom contributes his little quota to the building up. Work is carried between floors on inclined or spiral conveyors. Automatic conveying systems are adopted in many industries other than those associated with engineering. (J. G. H.)

AUTOMOBILE: *see* MOTOR VEHICLES.

AVEBURY, JOHN LUBBOCK, 1ST BARON (1834–1913), British banker (*see* 3.51), died at Kingsgate Castle, Kent, May 28 1913.

AVERESCU, ALEXANDRE, (1859–), Rumanian general and politician, born March 9 1859 at Ismail (Bessarabia), was a

volunteer in the war of independence against Turkey in 1877–8. Promoted officer at the conclusion of peace, he remained in the army and studied at the high military school of Turin (Italy). He was Minister of War in 1907 when he repelled the peasants' revolt. In 1913 he conducted the military operations in the war against Bulgaria as chief of the general staff. As commander of the II. and III. Armies, and later of the armies in the Dobruja, during the 1916 campaign, Gen. Averescu became enormously popular with his soldiers, a popularity which later on helped him considerably in his political career. In March 1918 he was entrusted by the king with the formation of a Cabinet and conducted the peace negotiations with the Central Powers. Afterwards he retired from the army and entered the field of politics. He was proclaimed president of the People's League, which later became the People's Party, and thanks to the popularity of Gen. Averescu this organisation was called to power in March 1920 with its president as Prime Minister. After holding this office for a year and ten months he resigned on Dec. 17 1921 but remained president of the party.

AVIATION: *see* AERONAUTICS; AEROPLANE; AIRSHIP; FLYING.

AYUB KHAN (1855–1914), Afghan prince, son of Shere Ali (*see* 3.77), died at Lahore April 6 1914.

AZCÁRATE, GUMERSINDO (1840–1917), Spanish politician, was born at León, Spain, Jan. 13 1840. Educated at the universities of Oviedo and Madrid, in 1868 he was appointed assistant professor of comparative jurisprudence at the latter university and four years later became professor. In 1875 he resigned rather than submit to the famous Orovio decree limiting the liberty of the chair. He was, however, reinstated six years later and became one of the group headed by Francisco Giner, to which Spain owes most of its up-to-date educational institutions. From 1868 he represented, almost continuously, León, in the Cortes, as a moderate Republican. He had learned by painful experience that the attempt to set up a republic in a country where there was no genuine Republican party could only result in anarchy and military dictatorship. He, therefore, expressed his approval of the reformist evolution toward monarchism initiated by Melquiados Alvárez, but, upon his defeat as a deputy, he proved the strength of his principles by refusing a seat as senator for life. After the Barcelona outbreak of 1909 he kept apart from the violent section of his party. His position was less that of a leader than of a man whose personal character gave a certain dignity to the anti-dynastic parties. He died at Madrid Dec. 14 1917.

AZERBAIJAN (*see* 3.80), a Socialist Soviet republic, forming part of the Transcaucasian Federation of Soviet Republics, inhabited principally by Tatars. The capital is Baku and the principal industry is provided by the oil wells there, the production from which in 1926 was improving (*see* TRANSCAUCASIA).

BACCELLI, GUIDO (1830–1916), Italian physician and politician, was born at Rome in 1830. After graduating in medicine at the University of Rome, he became assistant professor of medical jurisprudence in 1856, and some years later professor of clinical medicine. He soon acquired a great reputation as a practising physician, and devoted himself particularly to the study of malaria; his researches proving invaluable for the reclamation of the Roman Campagna. In 1875 he was elected deputy for a division of Rome, which he represented until his death. He was Minister of Education in various Cabinets from 1879–99, and of Agriculture under Zanardelli (1901–3); from 1889 to 1893 he was vice-president of the Chamber. A keen classical scholar, he took an active interest in archaeological matters, although in some of his projects, such as the famous *Passeggiata Archeologica* in Rome, he showed more enthusiasm than judgment. His labours for the isolation of the Pantheon and the creation of the Museum of Ancient Art and of the Modern Art Gallery in Rome deserved and met with more general approval. He died in Rome Jan. 11 1916.

BACON, HENRY (1866–1924), American architect, was born at Watseka, Ill., Nov. 28 1866. In 1884 he entered the University of Illinois to study architecture. From 1888 to 1897 he was with McKim, Meade & White, in New York, excepting the years 1889–91, which he spent in Europe as Rotch Travelling Scholar. From 1897 to 1903 he was a member of the firm of Brite & Bacon, in New York, but after that time he worked independently. Among his important works were the Court of the Four Seasons at the Panama-Pacific Expositions; the Union Square Savings Bank, New York City; the Public Library, Paterson, N.J.; the Waterbury General Hospital, Waterbury, Conn., and the Whittemore Memorial Bridge, Naugatuck, Connecticut. Of numerous monuments, some designed in collaboration with various sculptors, the following should be mentioned: the Lafayette Monument, Brooklyn, N.Y.; the Lincoln Monument, Lincoln, Neb.; the Longfellow Monument, Cambridge, Mass.; the Republic Monument and the Centennial Monument, Chicago, Ill.; the President Harrison Monument, Indianapolis, Ind.; the Civil War Memorial and World War Memorial, Yale University, and the Parnell Monument, Dublin, Ireland. In 1920 the Lincoln Memorial, at Washington, D.C., designed by him, was completed at a cost of more than $2,500,000. He died Feb. 16 1924 in New York City.

BACON, ROBERT (1860–1919), American banker, was born in Boston, Mass., July 5 1860. He graduated from Harvard in 1880, and the following year entered the banking business in Boston. In 1894 he joined the house of J. P. Morgan & Co. in New York. He was assistant Secretary of State, 1905–9, and then for a short time Secretary of State, succeeding Elihu Root on the latter's election to the Senate. Ambassador to France from 1909 to 1912, he was commissioned major in the U.S. Reserves in 1917, being assigned to the staff of Gen. Pershing in France. He returned to America with the rank of colonel in 1918, and died in New York City May 29 1919.

BACTERIOLOGY (*see* 3.156).—In the sections below are described the main features of the remarkable progress made in the science of bacteriology since 1910 and of the important additions to medicine and industry which have accompanied these developments. Reference should also be made to the article on filter passing microbes.

I. BACTERIA OF THE SOIL

The systematic study of the bacteria of the soil has been hampered by two main difficulties. The first of these is the want of a rational scheme for identifying and classifying the apparently limitless number of varieties that can be isolated from soil. Löhnis and Smith claim (1914, 1921) that a large number of bacteria exhibit complicated life-cycles of changing forms. Such cycles have been established and confirmed by other observers in the case of certain organisms, notably *Azotobacter chroococcum* and *Bacillus radicicola* and, if of general occurrence, they may supply a rational basis of classification. The second difficulty has been that of determining which of the bacteria isolated take an active part in the soil population.

H. J. Conn (1917) held that the bacteria most active in the formation of ammonia in soil belonged to types that grow with difficulty in ordinary plate cultures and that the large spore-forming rods so evident in such cultures were present in the soil mainly in a resting condition. Winogradsky (1925), employing a new method for staining micro-organisms in the soil itself, observed that in unmanured soil the bacterial flora consists of colonies of short rods and cocci, usually imbedded in the colloidal matter of the soil. In addition, such soil must contain a great variety of other bacteria in numbers normally too small to be apparent by his technique, for the addition of energy-giving material causes the appearance in preponderating numbers of one or a few types which differ according to the substance added.

Owing to this changing quality of the bacterial flora, misleading inferences are easily made from estimates of total bacterial numbers in soil based on platings of a diluted soil suspension. Such estimates, however, help to indicate the influence of soil conditions on the bacterial flora as a whole and the relations between this flora and other sections of the soil population. The bacterial numbers in a field soil rise and fall at daily and even hourly intervals. The work of Cutler, Crump and Sandon (1923) shows that the daily changes in bacterial numbers are related inversely to those of the active amoebae. There seems therefore to be a fluctuating equilibrium between the bacterial and protozoan sections of the soil population. The heating of the soil to 55° C., or treatment with toluene, at first reduces the bacteria, but eventually causes a marked increase in bacterial numbers, and there is evidence connecting this with the harmful effect of the treatment on the soil protozoa. Thus the existence of an equilibrium between the sections of the soil population complicates the action of physical and chemical conditions on the soil bacteria. In arable soil, therefore, no simple relationship is usually found between the bacterial numbers and the temperature or moisture. Conn (1914) has even observed that the freezing of soil may cause a large increase in the bacteria. The reaction of the soil has a marked influence on certain groups such as *Azotobacter* and the ammonia-oxidising bacteria which are very susceptible to acidity. The action of alkali salts on soil bacteria has been studied in America (Greaves, 1916) where soil alkali is a serious problem. Certain salts such as those of arsenic have been found in low concentrations to stimulate bacterial activities, but the cause of this action is not yet understood.

Activities of Soil Bacteria.—Chemical changes brought about by bacteria in the soil fall naturally into two groups, those that result in a release of energy which the bacteria utilise for their vital processes, and those by which the bacteria build up the material of their cells.

Certain groups of soil bacteria can obtain their energy from inorganic compounds. In addition to the ammonia and nitrite oxidising groups discovered by Winogradsky, and the hydrogen oxidising organisms found by Kaserer (1906), another group of such organisms has recently attracted much attention in America. These bacteria oxidise sulphur and sulphides to sulphuric acid (Waksman and Joffe, 1922), and raise the acidity of their environment to a high degree. This fact has been utilised in the treatment of potato scab disease by composting with sulphur; the scab parasite being intolerant of the acid conditions produced by the sulphur oxidation.

Nearly all the energy material present in soil, however, is derived from plant remains. There is evidence that the simpler carbohydrates are among the first plant constituents to undergo decomposition. The fermentation of pentoses by bacteria has recently been investigated by Fred Peterson and Davenport

(1920), who isolated an organism capable of splitting xylose and arabinose into a mixture of lactic and acetic acid. A large proportion of plant tissues consists of cellulose and its derivatives. It seems improbable that, in normal well-aerated soil, the anaërobic bacteria described by Omeliansky can play a leading part in cellulose decomposition. Macbeth and Scales (1913) isolated a number of aërobic bacteria claimed to be capable of decomposing cellulose, but their experimental evidence has been criticised. A remarkable organism was isolated by Hutchinson and Clayton (1919) and named *Spirochaeta cytophaga*. This organism commonly exists in the shape of flexible, tapering filaments but it possesses a complex life-cycle including a spherical "sporoid" stage. It will rapidly decompose filter paper, but its growth in artificial media is quickly inhibited by more soluble organic compounds such as sugars. More recently Gray and Chalmers (1924) isolated another organism, *Microspira agarliquefaciens*. The destruction of cellulose by this organism has been found to be stimulated by small quantities of xylose and lignin. The determination of the nitrogen and phosphate required for cellulose decomposition has led to the development of a process now in use, by which straw or other plant remains treated with appropriate salts are made to decompose into a mixture having a decomposition and properties closely resembling farmyard manure.

Ammonia-producing Bacteria.—A variety of bacteria can obtain energy by decomposing the nitrogen compounds in the soil with the release of ammonia. The work of Doryland (1916) and others has emphasised the fact that the ammonia is only a by-product in the economy of the bacteria. The common ammonia-producing bacteria can also derive their energy from carbohydrates and, when such compounds are present in excess, they can assimilate the ammonia and nitrate already present in their surroundings. It is for this reason that unrotted straw ploughed into the soil causes a temporary loss of nitrate and consequent lowering of fertility.

Nitrogen-fixing Bacteria.—Where non-nitrogenous sources of energy occur in sufficient excess, the groups of bacteria that assimilate free nitrogen may come into prominence. Thus Winogradsky (1924) found that the addition of mannitol to soil caused the predominance of the nitrogen-fixing bacteria *Azotobacter* or *Clostridium pasteurianum*. A large number of soluble organic substances can be utilised as sources of energy for nitrogen fixation, and the products of the decomposition of cellulose by *Spirochoeta cytophaga* can also be utilised by *Azotobacter* (Hutchinson and Clayton, 1919).

Several new organisms capable of assimilating nitrogen have been described (Bondorff, 1918; Fulmer and Fred, 1917) but there is no evidence that their importance compares with that of *Azotobacter* or *Clostridium pasteurianum*. The relative activity of the latter organism is difficult to estimate. It is a strict anaërobe but there is evidence that it may live in association with aërobic organisms that produce a local deficiency of oxygen around it (Omelianski and Solunskov, 1916). Attention is still directed to the nitrogen-fixing bacteria living in beneficial association with higher plants. The best known case of this is that of the organism inhabiting the root cells of leguminous plants. This organism, *Bacillus radicicola* (Beijerinck) has been shown to possess a complex life-cycle through which it passes in culture (Bewley and Hutchinson, 1920), in the soil (Thornton and Gangulee, 1924), and within the tissues of the host plant (Wallin, 1922). The cycle includes an actively motile stage during which the bacteria migrate through the soil. Infection usually takes place through a root hair and the bacteria induce the multiplication of the cells of the root cortex which they subsequently infect.

In normal plants, vascular strands from the centre of the root grow out into the tissues of the nodules, and it is believed that carbohydrate energy material, necessary for nitrogen fixation, is brought along them to the bacteria. Under abnormal conditions, nodules can be formed, in which these strands are absent or defective, and in such nodules practically no nitrogen is fixed but the bacteria become parasitic on the host cells, deriving their food by attacking the protoplasm (Brenchley and Thornton, 1925). The benefit that leguminous plants normally derive from the presence of *Bacillus radicicola* has led to many attempts at artificial inoculation by treating the seed with a suspension of bacterial culture. It has been shown that physiological varieties of the organism exist, each capable of infecting but a limited group of host plants and also distinguishable by serological methods (Klimmer and Kruger, 1914). The practice of seed inoculation has proved beneficial where a leguminous crop has been introduced into a district in which the soil is deficient in the correct variety of the organism.

Bacteriological Tests of Soil Fertility.—Many attempts have been made to estimate the fertility of a soil by bacteriological tests. No close correlation can be found between estimates of total bacterial numbers and soil productiveness. Attempts to gauge the biological activity of soil flora have usually been made by estimating the amount of ammonia or nitrate or the increase in total nitrogen when the soil is kept under laboratory conditions or added to nutrient solutions. Discordant results have been obtained, probably owing to the unnatural conditions to which the bacterial flora is thus subjected. Biological tests have been used with greater success to reveal definite factors in a soil that limit bacterial activity. Thus Christensen (1915, 1923) has devised bacteriological tests whereby unfavourable acidity and deficiency in available phosphate can be detected.

For references to Soil Bacteriology the following journals should be consulted: *Jour. Agric. Sci.*; *Jour. Agric. Research* (Washington); *Soil Science* (New Brunswick, N.J.); *Proc. Roy. Soc.*, Ser. B.; *Jour. of Bact.* (Baltimore); *Annals Applied Biology* (Cambridge); *Nature*; *Zentralblatt f. Bact. etc.* (Jena); Reports of U.S.A. Agric. Exp. Stations, etc. (H. G. T.)

II. BACTERIOLOGY IN INDUSTRY

Cellulose-decomposing Bacteria.—Light has been thrown on the activity of these organisms in the destruction of cellulose-containing textiles which become exposed to damp. Both cotton, flax, jute, wood pulp, and the textiles made from these fibres have long been known to decay, to become tender when stored under damp conditions. The financial losses thereby involved are very great and for American raw cotton alone have been estimated to amount to many millions of dollars annually. Aërobic cellulose-decomposing bacteria are responsible for a very large percentage of these ravages.

The study of the stages by which the bacterial decomposition of the cellulose molecule proceeds has thrown light on many observations which had hitherto been obscure. Thanks chiefly to Pringsheim's researches it has been established that cellulose (*q.v.*), on being acted upon by the enzymes of certain bacteria, yields cellobiose and glucose as intermediate decomposition products. Both of these sugars can be utilised as food substances, not only by a large number of bacteria which are unable to attack cellulose, but by herbivorous animals and by man. By the aid of these sugars, nitrogen-fixing bacteria, living symbiotically with cellulose-destroying forms, can fix atmospheric nitrogen and render it available for plant growth. The liberation of glucose from cellulose in the animal intestine also enables herbivorous animals to derive the same nutritive value from cellulose, as they would from a corresponding quantity of starch.

The final decomposition products of the bacterial decay of cellulose have been shown to comprise fatty acids, methane, hydrogen and ethyl alcohol. Quite recently efforts have been made to utilise cellulose-decomposing bacteria for the production of alcohol (*q.v.*) for industrial purposes. This work, however, is still in its infancy and it remains to be shown whether the very large quantities of cellulose containing plant débris which accumulate in nature can, in this way, be turned to useful account. The same may be said of the sporadic efforts made to produce methane and hydrogen by the fermentation of cellulose.

Hemicelluloses.—That ethyl alcohol can be produced industrially by the bacterial fermentation of hemicelluloses, another constituent of many plant débris, now appears to be established. The application of this process should be of considerable interest in many localities where liquid fuels are expensive. On the whole the bacterial activities which involve the decomposition

of hemicelluloses bid fair to become an important subject. The preparation of silage, for instance, has now definitely been shown to be associated with the bacterial fermentation of hemicelluloses contained in the plant tissues subjected to ensilaging. The same may be claimed to have been finally established during recent years for the spontaneous combustion of hay. Whether the fermentation process which tobacco undergoes during maturing belongs to this category of bacterial activities is likely, but not yet definitely proved.

Pectin.—The bacterial fermentation processes by which yet another constituent of vegetable tissues, their pectin, is decomposed has received much attention during the past decade and several new retting processes for the preparation of fibres such as flax and hemp have been evolved. The most important of these are the Ochmann process, conducted in running water at low temperatures and in the presence of oxygen, the Rossi process, carried out at blood temperature in the presence of oxygen, and the Carbone process, worked at blood temperature in the absence of oxygen.

Starch.—In the study of the bacterial fermentations of starch two lines of research deserve special mention. The first of these, the conversion of starch containing plant tissues into a mixture of butyl alcohol and acetone, derived its impetus from the requirements of the World War. During the period of the War the demand for acetone far exceeded the available supplies, and new sources for the production of this solvent had to be devised. The foresight of the British Govt. made it possible to evolve a fermentation process in which certain types of bacteria, related to the anaërobic retting bacteria, were utilised for the conversion of starch into a mixture of butyl alcohol and acetone. With the ever increasing demand for butyl alcohol this fermentation process is now well established industrially and in the United States more than 200 tons of butyl alcohol is being produced weekly.

The other line of research connected with the bacterial decomposition of starch is that of panary fermentations. It is on the fermentation processes occurring in the dough during rising that successful bread-making depends, and a thorough study of the complicated biological reactions thereby involved is long overdue. Serious efforts are now being made in the United States to throw light on these reactions.

Sugars.—In the study of the microbiological decomposition of sugars the most interesting recent progress is connected with the production of glycerine by the ordinary yeast fermentation of sugars, and with the conversion of sugars into lactic acid through bacterial action, the latter with a view to obtaining the sodium salt of lactic acid. This sodium salt yields very viscous solutions with water which, on account of their low freezing point, are superior to glycerine and lubricating oils for a great number of purposes.

The production of glycerine during the ordinary alcohol fermentation by yeast is based on Neuberger's and Connstein's observation that sodium sulphite, or other alkaline salts, added to a fermenting sugar solution interfere with the normal course of the reaction and cause glycerine and acetaldehyde to be accumulated at the expense of alcohol and carbon dioxide. Working this reaction on a technical scale, as much as 25% of glycerine, calculated on the sugar fermented, may be obtained.

In touching upon the bacterial fermentation of sugars it should be recalled that considerable progress has been made during recent years in the study of the interesting fermentation process to which freshly gathered cacao beans are normally subjected. In the way this process is carried out industrially micro-organisms—both bacteria and yeasts—are responsible for the desired changes occurring in the bean.

Dairying.—Though no startling revelations have been made in the field of dairy bacteriology during the last decade, progress has been steady and important. Attention has been paid to the important problem of securing a more hygienic milk by processes of eliminating the bacteria already present and by preventing their entry into, and their development in, the milk. In the manufacture of butter and cheese, where the presence of certain bacteria is essential, the conditions for the development of the desired forms have been further investigated. The additions of pure cultures of the types responsible for the required changes have gone far to ensure more reliable processes of manufacture as well as more stable products.

See H. Pringsheim, *Die Polysaccharid*, (1923); A. C. Thaysen and H. J. Bunker, *The Microbiology of Cellulose, Hemicelluloses, Pectin and Gums* (Oxford, 1925); *Jour. Instit. of Brewing; Jour. Indust. and Engineer. Chem.* (Easton, Pa.); *Jour. of the Franklin Instit.* (Philadelphia); *Biochem. Zeitsch.*, etc. (A. C. T.)

III. MEDICAL BACTERIOLOGY AND IMMUNOLOGY

Many advances have been made since 1910 in our knowledge of bacteria as causative agents of disease in man and animals and in the science of immunology.

Improvements in Technique

Dark Ground Illumination.—Much use has been made of this method of studying bacteria, whether in the live or fixed state. Its chief practical applications have been in the demonstration of slender objects such as the *Spirochaete pallida* in material from syphilitic sores (*see* Venereal Diseases), the detection of motility and the enumeration of bacteria in emulsions such as vaccines. To obtain the dark ground effect, the microscope requires to be fitted with a special form of condenser, of which there are now many models, and a powerful source of illumination is necessary. The rays from the source of light after reflection at the substage mirror can enter only the peripheral portion of the condenser and, owing to their obliquity, are then either wholly reflected from the upper surface of the cover-glass or, according to the type of condenser, refracted into space beyond the range of the objective lens. Should, however, small objects come in the way, such as bacilli possessing a different refractility from that of the fluid in which they are suspended, the rays are dispersed by them, and are able to enter the objective. Bacilli then appear as white spots on a dark background. With an ordinary condenser a very similar effect is produced by mixing material containing delicate organisms with india ink, or collargol or congo-red, and spreading in a thin film on a slide. Delicate organisms in the material can then be readily picked up from the surrounding dark field. Recently the photography of organisms beyond the range of ordinary microscopic vision has been attempted with the aid of ultraviolet light, but the method is as yet on trial. (*See* Microscopy.)

Enumeration of Bacteria.—Besides the dark ground illumination method used in conjunction with the well-known Thoma-Zeiss ruled slide chamber, in which bacteria can be counted directly, turbidity measurements give very accurate estimations, the turbidity of the bacterial emulsion, suitably diluted, being compared with that of a series of tubes containing varying concentrations of barium sulphate previously standardised to represent a definite bacterial content of the particular organism under investigation.

Isolation and Cultivation of Single Bacterial Cells.—For the cultivation of " pure line " strains of micro-organisms it is essential to start from a single microbe. In Barber's method (1904) a single bacillus in an appropriately diluted emulsion is picked up into an extremely fine capillary pipette working on a special holder under microscopic control. It is really founded on the earlier method of van Schouten (1899), who employed a fine glass loop for the same purpose. Barber's method has been also greatly developed in general cytological studies and it is now possible to perform surgical operations on single cells. In Burri's method, dilutions of the culture are mixed with india ink and drops of these are laid on gelatine or agar plates. Under the microscope these drops are examined, and if one is found containing a single bacillus it is marked and allowed to grow into colony form, or the single organism may be removed directly to a nutrient medium.

A recent method, elaborated by Barnard, depends on the fact that ultraviolet light destroys bacteria. A single bacillus is marked down, and between it and the entering rays a minute droplet of mercury is placed under microscopic control. The

bacillus is thus protected, while the surrounding organisms are killed. It can then be dealt with culturally.

Methods of Culture.—Numerous improvements in cultural methods have been introduced of late years, such as the addition of egg to a nutrient basis of agar, or the use of solid, inspissated mixed white and yolk of egg, especially for the growth of tubercle bacilli. A medium composed of broth and serum, covered with liquid paraffin, and containing a piece of sterile, unheated rabbit's kidney was introduced by Noguchi for the growth of spirochaetes, and has been recommended for other organisms of difficult culture. Attention has been directed of late to the importance of making culture medium of exactly the right degree of alkalinity, and the method now used for this purpose is to test and standardise the media at a constant temperature by means of delicate colour indicators, *e.g.*, phenol-sulphone-phthaleine. A hydrogen-ion concentration of 7·6 has been found the most suitable for general bacteriological purposes.

Anaërobiosis.—Anaërobic culture methods have been improved by the introduction of various patterns of jars to contain Petri dishes or test-tubes; the object of these is to facilitate the removal of all, or a part, of the oxygen with an air pump, and replace it with hydrogen or other indifferent gas. The removal of the oxygen is also attained by using the catalytic action of spongy platinum (or palladium) to produce slow combination of oxygen with hydrogen. After removing the greater part of the air with a pump and replacing it with hydrogen, the jar is closed and the catalyst contained in a small wire-gauze cage heated by means of an electric current. The remaining oxygen then combines quietly with hydrogen and this action keeps the platinum hot as long as it is required, *i.e.*, until the oxygen is used up.

Fermentations Produced by Bacteria

Chemical Processes Involved in Fermentation.—Bacteria are in many cases very selective in their chemical action on such substances as the sugars, higher alcohols and hydroxy acids, and produce from them a great variety of products, these reactions being largely used for diagnostic purposes. The trend of modern work on this subject is to show that specific enzymes are probably necessary for the first stage in the attack on substances of different chemical or stereochemical constitution, but that the immediate products of this attack are frequently of the same character. These then become changed under the influence of a system of enzymes which is common to a considerable number of different organisms, yielding final products of a similar nature, but in differing proportions. In some cases additional enzymes are present, which modify the result, yielding special products specific to a particular organism.

Thus, *B. coli* acts both on mannitol and glucose, probably by the aid of two distinct enzymes, but yields the same final products from both substances, in different proportions, corresponding to the difference in composition of the two compounds. On the other hand *B. lactis aerogenes*, which attacks the same two compounds and produces from them all the products yielded by *B. coli*, in addition converts a part of one of the intermediate compounds (probably acetaldehyde) into butylene glycol, which is not produced by *B. coli* and the formation of which is presumably due to the influence of a specific enzyme. The exact way in which the primary products of the first attack on the molecule are worked up may be greatly influenced by the conditions to which the organism is subjected, and, thus, the proportions in which the final products are formed may vary considerably.

Pasteur's dictum that "Fermentation is life without air" still maintains its validity. It is now interpreted in the sense that the changes summed up in the term fermentation proceed with evolution of energy, part of which can be utilised by the organism. In aërobic organisms this replaces the energy which, in aërobic life, is gained by the oxidation of food materials. Many bacteria (facultative anaërobes) can carry out their life cycle anaërobically provided that they are supplied with material which they can decompose with evolution of energy and with the production of an intermediate substance which can be assimilated by the organism (*e.g.*, *B. coli* in presence of glucose). In many cases this can be accomplished by providing a pair of substances, one of which can be oxidised (or reduced) at the expense of the other in the presence of the organism with evolution of energy and the production of an assimilable intermediate compound. Thus *B. coli* cannot grow anaërobically in peptone water in presence of either a lactate or a nitrate, but grows readily when both are present, the nitrate being reduced and the lactate oxidised to some substance (probably pyruvic acid) which is assimilable by the organism. The nitrate can be replaced by fumarate which is reduced to succinate.

Value of Sugar Fermentation Tests in Differential Diagnosis.—A very important, and usually very reliable, method of distinguishing between allied races and species of bacteria is that founded on their fermentative action (production of acid or acid and gas) on various carbohydrates and alcohols. In addition to carbohydrates and alcohols, the salts of the organic acids have been used for a similar purpose (citrates, tartrates, etc.). The sugar reactions are not invariably constant for the same kind, or even for the same strain, of bacteria but they are perhaps as constant as any other set of characters. In the diagnosis of a bacterial species, as in the case of other living things, it is often necessary to consider several characters and not to place reliance on a single characteristic.

Variation of Bacteria

Under the head of variation of bacteria three kinds of change are understood. (1) Fluctuation which implies the temporary change due to alterations of environment which do not persist when the special circumstances are removed. (2) Persistent variation which is hereditary and, whatever its cause, is not directly dependent for its continuance on the special circumstances, and (3) so-called cyclical variation by which bacteria are supposed to undergo successive changes in cycles, during which they assume very different forms and characters and may even become indistinguishable from the higher fungi presenting apparently sexual forms. The latter kind of change, however, is not generally accepted as occurring in any of the well-known pathogenic bacteria, in spite of the fact that it has been described since the earliest days of bacteriology. Fluctuation may be briefly dismissed by saying that wide variation in form and size are well known to occur in most groups and the physiological and morphological characters may be temporarily suppressed by special conditions.

Hereditary Variation.—True persistent hereditary variation has been only gradually accepted by bacteriologists since the identity of changed forms with the original strain has rightly been challenged till full proof was available. These variations, which have been called mutations, since they are hereditary and often appear with some suddenness, may affect many of the structural and functional characters of bacteria. Within limits, size and shape of the individual bacteria and their colonies are subject to great changes, and variation in regard to fermentation of carbohydrates undoubtedly occurs, though more rarely. Many mutants are best obtained by selecting colonies of different appearance. It not infrequently happens also that colonies which are several days old show, on their surfaces, small projections or papillae, which consist of bacteria which have acquired new properties.

Some of the most remarkable variations affect the agglutinability of the cultures by salt solutions and specific serum. A commonly found mutant in old cultures is one which is spontaneously agglutinable in salt solution (0·85%) while it has at the same time lost some of its agglutinability by the specific serum for the parent strain and also acquired new properties of serum agglutinability. Another variant occurring in the proteus and coli-typhoid group, the *O* form of Weil, has lost its heat-labile agglutinogen, responsible for flocculent agglutination, and at the same time ceased to be actively motile. Loss or change in pigment-forming characters is also well known. An important character which is liable to variation is virulence. The loss and the regaining of virulence may, to some extent, be controlled, and the change may persist in the strain.

Single Cell Variants.—Variants in different directions have been shown to arise from single cell cultures. The hereditary variants may persist indefinitely, especially if care and time are spent in obtaining them pure by repeatedly making plate cultures and selecting isolated colonies. In other cases reversion cannot be avoided.

The Bacteriophage

This represents a newly observed phenomenon, first described by F. W. Twort (1915) and F. d'Hérelle (1918). The former observed a lytic change accompanied by translucency of some colonies in certain cultures of *staphylococcus* and found that this lysis could be communicated to other normal colonies by an extract of the affected culture which had been passed through a Berkefeld filter, and was itself free from bacteria. D'Hérelle, starting with a Berkefeld filtrate from the faeces of dysentery convalescents, was able by adding a drop of this to a culture of *B. dysenteriae* (Shiga) to produce lysis of the bacteria. A drop of the resulting solution after filtration could be used to repeat the phenomenon in a fresh culture, and in this way a renewal of the active principle could be brought about indefinitely. This principle d'Hérelle called the bacteriophage (*Bacteriophagum intestinale*), and he maintains that it is an ultra-microscopic, living organism, which is parasitic in the bacteria and reproduces itself. The solution containing the principle is often active in a dilution of 1 in 100 million, and 5 c.c. of broth containing bacteriophage in this dilution, if inoculated with the sensitive culture, will reproduce in 24 hours in the incubator a clear solution containing the bacteriophage in the original strength, which again is still active when similarly diluted.

If a tube of suitable diluted phage, inoculated with *B. dysenteriae*, is incubated for three hours, and a loop of it then inoculated on agar, confluent growth of the bacteria may be obtained with a number of small, round, clear areas where no growth of bacteria has occurred. These spaces d'Hérelle called *tâchés vierges* and considered them to represent colonies of the bacteriophage which had devoured the bacteria. Other bacteria are attacked besides *B. dysenteriae*, *e.g.*, *B. typhosus*, *B. paratyphosus* and *B. coli*. Most strains of bacteriophage are specific for certain kinds of bacteria, or even for certain strains of these species. Thus some varieties of bacteriophage will act on "rough" variants of *B. dysenteriae* and on some strains of *B. coli*, but not on the corresponding normal or "smooth" cultures.

After the action of the bacteriophage on a broth culture and the resulting clearing of the original turbidity, it is usual for some bacteria to remain alive which, when cultured on agar, are found to be considerably altered in the appearance of their colonies. Their agglutinability by salts is also changed. These colonies are often resistant to the bacteriophage. There is no doubt that bacteriophage may be present in small quantities in cultures, but remain unnoticed, and it has been suggested that many variations, occurring apparently spontaneously, are in reality brought about by the presence of unrecognised bacteriophage. D'Hérelle has advocated the use of bacteriophage in the prevention and treatment of infective disease, but its value for this purpose is not widely recognised.

The question of the nature of the bacteriophage has stimulated a very large amount of research on account of its theoretical importance. If the more generally accepted view ascribing the properties of the bacteriophage to a non-living enzyme or catalyst were proved, the fact that it appears to infect and multiply in a culture of bacteria might by analogy throw light on some infective diseases associated with ultramicroscopic viruses affecting the higher forms of life. The characteristics which make it less probable that the bacteriophage is a living entity are its ready filtrability through a porcelain filter, its resistance to heat (60° to 65° C.), its resistance to acetone and chloroform and its inability to lyse dead bacteria or to multiply in the absence of a living bacterial culture.

Acute Infectious Jaundice or Weil's Disease.—This disease, which came into some prominence as a War disease, especially on the Western Front, was found by Inada and Ido (1914) to be due to a motile spirochaetal organism *Leptospira icterohaemorrhagiae*. In certain localities it appears to be a parasite in the kidneys of wild rats, and infection of food and water by the urine of such rats is the most likely mode of transmission. A similar organism has recently been found to be the cause of a disease in young dogs called *The Yellows*.

Yellow Fever.—Noguchi since 1919 has brought forward excellent evidence that another *leptospira* (*L. icteroides*) is responsible for yellow fever (*q.v.*), and the employment of therapeutic serum, prepared by immunising horses with this *leptospira*, has very favourably influenced the course of the disease. Also good reports have been received of the use of prophylactic vaccines in lowering the incidence.

Tularaemia.—McCoy (1911) in the course of examining ground squirrels in California for evidence of plague infection discovered another plague-like disease in these rodents which was not due to *B. pestis*. In the following year, he and Chapin isolated the specific organism and it was given the name of *B. tularense* from Tulare co. in California where the epidemic in the ground squirrels was prevalent. During the years preceding the demonstration of the organism, cases of severe lymphangitis in man apparently following insect bites had been observed in the state of Utah. Since the discovery of the parasite quite a number of human cases of infection have occurred in some of the American states. The disease is rarely fatal but a very protracted convalescence is the rule. The mode of infection in the field is almost certainly by the bite of the horse-fly (*Chrysops discalis*) which has fed on infected ground squirrels or jack rabbits. In the laboratory, also, workers engaged on research into this disease have been attacked, *e.g.*, at the Washington Hygiene Laboratories and at the Lister Institute, London. The mode of transmission in the laboratory is as yet unknown, but probably the organism gains entrance by the respiratory tract as in pneumonic plague. Outside the United States of America this disease of rodents has not, so far, been reported.

Melioidosis.—This disease was first described in 1913 by Whitmore as a "glanders-like disease" occurring in Rangoon, and indeed the clinical relationship to glanders, both in man and in horses, is very close. Their morbid anatomy also is very similar. It runs a more acute course, however, than glanders, and is usually fatal. The causative organism *B. whitmori* is primarily a parasite of rodents and as Stanton and Fletcher have found, it possesses a close serological relationship to *B. mallei*, the cause of glanders, but differs from it in its growth on nutrient media and in the fact of its motility.

Rat-bite Fever.—This is a prolonged, febrile disease, of which inflammation of the lymphatics and a well-marked rash on the skin, together with wasting, are prominent symptoms. The course of the disease is very irregular and the fever intermittent. A spirochaete has been described and is generally accepted as the causal micro-organism. The disease occurs in Japan, India and other parts of Asia, and cases have been recorded in Europe, including Great Britain and America.

Gas Gangrene.—During the World War the occurrence of large numbers of infections of wounds led to a close study of the bacteria responsible for them. The anaërobic bacilli in particular were investigated anew, and much confusion in their classification and nomenclature cleared up. To three species especially, *B. perfringens* (*B. welchii*), *Vibrion septique* (*B. oedematis maligni*) and *B. oedematiens*, most of the cases of gas gangrene were found to be due. From these three species, moreover, toxins and antitoxins were prepared which were found to be of service clinically. Unfortunately, these discoveries were not made till too late to be of use in the treatment of the large number of cases prevalent during the first years of the War. (*Rep. Med. Research Committee*, Spec. Rep. No. 39.)

Progress in Immunology

Antibodies Generally.—The study of the antibodies in the blood serum of animals which have been inoculated with bacterial suspensions or toxins, has proved of great value in many directions. In the case of antitoxin, apart from its great therapeutic value in diseases such as diphtheria (*see* Infectious

FEVERS), it is now possible to form some estimate of the susceptibility or immunity of an individual by determining the amount of antitoxin in the blood (Schick test in diphtheria). The other well-known antibodies, agglutinins, precipitins, bacteriolysins and opsonins, do not give an accurate measure of immunity. These latter are, however, used as important aids (1) in elucidating the processes concerned in disease and its cure, (2) in making a diagnosis of the presence of a disease, (3) in identifying a given bacterium by the use of a serum evoked in the animal body by inoculation of the particular species of bacterium concerned, or indeed, for differentiating bacteria that are very closely allied.

Agglutination.—The agglutination of bacteria by a specific serum appears to be a process of the same kind as the reaction which occurs when a diluted solution of protein, *e.g.*, serum protein or egg albumin, is added to a serum obtained from an animal which has been injected with this protein. In the case of bacteria, the phenomenon is less simple, since there is no doubt that many bacteria contain more than one substance, perhaps many, capable of exciting the production of agglutinins, and consequently, more than one agglutinin is present in the serum of the inoculated animal.

The extent of the variation, and difference in the composition, of these agglutinogenic substances is not yet fully known, but their existence and diversity are of importance in identifying or differentiating allied bacteria. When a serum has been prepared that will agglutinate a given kind of bacterium it is often found that it will also agglutinate other kinds of bacteria of the same group to a lesser degree. This fact suggests that these different bacteria have some factor that is common to them all in their composition.

One method of comparing antigenically different species of bacteria is to prepare separate agglutinating sera for each kind and to test the degree of agglutination of each emulsion with each serum. A more refined method of analysis is to treat the agglutinating serum with the emulsion, to remove the clumps by the centrifuge after a few hours, and then to test the supernatant fluid with a fresh emulsion to see whether the property of clumping has been removed or diminished for the same and other strains. This method (absorption of agglutinins) has been extensively used in attempts to classify the antigenic constituents of allied bacterial races. By this means many at first sight identical strains have been divided into groups and subgroups, *e.g.*, the *Salmonella* group by Schütze and Bruce White, the *meningococcal* group by Gordon and the *dysentery* group by Andrewes. These groups are sometimes separable by fermentation and other tests and are said to remain quite constant in culture, maintaining their finer differences. Perhaps sufficient time has hardly elapsed, or sufficient study been given, to this very difficult subject to decide to what extent the lesser distinctions are maintained in a state of nature or under varying conditions of culture.

The agglutinogens present in a given culture, which are usually considered, though probably not quite accurately, to be identical with the agglutinable substances, can be differentiated by other means. For example, there are agglutinogens which resist a temperature of 100° C. for 5 to 30 min. and others which can no longer be detected after this treatment. There is some evidence that the heat-labile antigens are, at least in part, associated with the flagella, since non-motile varieties of motile organisms are often deficient in the heat-labile antigen. These two classes of antigen are related to distinct agglutinins in serum. Another means of distinguishing antigens has been brought to light by chemical processes of extraction and purification (by ether, alcohol, etc.) and it has been found that certain partial components of a carbohydrate (*pneumococcus*, Avery and Heidelberger) or lipoid (*B. tuberculosis*, Zinnser) nature, play a part in these reactions, though probably in every case only when united with protein material.

Discordant facts which require harmonising with any accepted system of classification may be mentioned. (1) Some pure strains may lose or gain agglutinability in culture without apparent change in other respects. (2) Some variants may have lost their agglutinability with the serum made from the parent strain, but may agglutinate with serum made from the variant which leaves the parent untouched. (3) Cultures which seem alike culturally and as regards pathogenesis, *e.g.*, *staphylococci*, *meningococci*, *gonococci*, etc., may be readily differentiated by agglutination, and subdivided by absorption technique. (4) Strains which appear identical serologically may differ markedly in pathogenic properties, *e.g.*, *M. melitensis* and *B. abortus*. (5) Strains may change in virulence and in fermentation characters, and yet be unaltered serologically. Para-agglutination and heteroagglutination are similar phenomena which signify the agglutination of diverse strains by serum obtained from an animal which is suffering from an apparently unrelated infection, *e.g.*, the agglutination of *B. proteus XI9* by the serum of typhus fever patients (Felix and Weil).

The facts which have emerged during the recent extensive study of agglutination have given rise to the hypothesis that each bacterium contains a mosaic of antigens, some of which are highly specific and peculiar to each subspecies, while some are common to the whole species or group and others appear to be entirely unrelated as regards phylogeny and occur in very diverse bacteria (*e.g.*, Forssmann's nonspecific antigens). It is probable that the identification and classification of bacteria by their antigens have their limits, though the resultant data are extremely valuable in some cases.

Complement Fixation.—This is the name given to another procedure by which the presence of antisubstances to bacteria can be recognised in the blood serum of animals. In principle it rests on the discovery by Bordet and Gengou that when a bacteriolytic serum containing bacteriolysin and a suspension of the corresponding bacteria are allowed to interact in the presence of fresh serum, a constituent of the latter (alexin or complement) joins the combination of bacteria and antisubstance, and remains fixed to it, this union resulting in the death and solution of the bacteria. To render this fixation of complement obvious even where lysis of the bacteria is not visible, another system which also needs complement for its consummation is added to the mixture, and the occurrence or not of the first reaction is determined by the completion or the non-completion of the second reaction.

The most commonly used antigen-antibody system for the second system is a mixture of a suspension in salt solution of the red-blood corpuscles of the sheep and of a serum which is known to be lytic for them but which does not contain active complement. This latter desideratum can be assured by previously heating the haemolytic serum to 56° C. for 30 minutes. If there is free complement at liberty to join the red corpuscles and antiserum, the red cells break up, and the haemoglobin is set free as a clear solution in the surrounding medium. The colour and transparency of the solution is a readily observed indicator of the presence of free complement and, to some extent, of its amount. This by inference allows an estimate to be made of the reagents present in the first system. If no appropriate bacterial substance or no antisubstance is present, then no complement will be fixed in the first reaction, and consequently it will still be available for haemolysis.

It was found by Weil and his colleagues that the complement fixation in the group of bacteria which they especially studied (intestinal Gram negative group) was associated with the heat stable rather than with the heat-labile antigen (agglutinogen) in the bacteria.

Vaccines for Prophylaxis and Therapy.—A bacterial vaccine is a preparation of antigen (bacteria or their products) introduced into an animal to excite active immunity. The use of preventive vaccines is firmly established by animal experiment (*e.g.*, anthrax, plague, dysentery, enteric and paratyphoid fevers, etc.). So far as accurate experiments have been possible, the living bacteria, or bacteria killed at low temperatures, *e.g.*, 52° C., have been found more efficient than emulsions treated at higher temperatures, or by strong chemical agents.

The use of vaccines for treating disease rests on a very different

footing, since little or no satisfactory evidence from animal experiments is forthcoming, and the clinical results with human disease have been extremely irregular. The earlier hope that it would be possible to produce clinical improvement by graduated doses, fitted to the varying resistance to the disease as estimated by *in vitro* tests, has been for the most part given up, though new methods are often introduced and require critical examination. The hypothesis that the strain of bacterium (homologous) actually infecting the patient is the most suitable for treatment is unsupported experimentally and is now less regarded by clinicians. Experimental and clinical evidence have also pointed to the beneficial effects in some cases of inoculation with various foreign proteins and unrelated bacterial emulsions. Probably much of the vaccine treatment of the past was of no real value and a large part of the good effects reported have been due to a non-specific element in the inoculum.

National Collection of Type Cultures.—This collection of living cultures from all spheres of bacteriological activity was founded in 1920 at the Lister Institute, London, under the auspices of the Medical Research Council. It has been of great service to microbiologists in all parts of the world, over 2,000 strains being maintained in 1925. The second edition of the catalogue appeared in 1925 and can be procured from H.M. Stationery Office, London.

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BADEN (*see* 3.184).— A free state and territory of the German Reich, has an area of 5,819 sq. m. and a population (1925) of 2,319,581.

Political and Constitutional History.—Until 1918 Baden was a constitutional monarchy under a Grand Duke. The Government was always conducted in a liberal spirit, and although the population was mainly Catholic, Baden enjoyed the reputation of being a model small liberal state. During the World War social disturbances hardly existed here; the Social Democrats were accustomed to entering the Government, placed few difficulties in its path, and did not vote against the budget; while the heir to the throne, Prince Max, who was the last Chancellor of the Reich, worked hard for a peace by understanding and internal reforms. But his dynasty fell naturally with the rest; on Nov. 10 1918, a revolutionary provisional government was formed, containing representatives of the Social Democrats, the two Liberal parties and the Catholic centre. On Nov. 22 the Grand Duke abdicated with the consent of Prince Max.

Baden was the first German state to produce its new constitution (May 21 1919), although this was afterwards considerably curtailed by the Weimar constitution of the Reich. The constitution was republican and democratic, with a single Chamber, which possesses the right of legislation, chooses the Ministry and selects from it the minister president, who also bears the title of president of the state, but is not the head of the state, merely the person presiding over the Ministry. There are provisions for referendums; laws involving an amendment of the constitution must always be submitted to popular referendum. This constitution closely resembles that of the Swiss Confederation, but differs from it in that in Baden the Government is dependent on Parliament, which can at any time dismiss the whole Ministry or individual members of it. In Oct. 1925, after the new elections, the Liberals left the Government, which was carried on by a coalition of the Social Democrats and the Centre. (W. v. B.)

BADENI, KASIMIR, COUNT (1846–1909), Austrian statesman (*see* 3.34d), was born Oct. 14 1846 at Surachovo in Galicia. He studied law and served some years in the Ministry of the Interior and from 1879 at Cracow as lieutenant of the governor of Galicia. He resigned from the government service in 1886, but two years later was appointed Governor (*Statthalter*) of Galicia. In Sept. 1895 he was appointed Austrian Prime Minister and his attitude was at first satisfactory to the German-Austrians. In 1897, however, in order to gain the support of the Czechs for the new *Ausgleich* with Hungary, he made certain important concessions in respect of the use of the Czech language in Bohemia. This was done by ordinance, without parliamentary sanction, and met with violent opposition from the German deputies, some of whom were imprisoned. The storm of indignation aroused among the German-Austrians by this policy led to Badeni's downfall on Nov. 28 1897. He died at Radziechow, near Lemberg, in Austria, July 9 1909.

BADMINTON (*see* 3.189).—The development of this game in Great Britain since 1910 is evidenced by the increase in the number of clubs affiliated with its central organisation, the Badminton Association. In 1910 only 302 clubs were so affiliated, including Scottish clubs, while at the end of 1925 the number totalled 615 in England alone. A further total of 254 clubs belonged to the Irish, Scottish and Welsh Badminton Unions.

The World War necessarily checked the progress of the game, but since 1918 it has steadily gained in popularity, and with the aid of exhibition matches, which for some seasons have been held all over England, a better knowledge of the possibilities of Badminton has been acquired. Another symptom of the game's advance is the increase in the number of county associations, the chief object of which is the promotion of inter-county matches and competitions.

The game is still developing rather slowly on the continent of Europe, but it has advanced rapidly in Canada, and in 1925–6 a team of six British champions visited the Dominion for the purpose of playing exhibition matches. The team, captained by Sir George Thomas, arranged to appear in New York before returning to England.

The list of tournament fixtures in the season 1925–6 was in striking contrast to that of the season 1910–1. At that time only about a dozen open meetings were held, whereas the fixtures for 1925–6 numbered at least 25. International contests between England and Ireland, England and Scotland, and Scotland and Ireland, are now established features of every season. England retained her unbeaten record in 1925, though in 1924 she only escaped defeat at the hands of Ireland by the narrow margin of one match. In 1925 the British Open Championships resulted as follows: Men's Singles, J. F. Devlin. Ladies' Singles, Mrs. A. D. Stocks. Men's Doubles, H. S. Uber and A. K. Jones. Ladies' Doubles, Mrs. Tragett and Miss Hogarth. Mixed Doubles, J. F. Devlin and Miss K. McKane.

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BADOGLIO, PIETRO (1871–), Italian general, was born at Grazzano, Sicily, Sept. 28 1871. During the Italo-Turkish War he served in Tripoli on the staff. During the World War he planned and carried out the successful attack on Monte Sabotino which preceded the fall of Gorizia in Aug. 1916 and commanded the XXVII. Corps at the battle of Caporetto. From Feb. 1918, he acted as sole sub-chief-of-staff under Diaz. He conducted the Armistice preliminaries at Villa Giusti and signed the Armistice on behalf of Italy. In Nov. 1919, he was appointed to the rank of army general and was chief of the general staff in succession to Diaz until Feb. 1921. In 1923 he was appointed ambassador to Brazil, but returned to be chief of the general staff, a post which had been recreated when Sig. Mussolini took charge of the War Ministry.

BAEYER, JOHANN FRIEDRICH WILHELM ADOLF VON (1835–1917), German chemist (*see* 3.192), died at Munich Sept. 5 1917.

BAGHDAD (*see* 3.194).—The population, mostly Arab, was estimated in 1925 as 170,000. During the World War one of the two old gates, which were still fairly well preserved, was blown

up by the Turks, who also burnt the famous library of over 20,000 volumes. After the British occupation in 1917 a pontoon bridge was built across the Tigris and named after Gen. Maude; it is reached by a street cut through the city by the Turks for artillery transport. The theological building of the College at Mu'adhdham Al-al-Bait was formally opened by King Feisal on March 15 1924 and the foundation stone of the central block laid. A British Residency has been built near the river, and a palace for King Feisal on the outskirts. Sanitary conditions have been greatly improved and an efficient health service established; medical institutions include the New General Hospital, the Civil Hospital for Women and Children and an isolation hospital. A telephone system and an improved system of water supply have been installed. Schemes for the provision of electric power and a tramway service were submitted to the council of state in 1923. Irrigation schemes have been put into operation in the surrounding areas and flood protection measures carried out.

Developments in communications during and after the War have greatly added to the importance of Baghdad as the trade centre of 'Iraq. By the outbreak of the World War the projected line northwards to Mosul had been completed as far as Samarra. After the capture of the city by the British troops under Gen. Maude in 1917, railway construction was actively undertaken. By 1922 the line to the north had been extended to Sharqat, 185·5 m. from Baghdad, and other lines in operation were southwards to Basra, 356 m. and northwestwards to Khanaqin and the Persian frontier. The city has also developed into an important river port. The produce of the surrounding districts is distributed by rail and river, and a large trade with Persia and Kurdistan has grown up. The chief exports from the city are wool, gum, opium, dates, skins, hides and carpets; imports are cotton goods, coffee, sugar, indigo, pepper, tobacco, etc., which are largely re-exported.

Baghdad is an important air station on the route from Europe to India. A fortnightly air mail service from Cairo was established in 1921. In Oct. 1923 an Overland Mail Motor Service was inaugurated between Baghdad and Haifa, via Damascus, by the Nairn Transport Co., and by 1924 a regular weekly service was maintained. A wireless station, in regular communication with Cairo and Beirut, was brought into operation with effect from Jan. 25 1923; commercial traffic is accepted for Great Britain, Germany, the United States and Syria.

BAGHDAD RAILWAY (*see* 27.439).—The Baghdad Railway was, as originally set on foot, a predominantly German enterprise for the construction of rail communications from the Bosporos to Baghdad. Its military and economic importance to Turkey, its position as the keystone of German policies in the Ottoman Empire, its strategic menace to British and Russian interests in the Near East and its potentialities for undermining French influence in Anatolia and Syria, all combined to make it one of the outstanding problems of world politics in the 20th century.

Handicapped from the start by financial difficulties, the German promoters sought to internationalise the railway. An attempt to interest French and British capital in 1903 was only partly successful. The British Govt. refused to sanction participation in the project; but, in spite of opposition by their government, French bankers subscribed almost 30% of the shares. Subsequently the diplomatic resistance of the Entente Powers returned perennially to plague the Ottoman Govt. and the German concessionnaires. On the other hand, the steady progress in construction and the unexpected success of the sections actually placed in operation led British, French and Russian diplomacy to the conclusion that a policy of obstruction would prove barren. In 1908 the respective national policies toward the Baghdad Railway were reconsidered, and an honest effort was made in the convention of June 2 to reconcile the divergent interests involved.

Diplomatic Moves.—Anglo-Turkish negotiations of 1910–1 ran aground on the rocks of loans and increased customs duties. But the heretofore solid front of Entente diplomacy was broken in Nov. 1910, when, by the Potsdam Agreement, Russia agreed to abandon her objections to the Baghdad Railway in return for German recognition of the Russian sphere of interest in Persia. The Ottoman Govt. then prepared the way for an understanding with Great Britain and France by granting several valuable economic concessions in Anatolia and Syria to nationals of those Powers. The Balkan wars interrupted the course of the negotiations, but in Feb. 1914, a secret Franco-German convention settled all outstanding differences between French and German capitalists and between their respective governments.

Most significant of all, however, were the far-reaching agreements of 1913–4 between the British, German and Ottoman Governments. Turkey arranged a revision of the Baghdad Railway concession to conform with existing British economic and strategic interests in Mesopotamia and the Persian Gulf; Great Britain consented to an increase in the Ottoman customs duties. After very extensive negotiations between German and British business men having interests in the Near East, an Anglo-German convention[1] was initialled at the Foreign Office, London, June 15 1914. This document marked a complete rapprochement on a question which had been a sore point in Anglo-German relations for more than a decade. According to its provisions " two English members acceptable to His Britannic Majesty's Government " were to be elected to the Board of Directors of the Baghdad Railway Company; the terminus of the line was to be Basra instead of Kuwait on the Persian Gulf; and a policy of mutual diplomatic helpfulness was to be pursued as concerned the economic development of Mesopotamian resources (including oil-fields). Just before the outbreak of the World War the diplomatic problems connected with the Baghdad Railway had been all but settled.

Control of the Baghdad Railway by Germans was one of the principal factors in enlisting Turkey in the War on the side of the Central Powers. Once in the War the Turks, with German assistance, effectively used the Baghdad line in defence of the Dardanelles and Mesopotamia, as well as in two attempted invasions of Egypt. When the Germans lost and the Ottoman Empire was disintegrated the dream of "Berlin to Baghdad" became but a memory. All German rights in Turkish railways were abrogated by the Treaty of Versailles (1919); the German Govt. expropriated and delivered to the Reparations Commission substantially all the holdings of its nationals in the Baghdad Railway Company. In the unratified Treaty of Sèvres (1920) Turkey was obliged to confirm the confiscation of German railways in the former Ottoman Empire and to agree to any disposition which the Allies might choose to make of them.

But the Turkish Nationalists rejected the Treaty of Sèvres, and the Treaty of Lausanne (1923) did not provide for the liquidation of former German railway concessions. The greater portion of the railway remained in the possession of, and was operated by, the Turkish state. The Mesopotamian and Syrian sections of the line were handed over to the control respectively of the Kingdom of 'Iraq and the French administration at Beirut. To confound confusion, on Sept. 25 1918 the German owners of the Baghdad Railway had granted to the Anatolian Railway Co. an option on all their shares in the former company. Questions of compensation to the shareholders (among whom is the Reparations Commission) had not been decided early in 1926.

Construction.—By the outbreak of the World War the railway reached from Konia to the foot of the Taurus Mountains, and in 'Iraq the section Baghdad to Samarra had been completed. During the War construction was actively pushed forward in the direction of Mosul. The Taurus and Amanus tunnel systems were completed in 1918, and by the end of the War the line was laid from Konia to Nisibin. It connected with the Syrian system at Muslimiya north of Aleppo, a connection completed in time to enable the troops of Lord Allenby to enter Asia Minor in 1918 by rail. By 1924 a temporary bridge had been built across the Euphrates at Jerablus, a branch constructed from Derbesiyc

[1] See *The Political Science Quarterly*, vol. 38, pp. 24–44 (1923) and the Parliamentary debates reported in Hansard.

to Mardin, and the line was open for traffic as far as Nisibin. In 'Iraq the British had extended the line from Baghdad to Samarra as far as Qal'a Sharqat, and had linked up Baghdad with the port of Basra on the Persian Gulf. In 'Iraq, in 1926, further construction depended largely upon the outcome of the proposal to move the line to the more fertile and higher regions on the other side of the river Tigris. (*See* ASIA MINOR; PERSIAN GULF.)

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BAHAMAS (*see* 3.207), a British West Indian colony; area, 4,404 sq. m.; population, 54,886 (1924). On Sept. 27 1915 the Legislature voted £5,000 to defray the cost of a war contingent. In 1916 the War Contingent bill was passed for the maintenance at effective strength of a contingent of 200 men for the British West Indies Regiment. The first draft left Nassau on Sept. 9 1915. The colony contributed liberally to the various patriotic war funds. At first the effect of the World War was scarcely felt. Though labourers in Inagua and Long Cay suffered from the cessation of the stevedore trade, the demand for sisal and sponges was enhanced. When, however, the United States entered the War, the tourist business was adversely affected, but during the post-War period it more than recovered lost ground.

In 1913 a contract was entered into with the Peninsular and Occidental Steamship Co. and the Florida East Coast Hotel Co. for mail, passenger and freight steamship communication between Florida and Nassau during the winter, and for the provision of a first-class hotel in Nassau for five years at £5,000 a year. Their steamer "Miami" having run ashore, the contract was cancelled by the Government in 1915. A temporary service between Mayport (Jacksonville) and Nassau was then arranged. In 1914, by Act of the Legislature, a Development Board was established to develop the tourist trade, and in 1921 a contract was signed with the Munson Line for a weekly passenger and freight service from and to New York during the winter, and a fortnightly service during the summer.

Production.—The cultivation of tomatoes, an industry which has greatly developed since 1918, is making considerable progress; in 1924 exports were valued at £37,381. Pineapples are also cultivated and a fair export trade in canned pineapples has grown up. The extensive areas covered with pine forests are only partially exploited. The Board of Agriculture, which ceased to exist in 1910, was re-established in 1912 on broader lines. With the advice of the Marine Products Board the sponge industry is being pursued more scientifically; exports in 1924 were valued at £131,618.

Finance and Trade.—Revenue rose from £84,386 in 1910–1 to the record figure of £852,573 in 1922–3. In 1923–4 it was £553,375. The expenditure in 1910–1 was £85,315; in 1922–3, £377,164 and in 1923–4, £452,044. The reason for the increase in revenue is to be found in the expansion in the imports of spirits resulting indirectly from the 18th Amendment to the Constitution of the United States in 1919. The public debt, on March 31 1924, amounted to £20,219. The value of imports of wines, spirits and liqueurs rose from £7,237 in 1918 to £1,088,000 in 1923. In 1910 imports coming from the United States were valued at £220,621; from the United Kingdom at £81,266; and from Canada at £12,728. In 1924 the figures were: United States, £748,000; Great Britain, £507,000; and Canada, £173,000. The total value of the oversea trade during 1924 was £2,210,000, consisting of imports valued at £1,584,000 and exports at £626,000, domestic exports were worth £274,327.

Canadian Agreement.—The Bahamas, which had not taken part in the Canada-West Indies Conference of 1912, sent a representative to Ottawa in 1920 and were signatories to the Trade Agreement of June 18 of that year, increasing voluntarily the agreed preference from 10 to 25%. Under the Agreement Canada provided a three-weekly steamship service between Canada, the Bahamas, Jamaica and British Honduras, the Bahamas agreeing to contribute 25% with a maximum of £3,000 towards any deficiency in the working (*see* WEST INDIES). The Bahamas were represented again at the Conference of 1925 and were signatories to the Trade Agreement of July 8 of that year. Under this agreement such produce of the Bahamas as is dutiable in Canada receives a preference of 50% of the duties, with a specific preference of one half cent per pound on canned pineapples, while Bahamas sponges of marine production are admitted free of duty, foreign sponges paying an *ad valorem* duty of 17½%. The Government of Canada undertook to provide, within 15 months after ratification, a fortnightly mail, passenger and freight service between St. Lawrence ports in summer and other Canadian ports in winter, calling at Bermuda, the Bahamas and Jamaica fortnightly. The Government of the Bahamas undertook to contribute £2,000 per annum towards such services when established.

Public Works.—The revival of the tourist trade after 1918 resulted in increased attention being paid to public works. In 1923 the main channel and mooring basin of Nassau Harbour were dredged clear of sand by an American company and a Government dredger then commenced work on the remaining rock. In 1925 schemes were under consideration for the construction of a wharf, a new hotel and a new abattoir. Steps were also taken to improve the roads and repair the sea wall. A radio telegraph service, installed by the Anglo-French Wireless Telegraph Co., was completed in 1923. (*See* WEST INDIES.) (A. E. A.)

BAHIA or **SÃO SALVADOR** (*see* 3.210).—During the years 1900 to 1920 the population of Bahia increased about 38%; since 1920 this increase amounted to 13%. Official estimates place the population (1926) at 320,000. Bahia has made marked progress in extending new streets, in laying miles of new sewerage and in providing sanitation and improved health conditions; a more adequate water supply system is under construction; various civic improvements are announced, while there is unprecedented activity in the construction of residence and business property. The use of automobiles, motor-trucks and tractors in the country is rapidly growing, as mule carts and horse-drawn vehicles are disappearing from the streets.

Port improvements, begun in 1909, have made fair progress, and, when completed, will represent an outlay of about $20,000,000. Ships now dock, instead of anchoring in the bay, and the cargo is transferred in modern ways to and from well-equipped marine warehouses. During the five years, 1920–5, exports of cacao, hides, tobacco, coffee, sugar and hard woods ranged from 100,000 to 150,000 tons annually. Diamonds also were exported. Imports of manufactured goods ranged from 60,000 to 101,000 tons yearly. About 100 industrial plants are engaged in manufacture, but higher class goods and implements are imported. The improved financial condition of the State of Bahia reacts favourably on the city's progress. (W. A. R.)

BAHREIN (*see* 3.212), an archipelago off the Hasa coast, is a British Protectorate which for more than 50 years up to 1922 had been under the rule of Sheikh 'Isa ibn Khalifa. In that year, owing to the extreme old age of the ruling Sheikh and the prevalence of intrigues among his sons, the British authorities induced him to abdicate in favour of his son, 'Abdullah. Outwardly independent, the administration of the islands is, for all practical purposes, controlled by the British political agent stationed at the port of Manama. Bahrein is the centre of the valuable pearling industry of the Persian Gulf, and before the War ranked next to Kuwait as a clearing station for Central Arabian trade. (*See* PERSIAN GULF.)

BAINVILLE, JACQUES (1879–), French historian and journalist, was born at Vincennes, near Paris, Feb. 9 1879. His first literary work was a life of Louis II. of Bavaria (1900), written while travelling in Germany. He then devoted himself to criticism, and published many articles, as yet uncollected. But his path in life was already marked out. He came under the influence of Maurras, joined the Royalist party, and, at the time of the Dreyfus case, became in 1899 one of the original editors of the monthly review, *Action Française*. This review in 1906 became a daily paper, of which Jacques Bainville was appointed foreign editor. From that time he devoted his energies to his short daily articles, which were clear, well-written, intelligent and full of striking phrases that soon became proverbial, such as that on the Treaty of Versailles, "*trop doux pour ce qu'il a de*

dur, trop dur pour ce qu'il a de doux." His activities as a political journalist were interrupted by a visit to Russia during the World War, and by the publication of various works, which aroused great interest, not only among his Conservative followers, but also among critics in general.

Jacques Bainville was the first writer in France to deal with the political philosophy of the War. This he did in *L'histoire de deux peuples* (1915), a work in which the influence of Maurras is modified by that of Thiers and Albert Sorel. The struggle between France and Germany is traced back to the far-off racial antagonisms from which it sprang, and one seems to be reading the documents of an endless lawsuit between the two peoples. The book is breathless and a little superficial, but clearly and brilliantly written. After the conclusion of peace he published *Les conséquences politiques de la paix* (1920), a reply to the well-known work of Mr. Maynard Keynes. The title itself of this book reflects the spirit of the *Action Française*, with its motto of "Politics First," and is an indication of how widely Bainville's views differ from those of the Cambridge economist.

Bainville's most celebrated work is his *Histoire de France* in one volume (1923), which is a model of clearness, intelligence and grace of style. The doctrines of the *Action Française* in favour of the monarchical system are prominent, but they are considerably modified, and the dominating theme of the book is the continuity of political tradition in France. The author is not a trained historian, and a certain number of errors have crept in, but they are of minor importance. Jacques Bainville also became editor of *La Revue Universelle*, a fortnightly review with a considerable popularity. (A. Th.)

BAKELITE, the trade name for a new plastic which during the years 1910–25 has found increasing applications for varied purposes, ranging from radio, wireless telegraphy and other electrical devices to gears, grindstones, aeroplane propellers, self-lubricating bearings, jewellery and ornamental articles.

Appearance and Characteristics.—It has the general appearance of the natural resins; yet its extreme hardness, exceptional strength, infusibility, insolubility and general chemical inertness are properties lacking in the natural resins, of which amber, a fossil resin, is one of the hardest. Unmixed with other substances it is very transparent and of an amberlike colour which can be changed by the addition of suitable dyes. It can be produced colourless and transparent.

Uses in Industry.—For important technical uses it is mixed with fibrous materials, thus acquiring an opaque reddish-brown colour which is sometimes changed to black or other colours by means of dyes or pigments. It possesses neither the elasticity nor flexibility of rubber or celluloid but is rather rigid. But this rigidity and its faculty to withstand temperatures at which rubber, celluloid, and natural resins liquefy or are destroyed, together with its adaptability for being moulded rapidly, and with extreme accuracy, to various shapes, have made possible endless applications in industry. In the manufacture of ornamental articles, its greater strength and brilliancy than amber are advantageous. For electrical insulation it withstands increases of temperature which would be fatal to rubber or resinous compounds, even if the latter had as great a tensile strength; hence its numerous uses for wireless telegraphy, radiophones, telephones, electric lampsockets, generators, motors and other electrical equipment. It is used for mechanical devices where strength, resistance to moisture, oil and solvents, or increases of temperature are essential requirements. Paper or woven fabric impregnated with it and then hardened in a hot, hydraulic press gives sheets, rods and tubes which have found extensive uses, *e.g.*, for electrical insulators, silent transmission gears and aeroplane propellers. In both the latter applications its greater strength and resistivity to moisture make it preferable to rawhide gears or wooden propellers. By mixing it with emery or graphite such divergent uses as grinding wheels and self-lubricating bearings have been brought about. Transparent Bakelite laboratory apparatus permits handling hydrofluoric acid.

History.—The creation of a super-resin by chemical synthesis has been the result of efforts extending over half a century. More than 50 years ago Adolph Bayer and others, while engaged in the study of crystalline bodies engendered by the inter-action of aldehydes upon phenols, noticed in some cases the formation of resinous-looking substances. But they were entirely valueless, being no better than the worst of the natural resins and more expensive to produce. Later, Delaire, Blumer, Luft and others made repeated attempts to improve the quality of these synthetic resins (*see* Synthetic Resins). Their main efforts were directed toward the production of resins which could be substituted for shellac, a fusible, soluble resin. Thus originated several shellac substitutes, none of which on account of inferiority supplanted the natural product. Story, by using practically the same raw materials, produced an infusible product, but failed to control the reaction so as to obtain a final product of the required qualities for useful purposes. A rather baffling situation arose from the fact that the same formaldehyde and the same phenols might produce, under apparently the same conditions, the most varying products, ranging from crystalline substances, soluble in water, to fusible and soluble shellac substitutes, or, at times masses which refused to melt or dissolve.

Baekeland's Researches.—Early in 1909 L. H. Baekeland published the results of many years of research work on this subject. He indicated well-defined methods for producing each variety of substances with absolute regularity. He announced the important technical effect of the action of ammonia or other bases in conjunction with phenol and formaldehyde, thus directing the chemical reaction toward the formation of infusible products. He also introduced the simultaneous action of heat and pressure for insuring the same effect.

He thus succeeded in controlling a seemingly erratic chemical reaction, and rendered its technical utilisation possible. The infusible final product of maximum hardness he called "C." But he was able to stop the reaction at an intermediate substance called "A." The latter has all the external properties of a natural resin. It is very brittle, softens and melts when heated, and many of the resin solvents affect it. But it is different from the natural resins in that on the application of a somewhat higher temperature it soon hardens and is transformed into "C." This change is due to a regroupment of the molecules, known as polymerisation (*see* 14.881).

So the whole art of using these resinoids is to work them while they are still in the fusible, soluble "A" condition, which permits them to be dissolved or to be moulded while in the plastic state; then to apply enough heat to cause polymerisation into the final state "C." Chemical investigation indicates that the final product is a complex solid solution of several different chemical individuals. Bakelite is also known as phenol-resin, resinoid, redmanol, condensite, resinit, formite, amberite, sipilite, amberdeen, faturan, etc.

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BAKER, GEORGE FISHER (1840–), American financier, was born at Troy, N.Y., March 27 1840. When he was eight years old his family removed to Brooklyn, N.Y., and later to Williamsburg, New York. Most of his boyhood was spent at Dedham, Massachusetts. After a brief period of schooling at Williamsburg, N.Y., he entered Seward University, Florida, N.Y., from which he graduated at the age of sixteen. From 1858–65 he was a clerk in the State Banking Dept., his services being interrupted for six months at the outbreak of the Civil War, when he acted as secretary to Gov. E. D. Morgan of New York. When the national banking system was created in 1863, Baker interested a friend, Mr. Thompsen, who established the First National Bank of New York City, giving Baker a position as teller and offering him on credit all the stock he wanted. Baker refused, however, to go into debt and bought only 30 shares with his savings.

The bank at first grew slowly, dealing chiefly in government bonds; but when, in 1865, Baker became cashier and active

head it began to expand rapidly, being admitted to the Clearing House in 1868. Baker was frequently consulted by the Secretary of the Treasury and in 1877 he became president of the bank, the policy of which he continued to direct with such success as to make it one of the strongest banking institutions in America. In 1882 he acquired the Richmond and Danville Railroad which was the nucleus of a group reorganised as the Southern Railway. Later he obtained control of the Jersey Central and the Delaware, Lackawanna and Western, when these systems were in difficulty. In addition to the presidencies and directorships of numerous powerful corporations, he was president of the Metropolitan Opera House Association. His benefactions included large gifts to the Metropolitan Museum of Art, to the Red Cross and to universities. Conspicuous among the latter was one of $5,000,000 for the Graduate School of Business Administration of Harvard.

BAKER, GEORGE PIERCE (1866–), American educationalist, was born at Providence, R. I., April 4 1866. He graduated from Harvard in 1887 and from 1905 to 1925 was professor of English there. His courses dealing with the theory of the drama were highly successful, and his famous laboratory, known as the "47 Workshop," afforded practical training for his students. In Nov. 1924 he accepted an invitation from Yale University to become head of the new department of dramatic art. His works include: *The Development of Shakespeare as a Dramatist* (1907); *Dramatic Technique* (1910); and *Modern American Plays*, collected and edited with introduction (1920).

BAKER, NEWTON DIEHL (1871–), American lawyer, administrator and party leader, was born at Martinsburg, W. Va., Dec. 3 1871. He was educated at Johns Hopkins (A.B. 1892) and at Washington and Lee (LL.B., 1894). In 1897 he began the practice of law in his native town, removing later to Cleveland, Ohio. Here he soon distinguished himself as a lieutenant of Mayor Johnson in the latter's long struggle for tax reform and three-cent fares. Appointed city solicitor by the mayor in 1902, he held that office by election from 1904 to 1912 and that of mayor from 1912 to 1916. On the floor of the Democratic national convention of 1912 he fought successfully to release the Ohio delegation from the Unit rule, thereby contributing 18 votes toward the nomination of Wilson. As President-elect the latter offered him in 1913 the Secretaryship of the Interior, which he declined in order to push forward municipal reforms in Cleveland. Upon the resignation of Garrison three years later, however, he was appointed Secretary of War. Although an avowed pacifist, immediately after the organisation of the 65th Congress in 1917 he submitted a plan for universal military conscription, and remained at the head of the Department of War throughout the whole period of the World War and to the retirement of Wilson in 1921. Administration policies regarding preparedness, conduct of the War and treatment of conscientious objectors became the subject of severe criticism, much of it for partisan ends. In reply to this, he maintained before the Chamberlain Senate Committee early in 1918 that "no army of similar size in the history of the world has ever been raised, equipped or trained so quickly." After 1921 he resumed the practice of law in Cleveland. In the Democratic convention of 1924 he made a strenuous but losing fight for a strong League of Nations plank. (R. C. B.)

BAKST, LÉON (1866–1924), Russian painter, passed his childhood in St. Petersburg. He attended the Imperial Academy of Arts, but was obliged to leave after painting a too realistic "Pietà." As a member of the Society of Painters in Water Colours and as teacher to the children of the Grand Duke Vladimir, he succeeded both as a Court painter and in the fashionable world. Under the influence of Alexandre Benois, he changed his artistic outlook and joined the group "The World of Art" that was struggling for the recognition of modern art. He became secretary of the review edited by that group. From 1900 onwards he was scenic artist, first at the Hermitage Court Theatre and afterwards at the Imperial Theatres. He designed the scenery and accessories for the tragedies of Sophocles in the spirit of the Greek theatre and in the archaic style of the Aegina sculptures. He made a voyage to Greece and Crete of which he wrote an account, and his famous picture "Terror Antiquus" expresses his vision of mythic Greece.

In 1906 he exhibited in the Russian section of the Salon d'Automne in Paris. Two years afterwards he achieved considerable fame as the chief painter of scenery for the Russian ballets produced by Diaghilev. "Cleopatra," "Scheherazade" (1909) and "Daphnis and Chloe" were among his most notable achievements. He returned to Russia and founded a liberal school of painting. Afterwards he settled in Paris, where he designed the setting of the tragedies of D'Annunzio and of a play of Verhaeren. He painted the scenery and designed the costumes for the "Sleeping Princess," the fairy ballet of Tchaikovsky produced in London in 1921. He also produced several plays at the Paris Opera, among them the "Bewitched Night." Léon Bakst revolutionised the application of the decorative arts of the theatre and thus presented à unity of impression. The influence of his genius may also be seen in the costumes of the time. He died in Paris Dec. 27 1924. See André Levinson, *The Story of Léon Bakst's Life* (London, 1921.) (A. Le.)

BAKU (*see* 3·230).—The population in 1925 was about 250,000. Baku changed hands repeatedly between 1917 and 1920. After the break-up of the federated republics of Transcaucasia, Azerbaijan, Georgia and Armenia, formed in 1917, Azerbaijan constituted itself an independent Mohammedan republic early in 1918, claiming Baku as its capital, but in March the Russians and Armenians ejected the Tatar Moslems.

In July Baku was occupied by a small British force from Mesopotamia, but this was withdrawn in Sept. owing to the exhausted condition of the Armenian population and the arrival of Turkish reinforcements. By the terms of the Armistice in Nov. 1918, however, the Turks agreed to offer no objection to an Allied occupation, and on Nov. 17 a British force from Persia, with Russians and Armenians, reoccupied the town to preserve order. An Azerbaijan Govt. was established, but was wholly inexperienced, and the British military forces were forced to take over most of the work of civil administration. When the British troops were withdrawn in Aug. 1919, the order which they had brought to Baku was rapidly changed to chaos. A Russian force entered the town without opposition in April 1920, and, with the help of a rising of the local Bolsheviks, the Soviet Socialist Republic of Azerbaijan, forming part of the Transcaucasian Socialist Federal Soviet Republic, was proclaimed with Baku as its capital.

The Oil Industry.—In 1920 the oil wells in the Baku area were nationalised by the Soviet Government. The refining machinery was repaired, new wells drilled and new refineries erected. In 1923–4, 191 new wells were being drilled and, in May 1924, 1,929 wells were reported to be active, as against 709 in 1920. In 1913 the yearly output of oil amounted to 9,438,000 tons; in 1923–4 it was 4,241,863 tons, valued at 88,625,000 roubles. The republic has granted large tracts of land for the enlargement of the industry, and a pipe-line to Poti is projected. The town is connected with Batum by a pipe-line, as well as the railway, and with Krasnovodsk, across the Caspian, by steam ferries, and is only one day by steamer from the North Persian ports. The annual trade fair was revived in 1922.

BALAKIREV, MILI ALEXEIVICH (1836–1910), Russian composer (*see* 3.324), died at Petrograd May 28 1910.

BALANCE OF PAYMENTS.—By the term international balance of payments is meant in the first instance the statement of accounts or balance-sheet which could be compiled, were knowledge on this subject complete, referring to all those transactions between one country and others which involve monetary payments or obligations.

But a certain confusion is caused by the fact that the word balance is employed both for the balance-sheet itself and for any difference which may be shown between the total outgoings and the receipts. Actually the two sides of this account must balance, for every transaction which should be included must involve either a receipt, payment, credit or obligation. But the statements are frequently, indeed generally, drawn up in such a

way that a positive or negative balance may result. By positive balance is meant an excess of the apparent receipts over the apparent expenditure; by negative, the reverse.

Before the World War writers frequently excluded gold from the items composing the statement of accounts, and presumed that the net balance shown indicated the amount of gold which left or entered, or, but for short term borrowing, would have left or entered the country. Since the War, however, the most approved practice has been to include all monetary transactions, with the exception of the arrangement of banking or other similar commercial floating credits.

If it were possible, therefore, to draw up a complete statement for any country on this principle, the net balance would represent the increase in the country's floating credits or debits. But in practice a large number of items have to be estimated on an inadequate foundation of ascertained fact, so that the difference between the two sides of such an account is really composed of errors in estimation plus or minus changes in floating balances. In Denmark, and more recently in Norway and certain other countries, official statistics of bank balances are published annually, and the estimates can, therefore, be constructed using these statistics as the corner-stone of the whole structure of calculation and argumentation. For these countries, therefore, it is possible to obtain a more accurate estimate of one of the most interesting group of items brought out by the balance-sheet, namely capital movements, than it is for others.

The fact should be emphasised that a statement of the balance accounts of any country relates to monetary transactions only. Gifts in kind and reparations in kind are, therefore, when possible omitted—but money gifts or reparations paid by draft included. In practice it may frequently prove impossible to effect these exclusions. The export of currency notes is equivalent to the opening of a special form of credit.

The Chief Headings.—The types of transaction which may give rise to international monetary obligations are almost infinite; but the main headings may be grouped as follows: Inward or credit movements—exports of (1) merchandise; (2) gold bullion, gold and other specie and currency notes; (3) capital items, including receipts on account of amortisation of loans existing and new domestic securities sold abroad, foreign securities sold abroad, domestic real estate and other capital values sold abroad; (4) interest and dividends from foreign loans and capital invested abroad; (5) shipping freights, charter money and other earnings of national ships from abroad; (6) transport and similar earnings from foreign goods in transit; (7) post, telegraph and telephone receipts from abroad; (8) funds brought in by immigrants and returned emigrants and emigrants' remittances from abroad; (9) receipts from tourists; (10) receipts from foreign, diplomatic, consular and similar services; (11) commissions, insurance policies and premiums, brokerage, etc.; (12) miscellaneous. The reciprocal debit items are obvious and need no capitulation.

The compilation of such a statement in any country would entail special inquiry and a considerable element of conjecture. Thus allowance would have to be made for the possible over- or under-valuation in the trade statistics of the recorded imports and exports, for contraband trade and other omissions. Reliable statistics are seldom available for the so-called invisible items, *i.e.*, all items other than merchandise, coin and bullion. And in each country different measures for estimating the value of each item, dependent on the organisation of business, have to be adopted.

In spite of the practical differences which such estimates involve, the study of this question has received a remarkable amount of attention since the War. Official estimates for the year 1923 or 1924 have been prepared by 15 governments, the most elaborate being those of the United States of America. For this country very detailed statements, official or non-official, have been compiled since 1919. These are summarised in the table in the next column.

The final item represents in part errors and omissions, which in the last three years were estimated at −133, −115 and +4 million dollars. Complete accuracy can never be attained. But

United States: Balance of Payments (Millions of Dollars)
(Credits + Debits −)

	1919	1920	1921	1922	1923	1924
Exports of Merchandise (net)	+4,016	+2,950	+1,976	+734	+389	+970
Exports + and imports − of silver (net)	+ 152	+ 26	− 11	− 8	− 2	+ 36
Exports + and imports − of gold (net)	+ 160	− 50	− 667	−238	−294	−258
Export of U.S. currency (net)	+ 91	+ 103	− 100	. . .	+ 50	− 50
Interest on foreign investments (net)	+ 50	+ 50	+ 80	+351[1]	+417[1]	+464[1]
Ocean freight payments (net)	+ 93	+ 93	+ 33	+ 7	− 8	+ 8
Governmental expenditure abroad	−2,375	− 305	− 50	− 16	− 19	− 5
Immigrants' remittances, charity and tourist expenditure (net)	− 650	− 850	− 700	−700	−760	−855
Foreign Loans paid off	+ 515	+ 571	+ 255	+ 78	+ 23	+45
Sales of securities to foreigners	..	..	+ 48	+216	+412	+319
Repayment of principal of debts to U.S. Govt.	..	..	..	+ 31	+ 91	+ 23
Foreign investment of American capital	− 970	−1,445	−1,092	−963	−417	−909
Excess of credits + and debits −on all transactions	+1,082	+1,143	− 228	−508	−118	−212

[1]Includes interest received by U.S. Govt. from foreign governments.

the statement renders clear the manner in which the enormous net exports of the earlier years, largely to Europe, were covered by long-term loans and short-term credits, how the floating credits are being gradually liquidated, and how the export surplus itself sank from over $4,000,000,000 in 1919 to $389,000,000 in 1923. The increase of this surplus in 1924 was coincident with the revival of capital export.

Although the interest earned by the United States of America on her foreign investments rose from about $50,000,000 in 1919, to over $460,000,000 in 1924, it was still less than 50% of the receipts of the United Kingdom on this account. But, according to the estimates of the Board of Trade the net receipts of the United Kingdom estimated in 1913 at £210,000,000 were despite changes in the purchasing power of money only £220,000,000 in 1924. In 1926 very considerable revisions were made in the more recent estimates of the British balance of payments. The united figures for 1924 and the preliminary estimate for 1925 are as follows:—

United Kingdom: Balance of Payments (in Millions of Pounds)

	1924	1925
Excess of imports of merchandise and bullion	324	386
Excess of government payments made overseas	28	15
Total	352	401
Net income from overseas investments	220	250
Net national shipping income	130	115
Foreign ships disbursements in British ports	10	9
Commissions	40	40
Other services	15	15
Total invisible exports on balance	415	429
Available for investment abroad	63	28
New overseas issues on London market in year	134	88

The relative importance of the visible and invisible items in individual balances of international accounts varies enormously from country to country and from year to year. In the years immediately succeeding the War, most European countries showed a heavy visible negative, and most of the important extra-European countries a large visible positive balance of trade, the differences being accounted for mainly by short-term borrowings. (*See* TRADE, INTERNATIONAL.)

Of the countries for which estimates have been made, the United States, the United Kingdom, France, Austria, the Netherlands, Switzerland and Sweden, all obtained a net income from foreign investments in 1923. Switzerland and Italy earn a very considerable net income from tourists, estimated at somewhat over $27,000,000 for the former in 1924 and $119,000,000 for the latter in 1922. A number of European countries further acquire an important addition to their foreign purchasing power from the remittances sent by emigrants, the largest sums being received by Italy about $126,000,000 in 1923; Greece, about $25,000,000 in 1923 and $40,000,000 in 1924; Poland, $25,000,000–$30,000,000 in both 1923 and 1924; the Irish Free State roughly estimated at about $20,000,000 in 1924. The United States State Dept. reckons that remittances to Germany in 1924 from America alone were in the neighbourhood of $80,000,000.

The greater part of the emigrants' remittances received by Europe, but by no means the whole, is derived from the United States of America, whose outgoings on this account in 1923 and 1924 are given at $350,000,000. The net expenditure of her tourists and travellers is also enormously greater than that of any other country, amounting in 1923 to nearly $300,000,000 or more than half of the foreign earnings of British shipping in that year. (A. LY.)

BALDWIN, JAMES MARK (1861–), American philosopher (*see* 3.247). Leaving Johns Hopkins University in 1909, he occupied a chair at the National University of Mexico until 1913. In 1915–6 he lectured at Oxford University and the French provincial universities. He was made a professor at the École des Hautes Études Sociales, Paris, in 1919. His later writings include *The Individual and Society* (1911), *History of Psychology* (2 vol., 1913), *Genetic Theory of Reality* (1915) and *The Super-State* (1916).

BALDWIN, STANLEY (1867–), British politician, was born at Bewdley Aug. 3 1867, the only son of Alfred Baldwin, chairman of the Great Western Railway and for 16 years M.P. for the Bewdley division of Worcestershire. Descended from a family, long small landowners in Shropshire, Baldwin's great-grandfather, toward the end of the 18th century, migrated into Worcestershire and established at Bewdley an iron foundry which expanded with the passage of time into the great combination of iron and steel manufactories and collieries known as Baldwin's, Ltd. The development of this concern contributed to the making of Stanley Baldwin; for, deeply as he was rooted in the rich soil of the English midlands, his economic and social outlook was the result of close personal experience of the evolution of modern industry.

Besides the territorial and the industrial there was a third strain in Baldwin's character which came to him from his father's and his mother's people. It was that of Puritanism. Both his parents were of Puritan stock; both indeed were brought up as Wesleyan Methodists. His mother, who lived to see her son twice Prime Minister, was Louise, one of the five remarkable daughters of the Rev. G. B. Macdonald, a Wesleyan minister. Of Mrs. Baldwin's sisters, one became the wife of Sir Edward Burne-Jones; a second of Sir Edward Poynter, P.R.A., and a third of J. L. Kipling. Stanley Baldwin is thus a first cousin of Mr. Rudyard Kipling. Mrs. Baldwin was a great favourite with Rossetti and William Morris, and it was in this circle and from his close and constant association with his gifted relations that Baldwin derived an abiding taste for the best things in art and literature. His formal education was that given to young men of his class. In 1881 he went to Harrow and in 1885 to Trinity College, Cambridge, where he took his B.A. in 1888.

After leaving Cambridge Baldwin went into his father's business; and when his father entered Parliament in 1892 Stanley Baldwin became virtually the head of the concern. For nearly 20 years the business was the central interest of his life. He became a county magistrate and a county councillor, and lived the life of a country gentleman, with scholarly tastes and large and expanding business interests. In 1892 he had married Lucy, the eldest daughter of E. L. J. Risdale of Rottingdean, by whom he had two sons and four daughters. In 1906 he served his apprenticeship to politics by unsuccessfully contesting Kidderminster in the Conservative interest. Two years later his father died, and Stanley Baldwin succeeded to the chairmanship of the business, now converted into a joint stock company, to a seat on the board of the Great Western Railway and to the representation of the Bewdley division of Worcestershire.

On March 3 1908, the future Prime Minister took his seat in the House of Commons, and on June 22 made his maiden speech. It was a characteristically modest and sensible contribution to a debate on a subject of which he had intimate knowledge. He spoke in opposition to the Coal Mines (Eight Hours) bill from the point of view of the class which he and his family had represented for four or five generations. In the session of 1909 he had the chance of making a private member's motion. He chose as his theme the investment of British capital abroad, and in the course of his speech revealed himself as an ardent protectionist. But, although the House listened to him respectfully on the several occasions on which he spoke, he gave no special promise of future distinction. For nine years he did his work as a private member, quietly, effectively, simply and modestly.

Official Career.—Lord Edmund Talbot, later Viscount Fitzalan and then Chief Whip, noted Baldwin's ability and advised Bonar Law to make him his parliamentary private secretary. This was done in Dec. 1916, and from that moment Baldwin's advancement was astonishingly rapid. In Jan. 1917, he became a Junior Lord of the Treasury, but instead of going into the whip's office, he was kept busy " on the bench," deputising for the Financial Secretary who had no seat in the House. In June he became Joint Financial Secretary to the Treasury and in that capacity gave valuable assistance in debate to Mr. Bonar Law and Mr. Austen Chamberlain—successively Chancellors of the Exchequer. Accustomed to control the policy of a great business concern, Baldwin was not perhaps well fitted for a subordinate place in the official hierarchy, but his efficient work in Parliament was rewarded by admission to the Privy Council in 1920 and to the Cabinet when, in 1921, he became President of the Board of Trade. It was there that he first gave proof of the stuff that was in him; but in party politics he was still almost an unknown factor.

His chance, however, came in 1922. The Coalition formed by Mr. Lloyd George in Dec. 1916, and cemented by the general election of 1918, was by that time manifestly breaking. Many Liberals, and still more Conservatives, found that the Coalition imposed too great a strain on their political consciences. Mr. Lloyd George and his personal followers were anxious to appeal again to the electors as a Coalition. The majority of the Conservatives were opposed to them. The crisis came in Oct. 1922, when, in fear of a *coup d'état* by the Coalition Ministers, a meeting of the Conservative M.P.s was called at the Carlton Club on Oct. 19. Mr. Austen Chamberlain presided, and his weight, with that of almost all his colleagues in the Cabinet, was thrown into the scale of the Coalition. But they did not prevail with the rank and file of the party, who decided, there and then, by 187 votes to 87 to cut themselves adrift from Mr. Lloyd George and the Liberal wing of the Coalition, and to appeal to the country as Conservatives *sans phrase*. That meeting was the turning point in the history of modern Conservatism; it was the turning point in the career of Stanley Baldwin.

The result was due, apart from the determination of the rank and file, pre-eminently to two men: Bonar Law and Baldwin. The former emerged from retirement, to rescue his party from the Coalition. His action was heroic; the hand of death was already on him, and nothing but a high sense of duty induced him to essay a task manifestly beyond his strength. But Baldwin's was

the greater courage. Only recently admitted to Cabinet rank, yet plainly destined to a high place in politics; just approaching the zenith of his powers, physical and intellectual; with everything to lose politically by a false step, he took his courage in both hands and did simply what he believed to be right. His speech was characteristically brief and direct. He went at once to the "root of the whole difficulty—the position of the Prime Minister," and expressed his conviction that if the "present association" were continued, the disintegrating process in the Conservative ranks, already far advanced, would "go on inevitably until the old Conservative party was smashed to atoms and lost in ruins." Accordingly he declared himself "prepared to go into the wilderness if he should be compelled" by the dynamic force of Mr. Lloyd George to "stay with him."

The die was cast. The meeting voted with Bonar Law and Baldwin; Mr. Austen Chamberlain and other Unionist leaders went into the wilderness—temporarily—with Mr. Lloyd George; Bonar Law became Prime Minister—the first Conservative to hold the office in sixteen years; Baldwin became Chancellor of the Exchequer and principal lieutenant in the Commons; Lord Curzon of Kedleston remained Foreign Secretary and leader in the House of Lords.

The electors endorsed the verdict of the Carlton Club meeting; 344 Conservatives were returned, a clear though small majority over all other parties; but the Premier was a stricken man and after a few months in office resigned. Length and distinction of service, no less than intellectual pre-eminence, pointed to Lord Curzon as his successor; but the King was persuaded that, since the Labour Party had become the official Opposition, a peer-premier was no longer practicable. Accordingly Baldwin was invited to form a Ministry, and, assured of the loyal support of his colleagues, consented. The Ministry was easily reformed under the new Premier, but some of the ablest and most experienced Conservatives still remained outside the Ministry and the loss of Bonar Law was severely felt.

Baldwin's first Ministry was short-lived. In Nov. 1923, despite the fact that his parliamentary majority was intact, he decided to ask the electors for a vote of confidence in himself and in the policy which he believed could alone cure trade depression and relieve unemployment—protection for native industries. The country refused its assent. Out of the three parties none commanded an absolute majority in the new Parliament. Consequently the Baldwin Ministry, with 259 supporters, met Parliament. The Liberals, however, coalesced with the Labour men and turned out the Conservatives. Mr. Ramsay MacDonald, thereupon, became the head of a Labour Govt. and remained for nine months in office, until a hostile vote in the House of Commons compelled him to appeal to the country, with the result that Baldwin found himself at the head of a solid phalanx of 414 Conservatives. Commissioned to form a Ministry he not only invited Mr. Austen Chamberlain and other Conservative exiles to rejoin the Cabinet, but entrusted the Chancellorship of the Exchequer to Mr. Winston Churchill. Growing steadily in political stature, having won an electoral victory almost without parallel in recent history, he refused to exploit a party triumph.

Personality and Character.—The career thus outlined is one of the most remarkable in English political history. To what qualities or endowments may Baldwin's meteoric rise to ascribed. Fortune has undoubtedly been kind to him, though in politics fortune rarely smiles except on those whom she suspects to be worthy of her favours. Baldwin has still to win a place in the select company of great statesmen, but fate has given him an opportunity and he himself has given promise that he can take advantage of it. He starts with several initial advantages. The first, and not the least, is that his countrymen know him to be, like Pitt, pecuniarily disinterested. Pitt was a poor man, but his refusal of the Clerkship of the Polls proved that he counted money as dross compared with the public repute. Baldwin, a rich man, proved his public spirit when in June 1919 he presented to the Exchequer for cancellation £150,000 of the new War Loan, a sum representing approximately 20% of his total fortune. He hoped, in this way, to set an example of personal sacrifice. He clearly perceived that the country was in grave danger of "being submerged in a wave of luxury and materialism," and he believed that "a fool's paradise is only the ante-room to a fool's hell."

With the ideals of a patriot Baldwin combines the instincts of a Puritan. He appeals, therefore, if not like Gladstone to the Nonconformist conscience, to the best feelings of all good men, whatever their creed. "I stick all through to what I believe to be right." So Baldwin said at the Carlton Club meeting, and his countrymen instinctively recognized that he spoke with sincerity and simplicity. There is no pose about Baldwin, though his briar pipe comes (thanks to the photographers) perioulsy near one. Simple, sincere, disinterested, he is also shrewd. Brilliant he is not; and indeed all that makes for brilliance he almost ostentatiously disdains. He is slow of speech and a curious working of the face and puckering of the brows gives the impression that his thoughts are, like his speech, laboured. "My mind moves slowly," he wrote of himself.

His speeches reveal a fund of dry and rather caustic humour, but in verbal wit he does not excel, though his judgments on men and things are expressed, especially in private, with pungent force and directness. Rhetoric he profoundly mistrusts; oratory he regards with Froude as "the harlot of the arts." Yet he has a keen appreciation of style in literature, and though he is impatient of the intrusion of the intellectual into politics or industry, few men have a higher sense of the value of real education. Less of the scholar, in the narrower sense, than Gladstone or Peel, he belongs like them to the commercial aristocracy. He loves good art and good literature, but above all he loves nature, and his joy in the sights and sounds and smells of the English countryside is drawn from that quiet worship which is the basis of all true poetry. No one who was not at once patriot and poet could have made the speech which he made on St. George's Day, 1924.[1] (*See* CONSERVATIVE PARTY.) (J. A. R. M.)

[1] In 1926 he published *On England*, a volume of his best non-political addresses, and by his calm and humane demeanour during the general strike his reputation at home and abroad was raised.

BALFOUR, ARTHUR JAMES BALFOUR, 1ST EARL OF (1848–), British statesman (*see* 3.250). Mr. Balfour (as he then was) was confronted, as Conservative leader, after the General Election of Jan. 1910, with an embarrassing situation. While endeavouring to save the effective authority of a second Chamber and to avert Irish Home Rule, with his supporters still sore over the Tariff Reform controversy, he was faced by a Liberal Ministry dominated once more by a body of 80 Irish Nationalists, who held the balance of power in the House of Commons and insisted on a forward policy. He advocated the reform of the House of Lords as an alternative to the Ministerial Veto Resolutions, which he denounced as irrational.

In the lull in the party fight which followed the death of King Edward, he welcomed the suggestion of a conference between the parties to endeavour to arrange a compromise, and was one of the eight leaders who met on 21 occasions between June and Nov. without coming to an agreement. When the conferences failed and ministers announced another dissolution, he did his best to rouse the country to the dangers which, in his opinion, threatened it. When the second general election of 1910 confirmed the verdict of the first, dissatisfaction with his leadership, which had been long entertained by a considerable section of the Unionists, began to spread. It was pointed out that he had now led the party to three electoral defeats in succession: in 1906, Jan. 1910 and Dec. 1910.

The course of the session of 1911 intensified this dissatisfaction. Mr. Balfour did indeed fight the Parliament bill, in its passage through the House of Commons, with courage, persistency, acuteness and passion. In committee he strove hard, but in vain, to get fundamental laws exempted from its operation. But he shrank from encouraging the House of Lords to persist in opposition, when ministers announced that they had obtained the King's consent to the creation of sufficient peers to make its passage certain. He did indeed move a vote of censure imputing to ministers a gross abuse of the constitution in the

advice they had given to the Crown; but he declared that he would stand or fall with Lord Lansdowne in that statesman's recommendation to the Unionist peers to abstain from further resistance as being no longer free agents.

This attitude was passionately resented by a large group of "Diehards," who organised themselves under Lord Halsbury. Mr. Balfour's counsel prevailed, and the bill was allowed to pass; but his authority as leader had been seriously shaken, and in Nov. he decided that the time had come for him to resign. In announcing his decision to a meeting of the Conservative Assn. of the City of London on Nov. 8 he said that he desired to abandon his heavy responsibility before he could be suspected of suffering from a sort of petrifaction in old courses and inability to deal with new problems; and that he felt he had not the vigour, at his time of life, again to conduct a ministry. The announcement, in spite of the signs of discontent, came as a great shock to the party and the country.

Mr. Balfour was then only 63, and his powers as a parliamentarian were really at their height. Although he proceeded to devote more time to his manifold other interests in life—philosophy, science, literature and the fine arts—he still took at intervals a prominent part in debate, giving throughout a loyal support to his successor in the House of Commons, Mr. Bonar Law. The renewed controversy on Home Rule afforded him a great opportunity; and the powerful series of speeches which he delivered, at Westminster and elsewhere, in the course of the next three years, did much to awaken Great Britain to the imminent danger of civil war in Ireland, and to force ministers into the policy of excluding Ulster, in some form or other, from the operation of their bill.

When the World War broke out, he cordially accepted the policy of the Unionist leaders to sink all political differences in support of the national Government. Speaking at the Guildhall, London, on Nov. 11 1914, he said that the Allies were fighting for civilisation and the cause of small States, and, whether the War was short or long, they would triumph. In this spirit he joined the first Coalition Ministry in May 1915, becoming First Lord of the Admiralty under Mr. Asquith. He speedily restored the harmony of the Board of Admiralty, which had been distracted by a quarrel between Mr. Churchill and Lord Fisher. He also reversed Mr. Churchill's policy of differentiating between prisoners from submarines as compared with other German prisoners. Perhaps the best work which he did at the Admiralty was the issue, at intervals, of some cogent papers, mainly for the benefit of the Americans, indicating the great work of the British Navy in the War and exposing the fallacies involved in the captivating phrase, "the freedom of the seas."

The chief naval battle of the conflict, the battle of Jutland, was fought during his term of office; and he incurred widespread criticism by the manner in which the news was officially communicated to the public, the great losses in ships being dwelt on to such an extent as to suggest that, instead of being a victory, if an imperfect one, the action was a defeat. In Nov. 1916 Mr. Balfour brought Sir John Jellicoe into the Admiralty as First Sea Lord, Sir David Beatty becoming naval commander-in-chief. On the King's birthday, June 3 1916, Mr. Balfour's eminence and his patriotic readiness to resume in wartime, in spite of advancing years, official labours in a secondary position, were suitably recognised by the grant of the Order of Merit. When Mr. Lloyd George formed his Coalition Ministry in Dec. 1916, the Foreign Office, on the retirement of Lord Grey of Fallodon, was pressed upon Mr. Balfour, as it was essential to have there a man of experience and weight. He took up his new duties only a few weeks before Germany instituted the unrestricted submarine warfare which brought the United States into the War; and in April 1917, he headed a British mission which visited America in order to arrange for regular co-operation between the two countries.

His attractive personality greatly impressed his hosts, and he received the compliment of being invited to address the House of Representatives on May 5. He proceeded subsequently to Canada, and there addressed the two Houses of Parliament. The concentration of power in the hands of the War Cabinet and the great personal ascendancy which Mr. Lloyd George, as Prime Minister, rapidly acquired, tended to reduce the importance of the Foreign Secretary during Mr. Balfour's tenure of the post. It was, however, he, as Foreign Secretary, who in Nov. 1917 gave a promise on behalf of the British Govt. to provide a "national home" for the Jews in Palestine after the War. He went to the Paris Conference in 1919 as the second British plenipotentiary, and appended his signature to the Treaty of Versailles and to the abortive treaty of guarantee to France against German aggression.

When the Conference was over, Mr. Balfour relinquished the Secretary of State's seals to Lord Curzon, but remained in Mr. Lloyd George's Cabinet as Lord President of the Council. He was appointed chief representative of the British Govt. at the first Assembly of the League of Nations in 1920 and also at the International Conference at Washington, D.C., in the winter of 1921–2. At Washington he was, after the Secretary of State, Mr. Hughes, the leading figure of the Conference; and his prompt and cordial acceptance of Mr. Hughes's proposals for the scrapping of capital ships and their future strict limitation greatly impressed the American public. The Conference not only secured the limitation of navies, but also merged the Anglo-Japanese Alliance into the Four-Power Pacific Treaty, the other two Powers being the United States and France. On his return in 1922 from this mission Mr. Balfour was created, in March, a Knight of the Garter, though still a commoner, and in April, an earl.

During this year the question of Inter-Allied debts was pressingly raised by America, a purely creditor state; and Lord Balfour addressed the so-called Balfour note, on behalf of the British Govt., to the French Ambassador and the representatives of other European Powers. He pointed out that, while Great Britain, though more a lender than a borrower, was in favour of a general cancellation of Inter-Allied debts, she could not agree to the cancellation of European debts due to her, independently of the question of the British debt to the United States.

Lord Balfour had no sympathy with the feeling of hostility which was growing in the Conservative party throughout 1921–2 toward the continuance of a Coalition Ministry, and spoke in that sense at the Carlton Club meeting on Oct. 19 1922, which broke up the Coalition. He resigned office along with the other Unionist Coalition Ministers and did not join either Mr. Bonar Law's or Mr. Baldwin's Conservative Ministry in 1922–3. But he maintained a friendly attitude, and, after the fall of the Govt., he moved, in a party meeting on Feb. 11 1924, a vote of confidence in the ex-Premier which was carried by acclamation.

Lord Balfour was elected in 1919 Chancellor of his old University, Cambridge. In 1923 he published a further philosophical work, *Theism and Thought, a Study in Familiar Beliefs*. He became president of the British Academy, and was constant in his attendance at its meetings. He became president also of the National Institute of Industrial Psychology. Early in 1925 he paid a visit to Palestine, and was received with enthusiasm by the Jewish population which had accepted his invitation of 1917 to establish there a national home. No open Arab hostility was shown to him in Palestine; but in Syria, which he proceeded to visit, it flamed out in immediate menace and the French administration had to escort him hurriedly out of the country. On his return to England he accepted an invitation from Mr. Baldwin, on Lord Curzon's death, to join the Govt. as Lord President of the Council; and he was immediately detailed for the congenial task of presiding over a Civil Research Committee instituted by the Cabinet. (*See* CONSERVATIVE PARTY; ENGLISH HISTORY.)

(G. E. B.)

BALINE, ISRAEL (1888–), American song writer, known as Irving Berlin, was born in Russia May 11 1888, and was brought to the United States in 1892. Early poverty curtailed his schooling, and he left home at 14 to earn his living, finding employment as a singing waiter in various Chinatown and Bowery cabarets. There he began to write song lyrics and compose melodies. The increasing popularity of his songs enabled

him in 1919 to open a music publishing business. In 1920, in partnership with Sam Harris, he built the Music Box Theatre in New York City, for which he wrote a number of highly successful revues. "Alexander's Ragtime Band" (1911), "Everybody's Doin' It" (1911) and several other compositions gave him international popularity as the pioneer of ragtime music. Its subsequent evolution into jazz owes much to his later work, such as "Pack Up Your Sins" (1922) and "Everybody Step" (1921) characterised by complex rhythms and intricate melody.

See Alexander Woollcott's *The Story of Irving Berlin* (1925). A discussion of his work will be found in Gilbert Seldes' *The Seven Lively Arts* (1924).

BALKAN WARS, 1912–13.—This article gives an account of the campaigns of Bulgaria, Serbia, Greece and Montenegro, as allies, against Turkey, in 1912 and 1913, and also of the brief struggle that followed between the former allies, with Turkey and Rumania intervening, in the summer of 1913. When war broke out, all Macedonia, Albania and Epirus still formed part of the Ottoman Empire. This also included much of the hill country between Macedonia and Thrace, as well as Kosovo Polje and regions on the borders of Serbia and Montenegro, as the frontiers then existed, together with the tongue of territory forming the sanjak of Novi-Pazar that jutted up to the confines of the Austro-Hungarian Empire.

The Balkan League.—Military alliances, directed against Turkey, had been adjusted between Bulgaria and Serbia, and between Bulgaria and Greece during the early part of 1912; and the state of Macedonia, under Ottoman rule, served as an excuse for them to order mobilisation on Sept. 30 and Oct. 1. War was declared as soon as their armies were on their war footing, and active operations then at once commenced, Montenegro, which had no formal agreement with the others, actually starting the hostilities. The Turkish regular forces in Europe at the time comprised 12 divisions of very weak establishment in Thrace, and 12 similar divisions stationed at various points in the extensive Ottoman territories further to the west; organisation of a sort also existed for about doubling the number of divisions on mobilisation; but it would not appear that the actual numbers available during the opening and decisive weeks of the struggle exceeded about 100,000 combatants in Thrace and about 140,000 in the western theatres. Large military forces, it is true, existed in Turkey in Asia; but, owing to the activities of the Greek fleet, these could not be transferred to any part of European Turkey other than Thrace.

Against this, Bulgaria possessed nine very strong regular divisions, numbering about 180,000 combatants, with two strong reserve divisions formed after mobilisation. Serbia promptly placed five somewhat weaker regular divisions in the field, making up a total of about 80,000 combatants, with five well-organised reserve divisions ready to follow. Greece could muster four regular divisions of somewhat weak establishment, the combatants at the start numbering perhaps 50,000, with four reserve divisions to be set up on mobilisation. The Montenegrin Army on the other hand was wholly on a militia basis and was but ill-suited for fighting, except among its own mountains or immediately outside its own frontiers. Thus the allies, at the outset, enjoyed rather the advantage in respect of numbers; and, thanks to their reserve formations being much the better organised, they retained and indeed increased this advantage during the weeks of hostilities that followed.

I. THE THREE THEATRES OF WAR

Owing to the geographical situation, there were bound to be three practically distinct main theatres of war when the struggle began, viz.: on the Turko-Bulgarian frontier of Thrace, on the frontier between Macedonia and the allied Powers, Bulgaria and Serbia, and on the frontier between Greece and Turkey. Under a military understanding between Bulgaria and Serbia, six of the nine Bulgarian regular divisions were to have been allotted to the eastern theatre of war, while the remaining three

BALKAN WARS
(1912–13)
English Miles
0 50 100
Kilometres
0 50 100
Railways
AUSTRIA-HUNGARY
SERBIA
MONTENEGRO
BULGARIA
RUMANIA
TURKEY
GREECE
ALBANIA
MACEDONIA
THRACE
EPIRUS
THESSALY
Bucharest
Craiova
Sarajevo
Vidin
Ruschuk
Giurgiu
Constanța
Cernavoda
Danube R.
Bazargic (Dobrich)
Razgrad
Varna
Shumen
Nish
Pljevlja
Novi Pazar
Berkovitsa
Vrattsa
Plevna
Somovit
Trnovo
Leskovac
Kosovo Polje
Priština
Sofia
Mesemvriya
Burgas
Yambol
Tunja R.
Tatar Pazardjik
Stara Zagora
Philippopolis
Vasiliko
Cetinje
Scutari
Prizren
Kriva Palanka
Kumanovo
Kyustendil
Skoplje (Uskub)
Kocani
Veles
Radoviste
Khaskovo
Mustafa Pasha
Kirk Kilisse
Solaoghli (Seliolu)
Bunar Hisar
Viza
Adrianople
Lule Burgas
Constantinople
Ergene R.
Chatalja
Dimotika
Durazzo
Elbasan
Okhrida
Prilep
Monastir
Demir Hisar
Seres
Gumüljina
Kavalla
Ferejik
Rodosto
Sea of Marmara
Scutari
Semeni R.
Berat
Valona
Viosa R.
Vodena
Yenije Varda
Salonika
Gulf of Salonika
Dedeagach
Gallipoli Pen.
Bujair
Brusa
Kastoria
Kozani
Katerina
Argyrokastron
Elasson
Kalibaka
Larisa
Corfu
Yanniha
Trikkala
Volos
Edremid
Aegean Sea
Ionian Sea
Gulf of Arta
Lamia
Northern Sporades
Sea
Adriatic Sea
Drina R.
Morava R.
Cuprija
Užice
Ibar R.
Lepenac R.
Ishkr R.
Yantra R.
Tundja R.
Maritsa R.
Struma R.
Vardar R.
Bistrica R.
Aliakmon R.
Drin R.
Black Drin R.
White Drin R.
Tetovo (Kalkandelen)
Debar
Krivolak
Strumitsa
Orfani
Kavalla
Dulcigno
Alessio
Beglinitch
Stip
Rupel Mountains
Balkan Mountains
Rhodope Mountains
Pindus Mountains
Albanian Alps
Rila Mountains
Olympus
Pelion
Ossa
Parnassus
Othrys
Oeta
Pindus
Delphi
Thermopylae
Lamia
Arta
Prevesa
Santi Quaranta
Cape Matapan
Cape Malea
Cape Tainaron
Cape Gallo
Cape Spada
Cape Sidero
Cape Krio
Cape Salomon
Cape Papas
Cape Akritas
Cape Kalogria
Cape Araxos
Cape Skyli
Cape Kanapitsa
Cape Kephali
Cape Kakovigli
Cape Kaliakra
Cape Emine
Cape Galata
Cape Kaliakra
Cape Kaliakra
Cape Kaliakra

co-operated with the Serbian Army in operations directed against Macedonia. But Bulgaria altered this arrangement at the last moment, retaining eight divisions for the east and employing only the remaining one in the western theatre, and this, moreover, as it turned out, moved independently toward Salonika. It was, from the purely military point of view, a sound decision, as the Turks could not be reinforced in Macedonia from Anatolia, whereas they could be so reinforced in Thrace; but the action of Bulgaria in the matter tended to cause somewhat strained relations between that kingdom and Serbia at the very start.

Campaign in Thrace.—It will be convenient to take the campaign in Thrace first. The Bulgarian staff organised its eight regular divisions, destined for Thrace, with the two newly formed reserve divisions, as three armies, the II. Army on the right of the Maritsa, prepared to move on Adrianople, the I. Army in the centre more to the east, and the III. Army on the left about Yambol, prepared to move on Kirk Kilisse. On the declaration of war, on Oct. 17, the three armies advanced and they passed the frontier on the 18th and 19th to the northwest and north of Adrianople, and on the 22nd to the northwest and north of Kirk Kilisse.

Adrianople was a great entrenched camp, composed of many forts and works, fairly well armed; Kirk Kilisse was also provided with some works, but they were not of an efficient character. The II. Army advanced against Adrianople and to the west of it, with a view to investment, while the I. Army followed a line more to the east and from the 22nd to the 24th was engaged with the enemy about Seliolu, the battle ending in its complete victory. On that same day the III. Army entered Kirk Kilisse, after some severe fighting, capturing an immense booty. The Turkish field forces had originally been formed up about the Ergene; but they had been ordered north to take the offensive, and had thus brought on the encounter battles at Seliolu and Kirk Kilisse, in which they were heavily defeated. They retreated in confusion to the line Lule Burgas—Bunar Hisar, the victorious Bulgarians, owing to having outrun supplies, losing touch with them and therefore giving them time to reorganise to some extent.

On discovering the direction of their opponents' retreat, the Bulgarian I. and III. Armies found themselves, in the first instance, called upon to make a wheel to the left. Severe fighting took place on the 28th, 29th, and 30th in the country between Lule Burgas and Viza in which both sides suffered heavily and which ended in the Turkish right near Viza becoming seriously endangered; Nazim Pasha, the Ottoman commander-in-chief, thereupon ordered a general retreat, and his troops fell back to the Chatalja Lines, covering Constantinople. The victors were too exhausted to pursue, so that all touch with the defeated army was lost for the moment. In the meantime, the Bulgarian II. Army had invested Adrianople, and some troops were pushed on to Dimotika and to Dedeagach on the Aegean Sea.

After a few days, the I. and III. Bulgarian Armies, being reinforced and having their lines of communications in working order, advanced towards the Chatalja Lines and after a brief pause delivered an assault upon them on Nov. 17. The attack was repulsed at all points with heavy loss, and the Bulgarian command, sobered by this untoward experience, refrained from making a second attempt. The remains of the Ottoman field forces in the country to the west of the lower Maritsa had in the meantime been surrounded and compelled to surrender at Ferejik. Operations in Thrace now came to a standstill for a fortnight, and then, on Dec. 3, an armistice was signed between Bulgaria, Serbia and Montenegro on the one hand, and Turkey on the other, Greece being no party to it for reasons which will appear later. The Bulgarian campaign in Thrace had been brilliantly successful, although Adrianople remained in Ottoman hands; but the operations of the allies in the west had been no less triumphant.

Macedonia and the West.—The Serbian authorities had been very happy in their mobilisation arrangements, and by the time that war was declared, they were already in a position to concentrate their five reserve divisions, as well as their five regular divisions close to the Turkish frontier. Their I. Army, of five divisions, was about Vranje; their III. Army, of four divisions, was further to the west, north of Priština; their II. Army, of one division, with the Bulgarian 7th Div., was about Kyustendil in Bulgaria. The plan was for the I. and III. Armies to advance southward into Kosovo Polje and on Üsküb, while the II. Army came in from the east and from Kyustendil, ready to operate against the right flank of the Turkish forces known to be assembled at Üsküb and to the north of it. The action of the Bulgarian staff in only sending the one division to this theatre, instead of three divisions as previously agreed upon, necessarily weakened the effect of the threat of the II. Army against the Ottoman communications, and the 7th Bulgarian Div. in fact afforded practically no help at all, being bent on an eccentric march on Salonika via the Struma valley.

All three Serbian armies crossed the Ottoman frontier on Oct. 19 and 20 through the mountains, meeting with slight resistance. The Turkish forces were necessarily much dispersed in view of the vast area of the territory to be guarded; but an army of five weak divisions in the Vardar valley had been moving northwards towards the Serbian frontier, and most of it reached Kumanovo on the 22nd. The head of the Serbian I. Army had arrived within a few miles of that place on the same day and had taken up a position, where it was attacked by the Turks on the following day but succeeded in holding its ground. The remainder of the I. Army came up on the 24th and a general action ensued in which the Ottoman troops were signally defeated. They fled southwards, evacuating Üsküb and withdrawing the detachments posted further to the northwest which had been opposing the advance of the III. Serbian Army from about Priština. The victors, however, hardly realised how complete had been their success and, hampered as they were by the difficulties of the country and the delays in bringing up their impedimenta from beyond the frontier, they failed to take full advantage of it. It was not till the 29th that their three armies had joined hands and were prepared for further advance.

The disorganised Turks had for the most part withdrawn partly down the Vardar, and partly from Veles by Prilep towards Monastir; and on becoming aware of this the Serbian staff made an entirely new disposition of available forces. The II. Army was sent off eastwards to aid the Bulgarians before Adrianople; part of the III. Army moved westwards into Albania; the I. Army, reinforced, moved southwards to co-operate with the Greeks in disposing of the Turks known to be gathered about Salonika and Monastir. The sanjak of Novi-Pazar had in the meantime been occupied by Serbian and Montenegrin detachments, and Montenegrin forces had advanced against Scutari, but they had failed to make any impression on its defences. Although some unimportant Ottoman detachments were still to be found in northern Albania, the whole of that portion of Turkey in Europe lying north of a line stretching from about Štip on the east, to just north of Scutari on the west, was by the end of October, for all practical purposes, in the hands of the allies, while the 7th Bulgarian Div. was moving down the Struma valley and approaching Demir Hisar.

Greece and Salonika.—In the meantime, the Greek military forces had not been idle. The main army, under command of Crown Prince Constantine, had been concentrated in northern Thessaly when war was declared. A smaller force was assembling near the Gulf of Arta, destined for offensive operations in Epirus. The Ottoman military authorities had only told off four weak divisions, partly regular and partly reserve, to guard against hostile invasion in this southern theatre of war, and the task of the Greek troops in the region immediately north of Thessaly, at the outset, proved a simple one. The Crown Prince crossed the frontier on Oct. 18, occupied Elasson next day, and on the 23rd routed the Turks a little further to the north, his left occupying Kozani on the 25th. His right advanced at the same time, and on the 28th occupied Katerina on the shores of the Gulf of Salonika, where an advanced maritime base was established.

The Turkish forces defeated near Elasson had for the most

part retired on Monastir, where there was a considerable concentration of troops, owing to the army which had been defeated by the Serbs at Kumanovo having for the most part fallen back over the mountains towards this town. But Constantine, aware that the Bulgarians were on the move for Salonika, and determined for political reasons to get to that city first, merely pushed out one division north-westwards to guard his left flank, while with the bulk of his troops he advanced to Vodena. His position there was not wholly comfortable, for the Serbian forces were still a long way from Monastir and a Turkish army of three or four divisions had taken up position at Yenije Vardar so as to cover Salonika against hostile advance from the west. He attacked this position on Nov. 2 and 3, but was repulsed, and his flank guard was at the same time defeated at Banitsa and Kastoria by Ottoman troops that had been pushed south from Monastir. Two days later, however, a fresh attack upon Yenije Vardar proved successful, whereupon the Turks opposed to him there retired into Salonika, which he occupied on Nov. 9, 29,000 of the enemy laying down their arms.

On the following day the Bulgarian 7th Div. arrived and claimed the city for Bulgaria; but an agreement on the subject was patched up and the Crown Prince now divided his army in two, half remaining east of the Vardar, and the remainder moving westwards to co-operate with the Serbian forces in dealing with the enemy forces gathered about Monastir.

II. THE TURKISH COLLAPSE

Part of the Serbian I. Army had advanced to Prilep on Nov. 5 and had then halted for the remainder to come up in line, for Prince Alexander, who was in command, hoped to fight a decisive battle before Monastir with the whole of the troops that could be made available. The Turks had taken up a strong position north of the town and there they proposed to stand their ground. In the circumstances, Prince Alexander, whose impedimenta took time to cross the hills out of the Vardar valley, was not prepared to commit his army to the attack before the 14th. The date was subsequently deferred to the 18th, his plan being to deliver a frontal assault, while at the same time turning both of the enemy's flanks.

As it happened, however, the isolated Serbian division told off to operate against the Ottoman left delivered a premature night attack on the 15th, and had then to resist resolute Turkish counter-attacks during the succeeding two days, unsupported; but it managed to keep the enemy at bay, and when the battle was finally launched on the 18th, the Serbians were completely successful. The Turkish Army broke up. Half of it was killed, wounded, or captured; the other half made its way, in units or small parties, to the only friendly stronghold now left open—Yannina, in Epirus (Scutari was closely invested by this time). The victory of Monastir proved to be decisive, and all that remained for the allies to do in the western theatre of war was to march through Albania to the sea, occupying various points for police purposes, to reduce the two fortresses of Yannina and Scutari, and to take steps to meet the possibility of Austro-Hungarian intervention. Serbia and Montenegro therefore joined in the armistice that was signed on Dec. 3, as already mentioned, between Bulgaria and Turkey.

The Greek Govt., anxious to complete the occupation of Epirus and the capture of Yannina, were not parties to this suspension of hostilities. The operations north of the Gulf of Arta, in difficult country, had made somewhat slow progress at first; but on Nov. 10 Greek troops had arrived near Yannina, and within a few days a loose blockade had been established, which had not, however, prevented some of the Turkish fugitive detachments from entering the place after the battle of Monastir. A great part of the Hellenic field army was brought round by sea from Salonika during the winter, so as to ensure the fall of the fortress as soon as the weather should again become favourable for active operations.

Adrianople.—Negotiations between the belligerents were set on foot in London shortly after the armistice; but these were abruptly terminated on news arriving of a military *coup d'état* having been carried out on Jan. 23 at Constantinople, in which the existing Govt. was overthrown and Nazim Pasha, the commander-in-chief, was murdered. The military Govt. that had been set up denounced the armistice within a few days, and hostilities were resumed on Feb. 3, although Ottoman field armies had ceased to exist in Europe except within the Chatalja Lines and the Gallipoli Peninsula. The story of the second phase of this war is merely the final instalment of the sieges of Adrianople, Yannina, and Scutari. An effort was, it is true, made by the Turkish field forces in Thrace to debouch from the lines of Chatalja and Bulair with a view to relieving Adrianople, and this led to heavy fighting locally; but the Bulgarians held their own on both fronts, so Adrianople was perforce left to its fate by the Ottoman military authorities.

The terms of the armistice had not admitted of the revictualling of this extensive stronghold, which remained blockaded during the truce, and by the time that hostilities came to be resumed the garrison was already finding itself short of certain supplies. The investing forces at this time were composed of the Bulgarian II. Army, which had taken up the duty in the first instance, and of the Serbian II. Army, which had been transferred from the western theatre of war after the victory of Kumanovo. But although it soon became evident from attempts at sorties and increased desertion that the garrison was weakening, lack of transport and of artillery delayed preparations for an assault till the middle of March, and by that time the besiegers had been reinforced by three Bulgarian divisions which it was found possible to transfer from their former position before the Chatalja Lines.

The fortifications around the city of Adrianople consisted of a number of substantial, but very conspicuous, forts, with a girdle of infantry redoubts further out, the whole forming an extensive perimeter; but the only really modern works were a certain number of batteries, distributed in the intervals. The infantry redoubts, moreover, were open at the gorge—a serious source of weakness. The garrison at the time of the assault numbered about 50,000, and the allies chose the eastern side of the fortress for attack. A preliminary intensive bombardment of the works was carried out on March 24, and that night the whole of the advanced line on the eastern side was stormed. On the following night an assault was delivered upon the main position; but this was brought to a standstill by the Turkish wire, except at a point where one of the forts was captured by a single regiment. Although the commander of the regiment found himself at dawn to be isolated, he promptly struck out right and left against the rear of the works on either hand, and he thus cleared the way for unit after unit that had been held up by the frontal wire, so that within a few hours the whole line of eastern defences was in Bulgarian hands. Attacks were also being delivered at other points, and about mid-day on the 26th, the Turkish commandant surrendered unconditionally. The assault had cost the allies about 9,500 casualties.

Scutari.—Yannina had fallen three weeks earlier to a successful general assault delivered by the Greek troops under the Crown Prince. This took place on March 5 and the Turkish garrison, numbering about 30,000 wounded and unwounded, surrendered next day; at the end of March only Scutari remained to be taken. The Turkish commandant of this latter fortress had refused to recognise the armistice because its terms did not provide for his revictualling; but little actual fighting took place during the months of Dec. and Jan. On Feb. 7, however, a determined assault on important defences on the eastern side of the stronghold, which was only partially successful, was made by the Montenegrins; another was delivered next day, which made no progress. But on the 9th, the trenches were carried after a fierce combat, and the besiegers thereby gained a footing within the Ottoman line of defence. They, however, found that they could advance no further at this point.

A Serbian contingent had arrived shortly before this to take part in the siege, and the activities of the allies were now transferred to the south-western side of the fortress—its western side rested on Lake Scutari. Not until March 31 and April 1,

however, was an assault attempted in this quarter, and then the undertaking failed. The Serbian general took over the chief command after this rebuff, but jealousies, military and political, speedily arose, and on April 16 he and his forces took their departure. The Montenegrins had now to take over the whole of the besieging line, and the stronghold seemed safe from further assaults in consequence, but it nevertheless suddenly capitulated on April 22. The Great Powers had, however, decided that the place was to belong to the new State of Albania, and, under pressure from them, the victors were obliged on May 6 to evacuate it.

III. THE SECOND BALKAN WAR

Negotiations with a view to bringing the contest to an end had by this time been in progress for some weeks, and peace was signed in London on May 30. Under its terms, Turkey in Europe was, with the exception of the country lying close to Constantinople and to the Gallipoli Peninsula, partitioned between the victors, Bulgaria acquiring the lion's share. But the Balkan League was on the point of explosion, the Great Powers were trying to establish an independent Albania, Rumania in alarm at Bulgaria's aggrandisement was preparing to intervene, and a portion of northern Macedonia and Kosovo Polje remained in dispute between that kingdom and Serbia. Bulgaria also coveted Salonika, and had during April and May transferred her military forces from Thrace to the vicinity of the old Serbian frontier and of the borders of Macedonia, in preparation for making good her claims in the west. A state of tension consequently existed throughout the month of June, and at last, on the 30th, without warning or declaration of war, Bulgaria assumed the offensive against both Serbia and Greece.

The Bulgarian staff had arranged their forces as five armies, the I. Army facing the Serbian frontier between Vidin and Berkovitsa, the V. Army on its left, the III. Army about Kyustendil, the IV. Army about Kočani and Radovište, and the II. Army between Strumitsa and Seres facing the Greeks. The Serbian forces were disposed in three armies, the II. Army guarding the old Serbo-Bulgarian frontier, the I. Army in the centre about Kumanovo and Kriva Palanka, and the III. Army on its right about the Bregalnica; the Greek forces were holding a front between Gjevgjelija on the lower Vardar and the mouth of the river Struma.

The Bulgarian offensive, benefiting by surprise, was in the first instance successful. Their IV. Army broke in between the allies, reached the Vardar at Krivolak, and with the aid of the III. Army thrust back the Serbian front for some distance between that point and Kriva Palanka; their II. Army at the same time drove the Greek advanced troops in all along the front. But the allies were disposed in considerable depth, the Bulgarian soldiery had little heart for fighting once it became apparent that their antagonists meant to resist, by the night of July 1 the offensive had already died down, and it was then the turn for the Serbian and Greek troops to counter-attack.

Pressing forward on July 2, the Serbian I. Army drove a wedge through the Bulgarian line in the direction of Kyustendil, and on the two following days hustled the defenders in a south-easterly direction; the Serbian III. Army was in the meantime effectually checking any further advance on the part of the enemy about the upper Bregalnica. The Greek Army had brought up its reserves, and on the 3rd and 4th it counter-attacked, forced the Bulgarian II. Army back all along the line, and by the 7th had effectually outflanked the enemy's left. The result of these operations in the south was that the Bulgarian II. Army found itself obliged to retreat northwards up the narrow Struma valley, running the risk of being cut off by Serbian forces should these, advancing from Kočani and Kriva Palanka, succeed in occupying Jum'a-i-Bala. So, in view of the critical position of affairs, the Bulgarians made a desperate effort to retrieve the situation by initiating a fresh offensive. Their I. and V. Armies moved forward by several routes to threaten old Serbia, only to be repulsed at all points by the Serbian II. and I. Armies. The Bulgarian III. and IV. Armies at the same time advanced against the Serbian III. Army in the direction of the upper Bregalnica, and this latter effort achieved some measure of success; but it also had been definitely checked by July 10.

A brief pause ensued. Then, on the 15th, both Serbians and Greeks began pressing slowly forward. Bulgaria was by this time in a sorry plight, for Rumania had declared war and had begun an unopposed march on Sofia, while the Turks had issued from Chatalja and Bulair and had reoccupied Adrianople. By transferring their I. Army from the north to the hills east of Jum'a-i-Bala, and attacking the Greeks in the Struma valley with this and their II. Army, the Bulgarian staff made a final attempt to stem the pressure. But the venture came to nothing, and on July 31 the aggressors in this second campaign, surrounded by hostile columns that were converging on their capital from every quarter, sued for peace. This was signed at Bucharest on Aug. 10.

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BALL, THOMAS (1819–1911), American sculptor (*see* 3.263), died at Montclair, N.J., Dec. 11 1911.

BALLET (*see* 3.269b).—At the beginning of the 20th century the ballet, as seen in Paris or Milan, the centres of the two classical schools, still lived on in the crystallised form that had been perfected 60 years earlier in the days of Taglioni; while its music, scenery and costume still followed traditional ways and were regarded as accessories of minor importance. The supremacy of the old order remained unchallenged till 1906, when a new convention for stage dancing, initiated in America and perfected by an American, Isadora Duncan, appeared in Europe.

In this new form the maillot, the padded shoes and the ballet skirts gave way to bare feet, classic tunic and flowing drapery. There was no dancing *sur les pointes*, but stately movement from one deliberate " Greek " pose to another, to the accompaniment of music always carefully chosen from the works of Chopin, Gluck or some equally famous master. It had the air of being easy and natural, but was really the outcome of much thought and long training. Miss Duncan's figure was lithe and supple, her sense of rhythm was good, and she had acquired the certainty of balance that marks the first-rate dancer. Neither her dancing nor her theories were taken seriously till she arrived in St. Petersburg in 1907, where the two conventions met, the " classical " and the " classic," each at the highest point of its development. Reacting one upon the other, a new form emerged, the Fokine ballet, which combined the virtues of the two schools and quickly superseded both.

The Ballet in Russia.—The Russian Imperial Ballet was an institution that dated from the days of the Empress Elizabeth (1741–61). It had always enjoyed a full measure of Imperial favour, and had been kept in a state of high efficiency. From 1863 to the early years of this century its destinies had been ruled by Marius Petipa (born in Marseilles, 1819, died 1910), who had moulded it on the strictest lines of the Franco-Italian tradition. It was an age when long ballets were in favour, planned in five or six acts with prologue and epilogue, and lasting between three and four hours. Within the limits of its code the technical standard of the *corps de ballet*, which included almost as many men as women, was exceptionally high, and the virtuosity of its leading dancers was carried to the limits of human endurance. Apart from certain ballets by Tschaikovsky, the musical repertory was uninspired, and the mounting was as gaily irrelevant as anything the West could show.

After the resignation of Petipa and with the appointment of Michel Fokine as his successor several important changes began to appear. Fokine was strongly influenced by the theories of

Isadora Duncan, and it was in accordance with her teaching that the best composers and painters were brought in to write and decorate the new ballets, and that the ballets themselves were cut down to one act of such a length that three or four could be played in one evening. Though the old technique was by no means abandoned, it was modified by the addition of many of the Duncanesque movements; and the bare feet and Greek tunic began to alternate with the traditional uniform. Within a year of his appointment Fokine managed to sweep away the accumulated traditions of two centuries, and the ballet was at last free to express itself in any form that the dramatic subject demanded. The Russian Ballet remained practically unknown outside its own country till 1909, when a company from the Marinsky Theatre of St. Petersburg appeared at the Châtelet Theatre in Paris. This visit had been arranged to follow up the Exhibition of Russian Painting at the Autumn Salon of 1906 and the opera season of 1908, all three being designed to extend the knowledge of Russian art in the capital of their allies.

Development of the Diaghilev Ballet.—Serge Diaghilev (b. 1872), to whom the management of these three seasons had been entrusted, was known in Russia as one of the younger leaders of the Renaissance of Russian art. In 1894 he had planned and edited the first Russian review of the world's art, *Mir Iskusstvo*. Between 1899 and 1901 he had been attached to the service of the Imperial theatres under Prince Wolkonsky, but had been transferred to another post when it was found that his reforming zeal was displeasing to the official world. He was one of the warmest supporters of Isadora Duncan during her visit to St. Petersburg, and an equally staunch supporter of Michel Fokine when he began to put her theories into practice. For the Paris season he chose three of the new ballets of 1908, the *Pavillon d'Armide*, *Nuits d'Egypte* and *Chopiniana*, with the ballet from the opera *Prince Igor* and the best of the old type, Tschaikovsky's *Le Lac des Cygnes*. The success of the season was so marked that another was arranged for 1910 at the Opera, during which three of the most famous of ballets of his repertory were produced, *Scheherazade*, *Carnaval* and *L'Oiseau de Feu*. In these Diaghilev, now definitely in authority, was able for the first time to express his ideas fully, with choreography unfettered by too close adherence to any one theory, with music finely chosen and finely rendered, and with decorations that showed a judicious splendour in *Scheherazade*, and an equally judicious simplicity in *Carnaval* or *Les Sylphides*.

The company had by now accomplished the mission on which it had been sent, and with the cessation of state support, it became necessary for Diaghilev to take not only the artistic but the financial burden on his own shoulders. So in 1911 the "Diaghilev Ballets Russes" began the career of extended tours through all the capitals of Europe and America that has continued. For his dancers he still drew on Russia, but for all else he came to rely less and less on his own countrymen until it was almost exclusively to western Europe that he turned for his musicians and his painters. That this company, without a fixed home, with varying fortunes and an ever-changing personnel, has lived for so many years and never relaxed its experimental activities is a remarkable tribute to the genius of its creator. It has revived a moribund art and has revolutionised the world of dancing.

Choreography.—Up to the end of 1912 the choreography of all the ballets was the work of Michel Fokine. He was the great eclectic, the master of the composite ballet, who used the methods of Petipa, of Duncan and of the Russian folk dancers each in their proper environment with equal success; and his only comparative failures were in the two Greek ballets *Narcisse* and *Daphnis et Chloë*, when he worked exclusively in one idiom. He was the inventor of the modern ballet, and from his creations practically all the later developments can be traced. As a dancer Fokine was graceful and accomplished, but lacked the genius of his successor.

Vaslav Nijinsky took command for the season of 1913. He was much influenced by Jacques Dalcroze, a Swiss exponent of musical calisthenics, in accordance with whose theories the dancing in Debussy's *Jeux* was made to synchronise exactly with the beat of the music; while in Stravinsky's *Le Sacre du Printemps* the movement became a sort of rhythmic counterpoint in opposition to it. While both efforts had a scholarly interest neither proved satisfactory. In the latter ballet the loyalty of the company was severely tested, for the expression of primitive fear and rejoicing, demanded by the subject and its musical treatment, involved the rejection of all accepted canons of grace and the substitution of deliberate uncouthness. As a dancer, Nijinsky ranks among the greatest in history, and his premature retirement was an irreparable loss to the ballet.

Léonide Massine, who first appeared in 1914 in Strauss's *Lêgende de Joseph*, produced his first ballets in 1917. His work was a development of the Fokine ballet, sharpened by contact with Andalusian forms, which he studied closely before the production of Da Falla's *Tricorne*. His preference for angular rather than curved movement became more marked as time went on, especially in the ballets he designed for Diaghilev and Charles Cochran in 1924 and 1925. The best example of his inventive power was perhaps seen in *Le Rossignol* (1920), in his use of mass movements as foreshadowed by Nijinsky in *Le Sacre du Printemps*. As a dancer he is alert and certain in his balance, with a marked sense of rhythm.

Bronislava Nijinsky, Nijinsky's sister, designed the dancing in the ballets of 1922–4. Her choreography was vivacious but her sense of group movement a little deficient. Among the dancers, the more notable names are those of Tamara Karsavina, a dancer of perfect technique and compelling grace, who between 1910 and 1914 created most of the principal rôles; Lydia Lopokova who made her début in 1910 but who did not rejoin the company till 1918, when she reappeared in *Les Femmes de Bonne Humeur;* Vera Nemchinova, Lubov Tchernicheva, Olga Spessivtseva and Lydia Sokolova (Hilda Munnings), the only English dancer who could rank with them. Anna Pavlova danced with the company in 1909 and 1911. Among the men, in addition to the three *maîtres de ballet*, have been Adolf Bohm, Léon Woizikovsky and Stanislas Idzikovsky. The stage management remained throughout in the hands of Serge Grigoriev, and the principal teacher was Enrico Cecchetti, who retired in 1921.

Music.—The Diaghilev ballet proved the truth of Isadora Duncan's dictum that, for purposes of dancing, the quality of music is more important than the form in which it is written. Schumann's *Carnaval* and Rimsky Korsakov's symphonic suite *Scheherazade* have shown themselves as suitable for ballets as Tschaikovsky's *Casse-Noisette* or Delibes' *Sylvia*. Of Stravinsky's great ballets only the first, *L'Oiseau de Feu*, was written in detached numbers. His others, like those of Debussy, Ravel, da Falla and the younger French writers, are written in continuous form.

The orchestration of music written for the piano gave rise to adverse criticism in earlier days, but the orchestral versions of Chopin and Schumann were found to be so skilful and sympathetic that opposition was silenced. Tommasini and Respighi later on translated Scarlatti and Rossini as ably as Rimsky Korsakov and his friends had dealt with Chopin and Schumann. Stravinsky's version of Pergolesi in *Pulcinella* was perhaps more open to criticism owing to the very personal idioms he used. Manuel da Falla's *Le Tricorne* was the most successful of the later ballets, while the work of the modern French composers has not been so distinguished.

Decoration.—The outstanding name in this section is that of Léon Bakst (*q.v.*), who between 1910 and 1921 designed 14 ballets. In whatever style he might be working, Egyptian, Greek, Persian or Venetian, everything, while it was archaeologically justified, was impressed with his own rather flamboyant personality. His versatility was great, and his first two ballets, *Scheherazade* and *Carnaval*, came to represent the two main types of all the series of "Ballets Russes." The Western artists who decorated the later ballets, such as Pablo Picasso, André Derain and Georges Bracque, take higher rank as painters, but their work, always excepting Picasso's scenes for *Parade* and *Le*

Tricorne, seems to lack the instinctive and specialised sense of the theatre possessed by the Russian group, Alexandre Benois, Nicholas Roerich and Alexander Golovin. The essential qualities of Russian art were finely expressed by Michel Larionov in *Contes Russes* and Natalia Gontcharova in her setting of the opera ballet *Coq d'or*. Boris Anisfeld and Vladimir Polunin were the painters of most of the scenery; their difficult task was to translate on to 40-ft. canvases the intention of the two-ft. sketches furnished by painters of different nationality and outlook.

As regards the ballet outside the Diaghilev sphere there is little enough to record. In Russia itself the old decorations of Imperial days are used to adorn the old ballets, and as an institution it seems to have fallen under the ban which condemns all survivals of the *ancien régime*. In Paris and in Milan the stars rule the stage; the Pavlova ballet tours the world reaping a golden harvest from the virtuosity of its marvellous leader. The one independent company of higher endeavour, the Swedish Ballet, ended a short career (1919–24) that might have earned enduring fame had the dancing of its members been on the level of its leader's ideals and his powers of stage production.

List of Ballets.—The following is a complete list of the ballets produced by the Diaghilev company between 1909 and 1925.

M indicates the composer of the music, D the designer of the stage setting and costumes, C the choreographer:—

1909 *Le Pavillon d'Armide*, M—Tcherepnin, D—A. Benois, C—M. Fokine; *Prince Igor*, M—A. Borodine, D—N. Roerich, C—M. Fokine; *Le Festin*, M—Rimsky Korsakov, Tschaikovsky, Moussorgsky, Glinka and Glazounov, D—C. Korovin, C—M. Petipa; *Le Lac des Cygnes*, M—Tschaikovsky, D—A. Benois, C—M. Petipa; *Nuits d'Égypte* (*Cléopâtre*), M—Arensky, D—Léon Bakst, C—M. Fokine; *Chopiniana* (*Les Sylphides*), M—Chopin, D—A. Benois, C—M. Fokine.

1910 *Scheherazade*, M—Rimsky Korsakov, D—L. Bakst, C—M. Fokine; *L'Oiseau de Feu*, M—Igor Stravinsky, D—A. Golovin, C—M. Fokine; *Carnaval*, M—Schumann, D—L. Bakst, C—M. Fokine; *Giselle*, M—A. Adam, D—A. Benois, C—M. Petipa.

1911 *Sadko*, M—R. Korsakov, D—B. Anisfeld, C—M. Fokine; *Le Spectre de la Rose*, M—Weber, D—L. Bakst, C—M. Fokine; *Narcisse*, M—Tcherepnin, D—L. Bakst, C—M. Fokine; *Petroushka*, M—Stravinsky, D—A. Benois, C—M. Fokine.

1912 *Le Dieu Bleu*, M—Reynaldo Hahn, D—L. Bakst, C—M. Fokine; *Thamar*, M—Balakirev, D—L. Bakst, C—M. Fokine; *L'après midi d'un Faune*, M—C. Debussy, D—L. Bakst, C—V. Nijinsky; *Daphnis et Chloë*, M—Maurice Ravel, D—L. Bakst, C—M. Fokine.

1913 *Le Sacre du Printemps*, M—Stravinsky, D—N. Roerich, C—V. Nijinsky; *Jeux*, M—Debussy, D—L. Bakst, C—V. Nijinsky; *La Tragédie de Salomé*, M—Florent Schmitt, D—Soudeikine, C—Romanov.

1914 *Papillons*, M—Schumann, D—M. Doboujinski and L. Bakst, C—M. Fokine; *La Légende de Joseph*, M—Richard Strauss. Scenery, J. M. Sert. Dresses, L. Bakst, C—M. Fokine; *Midas*, M—Steinberg, D—D. Doboujinski, C—M. Fokine; *Le Coq d'Or*, Opera Ballet, M—R. Korsakov, D—N. Gontcharova, C—M. Fokine.

1917 *Soleil de Nuit*, M—R. Korsakov, D—M. Larionov, C—Leonide Massine; *Parade*, M—Erik Satie, D—P. Picasso, C—L. Massine; *Contes Russes*, M—Liadov, D—M. Larionov, C—L. Massine; *Les Femmes de Bonne Humeur*, M—Scarlatti, D—L. Bakst, C—L. Massine.

1918 *Les Jardins d'Aranjuez*, M—Fauré, Chabrier and Ravel, D—J. M. Sert, C—L. Massine.

1919 *La Boutique Fantasque*, M—Rossini, D—A. Derain, C—L. Massine; *Le Tricorne*, M—M. da Falla, D—P. Picasso, C—L. Massine.

1920 *Pulcinella*, M—Pergolesi, Stravinsky, D—Picasso, C—L. Massine; *Le Chant du Rossignol*, M—Stravinsky, D—H. Matisse, C—L. Massine; *Le Astuzie Femminili*, Opera Ballet, M—Cimarosa, D—J. M. Sert, C—L. Massine.

1921 *Chout*, M—S. Prokoviev, D—M. Larionov, C—M. Larionov, T. Slavinsky; *La Belle au Bois Dormant*, M—Tschaikovsky, D—L. Bakst, C—M Petipa.

1922 *Renard*, M—Stravinsky, D— and C—M. Larionov.

1923 *Les Noces*, M—Stravinsky, D—N. Gontcharova, C—B. Nijinska.

1924 *Les Biches*, M—F. Poulenc, D—Marie Laurencin, C—B. Nijinska; *Les Fâcheux*, M—G. Auric, D—G. Braque, C—B. Nijinska; *Les Tentations de la Bergère*, M—Monteclair, D—Juan Gris, C—B. Nijinska; *Le Train Bleu*, M—D. Milhaud, D—Chanel and H. Laurens, C—B. Nijinska.

1925 *Les Matelots*, M—G. Auric, D—P. Pruna, C—L. Massine; *Zéphyr et Flore*, M—Dukelsky, D—G. Braque, C—L. Massine; *Barabau*, M—Rieti, D—Maurice Utrillo, C—Balanchin.

See W. A. Propert, *The Russian Ballet in Western Europe* (1921).

(W. A. P.*)

BALLIN, ALBERT (1857–1918), German shipowner, was born in Hamburg Aug. 15 1857. Educated for a mercantile career, his first notable achievement was the organisation of the emigrant traffic on the Carr Line. He then took over the management of the passenger traffic on the Hamburg-Amerika Line, becoming, in 1886, director and shortly afterwards director-general of that enterprise. Under Ballin's leadership the Hamburg-Amerika Line expanded steadily, acquiring numerous other shipping companies and increasing its capital tenfold. By negotiating agreements with other shipping companies, Ballin practically reorganised Germany's shipping trade; and he was the author of the German-American shipping agreement of 1902. He died suddenly in Hamburg Nov. 9 1918.

BALLISTICS (*see* 3.270).—General agreement is to be found in the treatment of exterior ballistics in various countries, but the subject of interior ballistics, which is concerned with the behaviour of the gun, the projectile and the charge while the projectile is in the bore, has led to widely different methods of treatment.

I. INTERIOR BALLISTICS

The complexity of the physical laws involved makes the subject a very difficult one to treat with completeness theoretically, and the aim of most methods is to produce a solution which is in general accord with the theoretical laws as at present known, but which contains undetermined coefficients whose values can be adjusted so as to make the calculated results agree with the observed results in particular cases.

The maximum pressure inside the bore, and the muzzle velocity of the projectile on leaving the bore, are the quantities whose determination is most important—any rational method with two undetermined coefficients can be used to give agreement with observed results for maximum pressure and muzzle velocity in the case of one particular gun, charge and projectile. The soundness of the method employed will determine whether the results for other guns, charges and projectiles can be predicted with reasonable accuracy. In view of the divergencies between published systems, it is convenient here merely to indicate the systems of equations used, and the physical laws involved in any method, and then to give references to detailed accounts of each method.

Laws of Burning of Propellants.—The actual problem of interior ballistics is, of course, that of the mode of expansion of gases under high pressure. The problem is slightly different from those ordinarily met with in the domain of physics in that the mass of the gas is constantly being added to as the propellant burns, so that the first problem to be solved is the rate at which the propellant burns, and the dependence of this rate on the existing conditions of pressure, temperature and density. Modern propellants are for the most part colloids, and charges are composed of a number of grains of definite size and shape. For colloid propellants Piobert's "Law of Burning by Parallel Layers" is well established. This law states that at any instant during the burning of the grain the thickness burnt through in the direction normal to the exposed surface is the same over the whole surface.

The rate of burning of the thickness is a property of the propellant. Most methods assume that this rate of burning is a function of the pressure only and, following Sarrau (1876), use the relation

$$\frac{dy}{dt} = \mathrm{B}\mathrm{P}^{\alpha} \qquad (1)$$

where y is the fraction of the normal thickness burnt off at time t, P is the mean pressure at that time, and B and α are constants depending upon the propellant.

The systems in use differ chiefly in the choice of α; some values in use are:—

(1) $\alpha = 1$ (English and American practice; also used by Charbonnier and Sugot—France).

(2) $\alpha = \frac{2}{3}$ (Gossot and Liouville—France).

Function of Form.—Equation (1) yields information as to the rate at which the thickness is burnt away. Obviously the rate at which the volume is being consumed, that is to say the rate at which gas is being produced, will further depend upon the area exposed to burning at any instant. Thus, for a charge of given mass, one composed of small grains would be expected to be burnt more quickly than one composed of large grains. Thus the form of the grain must be taken into account. The different forms employed may be divided into three main groups:—

(1) Those which burn with a continually decreasing surface. To this group belong all solid grains and short cylinders with an axial perforation.

(2) Those which burn with a practically constant surface, such as long thin tubes.

(3) Those which burn with an increasing surface to a certain stage, the grain then breaking up into other forms quite different from the original shape. An example of this type is a cylindrical grain pierced longitudinally by a number of holes.

Since it is the volume of charge burnt that determines the amount of gas present at any instant, it becomes necessary to determine a relation between Z, the fraction of the charge burnt, and y, the fraction of the thickness of the grain burnt.

Charbonnier introduced the idea of a "function of form." Let S_0 be the initial surface of the grain, and S the surface when a fraction Z of the grain is burnt. Then, depending upon the geometry of the grain, it is easy, using the law of burning by parallel layers to deduce a relation of the type

$$S = S_0 \cdot \Phi(Z) \qquad (2)$$

$\Phi(Z)$ is the "function of form."

The combination of equations (1) and (2) leads to an equation

$$\frac{dZ}{dt} = C \cdot P \cdot \Phi(Z) \qquad (3)$$

where C is a constant. This is the required equation giving the rate of consumption of the charge at any instant.

In England and elsewhere a somewhat different practice is adopted. Instead of considering the surface exposed at any instant it is usual to deduce, from the geometry of the grain, an equation of form of the type

$$Z = f(y) \qquad (4)$$

and to use equations (1) and (4) in combination instead of the single equation (3), as in Charbonnier's system.

Characteristic Equation of the Gases-Expansion Equation.—The next step in the solution of the problem is to consider the behaviour of the gases when produced. Most methods take as characteristic equation a modified form of Van der Waal's Equation, namely,

$$P(V-\eta) = RT \qquad (5)$$

with the usual notation, due allowance being made, in calculating V, for the space occupied by the unburnt propellant.

V and η, of course, depend upon the amount of gas produced, that is, upon Z, and V also depends upon x, the distance the projectile has moved at time t, and upon the initial air-space.

Once burning is complete the relation between V and x is

$$dV = A \cdot dx \qquad (6)$$

where A is the area of cross-section of the bore.

Some methods assume that the expansion during burning is isothermal and equation (5) is written

$$P(V-\eta) = \lambda \qquad (7)$$

where λ is a constant.

Others assume that the expansion is adiabatic, or partly adiabatic and partly isothermal, and write

$$P(V-\eta)^K = \lambda \qquad (8)$$

where K is some constant intermediate in value between unity and the ratio of the specific heats of the gases. Whatever assumptions are made, the object is to produce a relation between P, Z and x which shall hold during burning. This relation is the "expansion equation." The motion of the projectile can now be considered in two stages, namely, during burning and after burning.

Motion while the Charge is being Consumed.—It is most convenient to take either Z, or y, as the independent variable during this stage, as each ranges from 0 to 1 during the stage, and supplies definite limits for any necessary integrations.

The variables concerned are P, x, t and Z, if Charbonnier's Function of Form is used. Thus three equations will be necessary in order to complete the system.

Equation (3) between Z and t, and the expansion equation between P, Z and x, are two, and the third is supplied by an equation of motion or energy, which, in its simplest form, can be written

$$m \cdot \frac{d^2x}{dt^2} = A \cdot P \qquad (9)$$

where m is the mass of the projectile.

If equation (4) is used as the equation of form, equations (1) and (4) replace equation (3), and the four equations now provide the complete system for the five variables P, Z, y, x and t. There is no difficulty in the integration of the equations.

Motion after the Charge Is Consumed.—Most methods take this phase as being adiabatic expansion and write

$$P(V-\eta)^\gamma = \text{const.} \qquad (10)$$

where γ is the ratio of the specific heats of the products of combustion. This, together with the equation of motion, forms the complete system for this phase. The most convenient independent variable to use is x, the shot travel, or, which is much the same thing, to use V, the volume. Methods differ in the choice of γ, some taking it to be 1·2, others leaving it undetermined, and fixing its value in particular cases by the comparison of calculated values with observed values of the velocity. Most methods agree in taking γ as constant over the range of temperatures occurring in a gun.

Secondary Considerations.—So far nothing has been said concerning the energy expended in

(1) Engraving the driving band of the projectile; (2) Friction between the band and the rifling; (3) Rotation of the projectile; (4) Recoil of the gun; (5) Kinetic energy of the gases; (6) Heat losses by conduction through the material of the gun.

It is in allowing for these losses that the difficulty of reconciling calculated results with observed results arises. In general, the heat losses by conduction are considered negligible, and the others are usually compensated for by writing, instead of m, the mass of the projectile, a fictitious mass m', given by the equation

$$m' = i(m+\mu c) \qquad (11)$$

where i is a correction coefficient and is greater than unity,

and μc is the mass of the charge.

$$0 < \mu < 1.$$

Another point to be considered is the pressure at which the projectile commences to move, known as the "shot-start" pressure. An obvious simplification is to take this as zero; this assumption is made in many methods in use. Hadcock (*Proc. Roy. Soc.*, A, vol. 94) in his system allows for a definite shot-start pressure.

Thermodynamical Method.—A method differing in principle from most others is that of Henderson and Hassé (*Proc. Roy. Soc.*, A, vol. 100). The authors give first of all an account of the chemistry of the explosion, and finally evolve an expression for the heat-content of the gases as a function of the absolute temperature only. By the use of an equation of form, a rate of burning law, and equating the energy lost by the gases to the kinetic energy of the projectile (allowing for losses by a fictitious mass m'), the system of equations is complete. Full details of the solution are given in the paper cited. This method further differs from others in that no assumption is made as to the constancy of the ratio of the specific heats.

Monomial Formulae.—Sarrau and others have attempted to express the muzzle velocity and maximum pressure by means of monomial formulae obtained empirically. Such formulae have no theoretical foundation, and are of very restricted application, inasmuch as they are the equivalent of the differential coefficients of muzzle velocity and the maximum pressure with respect to the variables involved for one particular set of values of those variables. They can be relied upon to give accurate results only for cases varying very little from the particular one upon which they were based.

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II. EXTERIOR BALLISTICS

Modern developments in artillery material, and more especially the requirements of anti-aircraft gunnery, have rendered essential a knowledge of the elements at all points of a trajectory, and not merely those at the point of fall, as heretofore.

Law of Air Resistance.—The air resistance R, depends upon 1. The velocity, v, of the projectile. 2. The calibre, d, of the projectile. 3. The shape of the projectile. 4. The steadiness in flight. 5. The physical characteristics of the air in which the projectile is moving, namely, the density, viscosity and elasticity.

For a projectile of given shape and steadiness, dimensional considerations lead to the form

$$R \propto \rho d^2 v^2 f\left(\frac{v}{a} \cdot \frac{vd}{\nu}\right) \qquad (1)$$

where ρ = the density of the air,

a = the velocity of sound in air (a measure of the elasticity),

ν = the kinematic viscosity,

f is a function of the two arguments $\frac{v}{a}$ and $\frac{vd}{\nu}$, both of no dimensions,

f is called the *drag coefficient*.

At velocities less than the critical velocity

$$f = A \cdot \frac{\nu}{vd}$$

and the expression (1) reduces to the form

$$R = A \cdot \rho \cdot dv \cdot \nu,$$

the ordinary expression for the resistance of a viscous fluid.

At velocities greater than the critical velocity,

$$f = A\cdot\frac{v}{vd}+B,$$

where B is some constant. As v increases the value of the second term becomes of more and more importance, till at velocities of the order of 600 ft./sec. f is practically constant, and the expression (1) leads to a quadratic law of resistance.

At still higher velocities, the argument $\frac{vd}{v}$ has little effect, and in most ballistic work it is assumed that

$$R \propto \rho\cdot d^2\cdot v^2\cdot f\left(\frac{v}{a}\right). \qquad (2)$$

Experiments of Bashforth, and later those of the Gavre Commission, 1888, were all directed to the determination of $v^2\cdot f\left(\frac{v}{a}\right)$ as a function of v only, whereas it appears from the foregoing that the value of a, in other words an elasticity effect, also should be taken into account. Thus the effect of a change of temperature will be twofold —firstly, it will affect the density, ρ, and secondly it will affect the elasticity, and hence a.

Density of the Air.—Since the resistance depends upon the air density, any small arc method will demand a knowledge of the density of the air at each point of the trajectory. As is well known, this density diminishes with height, and it is usual to assume a standard density lapse, given by a formula of the type

$$\rho = \rho_0\cdot c^{-hy} \qquad (3)$$

where ρ = density at a height y,
ρ_0 = density at ground level,
and h is a constant.

This may be expressed more generally in the form

$$\rho = \rho_0\cdot H(y), \qquad (4)$$

where $H(y)$ is some function of the height: $H(y)$ may be given as a formula or in tabular form.

Trajectories are calculated for this assumed density structure, and any variations from this assumed law are allowed for in differential variations.

Ballistic Coefficient.—From (2) the resistance to a projectile of given shape and steadiness is given by

$$R \propto \rho\cdot d^2\cdot v^2\cdot f\left(\frac{v}{a}\right).$$

As in 3·271 it is assumed that the shape and steadiness can be allowed for by coefficients κ and σ respectively, and the retardation, r, experienced by a projectile of mass m, and coefficients κ and σ is given by

$$r = \frac{\kappa\cdot\sigma\cdot\rho\cdot d^2\cdot v^2\cdot f\left(\frac{v}{a}\right)}{m}. \qquad (5)$$

The quantity $\frac{m}{\kappa\cdot\sigma\cdot d^2}$ is denoted by C, and is called the *ballistic coefficient.* C, as thus defined, depends upon the density, and therefore upon the height.

With this notation, (5) becomes

$$r = \frac{v^2\cdot f\left(\frac{v}{a}\right)}{C}. \qquad (6)$$

Choice of the Resistance Law.—As has been pointed out, all previous experiments have been directed towards the expression of the drag coefficient as a function of v alone, and not of $\frac{v}{a}$. Further, in the application of these experimental results to the compilation of tables for use in the calculation of trajectories, attempts have been made to give the law of resistance a functional form.

Thus, the results of Shoeburyness experiments of 1906 have been expressed in the form $R = Av^n$, where values of A and n were given for different regions of velocity. A and n were so chosen that the aggregate was a continuous function, but the differential coefficients were discontinuous at the points where A and n changed—the "n-junctions" as they are called. This being so, any attempt at checking step-by-step integration by the method of differences will break down at these points.

In France the method has been to utilise the Gavre Commission results; these results have been smoothed, and attempts have been made to express them by a continuous function which also has continuous differential coefficients. One such formula, based on the Gavre results, is that of Le Chef d'Escadron Démogue, and is as follows:—

$$\log f(v) = \log\left[0{\cdot}2550+\frac{\sqrt[4]{1+0{\cdot}0392\left(\frac{v'}{10}\right)^8}}{27226+494\,v'^2}\cdot tan^{-1}v'\right] \qquad (7)$$

where $tan^{-1}v'$ is expressed in minutes of arc and $v' = \frac{v-330}{550}$ (where v is in metres per sec.).

All small arc methods used at present depend on a resistance law (or tables of resistance) given as a function of v only. When experimental methods yield a law based on the argument $\frac{v}{a}$, it will be essential to consider the value of a at each point of the trajectory, thereby taking into account the elasticity effect. With this remark, the following work will refer to the resistance law as $\rho.d^2.v^2.f(v)$, since existing tables afford this information only. Equation (6) will thus become

$$r = \frac{v^2\cdot f(v)}{C}. \qquad (8)$$

The Differential Equations of Motion of the Projectile.—Treating the projectile as a heavy article, the equations of motion are of the form

$$x'' = -r\cos\theta \qquad (9)$$
$$y'' = -g - r\sin\theta \qquad (10)$$
$$x' = v\cos\theta. \qquad (11)$$
$$y' = v\sin\theta \qquad (12)$$

x', y', x'', y'', have the usual significance, and θ is the angle that the tangent to the trajectory makes with the horizontal.

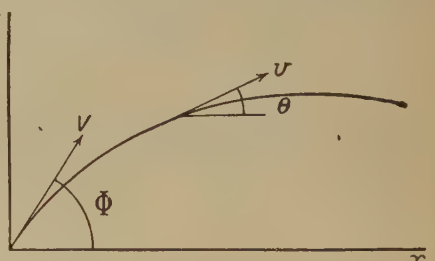

FIG. 1.

From the above equations of motion, the following equation follows immediately

$$g\cdot\frac{d(v\cos\theta)}{d\theta} = r\cdot v. \qquad (13)$$

Equation (13) contains only the two variables v and θ (if, for the moment, the dependence of C on y is neglected). It is the differential equation of the hodograph and serves as the starting point for most of the small-arc methods, and for this reason is sometimes referred to as the *principal equation.*

Integration by Small Arcs.—Briefly stated, the problem is: given the elements x, y, v, θ, t and the ballistic coefficient at the beginning of an arc of the trajectory and one element at the end of the arc (this element thus fixing the size of the arc), to determine the other elements at the end of the arc. (See fig. 1.) The methods in use differ chiefly in the element used to fix the arc; this element is usually referred to as the independent variable.

The French method is to use θ as the independent variable, choosing the size of arc so as to have a given total curvature, usually a whole number of degrees. The method used is the *Méthode G.H.M.*[1] In Great Britain and the U.S.A. time is used as the independent variable. Italian methods make use of a generalisation of Siacci's method (Bianchi), in which the chord and its perpendicular are taken as the co-ordinate axes for each arc. According to Cranz, the Germans make use of a purely graphical method of integration.

Integration in Small Arcs—Time as Independent Variable.—The suffix 0 will refer to values at the beginning of the arc, and the suffix 1 to those at the end.

q will be used to denote $v\cos\theta$, the horizontal component of velocity.

Equations (8) and (13) lead to

$$\frac{d(v\cos\theta)}{d\theta} = \frac{v^2f(v)}{Cg} \qquad (14)$$

Also from the equations of motion

$$\frac{dt}{d\theta} = -\frac{v}{g\cos\theta}. \qquad (15)$$

Hence

$$\frac{dq}{dt} = \frac{d(v\cos\theta)}{dt} = -\frac{v^2f(v)\cos\theta}{C}. \qquad (16)$$

$$\int_{q_0}^{q_1}\frac{1}{q^2}dq = -\int_{t_0}^{t_1}\frac{\sec\theta f(v)dt}{C} \qquad (17)$$

leading to

$$\frac{1}{q_1}-\frac{1}{q_0} = \frac{\sec\bar{\theta}f(\bar{v})}{\bar{C}}(t_1-t_0) \qquad (18)$$

where $\bar{\theta}$, $\bar{v}$, and $\bar{C}$ are appropriate mean values estimated from the values for preceding arcs; $f(\bar{v})$ is at once obtained from tables.

It follows from (15) that

$$\int_{\theta_0}^{\theta_1}\sec^2\theta\cdot d\theta = -\int_{t_0}^{t_1}\frac{g}{q}\cdot dt \qquad (19)$$

integrating

$$tan\,\theta_0 - tan\,\theta_1 = \frac{g}{\bar{q}}(t_1-t_0). \qquad (20)$$

Further

$$x_1-x_0 = \bar{q}(t_1-t_0) \qquad (21)$$
$$y_1-y_0 = tan\,\bar{\theta}(x_1-x_0) \qquad (22)$$

[1] Garnier-Haag-Marcus. A full account of it is to be found in Garnier: *Calcul des trajectoires par arcs successifs*—Gauthier-Villars (1919).

Equations (18), (20), (21) and (22) are the working equations. (t_1-t_0) is chosen so that the above equations are true to some predetermined numerical accuracy.

As a first approximation, the following mean values are taken

$$\begin{aligned} \bar{q} &= \tfrac{1}{2}(q_1+q_0) \\ \tan\bar{\theta} &= \tfrac{1}{2}(\tan\theta_1+\tan\theta_0) \\ \bar{y} &= \tfrac{1}{2}(y_1+y_0) \\ \bar{v} &= \bar{q}\sec\bar{\theta} \end{aligned} \qquad (23)$$

The procedure may be summarised as follows:—

(1) From previous arcs estimate $\tan\bar{\theta}$, $\bar{C}$, and $\bar{v}$ and so, from equation (18) and the known value q_0, calculate q_1.

(2) With this value of q_1, calculate $\bar{q}\sec\bar{\theta}$, which should now be checked against the estimated value of v.

(3) If the two values do not agree, use the calculated value of $\bar{v}$ as a fresh estimate of $\bar{v}$, and repeat the process till no difference (to the degree of accuracy employed) is obtained.

(4) The values of x_1, y_1 and θ_1 are at once obtained from the working equations, and the next arc can now be calculated.

It will be found necessary to use small values of (t_1-t_0), say $\frac{1}{4}$ second, when v is near the velocity of sound in air, as $f(v)$ will be changing rapidly in this region.

The above procedure makes use of estimates from the preceding arcs. In the case of the first few arcs, therefore, the procedure is somewhat different.

From equations (14) and (15)

$$\frac{\delta q}{q}=\frac{vf(v)}{C}\delta t \qquad (24)$$

From the initial conditions, namely, the muzzle velocity, angle of departure, and value of C at the ground level, an estimate of δq and therefore of q for the first arc can be made. Hence, from equations (20) and (22) $(\tan\theta_1-\tan\theta_0)$ and (y_1-y_0) are obtained.

These values lead to values of $\bar{C}$, $\sec\bar{\theta}$, and $\bar{v}$ sufficiently accurate for a first working of the arc. From the results, better estimates are made and the arc is reworked, the process being repeated till the required degree of agreement between estimated and calculated values is obtained.

The second and third arcs are worked on similar lines, except that the results for the first arc facilitate the estimation of δq.

The fourth and succeeding arcs can now be worked by the general process.

Differential Variations.—In the calculation of trajectories a certain set of standard conditions has been assumed, namely: (1) Earth motionless. (2) No wind. (3) Standard density structure. (4) Muzzle velocity, V, and the ballistic coefficient, C, are constant and known. (5) Further, if $\frac{v}{a}$ is admitted as the argument of the drag coefficient, a standard temperature (or elasticity) structure will have to be specified in addition to the density structure.

The effect of small variations in the initial conditions, V, C and ϕ can be found by interpolation between calculated trajectories. For other variations, it has been found desirable to consider variations in the elements of the trajectory as functions of the variations from normal conditions to which they are due, and to solve the differential equations of the variations by an extension of "small-arc" methods. Such a method is that discovered by Professor G. A. Bliss and improved by Dr. T. H. Gronwall.

Effect of Wind.—The effect of a uniform wind throughout the trajectory can be calculated by a simple consideration of the velocity of the shell *relative to the air*, it being borne in mind that this is the velocity for which ballistic tables are calculated.

Wind velocities being small compared with projectile velocities, it will be seen that the uniform wind may be resolved into two components, one in the plane of fire, and affecting the range, but not the line, and the other perpendicular to this plane, and affecting the line only. In general, of course, the direction and speed of the wind will seldom be uniform throughout the trajectory. It being assumed, however, that the wind structure can be determined by observation, the method of correction is exhibited in the following paragraph:—

Weighting Factors: Application to Conditions Varying throughout the Trajectory.—Let there be some condition E (maybe wind, density, elasticity, etc.) which is not that for which the normal trajectories were calculated, and which does not vary by the same amount from normal throughout the trajectory, but whose variation from normal at any particular point is known. The trajectory is divided into a number of zones, generally 10, of equal height. The mean variation from normal of E in each zone is known.

Let ΔR_0 be the range correction for a variation ΔE of E from normal throughout the whole trajectory.

Let ΔR_p be the total range effect produced by a variation ΔE in the p^{th} zone alone, E being considered normal in all the other zones. (This can easily be done by small arc methods.)

Hence $$\Delta R_0 = \sum_{p=1}^{p=10} \Delta R_p.$$

The ratios $\frac{\Delta R_1}{\Delta R_0}, \frac{\Delta R_2}{\Delta R_0}$ are denoted by the quantities w_1, w_2, and are called weighting factors, since they show the weight of the variation ΔE in each zone.

Now let the variation of E from normal be different in each zone, ... δE_1 in the 1st zone, δE_2 in the 2nd zone, and so on. Then, the variations possessing the proportional property of 1st order variations,

$$\text{Range effect in 1st zone} = \frac{\delta E_1}{\Delta E}\cdot\Delta R_1 = w_1\delta E_1\cdot\frac{\Delta R_0}{\Delta E}$$

$$\text{Range effect in 2nd zone} = \frac{\delta E_2}{\Delta E}\cdot\Delta R_2 = w_2\delta E_2\cdot\frac{\Delta R_0}{\Delta E}$$

and, by summation,

$$\text{Total range effect, } \Delta R = \frac{\Delta R_0}{\Delta E}\sum_{1}^{10} w_p\cdot\delta E_p,$$

that is to say $\sum_{1}^{10} w_p\cdot\delta E_p$ is the variation in E which, if uniform throughout the trajectory, would produce the same effect as the given variations in the different zones. Hence, given the weighting factors, and the variations in each zone, the problem is reduced to finding the effect of a uniform variation throughout the trajectory, and this follows from the principal variations already calculated. Weighting factors are calculated and classified according to the height of the trajectory concerned. They can be calculated for range wind, cross wind, density,[1] and elasticity.[2]

The following are typical values of cross wind weighting factors:—

Vertex Height	No. of zone counting upwards from ground									
	1	2	3	4	5	6	7	8	9	10
1,500 ft.	·05	·06	·07	·07	·07	·09	·09	·10	·15	·25
4,000 ft.	·08	·08	·08	·08	·08	·09	·09	·10	·10	·22
12,000 ft.	·05	·06	·06	·07	·07	·08	·08	·10	·13	·30

The above table brings out the greater importance of variations in the top zones compared with those near the ground.

Rotation of Projectiles—Yaw—Drift—Stability.—Thus far the projectile has been considered as a heavy particle, and no account has been taken of the rotation necessary to keep it point foremost, nor of the forces that may be called into play by any oblique presentation of the elongated projectiles. Jump card[3] experiments have shown that the axis of the projectile does not always lie along the tangent to the trajectory. The angle between them is called the angle of yaw. When yaw is developed the line of the resultant air pressure intersects the axis at a point in front of the centre of gravity, and this air pressure exerts a moment about the centre of gravity in such a direction as to increase the yaw. Due to the rotation of the projectile about its axis, precession and nutation of the axis ensues. If the spin is insufficient, this moment may cause the projectile to become unstable.

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BALLOON: *see* AIRSHIP.

BALMONT, CONSTANTINE (1867–), was born June 3 1867 at Gumishche, in the province of Vladimir, on his father's estate. A scholar of Elizabethan drama and of Shelley, he first became known as the translator of the latter and the apostle of

[1] In practice, temperature weighting factors (for density effect only) are calculated instead of density weighting factors, as it is easier to measure temperature variations from a standard temperature structure than actually to measure densities.

[2] The application of elasticity weighting factors is in process of development.

[3] A very complete account of jump-card experiments and their analysis, and the conditions of stability, will be found in the "Aerodynamics of a Spinning Shell," by R. H. Fowler, E. G. Gallop, C. N. H. Lock and H. W. Richmond, F.R.S. (*Phil. Trans. Roy. Soc.*, A, vol. 221), and Part II. of a paper on the same subject by R. H. Fowler and C. N. H. Lock (*Phil. Trans. Roy. Soc.*, A, vol. 222).

his ideas. His extensive travels in South Africa, Mexico, New Zealand and Spain account for the exotic vein in his poetry. He produced his best work during the 'nineties and the early years of the present century. The very titles of the volumes published during this period—*Under the Northern Sky* (1894), *Silence* (1898), *In Boundless Space* (1895), *The Burning Buildings* (1900), *Only Love* (1903), *Let us be like the Sun* (1903)—indicate the stages of his development from pure aestheticism to an aggressive and partly anarchical Nietzschean poetry, which brought him immense popularity and made him the acknowledged head of a younger generation of Russian symbolists. This vogue has long since passed, but he remained one of the finest of modern Russian lyric poets. *The Liturgy of Beauty* (1905), *Evil Charms* (1906), *The Bird of Flame* (1907) are representative of his later work. He has also written several volumes of prose. In 1918, shortly after the outbreak of the Bolshevik revolution, he went to live in Paris.

BALTIMORE (*see* 3.288).—The population of Baltimore, the eighth city of the United States in number of inhabitants, increased in the decade 1910–20 from 558,485 to 733,826, of which number 108,390 in 1920 were negroes, as compared with 84,749 in 1910. The population in 1925 was estimated at 794,000. The taxable basis increased from $915,433,444 in 1918 to $1,543,064,251 in 1925.

Manufactures.—In 1919 the capital invested in manufactures was $434,243,740; the value of their output was $677,878,492, and the wage-earners in manufacturing plants numbered 97,814. In 1923 the wage-earners increased by 4,963 and the manufacturing capital by $15,992,500. This great increase may be attributed to differential freight rate on goods from the west, deep-water manufacturing sites, steamship connections, coastwise and foreign, and abundance of labour. Baltimore is a popular city with labour because in normal times its markets are notably cheap, and the continuance in Maryland of the ground-rent system makes possible the purchase of homes by labouring men on easy terms. In 1923 permits were granted for the construction of 4,203 dwellings, and other building permits increased the total to 20,303. Of 130,000 residences, 62% are owned by the occupants. In 1922 Baltimore handled 4,326,000 tons of foreign merchandise and 1,103 vessels cleared for foreign ports.

Municipal Improvements.—The physical characteristics of Baltimore have been much altered since 1910. By a paving loan of 1906, and by a special paving tax of 1912, funds were provided for the conversion of 210 m. of the cobblestone streets into modern smooth-paved ones at a cost of $9,500,000. Three concrete tubes were constructed in the bed of Jones Falls, which had become an unsightly open sewer, and into these the stream and an additional flow of storm-water sewage were directed and carried through the city for a mile and a half. On top of these tubes a highway was constructed, known as the Fallsway, which relieved the congestion of north and south traffic between the water front and the uptown railway yards. At a cost of $23,500,000 the main work of installing a new sewerage system, begun in 1905, was completed in 1916. A dam at Loch Raven, with a capacity of 2,000,000,000 gal., and a filtration plant at Montebello for impounding and purifying the Gunpowder river water supply were constructed. A boulevard connects several of the parks. A Memorial Hall, commemorating those who died in the World War, was dedicated in April 1925.

Legislation.—One of the most important changes was the passage in 1918 of an Act of the Maryland Assembly by which, to the 32.19 sq. m. of Baltimore territory, were added 51.83 sq.m. of land and 11.30 sq. m. of water, making the total area 95.32 sq. m. and adding about 100,000 persons to the population. At the November election in 1920, the people voted overwhelmingly in favour of four improvement loans, aggregating $51,750,000.

Finance.—Fifty-three Baltimore banks and trust companies, exclusive of private banking firms, showed on Jan. 1 1925 aggregate resources of $601,934,355, and deposits of $500,079,982. In 1924 bank clearings reached a total of $5,025,334,741, a gain of 3·8% over the preceding year and of 121.7% over 1917.

Education.—The Johns Hopkins University established a School of Public Hygiene in 1920, and in 1925 it announced that it intended to discontinue its collegiate and undergraduate Engineering Dept., confining itself to higher education. Loyola College has opened new buildings in the northern part of the city. A number of fine public schools have been built, and several high schools have either been constructed or are planned. The Enoch Pratt Free Library, constituting the public library system of the city, has a central library building and 26 branches.

The mayors of Baltimore have been: from 1907–11, J. Barry Mahool (Dem.); 1911–9, James H. Preston (Dem.); 1919–23, William F. Broening (Rep.); 1923–7, Howard W. Jackson (Dem.). In 1923 the City Council was reorganised so as to consist of one House instead of two.

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(B. C. S.)

BALUCHISTAN (*see* 3.291), a minor province of British India with agencies attached. The area is 134,638 sq. m., the population 799,625 (1921).

Development.—The chief features in the history of Baluchistan during the period 1910 to 1925 were her weathering of the storms set up by the World War and the Afghan War that followed on its close, the increase to the railway system in the administered districts and the development of road communications in the vast areas that make up the frontier state of Kalat.

Effect of World and Afghan Wars.—The Sandeman system, the essence of which is the administration of frontier tribes as far as may be on tribal lines according to tribal custom through tribal chiefs and headmen, stood the strain of the World War well. The only serious trouble that arose was among the Marri Baluch, a tribe whose depredations were a household word in the plains of Sind before the days of Sandeman, and whose natural unruliness had been encouraged by the weak personality of its last two Chiefs. Affected by pessimistic rumours of German victories and British defeats, and strengthened in their pessimism by a call for recruits for the army, the Marris attacked the Gumbaz post in Feb. 1918. Driven off with the loss of 125 killed, they looted and burnt the Kohlu sub-tahsil, and with the help of the Khetrans sacked Barkhan and Fort Munro, and held up a train between Sibi and Harnai. Retribution was swift. After severe chastisement from a punitive column the Marri Chief surrendered with the whole of his tribe early in the following April.

The Pathan portions of Baluchistan, over which the World War passed without rousing much restiveness, were more seriously troubled by the Afghan War. But this was due to external causes. The collapse of the militia in the North West Frontier Province, the abandonment—as many believed, needlessly—of the militia posts in the Upper Tochi, the consequently inevitable abandonment of Wana in south Waziristan and the gallant but tragic retreat of its garrison through north Baluchistan, set up a conflagration throughout the greater part of the lower Zhob. In Fort Sandeman and its immediate neighbourhood it was soon brought under control. But it smouldered on for some time in the more inaccessible areas, especially those abutting on the Waziristan border.

Communications.—The World War was responsible for bringing into being two long-standing railway projects. The first of these was an extension from Khanai on the Sind-Pishin railway to Hindubagh. Constructed in 1916–7 in order to speed up the transport of the Hindubagh chromite deposits, then in urgent demand for munitions, it is almost bound to prove the first stage of a railway extension to Fort Sandeman, eventually perhaps to link up with the North West Frontier strategic railway system. More dramatic was the extension of the Nushki railway along the Nushki-Seistan trade route (with which the combined genius of Lord Curzon and Colonel Webb Ware had bridged the Chagai desert some 20 years before) first to Dalbandin (118 m.) in Jan. 1917, then to Mirjawa (269 m.) on the Perso-Baluch border in

Feb. 1919, and finally to Duzdab (52 m.) in the following April. It is hardly rash to hazard the prophecy that, given the continued control of American financial advisers over the Persian Treasury, under the masterful rule of the new Shah Reza Khan, railhead will not long remain at Duzdab.

Kalat State.—There have also been developments in many branches of the administration of the Kalat State, but none more marked, perhaps none more needed, than in communications; 600 m. of road have been driven through Makran, 500 m. through Jhalawan and 250 m. through the Kachhi. Formerly it took weeks, growing into months, to travel from the capital town of Kalat to the outlying parts of this state which sprawls over more than 73,000 square miles. A motor-car can now cover the distance in as many days, and the effect on the general betterment of the administration has been immediate and great.

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BANAT: *see* RUMANIA.

BANCROFT, HUBERT HOWE (1832–1918), American historian (*see* 3.309), died at Walnut Creek, Cal., March 2 1918. He published in 1909–10 *The Book of Wealth* and in 1912 *Retrospection, Political and Personal*, giving an account of his labours.

BANCROFT, SIR SQUIRE (1841–1926), British actor and manager (*see* 3.309), published in 1925 a further book of reminiscences, *Easy Chairs*, and died in London April 19 1926.

BANDELIER, ADOLPH FRANCIS ALPHONSE (1840–1914), American archaeologist (*see* 3.311), died in Madrid March 19 1914. His last published works were *The Islands of Titicaca and Koati* (1910) and *The Ruins of Tiahuanaco in Bolivia* (1912).

BANERJEA, SIR SURENDRANATH (1848–1925), Indian (Brahmin) politician and journalist, was born Nov. 10 1848 in Calcutta. Passing for the Indian Civil Service at the open competition of 1870, he was retired after two years' service, and then opened a small school in Calcutta which soon expanded into the well-known Ripon College. His work as a political reformer began in 1876 when he founded the Calcutta Indian Association and three years later he became editor of *The Bengalee* newspaper. In subsequent years he became the centre of many stormy episodes. He was one of those who established the Indian National Congress in 1883, and presided over the Poona session of 1895 and again at the meeting at Ahmadābād in 1902.

In 1893 Banerjea was elected to represent the Calcutta corporation on the Bengal Legislative Council, and was twice returned to the central Legislature as member for Bengal. He gave evidence in 1897 before the royal commission on Indian expenditure and frequently visited England in connection with deputations and political missions. Vehemently opposing the administrative partition of Bengal effected by Lord Curzon in 1905, he supported the boycott of foreign goods which arose from the upheaval. He always exhibited, however, a preference for consitutional agitation, and was among the first to welcome the Montagu-Chelmsford reforms. Severing his association with the congress, which had passed under "extremist" control, he formed an "Indian Liberal" organisation, and accepted office as Minister for Local Government and Sanitation in Bengal. A knighthood was conferred upon him in Jan. 1921, and in 1924 he retired into private life. Shortly before his death on Aug. 6 1925 at Barrackpore, he published his autobiography, *A Nation in Making*.

BANFFY, DEZSŐ, BARON (1843–1911), Hungarian statesman (*see* 3.315), died in Budapest May 24 1911.

BANG, HERMANN JOACHIM (1858–1912), Danish author (*see* 3.315), died Jan. 29 1912. In 1910 a volume of his essays appeared, *Masker og Mennesker*, followed in 1911 by a volume of short stories, *En dejlig Dag*. His collected works were published in six volumes in Copenhagen and Oslo (1912). See F. Poppenberg, *Nordische Porträts—Hermann Bang* (1904).

BANG, NINA HENRIETTE WENDELINE (1866–), Danish politician, was born at Copenhagen, where, in 1894, she graduated M.A. She married a politician, Gustav Bang, who died in the year 1915. Devoting herself to economic studies, she was active as a Social Democrat in politics and journalism, and in 1918 became a member of the Landsthing (Upper House). In 1924 she joined the first Danish Social Democratic Government under Theodore Stauning as Minister of Education, thus becoming the first woman Cabinet Minister in the world. With the support of Danish and foreign scientific funds Mrs. Bang commenced, in 1906, the publication of a comprehensive work about the dues on the Sound, *Tables of Shipping and Goods Transport on the Sound, 1497–1660* (1906–22).

BANGKOK (*see* 3.316), Siam.—Since 1910 new roads have been built, and a number of Chinese banks have made the city their headquarters. Trade is flourishing, having doubled since 1907; in 1923–4 the exports were worth £15,741,609 and the imports £12,511,801. Over 85% of the trade of Siam goes through Bangkok, and 1925 was a record year for the export of rice, the chief product and article of export of the country (1,324,363 tons). There are about 80 rice-mills working in the city and neighbourhood. The naval arsenal dock has been reconstructed, and a dry dock built by the Bangkok Dock Company. Vessels of 13 ft. draught can cross the bar. A railway to Penang, which shortens the journey to Europe by three days, was opened in 1918; since 1922 express services have been run to Penang and Singapore. The line to the northeast was being extended to Korat in 1926, and the building of a bridge across the Menam Chao Bhraya river will link the northern and southern railway systems. In 1917 the Chulalongkorn University was opened.

BANKING AND CREDIT (*see* 3.334).—Although pre-War economic literature laid the foundations of modern theories of credit control, it was the disorganisation of the War period and the efforts since made to re-establish currencies on a firm basis which have given the control of credit its present practical and scientific interest. In order to classify the points at issue, it is desirable to start with the most general case, and to make corrections for the specific influences exerted by particular systems of currency standard and by the peculiarities of environment.

I. THE CONTROL OF CREDIT

The theory starts from the assumption that the flow of purchasing power in an economic community is governed, in the last resort, by the activities of the central bank, for the central bank, under all circumstances, is the final source for the supply of media of payment. Even when an economic community has not itself a central bank, its monetary phenomena are affected by the actions of the central banks of other communities, given a world economic order, so that, broadly, the monetary phenomena of the economic universe as a whole are functions of the activities of the central banks. Given a central bank, then, the funds at the disposal of the community are subject to its control. For, if it pursues a policy of stringency it can, directly and indirectly, deprive the outer money market of funds and thus create a universal stringency; if it pursues a policy of expansion, it can add to the resources of the outer money market and thus produce a state of universal fluidity.

Since the theory further postulates that the price-level is a function of the mass of media of payment in circulation, it follows that the price-level is itself dominated by the monetary or credit policy of the central bank; in the last resort, it is governed by the conception of their responsibilities entertained by the leading functionaries of such a bank. It is irrelevant whether the central bank emits purchasing power in the form of book-credits or of cash: first, because an expansion in the former will lead to an expansion in the latter; second, because the bank will govern its grant of credit in the first form by the power which it possesses of expanding the second form. Hence, the generalised theory lays it down that it is not the volume of cash which governs the volume of credit, but the volume of credit which governs the volume of cash in circulation, since, in its most general form, the power of the central bank to emit cash is unlimited.

Given that central banks possess the powers attributed to them by the theory, two groups of questions arise: (1) Through

what mechanism does the impulsion to expand or contract credit affect the economic structure? (2) What are the appropriate devices by which these impulses can be regulated?

Varying Views.—Three groups of views may be distinguished, though there are elements common to all these views.

(*a*) One group of writers lays great stress upon the influences exerted directly or indirectly by divergences in the movement of real and nominal interest rates, or by the differences between the money rate of interest and the rate of return on real capital (normal rate of interest), in periods of expansion or contraction. Thus it is argued by Irving Fisher that if at a time when prices are rising, money rates of interest rise less rapidly, the real rate of interest may be falling, though the money rate charged may be rising. Or, as is urged by Wicksell, if the normal equilibrium rate of interest is given, any offer by bankers to lend at less than this rate will discourage lending to bankers and encourage borrowing from bankers; this will itself cause prices to rise, and unless bankers' rates of interest are again equilibrated with real rates of return on capital, a constant pressure in the direction of further expansion will be felt. The converse is of course the case when nominal rates are above real rates or when money rates are above normal rates; both as regards a rise and a fall, divergences tend to be cumulative in their effects.

It is to be noted that Fisher's theorem and Wicksell's are by no means identical. Irving Fisher's "real" rate of interest is based on the relation (in terms of *goods*) between the value of what is borrowed as compared with what is repaid, and is contrasted with the rate per cent on the amount of money borrowed: Wicksell's "normal" rate is the price (in terms of money) which will just equilibrate demand for (real) capital with the supply of it. Whatever the price-level, this rate itself may be undergoing a change which may increase or decrease the divergence between it and the money rate at which loans are being contracted: Fisher's conception essentially rests on changes in the price level not compensated by changes in the money rate of interest.

(*b*) A second view, that of Professor Cassel, places most stress on the discrepancies that can occur between the *real* supply of savings and the *nominal* supply of savings, *i.e.*, the volume of purchasing power. If the supply of purchasing power is so great as to add to the current real savings of the community an artificial supply, leading to additional demands on the available productive powers of the community, prices will inevitably be driven up. Conversely, a fall in the price-level can be produced if the supply of purchasing power reduces the nominal volume of savings below the current real savings.

(*c*) Current British theories have borrowed from the views already mentioned, but lay stress also on the relationship between profit-margins, the supply of purchasing power and the rate of discount. Thus, in Mr. Hawtrey's treatment of the problem, an increase in the volume of purchasing power will be distributed as increased income, will induce traders to give larger orders and will result, since production is not absolutely elastic, in rising prices. The temptation to the trader is in part speculative, since stocks in his hands go up in value, but it arises in part from the relative lowness of interest rates, since this widens the margin between traders' income and traders' cost, in particular the cost of carrying stocks.

The Discount Rate.—Whatever be the angle of approach, it is clear that the dominant theories lay great stress upon the rate of discount, which, as the price which is paid for the current use of purchasing power, appears to all groups alike as the legitimate instrument by which an excess or deficiency in the supply of purchasing power can be prevented. Having thus outlined the dominant theory of credit control, it becomes advisable at this stage to refer to the limiting conditions and the qualifications which, in the opinion of the present writer, it is necessary to introduce.

The Influence of Particular Currency Systems.—The general theory assumes that the central bank completely controls the supply of purchasing power. This is, however, only true in exceptional cases, when the country is not on a metallic standard basis (or if, being on such a basis, the central bank controls the entire output, the state refraining from issuing an independent currency of its own). When a community is on a metallic basis, the price-level is ultimately controlled by the output from the mints, so long as it effectively remains on that standard. For, if the central bank increases the supply of local purchasing power to such an extent as to lose parity with gold or other metal, the community is no longer on a metallic basis. If the central bank is given the power to refuse gold at will and the mints are not obliged to take gold and give coin at the request of other holders, the country is not on a true gold basis. But if the central bank attempts to maintain its local currency at least on a par with gold, and if the bank accepts gold freely, or in default of such acceptance gold can be turned into coin at will at the mint, then the power of the central bank to prevent the value of gold from falling (and with it the local currency) is limited by the degree to which it can withdraw alternative forms of currency from use.

The practical condition is that the liabilities of the bank should remain constant, whilst its earning assets should be replaced by gold as it comes in, *i.e.*, that the gold reserve should increase at the expense of other items on the assets side of the balance sheet. In this way, the effect of increased supplies of gold in influencing the value of currency can be delayed until the gold is equal to 100% of the unaltered liabilities. After that point is reached, the central bank is powerless to prevent the value of the currency from falling. Within this margin, laxity or stringency of credit-administration will still remain important elements, but as soon as a community is on the gold standard, it will be the gold supply which will *ultimately* dominate the situation; laxity, however, will drive the country off the gold standard and stringency—in the form of accumulating large reserves—will prevent a relative upward swing of prices—relative, that is, to other gold-using areas.

The second assumption of the theory is that the central bank only issues credit in response to a commercial demand. But this is certainly not always the case; in particular, it was not the case during the War, when the central banks made part of the machinery of War, issuing vast loans to the governments. To this aspect of the subject we return below. Here it is only necessary to state that, even if the central banks had practised a policy of extreme self-denial and had refused direct assistance to governments, it would not have altered the situation very much; for the governments could have issued currency of their own or, alternatively, have borrowed from the central banks indirectly. Even had the banks attempted to apply business principles to these indirect loans and discounts, it would not have made the slightest difference. The governments would have received the *net* proceeds (minus a further deduction representing commission to the borrower for undergoing the trouble involved), and would have profited from the taxation of the large profits of the central banks, so that loans plus tax would have resulted to the same thing, though loans might have been somewhat smaller and proceeds from the taxation of central banks might have been somewhat larger than was actually the case.

The third assumption of the dominant theory is that it is always possible for the central bank to control the credit situation, *i.e.*, that it is always either actually the lender, or can make itself the lender, whose loans are necessary to satisfy the (marginal) effective demand in the market. This aspect of the theory is the more important in that it raises the whole question of the effectiveness of the discount-rate as the chosen instrument of credit control.

Experience has revealed that both on psychological and technical grounds the efficacy of the discount rate is subject to qualification. It is clear that a given rate can only be effective if borrowing actually takes place at that rate. Even in pre-War days, however, this was not always the case. There developed, therefore, on the part of the Bank of England, the practice of selling securities for cash and their repurchase for account, with the intention of depriving the market of funds and therefore causing a demand for accommodation at the bank, which, of course, meant that the bank rate became "effective." This is one aspect of a truth which can be expressed thus: that a central

bank can influence the money market not only by its *discount* policy, but also by its investment policy, that is to say, that so far as the effects on market rates are concerned, it makes, *quantitatively*, no difference whether a given volume of funds is added to market resources, or is withdrawn from the market, by means respectively of additional discounts or additional investments, or by reduced discounts or reduced investments. The difference between the two methods lies in the fact that the discretionary power of the central bank is greater in the one case than in the other; when a central bank attempts an exclusive control by means of variations in discounts, it may find that the willingness of the market to absorb funds may be less than it desires. This is in itself a confirmation of the view that the discount rate may not always be fully efficacious in producing the desired effect, since there is a limit below which the rate cannot fall. On the other hand, when the central bank is selling securities and therefore reducing the funds at the disposal of the market, it can *enforce* a given rate. A central bank, then, by expanding its holdings of investments may influence the market in the desired direction even though a reduction in discount rate has had no, or insufficient, effect; a reduction in investments need not be accompanied by a rise in discount rate, though it will obviate the necessity for a reduction. The systematic exploitation of these facts constitutes the so-called " open market " policy of the Federal Reserve System, inaugurated on a systematic scale in 1923 and fully set forth in the 10th annual report of the Board.

Discrimination.—Even in pre-War days it was the practice of central banks to supplement the discount rate by a gradually increasing stringency of discrimination in the choice of bills they would discount, whenever undue demands were being made by the market for accommodation. In post-War days, this embryonic policy has developed into a fully conscious policy of *rationing* on the part of certain central banks in those countries, which have just emerged—as namely, Austria, Hungary, Germany —from a period of violent change in the value of the monetary standard. This points in itself to certain defects in the " method of discount rate variations." For, though it may be true that if a given volume of accommodation will be afforded by a central bank, it can make, ultimately, no difference whether this amount is distributed by fixing the quantity and apportioning it on given principles, or by fixing the price appropriate to a given quantity and allowing the market to determine those who will buy that quantity at the price fixed, yet there seem to be certain advantages in the method of rationing which cause it to be preferred. The central bank retains the power of *discrimination* between one borrower and another to a much greater extent in the case of rationing, but, apart altogether from this point,the determination of what *will* be the " equilibrium price " appropriate to a given quantity is purely experimental and may lie at such unusual levels as to defy completely calculation or prevision. Thus, even a 98% discount rate proved ineffective in Germany before the cessation of inflation and, if rates of this order of magnitude have to be applied, it may be better to approach the problem of regulation from another angle, *i.e.*, from the angle of pre-determined limits of quantity.

In other words, though there may always be a rate which, if enforced, will be deterrent, it may be more difficult to enforce that rate than to employ an alternative device. The argument that, if borrowers know that a rise in rates will be ruthlessly employed, a considerable rise of rates will in fact be avoided, rests on a psychological premise which is not universally valid and upon economic grounds which are not always applicable. The argument assumes in fact (*a*) that the cost of credit is a sufficiently large item of expense as to make an upward or downward movement in the cost of credit an appreciable element in the calculation of profit or loss; (*b*) that, apart from the direct incidence of profit or loss, borrowers believe an alteration of discount rate to be a sufficiently accurate guide to the future conditions of business as to cause them to anticipate loss if they do not immediately begin to contract their commitments. The extent to which a belief of this sort prevails is not a fixed magnitude: it varies with individuals, times and nations.

Whilst the modern theory of credit control undoubtedly contains elements of permanent scientific value, it cannot be said that unanimity prevails either as regards the logical structure of the theory or the practical value of its results. Its elaboration is in the main the consequence of the currency chaos of the last decade. The reintroduction of the gold standard does not absolve central banks from the task of credit-regulation: the formula that a central bank must watch its reserves is merely a practical maxim which conceals the important scientific truth that the preservation of adequate reserves *involves* at all times supervision of credit conditions. In fact, central banks have always supervised credit conditions, unless diverted from their true object by erroneous theories or by the exigencies of governmental finance. Modern research is likely to influence central bank practice by the provision of sensitive statistical and economic indices, which will throw light upon underlying economic conditions earlier than the movement in the reserve position could do—a development which is being forced upon the Federal Reserve System in the United States, for instance, by the inapplicability of the reserve test under the present conditions of surplus gold reserves.

II. THE CENTRAL BANKS AND THE WAR

At the outbreak of the War the world was upon the gold standard. European countries, the Dutch East Indies, Japan, possessed central banks, generally endowed with the monopoly of note issue: in the United States of America the Federal Reserve System was just beginning to operate. The absence of true central banks elsewhere, particularly within the British Empire, was compensated by the maintenance of cash balances in London and in New York (on the part of Canadian banks); these balances, replenished by the rediscounting facilities available, especially in London, enabled local banking systems to use the older money markets as central banks whenever the necessity for expansion was felt. In this way, the whole world credit structure turned on the gold reserves of the established financial centres.

Gold Reserves.—The central banks maintained gold reserves larger than were absolutely necessary, partly out of conservatism, partly because of the belief that large gold reserves would constitute an element of strength in times of war. These gold reserves they were enabled to accumulate the more easily because (1) the world output of gold was expanding; (2) small notes in certain cases were allowed to circulate in order to divert gold to the central bank; (3) the note issue regulations were designed to prevent a too free expansion of the note issues, whilst the notes were kept at par with gold either by direct conversion into gold on demand or by conversion into assets which were at par with gold.

The note issues were limited either by (1) the requirement of a maximum limit without any specific reserve ratio (France) or (2) by the requirement of a percentual reserve without limit of issue (as in Denmark, Switzerland, Holland); or (3) by a combination of a percentual reserve requirement (usually $33\frac{1}{3}$ or 40%) with a fixed " uncovered " issue (Germany, Austria). In certain cases, *e.g.*, the United Kingdom, Russia, Norway, the principle was maintained that *above* a certain limit the entire issue should be fully covered, though this is only a variant of (3) above. The " uncovered " issues had generally to be backed by specified securities, usually commercial bills of exchange with 3 or 2 signatures, thus linking the volume of notes with trade movements and giving elasticity to the whole system.

To avoid the danger of governmental exploitation of the note issue, Treasury Bills could not be included in " eligible " discountable paper, or, alternatively, the amount which the government could borrow was limited. In order to combine elasticity with the maintenance of gold parity, the constitution of certain central banks had instituted the principle of the taxation of excess issues, *i.e.*, the reserve requirements could be temporarily suspended, provided that a tax was paid on the volume of notes in excess (Germany, Sweden, United States). The intention was that the discount rate should be proportionately raised, but this by no means always happened in practice; the central

banks refraining from raising the rate in order to avoid burdening industry and commerce with too heavy rates. The profits of the banks were generally divided between the shareholders and the governments, after provision had been made for reserves, and the general relations between the bank and the government usually enabled the latter—following the model of the Bank of France—to appoint the chief executive officials and thus exercise considerable indirect influence.

The War resulted in the central banks of the world being turned into currency manufacturing institutions. The notes of the banks were made inconvertible, or, where this was not the case, the free export of gold was prohibited. Usually, both steps were enforced. The governments financed themselves by discounting Treasury Bills or other obligations; apart from this direct borrowing, indirect inflation was practised by the banks granting loans at lower rates of interest against War Loans or other government securities. Even amongst the neutrals, mobilisation charges and subsidies and other extraordinary expenditure worked in the direction of depriving the central banks of free power of control; in their case also, gold imports from the belligerents produced "gold inflation," and even where, as in the case of the Scandinavian central banks, the right to refuse gold was granted (1916), errors in banking administration were made. It was probably inevitable that the central banks should lend themselves to the financial exigencies of their governments, but apart from this, throughout the War, the central banks were guilty of absurd delusions as to the value of gold reserves at a time when their notes were inconvertible and gold reserves could do nothing to maintain their value. Finally, bank administrations generally inverted cause and effect and attempted to justify their enormous issues of currency by arguing that higher prices required more currency, so adding intellectual confusion to economic disorganisation. To this belief and to the persistent idea that it is safe to lend "so long as the security is good" must be ascribed some of the orgy of inflation which was the part cause of the post-War "boom" of 1919–20, after the worst of the governmental pressure had been removed (*see* CURRENCY).

The net effect in Europe was that between 1913 and 1919 the total gold in banks and in circulation fell from $3,764,000,000 to $3,240,000,000: the neutrals (Scandinavia, Switzerland, Holland and Spain) gaining $720,000,000, the belligerents losing $1,247,000,000. The relative importance of loans to government and on government securities before and after the War to the totality of all productive operations of the chief European central banks is brought out in the following table. The absence of Sweden is due to the transference of government loans from the central to the commercial banks before the end of the inflationist period, *i.e.*, roughly before the end of 1920.

Percentage of Total Earning Assets of Central Banks (Represented by Claims on Governments and Advances on Government Securities)

	1913	1918	1920		1913	1918	1920
Portugal	74	77	74	Netherlands	6	23	14
France	43	86	86	Finland	1	53	54
Belgium	12	88	87	Japan	27	6	14
Bulgaria	47	84	81	Switzerland	..	44	51
Serbia	61	53	85	Spain	34	31	27
Greece	31	17	75	United Kingdom	38	49	59
Rumania	31	69	86	Italy	23	69	59
Denmark	2	34	25	United States	..	10	9
Germany	21	98	98				

III. CENTRAL BANKING SINCE THE WAR

New Central Banks.—Since the end of the War two main developments are to be noted: firstly, a considerable extension in the number of central banks, and, secondly, a considerable degree of reorganisation in the central banks of certain countries, such as Germany and Russia, already possessing such institutions. Both these developments are to a large extent the common result of a single cause, viz., currency disorganisation, but the extension in the number of central banks is also due to the emergence of new states. Thus the separation of the Baltic States from Russia has led to the creation of the Banks of Estonia (1919), Lithuania (1922) and Latvia (1923): the re-creation of Poland led, first, to the State Loan Office and, after currency chaos, to the Polish National Bank (1924); the splitting up of Austria-Hungary and the liquidation of the old Austro-Hungarian Bank has resulted in the formation of the Banking Office of the Czechoslovakian Republic (though legislation in 1920 and 1925 has prepared the way for a new central bank), in the formation of the Austrian National Bank in 1922 and the National Bank of Hungary in 1924.

Currency disorganisation in Russia led to the new State Bank of the U.S.S.R. in 1921. Currency chaos in Germany led in Oct.–Nov. 1924, first to the creation of the Rentenbank (now in liquidation) and, under the aegis of the Dawes Commissioners, to the reorganisation of the Reichsbank in 1924. Danzig was provided with a central bank in 1924. In South and Central America, the first steps towards a new central bank were taken in Mexico in 1923: Colombia erected a bank in the same year: Peru had founded a reserve bank in 1922 and Chile one in 1925. In the British Empire, the first steps towards central banking in India were taken by the absorption of the three presidency Banks into the Imperial Bank of India in 1920: in Australia the Commonwealth Bank Act of 1924 has reorganised the bank (formerly a purely commercial institution) on the lines of a central bank: in South Africa a reserve bank was created in 1920, and under Canadian legislation of 1923 (supplementing emergency legislation of 1914), the Ministry of Finance has been given certain of the powers of a central bank.

One may envisage this movement under three heads: (1) the general intellectual forces which have shaped it, (2) the agencies which have furthered it, (3) the technical aspects of the new institutions.

(1) *Brussels and Genoa Conferences.*—The underlying theory has already been previously explained, but it was at the two International Conferences of Brussels (1920) and Genoa (1922) that the theory was prominently expounded. At Brussels attention was mainly fixed upon the cessation of inflation, but the Conference called for the establishment of new central banks in countries where they did not already exist. It was at Genoa that a broad programme was laid down. The second commission of the Conference, acting upon the report and draft resolutions of the committee of experts, called for the universal establishment of central banks and the inauguration of the policy "of continuous co-operation among credit banks of issue, or banks regulating credit policy in the several countries." Such "co-operation . . . would provide opportunities of co-ordinating their policy, without hampering the freedom of the several banks." By resolution 12 it was left to the Bank of England "to call a meeting of such banks as soon as possible," in order to elaborate an International Convention regulating the reserve policy of the banks in order to avoid, what was feared might result from the return to the gold standard, "a struggle for gold," and hence considerable fluctuations in the purchasing power of gold.

(2) *Co-operation between Central Banks.*—The International Conference thus proposed has not taken place, but there is nevertheless a considerable degree of informal co-operation at the present time. The Governors of the Bank of England and of the Federal Reserve Bank of New York are in frequent personal touch with one another and the actual policy of certain European central banks has been greatly influenced by the advice which has been tendered to them, as well as by the assistance afforded them, by the Bank of England. Thus the pegging of the Hungarian crown in terms of sterling was made one of the conditions of an advance of £4,000,000 in 1924: the Austrian crisis of 1924 was accompanied by movements in the Austrian bank rate instigated by the bank, whilst the recent credit policy of the National Bank of Belgium has also been influenced by the attitude of the British authorities.

Actual developments have also been powerfully affected by the prestige of the Federal Reserve System and by the influence which the League of Nations has been able to bring to bear. The economic pre-eminence of the U.S.A. has resulted in the

Federal Reserve System becoming the model which has been followed in Latin America and in South Africa (especially as regards the ownership of shares in the reserve bank by outside banks and in the framing of rules governing "eligible" paper) and has also left its mark on Europe, a result which is, of course, due in part to the selection of American economists and experts (notably Prof. Kemmerer, of Princeton) to guide the reorganisation of banking and currency conditions. The Finance Committee of the League of Nations influenced the form taken by the National Bank of Austria and the new National Bank of Hungary. Experience gained in the erection of these banks served as a basis for reform in Germany.

(3) *Technical Aspects of Central Banks.*—So far as the technical aspects of the newer institutions are concerned, the following points may be noted:—

(*a*) The tendency to assimilate sight deposits or demand liabilities and notes in circulation for reserve purposes. Thus demand liabilities have either to be specifically protected, as in the case of Peru, South Africa and the Reichsbank (where a 40% reserve in the shape of immediately available bank balances and short bills must be held), or demand liabilities and notes are added together for the purposes of calculating the reserve ratio, as in Austria, Hungary, Czechoslovakia, Colombia.

(*b*) The tendency for permission to hold part of the "cash" reserve not in actual gold coin or bullion, but in the shape of foreign bank balances and foreign bills. In Germany 25% of the cash reserve may be in foreign exchange assets; in most of the newer bank constitutions no distinction is drawn between actual gold in vault or held in the shape of gold assets. The actual cash ratio also varies considerably—20% in the case of Austria, Hungary and Czechoslovakia (in all these cases provision is made for a progressive rise in the minimum ratio in the course of time); 25% in the case of Russia, 30–33⅓% in the case of Poland, Lithuania and Danzig; 40% in the case of Germany and South Africa; 50% in the case of Peru, Esthonia and Yugoslavia; 60% in the case of Colombia.

(*c*) A third tendency is for the introduction of the principle of the taxation of excess issues, or, as it may also be put, the taxation of deficiency reserves, and to insist that at a time when these rates of taxation are being enforced, the discount rate must be at a given level, so as to cause the borrower to bear the burden. Thus, in the case of the new Reichsbank the bank rate must be at least 5% if the reserve is less than 40% for more than one week, and the discount rate, when an excess tax is being imposed, must be raised not only by the amount of the tax, but by one-third more.

(*d*) A fourth feature is the tendency to limit very closely the borrowing powers of the governments at the central bank. In the case of Austria and Hungary such loans are forbidden altogether; in Czechoslovakia loans are only allowed to the state against customs and tax warrants and the products of state industries (Article 129 of Act of 1920); loans to the German Govt. by the Reichsbank are limited (apart from fixed amounts which may be loaned to the Posts and Railways) to 100,000,000 marks for a maximum period of three months (Article 25 of Bank Act). It must not be overlooked that most of the new European central banks start with vast sums owing them by the state, in consequence of notes issued during the inflation period, and provision for the gradual reduction of these debts, usually out of the share of the profits falling to the state, has had to be made.

So far, in most of the countries where a central banking reorganisation has taken place as part of, or in connection with, currency reform, the central bank has been successful in maintaining the international value of the new currency unit, though Poland is so far an exception. The task of stabilising the values of these currencies in terms of gold was made easier by the fact that they were usually very much undervalued abroad, so that it was possible to peg the foreign exchange value and yet allow of a very considerable degree of internal currency expansion. But the experience of Austria in 1924 and of Germany in 1925 shows that the point must ultimately come when an almost brutal use of restrictive powers must be made in order to safeguard the stabilised currencies from a new decline. Thus the central banks of Europe have so far hardly even considered the problems which the newer theories of credit control have raised, viz., the stabilisation of the whole field of business in the interests of stable price-levels. Some of them, particularly the Bank of France, are still struggling with the problems presented by government finance; but in general it may be said that in the field of central banking in 1926 the worst is definitely over and that a new era has definitely begun.

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IV. BANKING IN THE UNITED STATES

The panic of 1907 and the recovery which followed it formed only a temporary interlude in the general development of the United States banking system; immediately afterwards the country entered upon a period of prosperity which continued practically unbroken until 1914. Lessons learned during the panic, however, convinced the community of the necessity of making some change in the note-issue system. The Aldrich-Vreeland law of 1908, while providing for so-called emergency currency, also established the National Monetary Commission, which was directed to inquire into the general situation of the banking and currency problem with a view to formulating a broader and more comprehensive statute.

This Commission presented in 1910, a general bill covering the whole field of banking reform, but political changes caused delay. The preliminary drafts of a new measure were prepared under the direction of a sub-committee of the Banking and Currency Committee of the House of Representatives, and the Bill so formulated became the Federal Reserve Act, entered in the statutes on Dec. 23 1913. It was undoubtedly the most important measure relating to banking or currency in the United States since the Civil War, and it made possible the important financial services rendered by the United States during the World War, The Federal Reserve System necessarily accepted the existing National Banking System as a basis, building upon a foundation already firmly established in American finance.

The National Banking System (*see* 3.345) had proved inadequate, partly because in time of stress there was no recognised means of relieving hard-pressed banks, and partly because the currency was inelastic, being limited by the amount of bonds available, besides being slow in issue and redemption. Agitation after the panic of 1893 for the issue of emergency currency as a means of checking the development of acute panics ultimately grew into a demand for a currency not purely of emergency nature, but elastic, as required by business needs, and therefore including issues of ordinary bank notes protected by the joint guarantee of the banks. The only practical outcome of the agitation was seen in certain of the sections of the Gold Standard Act of 1900.

The Federal Reserve System.—The Federal Reserve Act was the outgrowth of a gradual movement in the direction of central banking. It sought to provide elastic currency, not by changing existing law but by adding a new type of institution, the Federal Reserve banks, whose membership (stockholders) was to consist of national banks, compulsorily included, while institutions organised under state law (banks and trust companies) might at will also become members. Each member bank was required to contribute to the capital of its local reserve bank a sum equal to 3% of its capital and surplus, and to become liable for an additional 3% in case of necessity. The directing mechanism of the system was the Federal Reserve Board, consisting of five members (later raised to six) chosen by the President of the United States, with the Secretary of the Treasury and the Comptroller of the Currency as *ex officio* members. The essential requirement of the Act was the compulsory transfer of the reserves of member banks to the Federal Reserve banks, the reserve provisions requiring a 6% minimum of vault cash, and a 7% minimum of balances on the books of the reserve banks, while the remaining 5% of the reserve required in central reserve cities might be either in vault or in the reserve bank. This was the so-called divided reserve. Each reserve bank was authorised to issue currency against commercial, industrial or agricultural paper,

with a maximum maturity of six months except when of agricultural origin, in which case the maximum maturity was 180 days. Deposits of notes ready for issue were to be made with an officer known as the Federal Reserve Agent, there being one such officer at every Federal Reserve bank. Each Federal Reserve bank was governed by a board of directors, six of whose members (three bankers and three business men) were chosen by constituent member banks voting in three separate groups according to size of capital, while three (including the Federal Reserve agent, who was also the chairman) were chosen by the Federal Reserve Board. The Board was given the function of passing on, and establishing, rates of discount, such rates, however, being originally named by the boards of directors of the several Federal Reserve banks.

In the following table, compiled from reports obtained by the Comptroller of the Currency, the advance in the number of organised banks, including national, state, savings and private banks, loan and trust companies between 1910 and 1925 is shown:—

	Resources in Millions of Dollars						*Liabilities in Millions of Dollars*						
	Number of Banks	Loans and Discounts	Investments	Due from Banks	Cash on Hand	Aggregate Resources	Capital Stock	Surplus Fund	Undivided Profits Less Expenses	Due to Banks	Individual Deposits	United States Deposits	National Bank Circulation
1910	23,095	12,495	4,723	2,393	1,423	22,450	1,879	1,547	404	2,225	15,283	54	675
1913	25,993	14,568	5,407	2,776	1,560	25,712	2,096	1,676	573	2,584	17,475	49	722
1914	26,765	15,288	5,584	2,872	1,639	26,971	2,132	1,714	562	2,705	18,517	66	722
1915	27,062	15,722	5,881	3,233	1,457	27,804	2,162	1,732	639	2,783	19,135	49	722
1920	30,139	31,208	11,387	5,833	1,076	53,079	2,702	2,410	976	3,708	37,315	175	688
1921	30,812	28,932	11,381	4,974	946	49,671	2,903	2,542	910	2,809	34,844	390	704
1922	30,389	27,860	12,547	5,414	829	50,425	2,943	2,697	933	3,244	37,194	128	725
1923	30,178	30,416	13,672	5,597	797	54,034	3,052	2,799	954	3,610	40,034	238	720
1924	29,348	31,427	14,228	6,121	911	57,144	3,114	2,967	971	3,928	42,954	152	729
1925	28,841	33,883	15,400	6,774	951	62,057	3,169	3,173	1,007	4,370	46,763	147	648

While state banks and trust companies included the bulk of the investment institutions of the nation, the commercial banking assets were predominantly held by national banks. On June 30 1925, these numbered 8,072 with deposits totalling $19,909,669,000 and total resources, including rediscounts, reported at $24,350,863,000. Since 1890 there had been a rapid development of trust companies in many parts of the United States, while savings banks had also expanded rapidly both in the number of depositors and in assets; depositors increased from 6,107,083 in 1900 to 13,971,793 in 1924, and deposits from $2,449,547,885 in 1900 to $8,439,855,000 in 1924. The corresponding increase in trust companies was from 1,564 in 1914 to 1,680 in 1925, with a growth in aggregate resources from $5,489,500,000 in 1914 to $11,563,549,000 in the later year.

Effect of the World War.—The sudden advent of war in Europe necessarily subjected the banks to a very severe shock and pushed into the background the immediate questions of competition between different classes of institutions. Specie payment was suspended, and a severe drain of gold out of the country was caused by England's effort to supply herself with funds. There was also some fear that American foreign trade might be wholly or largely cut off. German war vessels, however, were soon driven from the North Atlantic, and the movement of products from the United States to Europe was resumed upon a limited scale. The banks, which had begun the issue of clearing-house certificates on Aug. 3 1914, were able to retire their obligations on Dec. 1 of the same year, although the Stock Exchange (which had been closed on July 31) was not reopened until later. As the requirements of European countries for goods became heavier, and as export shipments from the United States increased, the banks entered upon a period of unusual prosperity. Credit became comparatively safe, not only because of the upward movement of prices but because of the fact that the large purchases of goods made for European account were in most cases practically guaranteed by the European governments. The number of banks increased steadily, and both savings and commercial deposits advanced. There was little need to call upon Federal Reserve banks for rediscount accommodation, and they practically remained inactive.

After the United States entered the War a paper basis was established, and much of the enormous increase in the gold holdings of the United States was impounded. Congress passed an Act (June 21 1917) changing two fundamental ideas in the Federal Reserve Act. The maximum reserve requirement was reduced from 18% to 13% in central reserve cities, with the proviso that the entire amount should be carried in reserve banks, and the issue of notes directly against gold was permitted. The Act also extended to state institutions more liberal conditions for entry into and withdrawal from the system. Membership increased rapidly from 1917 onward, and by the close of 1925 (after some post-War reaction) the total number of member state institutions was 1,441, the national bank members being 8,048 in number.

The War effected far-reaching changes in the portfolios of paper holdings of the banks of the country. The public were encouraged to save and to use their savings in the purchase of Liberty Bonds, but large assistance had to be extended to bond-buyers to enable them to make their payments. The Government also became a heavy purchaser of all classes of commodities, and paid for them largely by issues of Treasury certificates. Thus the investments of the banks and their portfolios of paper came to consist largely of government obligations or of notes collateralled by such obligations. Many of the states, moreover, had, in imitation of the terms of the Reserve Act, modified their local laws so as to permit state institutions to take on fiduciary functions previously confined to trust companies. The national banks were also assuming savings-deposits functions. Hence the growth of the so-called department store type of bank, characteristic of the post-War period. While the growth of a discount market had been restricted by War conditions, the Federal Reserve Act had laid the foundations of it, particularly through its authorisation of the creation of bankers' acceptances and the provision for foreign branch banks. There was a mushroom growth of foreign branches established by American institutions during the years 1914–20, while acceptance paper also developed, at first tentatively, but later to an average amount aggregating about $750,000,000. The effort to introduce the trade acceptance or commercial bill was not very successful in displacing the single-name paper made under the open account system, which had become the staple in American banking.

Working of the Federal Reserve System.—The operations of the Federal Reserve System as such from 1914 to 1925 may be divided into four periods: the first from Nov. 2 1914 to the declaration of War by the United States, April 6 1917; the second from the latter date to about Nov. 4 1919; the third from Nov. 4 1919 to the beginning of the year 1921; and the fourth from the latter period until the end of 1925. In the first period the Federal Reserve banks were organised, obtaining the collaboration of the financial community, and introducing new standards of commercial paper through a system of regulations and the installation of a national and district clearance and collection system. The Federal Reserve Act had authorised the Board to

act as a clearing-house for the several reserve banks, and early in 1915 the so-called gold settlement fund at Washington was created, and eventually a daily system of telegraphic clearing between reserve banks was developed. Supplemented by an inter-district plan which laid the basis for an extensive plan of "par" collection within the several districts, this new enterprise helped to eliminate excessive internal rates of exchange and to establish a uniform condition of remittance throughout the United States. This work had been fairly successfully inaugurated by 1917, and in anticipation of war a large supply of Federal Reserve note currency had been printed.

During the second period the system seconded the Treasury Department in paying for the War and in financing European nations compelled to rely upon American aid. The Armistice found the country with an inflated price level and a somewhat undermined banking situation. It would have been well had the Reserve System set itself at once to reduce inflation, but, as usual, political consideration intervened. The fifth Liberty Loan was not floated until the spring of 1919, and heavy advances aggregating about $2,500,000,000 were made to European nations after the Armistice. The Reserve System found the pressure too strong, and permitted inflation to continue during 1919 and early 1920. Reaction set in during the spring of 1920 and became serious at the end of that year, the close of the year and the beginning of 1921 being a period almost of panic. Rectification had become necessary, and the Reserve System had raised its rate of discount fairly steadily during the year 1920. Deflation had been brought about in some measure through changes of rate, but probably in much larger degree through the efforts of the banks and business men of the country to restore normal conditions. The opening of the fourth period in 1921 found the system working for the first time under approximately normal circumstances. During the years 1921–5, therefore, the operations of the reserve banks were more closely adjusted to the general banking situation, and it was possible to judge the general results of the new law.

Expansion of Reserve Banks.—The great expansion resulting from the fiscal transactions of the Treasury coincided with the upward swing of business taking place soon after the complete establishment of the collection system. Greater efficiency was secured through the opening of new branch offices at strategic points, In all 22 branches were created, certain of them acting primarily as collection agencies, while others added very considerable powers in the rediscounting of paper and the holding of reserves. Early in the War the system entered into agency relationships with the Bank of England, whereby that institution was to hold funds in trust for the Federal Reserve banks jointly, while they in turn were to undertake similar duties for the Bank of England. It was understood at the time that the agency relationship would not, until after the War at least, lead to the performance of functions involving the buying and selling of bills or operations in the discount market. Similar relationships were later concluded with the Bank of France, the Bank of Japan and various other central foreign institutions, but the relationship was on a restricted basis, and did not result in the undertaking of international discount operations.

The position of the Reserve Banks on Oct. 28 1925 was as follows:—

Assets	
Gold with Federal Reserve Agents	$1,377,127,000
Gold redemption fund with U.S. Treasury	47,770,000
Gold held exclusively against Federal Reserve notes	1,424,897,000
Gold settlement fund with Federal Reserve Board	716,589,000
Gold and gold certificates held by banks	641,063,000
Total gold reserves	2,782,549,000
Reserves other than gold	110,511,000
Total reserves	2,893,060,000
Non-reserve cash	52,932,000
Bills discounted:—	
Secured by U.S. Government obligations	293,285,000
Other bills discounted	296,709,000
Total bills discounted	589,994,000
Bills bought in open market	328,717,000
U.S. Government securities:—	
Bonds	56,020,000
Treasury Notes	248,477,000
Certificates of indebtedness	20,260,000
Total U.S. Government securities	324,757,000
Other securities	3,220,000
Foreign loans on gold	3,399,000
Total bills and securities	1,250,087,000
Due from foreign banks	640,000
Uncollected items	684,027,000
Bank premises	61,557,000
All other resources	18,120,000
Total resources	$4,960,423,000
Liabilities	
Federal Reserve notes in actual circulation	$1,694,771,000
Deposits:—	
Member bank—reserve account	2,227,212,000
Government	38,670,000
Foreign bank	12,071,000
Other deposits	19,311,000
Total deposits	2,297,264,000
Deferred availability items	617,350,000
Capital paid in	116,602,000
Surplus	217,837,000
All other liabilities	16,599,000
Total liabilities	$4,960,423,000
Ratio of total reserves to deposit and Federal Reserve note liabilities combined	72·5%
Contingent liability on bills purchased for foreign correspondents	$36,849,000

The experience of American banks after the "silent panic of 1920–1" was somewhat chequered. There was a steady and substantial growth in assets and in turnover, the banks getting back more than they had lost through shrinkages resulting from the panic. But the results of the inflation which had led to the conditions of 1920–1 could not be avoided. In many cases, after the immediate effects of the shrinkage of prices had been overcome, banks found themselves in a weakened and unsatisfactory condition. In the case of not a few of the larger institutions this necessitated compulsory contributions by directors or additional subscriptions to stocks by stockholders, in order to make up the shortage resulting from losses. In other cases, however, there was an inevitable breakdown. As a result the years 1924 and 1925 saw a marked shrinkage in the number of banking institutions in existence, partly due to the constantly increasing number of mergers necessitated in many cases as a means of avoiding failure, and partly to the great number of actual failures, which in 1924 amounted to 777 and in 1925 to a total of 612.

In some measure this unfortunate record was the result of over-speculation during and after the War. In the middle-west and south-west, for example, where the bulk of the failures took place, extraordinary and unreasonable loans had been freely made by the banks upon farm land or live stock or both, while large advances upon inadequate security, oftentimes unsold produce, were common. The oversight of banking had been inadequate and limited; and the general supervision exerted by state banking authorities, in view of the greatly increased number of institutions, grew steadily more and more inadequate. The National Banking System also suffered from insufficient and careless oversight of its members, and had too readily and too hastily granted bank charters in favour of institutions that had but slight hope of success. The banks themselves had been inclined to engage in undesirable operations. Although the Federal Reserve System was expected to diminish the volume of speculation, it had not done so, events both during and after the War showing that the country banks were more inclined than ever to pour their money into the speculative market, while funds were withdrawn from the slow and steady development of legitimate business in the interior of the country. Other factors in post-War banking were a return to almost exclusive interest in domestic operations, and a tendency for the smaller American banks to invest heavily in bonds of long maturity. The general tendency has, therefore, been rather towards a diminution in the degree of liquidity. Meantime there has been a marked growth of branch banking legislation and practice. Under the administrative rulings of the Comptroller of the Currency, many national banks have created branches within their own cities, while state banks and bankers have proceeded along similar lines. In general the states have come to be divided into three groups: one possessing positive laws permitting branch banking; a second having no definite law on the subject, but permitting branches more or less restricted by administrative ruling; and a third carrying on its statute books definite legislation opposed to branch banking. Altogether more than 2,000

branches in all existed at the end of 1925, in the various states, a fair proportion of them being branches of national banks located in the same city as the parent office.

In spite of adverse conditions the Federal Reserve System succeeded in unifying and consolidating the legitimate interests of the banks, and tended to eliminate many of the doubtful and unsatisfactory methods which had prevailed before its organisation. The fact that the system was not successful in accomplishing some of its chief objects did not in any way detract from its successes, especially that of strengthening the condition of the city banks in many very important particulars. It seems fair to conclude that the Federal Reserve System did not function very successfully in the country districts; its chief success was apparently found in connection with city institutional lending and in the initiation of broad general improvements of method, such, for example, as those that relate to the clearance and collection system.

AUTHORITIES.—*Reports* of Secretary of the Treasury, Comptroller of the Currency and Federal Reserve Board, 1914–25, inclusive; Federal Reserve *Bulletins*, 1915–26, inclusive. (H. P. W.)

BANTING, FREDERICK GRANT (1891–), Canadian scientist, was born in Canada and educated at the University of Toronto. He served in the World War and then practised medicine in London, Ontario, until May 1921, when he commenced research on the internal secretion of the pancreas at the University of Toronto. In 1922 it was announced that he, with Prof. Macleod and others, had succeeded in preparing insulin, a specific cure for diabetes. He was appointed professor of medical research at the University of Toronto in 1923 and together with Prof. Macleod received the Nobel Prize for medicine in the same year. *See* INSULIN; THERAPEUTICS.

BAPTISTS (*see* 3,370).—The Baptist World Alliance, formed in 1905, has drawn together the Baptists of all lands, and has facilitated a systematic survey and more systematic work. International congresses have been held in London, Berlin, Stockholm, Philadelphia; another is due at Toronto in 1928. Similar meetings have been held in the Southern Hemisphere. An executive is appointed every five years, whose European office is at 4, Southampton Row, London.

I. IN THE OLD WORLD

The troubles of continental Baptists during the World War called forth abundant sympathy and practical help from their brethren. A conference at London in 1920 resulted in linking each national group on the Continent with one of the stronger groups elsewhere, in fostering theological seminaries within each country, and in the most promising students receiving further training in Germany, Sweden, England and America. A conference in Chicago in 1925 planned for professors from Sweden, England, Canada and the United States to visit certain countries of central Europe for aiding the national seminaries and conducting special short-term schools.

Great Britain.—Britain has seen a great strengthening of the Baptist Union, from whose memory the old distinctions of "general" and "particular" have faded away. Important financial measures are raising the standard of sustentation and superannuation, and linking the churches in closer fellowship. Much attention is given to the training of lay preachers, whose real importance had been somewhat overlooked. The problem of training and settling ministers is being viewed as a whole, and after careful thought two great changes have been adopted. There is a strong tendency to fix a term for the period of service in any one post, often five years, with the possibility of renewal. Then, to facilitate interchanges and to bring the churches into closer relations with the union, a 17th-century office has been revived and modified. General superintendents work in large areas, one for the English-speaking churches in Wales, one for Scotland, one for London and eight for the rest of England. These ministers confer monthly.

Development in Russia.—On the continent of Europe, the most remarkable development has been in Russia, where the increase has been phenomenal. No trustworthy figures have been published by the Soviet Govt. but from many quarters reports are sent of untiring evangelists increasing the membership by 30% a year. Whereas the highest figure mentioned in 1911 was 100,000, the lowest mentioned in 1925 is 1,000,000; one responsible leader claims 2,000,000 in his section, and a prominent statesman speaks of 3,500,000. Growth has outstripped organisation, but two groups are fairly well knit. The older radiated from Tiflis and Kiev, and flourishes among the peasantry; the younger radiated from Petrograd and embraces a large number of more cultured people. These are now re-arranging themselves on geographical lines; already there is a Ukrainian Baptist Union, and careful attempts are being made to evolve one all-Russian Union on lines congenial to the Slavic genius, as also to establish one or more theological seminaries. In South America, the initiative is still largely with missionaries from North America and Europe.

Africa.—In Africa, too, progress depends on the guidance of foreigners. Under the French, Belgian and Portuguese flags work must be conducted in native languages, or French or Portuguese. There is no sign of such wholesale adoption of Christianity as has taken place among Africans in America; these distant relations however recognise their special obligations and discharge them in the west and south.

Developments in Asia.—In Asia the feature of recent years is the growth of strong native missions in India and China, which are grateful for past help from Europe and America but which are taking tentative steps of their own. One conference passed a resolution that it now understands the need of the churches, and will indicate to foreigners the kind of help and helpers desired. Baptists of south China have assumed all responsibility for planning and administering the work in all phases, and their decision is hailed with deep satisfaction by the missionaries and the Foreign Boards. The Christian Literature Society for China has a majority of Chinese as authors, editors and managers. The Christian universities in both lands are still largely influenced by foreigners. (W. T. W.)

II. IN THE NEW WORLD

The Baptists of America were in 1925 organised in 14 national, or approximately national, bodies. Of these, the Northern Baptists Convention had at that date, a membership of 1,419,791; the Southern Baptist Convention 3,574,531; and various negro conventions 3,044,528. After allowance has been made for duplications, the total membership of the Baptist churches in the United States was 8,025,348. The total value in 1925 of church property of American Baptists was $343,540,300, and the amount raised for missions and various other beneficences was $18,493,717 with a total amount of annual contributions of $74,504,611. These large figures indicate a rapid development.

The Northern Baptist Convention.—Prior to 1907 the Baptist churches of the northern states had no central body to which they could send delegates. There existed a number of societies engaged in foreign and home missions and publication, but these were not strictly representative bodies. In 1907 there was a tentative organisation of a Northern Baptist Convention which was subsequently developed into a permanent body, composed of delegates from local churches and 37 affiliating organisations, including state conventions. This body has no authority, but has very great influence. Perhaps its most important operation was its adoption of a five-year programme for the purpose of stimulating the evangelistic and benevolent activities of the churches.

During the World War, the convention co-operated patriotically with national activity, but found that the finances of the societies were in danger of serious deficit. There was, therefore, organised a campaign to raise $100,000,000 during a period of five years. The convention also entered into the Federal Council of the Churches of Christ in America and the Inter-Church World Movement. As a result of the situation in which the nation then was, the Northern Baptists found themselves obligated for large sums to the Inter-Church World Movement at the very time they were engaged in raising the vast sum voted. These obligations were met, but the total amount raised in the campaign was ap-

proximately only 60% of the total amount desired. The cost of operating foreign missions rose more rapidly than the income, and there has been a need of some limitation of missionary expansion. In 1925 the Northern Baptists had in the foreign field 805 missionaries; 2,154 churches with 8,321 native workers, 3,645 schools of all grades, with 136,178 pupils; and 84 hospitals and dispensaries. The Northern Baptists at the same time maintained 14 seminaries, three training schools, 23 universities and colleges, five junior colleges and 18 academies. They furnish a large number of leaders in theological thinking and scholarship.

The denomination has suffered considerable inner disturbance because of the efforts of certain conservative elements in the denomination to get control of the convention and adopt a confession or creed for the churches. This move was so thoroughly opposed to the Baptist policy that it was rejected overwhelmingly when finally the vote was taken upon it. At the same time, the agitation has been continued by persons, several of whom are not members of the Northern Baptist Convention, who have founded the Baptist Bible Union for the purpose of maintaining what seems to them to be fundamental Baptist positions.

The Southern Baptist Convention.—This body is vigorously expressing itself in various forms of denominational activity in the South. Southern Baptists have declined to enter the Federal Council of the Churches of Christ in America and the Inter-Church World Movement. In 1919, however, they instituted a drive for $75,000,000 and pledged $90,000,000, which has been approximately 65% successful. The Southern Baptists are organised somewhat differently from their Northern brethren, having boards rather than societies. They have a large number of churches, many of which are in rural districts. Theologically, the Southern Baptists are conservative and especially insistent upon immersion as the mode of baptism. Their development in wealth and prestige, especially noteworthy in Texas, is attested by their support of two theological seminaries, three training schools, 32 universities and colleges and 28 junior colleges. They have established a large number of hospitals, several of which have a large income. They also maintain a number of orphanages. They are making, especially through the faculty of the Southern Baptist Theological Seminary at Louisville, distinguished contributions to theological scholarship.

The Negro Baptists have organised a number of national, or semi-national bodies, the two largest of which are the National Baptist Convention and the National Baptist Convention of America. These bodies maintain various missionary societies and publication societies with costly buildings; they are well organised and efficiently led. They maintain several theological seminaries and are active in educating the youth of their churches.

Foreign-Speaking Baptists.—For a number of years, there has been work carried on by Baptists among foreign-speaking immigrants in the United States, and these efforts have resulted in the establishment of a number of Baptist Conventions and other organisations in the various nationalities. The largest of these bodies are the German and Swedish Conventions, which represent a total membership of something like 65,000. In addition smaller bodies of Danish, Norwegian, Czechoslovak, Polish, Hungarian, Finnish, Italian, French, Portuguese, Rumanian and Russian bodies have also been organised. There are also a large number of unorganised, foreign-speaking Baptists. In fact, it is common for such foreign-speaking citizens of America, who have broken with their state churches, to organise under the simple forms of Baptist denominations. The exact number of all the foreign-speaking Baptist bodies, so far as can be discovered, is approximately 82,000. These foreign-speaking groups have been of very great value in the process of Americanisation, for, as a rule, the second generation either speaks English or joins English-speaking churches. (S. M.)

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BÁRÁNY, ROBERT (1876–), Austrian physician, was born in Vienna April 22 1876, and became a lecturer on diseases of the ear at the university there in 1909. In 1915, when he was a military doctor at Przemysl, he was taken prisoner by the Russians, but after some time he was released as an invalid. In 1917 he was invited to Uppsala University as assistant professor for ear and throat diseases and thus gained the title of professor. In 1914 he won the Nobel Prize for medicine for his investigations in physiology and the methods of diagnosis, of great significance in the development of internal surgery. Bárány also carried out important investigations in the physiology and pathology of the cerebellum, and worked out a method for the objective diagnosis of one-sided deafness. His works include *Physiologie und Pathologie des Bogengang-Apparats beim Menschen* (1907).

BARBADOES: *see* WEST INDIES, BRITISH.

BARBUSSE, HENRI (1874–), French man of letters, was born in Paris May 17 1874. Educated at the Collège Rollin, he became a journalist. In 1910 he was editing the periodical *Je Sais Tout*, but found time to write novels, of which *Les Suppliants* (1903) and, in particular, *L'Enfer* (1908), an intense tragedy tinged with melodrama, won considerable success. He is known chiefly for a brutal piece of realism, *Le Feu* (1916), which won the Prix Goncourt in 1917 and remains one of the most unforgettable pictures of modern war. Later he became a correspondent of the socialist journal *L'Humanité* and devoted his time to preaching against war. Among his other works are *Clarté* (1919); *La lueur dans l'Abîme* (1920); and *Quelques coins du coeur* (1921).

BARCELONA, SPAIN (*see* 3.391), has continued to increase in size and population during recent years. In Dec. 1923 the population was 760,572 and it is now the largest town of Spain. The War brought great prosperity to Barcelona, which supplied large quantities of war materials and manufactured goods, and this is shown in the appearance of the place. Broad avenues have been driven through the old quarter and the slopes of Montjuich converted into a fine park with terraced gardens, an open air theatre and a stadium. At the foot of the hill are the buildings for the exhibition of 1926. The Pedralbes Palace was presented to King Alfonso on the occasion of his visit to Barcelona in May 1924, by loyal Catalonians. The aim of the donors was to improve relations between Castile and Catalonia by providing a home in a pleasant climate which should be visited regularly by royalty. The palace, which was completely furnished by the donors and embellished with much marble, bronze and giding, stands in the suburb of Sarria on the lower slope of the hills and has fine views; everything in it is said to be of Catalan origin. A tube railway was opened in Dec. 1924 and a line of the Metropolitan Railway, linking up the northwestern suburbs of Gracia and San Gervasio, in Dec. 1925; a new dry dock has been constructed in the harbour.

Barcelona, fulfilling its old reputation as the centre of revolutionary ferments, was in 1916 the headquarters of the system of infantry committees of defence, which led to a conflict, and had serious political effects. In 1921 a conference on communications and transport was held under the auspices of the League of Nations and led to the formation of an international body, the technical and advisory commission on traffic problems. After the War Barcelona suffered, like other places, from the crisis in trade; the Spanish commercial treaties have also been a severe blow to the metal industries. In 1923 there was a general strike, with conflicts between the police and Syndicalists. Under a law promulgated in 1924, many suggestions made by the Barcelona municipality have been adopted. The alcalde or mayor is now elected by popular vote, and the number of electors is much greater. The municipality, in common with others in Catalonia, has been given wider administrative powers. In Sept. 1925 there was a military revolt in Catalonia and martial law was enforced for a short time.

BARCLAY, SIR THOMAS (1853–), English lawyer, was born in Dunfermline, Scotland, and after studying at the universities of London, Paris and Jena, went to Paris as a correspondent of *The Times* in 1876. He was called to the bar (1881) and in 1882 resigned from *The Times* in order to study French

law practice. From 1900 onwards he was constant in his advocation of cordial Franco-British relations. In 1903 and 1904 he visited the United States and agitated for an Anglo-American treaty of arbitration and conciliation, and in Feb. 1905 visited Berlin, at the invitation of the Associated Chambers of Germany with a view to promoting improved relations with that country. He was elected to Parliament as Liberal member for Blackburn in 1910. Amongst his numerous publications on international law and relations may be mentioned: *Problems of International Practice and Diplomacy* (1907); *International Law and Practice* (1917); *New Methods for Adjustment of International Disputes* (1918); *Le Président Wilson et l'évolution de la politique étrangère des États-Unis* (1918).

BARING-GOULD, SABINE (1834–1924), British novelist (*see* 3.401), published *The Evangelical Revival* (1920) and *Early Reminiscences* (1923). He died at Lew Trenchard, Cornwall, Jan. 2 1924.

BARKER, SIR HERBERT ATKINSON (1869–), British manipulative surgeon, was born in Southport, Lancs., April 21 1869. Educated with a view to following the legal profession, at an early age he showed an aptitude for manipulative surgery and in 1889 was placed under the tutorship of Mr. J. Atkinson. On the latter's death in 1904, Barker took over the practice and in the following years he acquired a wide international reputation. He specialised particularly in the correction of abnormalities of the joints by manipulation, and the cure of derangements of knee cartilages and flat-foot. Although Sir Herbert performed an extraordinarily large number of successful operations, his methods never met with the formal approval of the medical profession, who steadily refused to admit him officially to their ranks. He was knighted, however, in 1922, as the result of a memorial to the Prime Minister signed by several of the most distinguished surgeons of his day. His written works consist principally of articles in various periodicals urging the medical profession to study more closely his own methods of bloodless surgery. *See* MANIPULATIVE SURGERY.

BARKLA, CHARLES GLOVER (1877–), British scientist, was born June 7 1877, the son of John Martin Barkla, secretary of the Atlas Chemical Co., Widnes, Lancashire. He was educated at Liverpool Institute; University College, Liverpool; and Trinity and King's Colleges, Cambridge. In 1902 he became Oliver Lodge fellow of Liverpool University, and demonstrator and assistant lecturer in physics, 1905. In 1907 he was lecturer in advanced electricity, and from 1909–13 Wheatstone professor of physics in the University of London (King's College). He was then appointed professor of natural philosophy at the University of Edinburgh. He became Bakerian lecturer at the Royal Society 1916, and Hughes medallist of the same society in the following year. In 1917 he was awarded the Nobel Prize for physics. He has written numerous papers on electric waves, X-rays, etc., for various scientific journals.

BARLACH, ERNST (1870–), German artist and poet, was born at Wedel, Holstein, on Jan. 2 1870. After distinguishing himself as a sculptor he attracted public notice with his dramatic works, *Der tote Tag* (1912), *Der arme Vetter* (1918), *Die echten Sedemunds* (1920), *Der Findling* (1922) and *Die Sündflut* (1924). He received the Kleist prize for the last named drama in 1924. He illustrated the majority of his pieces with woodcuts. He is an expressionist and his philosophical dramas represent the mythical struggles of mankind with the powers of darkness. Notwithstanding the massiveness of his forms, his drawing and sculpture reflect a delicate and sensitive understanding.

BARNARD, GEORGE GREY (1863–), American sculptor, (*see* 3.410), completed his two great groups of 31 statues for the Pennsylvania Capitol at Harrisburg in 1912. His bronze statue of Lincoln, heroic in size, was unveiled in Lytle Park, Cincinnati, in 1917. This statue aroused considerable public discussion, prominent art critics denouncing it as devoid of any artistic qualities. On the other hand many admirers of Lincoln, including Miss Tarbell, his biographer, and Theodore Roosevelt warmly praised the work, but his son, Mr. Robert T. Lincoln, objected to placing replicas in London and Paris, and the council of the National Academy of Design issued a formal protest. Among Mr. Barnard's more noticeable later works were "Rising Woman," in marble (1918), and "Adam and Eve," marble group (1923), both purchased by J. D. Rockefeller, Jr.; "A Monument to Democracy" (1920), containing 400 figures in plaster; and "Let There Be Light," a bronze statue of heroic size, for Louisville, Ky. (1925).

BARNARD, J. E. (1870–), British physicist, was born in London and achieved considerable success in the science of microscopy. He carried out very valuable work at the National Institute for Medical Research, Hampstead, London, where he was in charge of the department of applied optics, by co-operating with Dr. Gye in the demonstration in 1925 of the existence of the cancer virus. He held in addition the post of lecturer at King's College, London, and was president and honorary secretary of the Royal Microscopical Society, London. He was elected F.R.S. in 1924.

BARNES, ERNEST WILLIAM (1874–), British divine, was born on April 1 1874 and was educated at King Edward's school, Birmingham and at Trinity College, Cambridge, where he had a brilliant career, being bracketed second wrangler in 1896 and elected in 1898 to a fellowship of his college. Ordained deacon in 1902 and priest in 1903, he held various appointments at Trinity College, Cambridge, becoming tutor in 1908. He wrote many valuable papers on mathematics and in 1909 was elected F.R.S. In 1915 he was appointed Master of the Temple and in 1918 Canon of Westminster. He rapidly acquired a reputation as a vigorous and broad-minded preacher and in his sermons discussed either evolution and science, or the more homely aspects of Christianity, with equal candour and individuality. In 1924 on the recommendation of Mr. Ramsay MacDonald, Canon Barnes was appointed Bishop of Birmingham. In this capacity his "advanced" views, and in particular his refusal to sanction the practice of the reservation of the Sacrament which he considered contrary to the spirit of the Prayer Book and likely to foster superstition, led to sharp controversy with the Anglo-Catholic elements of his diocese and attracted wide public notice in England.

BARNETT, JOHN FRANCIS (1837–1916), British composer (*see* 3.414), died in London Nov. 24 1916.

BARNETT, SAMUEL AUGUSTUS (1844–1913), British divine and social reformer (*see* 3.414, died at Hove, Sussex, June 17 1913. See Henrietta Barnett, *Canon Barnett: His Life, Work and Friends* (1918).

BAROTSELAND (*see* 3.424), the southwest division of Northern Rhodesia and a native reserve. Except for the substitution, in 1924, of direct imperial control for that of the Chartered Company no change was made in the political status of Barotseland. Europeans, other than officials, missionaries and traders approved by the paramount chief, are not allowed to settle in the country. The Barotse have shown keen interest in education, and large numbers profess Christianity. Lewanika (*see* 16.519), who had placed Barotseland under British protection, died in 1916, and was succeeded as paramount chief by his eldest son, Litia, who took the name of Yeta III. The chief is aided by a *ngambella* (prime minister) and a *kotla* (council); he has no jurisdiction over Europeans.

See D. W. Stirke, *Barotseland. Eight Years among the Barotse* (1922).

BARRACKS (*see* 3.427).—This article deals only with the building of barracks by the British Govt., as that is the only authority that is continually building them in various parts of the world. Other countries have built large, solid barracks in military centres and these barracks stand for long periods, whereas the British authorities are constantly reorganising and changing, so that new barracks necessarily follow. As regards the United States, the subject is dealt with under the heading TRAINING CAMPS (*q.v.*).

In Great Britain barrack construction has been in the hands of the Royal Engineers since 1918, as it was before 1904. During the intervening period (1904–18) an architectural branch under civil control existed at the War Office to deal with new barracks

and hospitals at home stations, while services of a minor nature at home and all services abroad remained with the Royal Engineers.

Lighter Barracks.—About 1906–7 proposals were made to the Army Council to introduce a lighter form of barrack construction. Previously it had been considered economical to build as solidly as possible, on the ground that the cost of repairs was less than that of a temporary building, while the life of the building was longer. It was pointed out, however, that this was a fallacious argument to apply to buildings which were required for a service that was subject both to frequent changes of policy and to changes of standard imposed by progress in science, and that, moreover, constructional science had reached a point where it was possible to construct buildings which, while suitable to military needs, were less expensive in cost, more rapidly erected, more easily altered, and very little more costly to maintain than the more substantial type hitherto adopted.

Just then an opportunity occurred of making the experiment on a fairly wide scale. An earthquake at Kingston, Jamaica, had destroyed completely the military barracks and all the administrative offices and staff quarters and urgent representations were made for their immediate replacement. Neither labour nor material being available locally, it was decided to build the new barracks with a skeleton steel framework, vertical steel stanchions, braced below by steel horizontal joists, and, above, by a composite steel and wooden truss. The stanchions were bolted to a flat steel plate, set in a concrete block in the ground, and they were calculated to carry the whole weight of floors, walls, roof and other contingent parts, such as windows, doors, shelves, etc. The walls, which carried no weight but were merely screens from the weather, were composed of a double panelling of metal lathing fastened to the steel stanchions and plastered over, the space between the two sets of panels acting as a non-conductor of temperature. The material was prepared in England and erected on arrival in Jamaica by a company of the Royal Engineers. The barracks were quickly erected and proved a great improvement, both in comfort and convenience, over the old ones, while there was a very considerable saving in the cost. Encouraged by the success of the experiment in Jamaica, a similar form of construction was tried in England at Bordon, near Aldershot, where a barrack with some accessory buildings was urgently required for a field company of Royal Engineers.

Figure 1 shows the ground-floor plan of a modern double-storeyed barrack to accommodate two platoons of infantry. The floor above is similar. On each floor are two barrack-rooms, each for 15 men, with an ablution-room and sanitary annex in close proximity and with a room for one N.C.O. between the two barrack-rooms. The walls are built between steel stanchions, of brick 4½ in. thick rendered with ordinary plaster inside and rough-cast outside, the steel stanchions carrying the weight of the roof, floors, etc. The same type of construction has been applied with great success to other buildings.

Hutting during the War.—When the accommodation for the new armies came to be considered in the first few days of the World War, it was decided to adopt a cheap design of hut which could be readily erected, and easily adapted to any form of temporary material and to any reasonably level site. In addition the following points were settled:—

(*a*) Huts to hold one sergeant and 24 men should be constructed giving 48 sq. ft. of floor area per man. (*b*) There should be two principal spans of hut, 20 ft. and 28 ft., and, as far as possible, all the various buildings should be planned to fit one or the other of these. (*c*) There should be a battalion cook-house, with cooking range and boilers for 1,000 men and having on either side of it dining-rooms for 500 men each. Between the cook-house and the dining-rooms there should be sculleries. (*d*) There should be in each battalion a bath-house with a central heating boiler and hot and cold water laid on to the showers, which should be in the proportion of 5 to every 100 men. (*e*) There should be a regimental institute of three rooms, namely supper-room, games-room and corporals' room; the bar and beer cellar to be between the supper-room and corporals' room so that central serving could be arranged. There was also provided a kitchen and scullery in an annex. (*f*) There should be officers' and sergeants' messes planned to accommodate 30 officers and 50 sergeants respectively, and consisting of a mess-room and an ante-room in one block, joined by a short passage with a kitchen block. (*g*) Four drying-rooms, fitted with stoves and bars, should be provided, in which wet clothing could be hung. (*h*) The latrines should be on the dry-earth system and the ablution-rooms and urinals should either lead into soak pits or into sewage filters. (*i*) The lighting should be done by electric lamps.

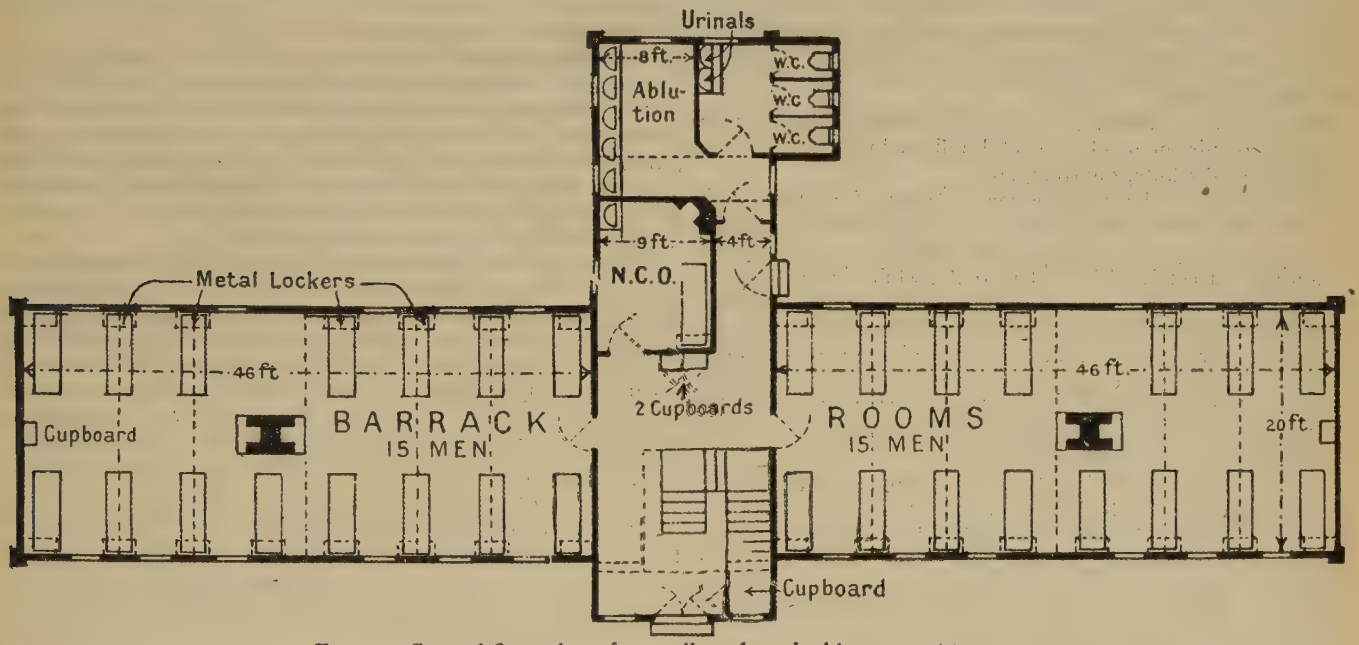

FIG. 1.—Ground floor plan of a small modern double-storeyed barrack.

Considering the urgency of the matter, it would not have been surprising if extensive changes had proved necessary after the camps, so built, came into use. Changes, however, were few, although several details were amended. Thus some of the accessories were afterwards omitted, such as the dining-rooms, on the ground that the men could dine in their sleeping huts if necessary.

As regards material, some of the earlier huts were founded on brick piers. This was a mistake and it would have been better to have had a stout pile of creosoted wood. The brick piers involved bricklayers and bricks and mortar and the provision of these often meant delay. The framework of walls, roofs and floors was mainly red fir of market scantlings. A light steel frame-

work was used in some cases, with expanded metal plastered on one side, and sheet iron painted in the interior of the room, but this was costly compared to timber. For lining, match boarding and 3-ply wood were used. Asbestos sheets were tried at first, but were found very brittle unless the backing of timbers was fairly close, and S.X. boarding and other fibrous matter were also employed but were not found suitable. The floors were, in most cases, of planking.

Hospital Huts.—On the outbreak of war in 1914, the whole question of hospital design came, necessarily, into great prominence and the following types of hospital huts were standardised:

(*a*) A ward hut, 140 ft. long by 20 ft. wide, comprising a 24-bed ward for ordinary cases and a separate small ward for one special case, a nursing sisters' duty-room, a scullery, a linen cupboard, and ablution and bath-rooms; (*b*) a hut, 160 ft. by 28 ft. for the administrative offices, consisting of an out-patient department with a consulting-room, waiting-room and dispensary, the offices of the principal medical officer, his clerks and registrars, the matron's office, a nursing sisters' duty-room, a clinical laboratory, the orderly medical officers' room and the medical board-room; (*c*) an operation hut, 51 ft. by 36 ft., containing the operation-room, X-ray-room, anaesthetic-room, sterilising-rooms, preparation-room, store and photographic developing-room; (*d*) a mortuary hut, 30 ft. by 14 ft. 8 in., containing a post-mortem-room, a body chamber and a viewing-room; and (*e*) a disinfecting hut, into which all foul clothing, bedding, etc., is brought, passed through a disinfector and, after treatment, re-issued.

Other hospital buildings, with certain modifications to meet the varied requirements of a hospital, followed the usual lines for ordinary barrack huts, quarters, etc.

Portable Huts.—There were many types of portable light huts made of wooden framework and canvas, but they were not found satisfactory for prolonged use, affording no better protection against cold and heat than tents, while the edges of the framework caused the parts of the canvas in contact with them to wear rapidly. Portable huts of corrugated steel bent to a circular form, were, however, most useful. Their great advantage was that the materials could be packed up together so as to take up little space; and the one disadvantage was that, at a time when steel was much required for other services, it was difficult to get supplies of these huts in large numbers.

Training Camps.—The first military training camps in the United Kingdom were built respectively at Aldershot, England, and at the Curragh, Ireland, now replaced by the training camp at Catterick, Yorkshire, between 1855 and 1859. When the World War broke out in 1914, a demand arose once more for training centres, and the problem of hutments had again to be dealt with. The types of huts adopted have already been described; it is here proposed to deal very briefly with (*a*) the principles on which sites were selected; (*b*) the system of grouping the typical designs so as to form suitable unit hutments and the grouping together of these unit hutments; (*c*) the accessory services incidental to such groups of hutments.

Selection of Site.—The following principles governed the selection of sites: (1) It was essential that there should be open ground available at all times of the year for manoeuvring and field-works, and suitable positions for rifle ranges, for bombing practice, entrenchments and similar activities; (2) the soil should be, preferably, gravel or chalk; there should be good drainage, and generally healthy surroundings; the water supply should be ample, and either pure or capable of being purified; (3) there must be ample means of communication by rail, or water, or both, and while the site should not be on a main line of railway so as to impede other movements, it should not be far away from existing railways; (4) lastly, from the engineers' point of view, besides traffic facilities, it is desirable that materials should be easily procured, water abundant, labour not unreasonably difficult to obtain and supervise, and, if possible, an established local system of waterworks, drainage works and electrical power in which by agreement the camp might partake.

System of Grouping.—The area required for a hutted camp for an infantry battalion is about 1,100 ft. by 500 ft., out of which the parade ground takes up a space about 430 ft. by 300 feet. Facing one side of the parade ground is the officers' mess with the living huts for officers on either side of it. On the opposite side are the barrack huts, which are grouped on either side of a central line of buildings comprising the sergeants' mess, the shower baths, dining-rooms and cook-house, the drying-room and the regimental institute. Flanking the parade ground are the guard house and offices, the horse shelters, saddle- and harness-rooms and forage stores, the vehicle shed and the mobilisation equipment store. Hutted camps for other units are designed on generally similar lines. In grouping such unit hutments into a divisional camp or cantonment, it is desirable that such buildings as the hospital, post-office, power station, army ordnance store sheds, supply depôt, banks, etc., should be centrally situated. The main training ground should lie on one side of the camp and as near to it as possible.

Accessory Services.—It is only possible here briefly to enumerate the accessory services for a large cantonment. They comprise (1) hospital, (2) roads and railways, (3) water supply, (4) lighting, (5) refuse disposal and sewage. In addition to hutted camps for brigades, divisions, etc., there were similar cantonments for (1) remount depôts, (2) ordnance stores and (3) aerodromes. The broad principles of lay-out and construction are similar. (R. G. P. H.)

BARRAGE: *see* ARTILLERY.

BARRÈS, MAURICE (1862–1923), French writer and politician (*see* 3.434). Maurice Barrès always considered himself a Lorrainer, charged with the interpretation and the vindication of his own people. His schooldays were spent at the Lycée of Nancy, and, immediately after, he made his literary *début* with some ironical pamphlets which successfully displayed his intellectual "dandysme." Renan paid him the compliment of being annoyed by his *Huit jours chez M. Renan* (1888).

He enhanced his reputation by the three volumes of the *Culte du moi*, which appeared from 1888 to 1891. They provoked much ridicule in the Press, but the humour, charm and "prétiosité" with which he developed his theme of the cultivation of the "ego," and thus an harmonious inner life, was hailed with delight by the younger generation. Many of the ideas which permeate his later works may be found in his second work *Un homme libre* (1889), which exercised a considerable influence on his generation. The section dealing with Lorraine was described by Ernest Lavisse as an admirable piece of historical psychology. His third book, *Le jardin de Bérénice* (1891), a novel, showed great delicacy of feeling and subtlety of style, and was inspired by the author's electoral campaign at Nancy as Boulangist candidate. He was only 26 when he was elected to the Chamber, and from that time he led a life divided between literature and politics.

Intelligent, ardent, ambitious, modelling himself now on Benjamin Constant and now on Disraeli, Barrès, during the period between the end of Boulangism and the Dreyfus case, hesitated as to the wisest course to pursue. He stood for one of the Paris divisions as a Socialist patriot, and was defeated. In 1892, he wrote a short novel, *L'ennemi des lois*, the subject of which was anarchy. He travelled in Italy and in Spain. He edited for about six months a paper called *La Cocarde*. Maurras was his colleague in this venture, and together they roughly blocked out the future doctrines of the French Nationalist party.

In 1897, he began the publication of his most important work, *Le roman de l'enérgie nationale*. The generation and *milieu* described are his own. His characters are types rather than living beings, but as a delineation of a period it may be ranked with *Le Rouge et le Noir* and *L'Éducation sentimentale*. The second volume, *L'appel au soldat*, contains a vivid account of the Boulangist movement, and the third, *Leurs figures*, a picture of parliamentary life at the time of the Panama affair, bears comparison with the pages of Saint-Simon.

The Dreyfus case, in which he took an active interest, made him a vehement Nationalist. He now assumed the position of spokesman for Lorraine, and undertook the series entitled *Bastions de l'Est. Au service de l'Allemagne* (1905) describes the year of military service under Germany of a young Alsatian, and *Colette Baudoche* (1909) tells the story of a young girl from Metz. The War brought these books a rather artificial success as propa-

ganda. Meanwhile, Barrès was writing admirable descriptions of travel in France—*Les amitiés françaises* (1903), in Greece—*Le voyage de Sparte* (1906), in Syain—*Greco* (1912). They contain some of his best work, and some of the finest prose in the language.

The War was the apotheosis of his doctrines. He redoubled his activities. His work as a journalist had always been remarkable in quality, it now became remarkable in quantity also. He achieved the feat of writing an article for the *Echo de Paris* every day for four years. These, when they were re-issued in the long series, *L'ame française et la guerre* (1915–9), did not retain their original popularity.

After the War, Barrès carried on his rôle as defender of the French Eastern front by a mediocre work, *Le génie du Rhin* (1921). He returned to pure literature with his novel *Un jardin sur l'Oronte* (1922), which derives its inspiration from his earlier travels in the East. These he described in *Une enquête aux pays du Levant*, which appeared in 1923 on the very day, Dec. 5, of the author's sudden death in Paris from heart failure. He left much unpublished work, the materials for the autobiography, *Mémoires*, on which he was engaged, and a large correspondence, which will probably prove to be one of the most interesting of his generation.

He was, when he died, even more than Anatole France, the most significant figure among contemporary French men of letters. The influence of his political thought had worn itself out, but his literary authority still swayed the younger generation. He had the power to charm. The prejudices, the narrowness and the egotism, with which he had been reproached, gradually disappeared. The qualities of sympathy and reverence always commanded his esteem, and his epic of the countryside, *La colline inspirée* (1913), reveals the springs of his religious life. His old age would have been fruitful, and his death deprived us of recollections which might have rivalled *Les Mémoires d'outre-tombe*. Of all French writers he may best be compared with Chateaubriand. Like Chateaubriand he created but one living figure, himself, but into that figure he breathed the soul of contemporary France, and thereby captured the heart of his generation. (A. Th.)

BARRIE, SIR JAMES MATTHEW (1860–), British novelist and dramatist (*see* 3.435), from 1900 onwards wrote almost exclusively for the theatre. *Peter and Wendy* was published in 1911, and even this was only a kind of pendant or satellite to that shining star of the Christmas theatre, *Peter Pan*. As for the plays written since that time, Sir James became more expert, as he grew older, in keeping the balance between comedy and pathos, and more daring in preaching from the stage a very simple gospel, the gospel that is to be found in his famous rectorial address delivered at St. Andrews University on the subject of Courage.

In that address (1922) he described his business in life as "playing hide and seek with angels," and in most of his later work will be found an underlying appeal to make life, as far as is possible, a game with angels, to become as little children, and to prefer a heavenly failure to a too-worldly success. He was attacked by a newspaper proprietor, at the time of this address, for preaching an "immoral gospel" *virginibus puerisque*, and for popularising a religion of failure; and, indeed, Sir James frankly said in it: "When you reach the evening of your days, you will, I think, see with, I hope, becoming cheerfulness—that we are all failures, at least all the best of us." The theme of the vanity of success recurs, now comically, now mournfully, throughout his later work. It is the dominant theme in *The Will*, a short and sentimental play produced in 1913, where we see the folly of success expounded in terms of commonplace life without the author's usual fantastic elaborations. *The Twelve Pound Look*, which belongs to about the same period, is a more comic treatment of the same theme. The hero, who is described in the stage directions, as "a pleasant rotundity with a thick, red neck" is a successful city man about to be knighted.

Sir James Barrie is, in the general opinion, more infallibly an artist in his comedy than in his pathos, and *The Twelve Pound Look* is, perhaps, the most successful of all his one-act plays. *Pantaloon* and *Rosalind* are two other one-act pieces which are published in the same volume with *The Twelve Pound Look* in the collected edition. They are both plays of mixed comedy and pathos, which take us behind the scenes in the theatre, and show us the puppets escaped out of the limelight into the joys and sorrows of ordinary life—especially perhaps the sorrows. *Rosalind* was written, it is said, for Miss Ellen Terry, and it is a charming dramatisation of the tribute which the author afterwards paid to Miss Terry at St. Andrews: "The loveliest of all young actresses, the dearest of all old ones; it seems only yesterday that all the men of imagination proposed to their beloved in some such frenzied words as these, 'As I can't get Miss Terry, may I have you?'" Another and longer play written during this period was *The Adored One*, which was censured by a number of critics on the ground that it was a joke about murder.

Barrie's War plays are of no permanent importance. *Der Tag*, produced in 1914, is merely a political argument in which, very properly, the Kaiser gets the worst of it. *The New Word*, written about the same time, is a comically moving little piece, about the pride of the elders of a family in the young second lieutenant they have given to the army. *A Kiss for Cinderella* (1916), though in some respects a comedy of the War, does not depend on the War for its chief appeal, but is the fullest expression of the genius of Barrie that playgoers had had since those marvellous years, 1903 and 1904, that produced *Quality Street*, *The Admirable Crichton*, *Little Mary* and *Peter Pan*. *A Kiss for Cinderella* is as sentimental as *Quality Street*, as ingenious as *The Admirable Crichton*, as childishly comical as *Little Mary* and as much a Christmas dream and as popular with infants as *Peter Pan*.

In *A Kiss for Cinderella* we realise how near is the author's genius to that of Hans Andersen, on the one hand, and of Dickens, on the other. Like Hans Andersen he mixes the everyday world with fairyland, and like Dickens he entices us to that borderland of laughter where we suddenly find ourselves in tears. There surely never was a play in which the dramatist played "hide and seek with angels" to better purpose. At one moment we might be reading *The Little Match Girl;* at another we might be behind the curtain at a scene between Dick Swiveller and the Little Marchioness; but there is a special kind of broken-hearted fun that no one from the beginning of the world ever invented before the coming of Sir James Barrie.

In 1917, he produced *Dear Brutus*, a comedy with tragic implications, which takes us into still remoter regions of dreamland than we visit in *A Kiss for Cinderella*. Here, as in others of his plays, we find ourselves wondering whether Sir James Barrie is not, after all, as fundamentally pessimistic as Thomas Hardy. If he takes us into dreamland for an hour, it is to show us the "might-have-beens" of everyday existence, and he leaves us wondering whether everything that happened was not fated, and whether the "black spot" in many of us was not born with us. "What really plays the dickens with us," says Purdie in the play, "is something in ourselves. Something that makes us go on doing the same sort of fool things, however many chances we get."

At the same time, such is the complex nature of men of genius, it would be as absurd to label Sir James Barrie a pessimist as it would be to label him, as some have done, a sentimental optimist. He is in the difficult position of a man who believes that the world can be saved by goodness, but does not see how goodness is possible unless you are born with it—who loves human nature but does not trust human nature to behave as it ought to behave. He sees the world populated by angels and ordinary people, and he is hurt, for all his jokes, that ordinary people should behave like ordinary people. This to him is the enduring doom of life, as we see in *Mary Rose* (1920).

Here, as in *A Kiss for Cinderella* and in *Dear Brutus*, we have an escape into dreamland or into some world of the fourth dimension. In his early work, Sir James had seemed to believe in the final consolation of kindness, but in *Mary Rose* we feel that, though he still believes in the consolation of kindness, he suspects that there is for human beings a tragedy beyond all

consolation, and that the terrible thing in life is not only that people we love must die but that we forget them. "Fanny," says Mary Rose's father, congratulating himself years after her disappearance on the Scottish island, "this should be put on my tombstone, 'In spite of some adversity, he remained a lively old blade to the end.'" There you have at once the Barrie comedy and the Barrie tragedy. And then comes the Barrie half-consolation in the aged mother's reply: "What better encouragement to the young than to be able to tell them that happiness keeps breaking through?" It will be seen from all this that Sir James Barrie's comedy is comedy *de profundis*. Written in 1926, his only play since *Mary Rose* has been his one-act enigma, *Shall We Join the Ladies?* (1922).

Barrie received a baronetcy in 1913, and the Order of Merit was conferred on him in 1922. His address to the students of St. Andrews was followed by one or two other speeches, at Dumfries and elsewhere, which have been full of matter of interest to the biographer as well as of characteristic good counsel and jest and playful, mystifying make-believe. His speeches were reported in the popular Press at a length that suggests that he was a national literary figure with no rival on the same high level of popular admiration but Mr. Kipling. He is at once jester and tender-hearted moralist with a rare kind of genius that cannot but be loved by common men and women. "Stuff in that young man," wrote Stevenson of the early Barrie in a letter to Henry James, "but he must see and not be too funny." Stevenson's fear has proved to be quite unfounded. The funnier Barrie has become, the more serious he has become and the more he has given us of the fundamental emotions of pity and of love.

(R. Ly.)

BARRILI, ANTONIO GIULIO (1836–1908), Italian novelist (*see* 3.436), died Aug. 15 1908.

BARROW-IN-FURNESS (*see* 3.443).—The population (63,770 in 1911) was 74,254 in 1921. The area of the borough is 11,002 ac. of land, with 1,311 of water and 10,385 of foreshore. The shipbuilding yards developed greatly during the War period and war vessels of all types, including dreadnoughts and submarines, were constructed.

The Cavendish dock adjoining the Ramsden dock on the east, 146 ac. in extent, has been leased by the Furness Railway Co. to the firm of Vickers, Ltd., for the construction of airship sheds and for the manoeuvring of airships and dirigibles. The airship factory is situated on Walney I., which is connected with the mainland by a bridge with an opening span of 120 ft. for the passage of vessels. Among the public buildings constructed since 1911 are the town hall with a clock tower 170 ft. high, and a workingmen's club and institute, the gift of a former mayor; a Carnegie library was opened in 1922. The N. Lonsdale Hospital and the Infectious Diseases Hospital have been extended. Further electrical power is now obtained by works on the Leven river at Backbarrow near Lake Windermere for Barrow and other towns.

Vickerstown on Walney I. is a rapidly growing township and is becoming more and more a residential suburb of Barrow. The James Dunn park is on the east, and the Biggar Bank, a public recreation ground facing the Irish Sea, on the west side of the island.

BARRY, ALFRED (1826–1910), English prelate (*see* 3.444), died at Windsor April 1 1910.

BARRYMORE, ETHEL (1879–), American actress, was born Aug. 15 1879 in Philadelphia, and was educated at the convent of Notre Dame in that city. She made her *début* in 1896 in the company of her uncle, John Drew. In 1897 she first appeared in England in *Secret Service*, and with Sir Henry Irving's company in *The Bells* and *Peter the Great* (1898). She was first starred by Charles Frohman in *Captain Jenks* in 1900, and subsequently became one of the leading actresses in the United States, appearing in, amongst other plays, *A Doll's House* (1905), *Alice-sit-by-the-Fire* (1906), *Déclassé* (1922), and *The Second Mrs. Tanqueray* (1924).

Her brother, JOHN BARRYMORE (1882–), who first appeared on the stage in *Magda* in 1903, established his position as one of the foremost American actors. He appeared in *Richard III.* in 1920, and in *Hamlet* in 1923. The latter success he repeated at the Haymarket Theatre, London, in 1925. He also achieved success in motion pictures.

Another brother, LIONEL BARRYMORE (1878–), made his first appearance in 1893 in *The Rivals*, his grandmother, Mrs. John Drew, taking the part of Mrs. Malaprop, and had a successful career on both the stage and the screen.

BARTELS, HANS VON (1856–1913), German painter (*see* 3.447), died at Munich Oct. 5 1913.

BARTHOU, JEAN LOUIS (1862–), French politician, was born at Oloron-Sainte-Marie Aug. 25 1862. He practised as a lawyer in Pau and in 1889 was elected deputy. He became Minister of Public Works in the Cabinet of Charles Dupuy, 1894, in which Poincaré also made his début as Finance Minister. Minister of the Interior in the Méline Cabinet of 1896, he returned to the office of Minister of Public Works in 1906, under Sarrien. Successively Keeper of the Seals and Minister of Justice, he combined in 1913 the duties of Premier and Minister of Public Instruction. He was minister without portfolio in Painlevé's Cabinet during the World War, and Minister of War in that of Briand in 1921. He will be principally remembered as the able representative of France at the Genoa Conference, 1922. Barthou was elected Senator in July 1922, and was president of the Reparations Commission in October of the same year. His principal written works are *L'action syndicale* (1904), *Mirabeau* (1913), *Lamartine orateur* (1916) and *Les amours d'un poète* (1919).

BARTLETT, PAUL WAYLAND (1865–1925), American sculptor (*see* 3.450), gave further evidence of his abilities in a number of statues, the most notable of which were the group in the pediment over the House wing of the Capitol, Washington, D.C., the six statues in front of the New York Public Library, a statue of Benjamin Franklin at Waterbury, Conn., and his "Patriotism" in red granite at Duluth, Minnesota. Most of his life was spent in France, where he was made a commander of the Legion of Honour shortly before his death in Paris on Sept. 20 1925.

BARTÓK, BÉLA (1881–), Hungarian composer and pianist. Born March 25 1881 at Nagyszentmiklós, Transylvania, he began composition at the age of nine and studied first under László Erkel and later at the musical academy, Budapest, under Stephen Thoman and John Koessler. In 1903 his symphonic poem "Kossuth" was performed in Manchester under Hans Richter. The strong national movement prevailing in Hungary at this time influenced his work considerably and resulted in his researches into folk music and traditional melodies. The outbreak of the World War put an end to his travels, and he became, of necessity, reserved and isolated. The post-War generation, however, hailed him with enthusiasm. Among his most notable works are "Bluebeard" (1918) and the pantomime, "The Wonderful Mandarin." He has also written chamber music and numerous works for the piano. In 1906 he became a professor at the musical academy, Budapest.

BARTON, CLARA (1821–1912), American philanthropist (*see* 3.452), died at Glen Echo, Md., April 12 1912. She is the only woman whose name has been taken by a post of the Grand Army of the Republic.

See Mrs. Corra Bacon-Foster, *Clara Barton, Humanitarian* (1918).

BARTON, SIR EDMUND (1849–1920), Australian lawyer and statesman, was born in Sydney Jan. 18 1849. Educated at the grammar school and university there, he was called to the bar in 1871, becoming a Q.C. in 1889. He entered politics in 1879, and was elected to the New South Wales Legislature by the University of Sydney. From 1883 to 1887 he was Speaker of the House of Assembly; and in 1889 he became Attorney-General. In 1896 he had succeeded Sir Henry Parkes (*see* 20.831) as leader of the Federation movement; and in 1900 he led the delegation which presented the Commonwealth Constitution bill to the Parliament in London. The following year he became Australia's first Federal Prime Minister. He held office for two years, when he was made senior puisne judge of the High Court of Australia, being succeeded in the Premiership by Alfred Deakin. Sir Edmund was throughout his career an ardent supporter of

Imperial Preference and an advocate of protection. He died suddenly at Medlow Bath, near Sydney, Jan. 6 1920. Known affectionately as the Father of Australia, he inspired throughout his long career as a politician a deep personal devotion.

BARUCH, BERNARD MANNES (1870–), American financier, was born in Camden, S.C., Aug. 19 1870. He graduated from the College of the City of New York in 1889 and for many years was a member of the New York Stock Exchange. In 1916 he was appointed a member of the advisory committee of the Council of National Defence, and subsequently became chairman of the Committee on Raw Materials, Minerals and Metals, and of the War Industries Board. In 1919 he became a member of the Supreme Economic Council of the Peace Conference in Paris, and in the same year was appointed by President Wilson a member of the Industrial Conference in Washington. He wrote *The Making of the Reparation and Economic Sections of the Treaty* (1920) and articles for this *Encyclopædia*.

BASANAVICIUS, JONAS (1851–), Lithuanian statesman, was born in the province of Suwalki in 1851 and educated at Mariampol. He then proceeded to Moscow University, where he studied philology, history and medicine. His name was particularly associated with the famous journal *Ausra* (Dawn), which he issued in East Prussia and smuggled into Lithuania during the last decades of the 19th century. In 1885, however, he was obliged to leave Germany and for many years practised as a doctor in Bulgaria. In 1905, after the Russian Revolution, he was unanimously elected president of the famous Diet of Vilna. Besides being a national leader and a patriot, he was equally famous as a scholar and issued numerous publications in Bulgaria, America and Lithuania. He was especially interested in Lithuanian folklore and his work *From the Life of Ghosts and Devils* deals with this subject. He has been styled the "Patriarch of the Lithuanian Renaissance." He was the founder and president of the Lithuanian Scientific Association.

BASCOM, JOHN (1827–1911), American educationalist (*see* 3.458), died Oct. 3 1911 at Williamstown, Massachusetts.

BASEBALL (*see* 3.458).—In the period 1910 to 1925 the world series games played annually between the winning teams of each of the two major leagues, the American and the National, remained the most popular sporting contests in the United States. Around the two major, which retained their undisputed supremacy, grew up an elaborate system of minor leagues. These leagues were graded A, B, C and D, roughly according to the population of cities represented. Later the three most prominent of the minor leagues assumed a rating, which gave them some privileges formerly claimed exclusively by the majors.

In 1914 there were no fewer than 52 minor leagues in the complicated structure known as organised baseball. In that year the supremacy of the major leagues was threatened by the formation of the Federal League. This league, backed by sport-loving millionaires, fought tenaciously for two disastrous seasons and then collapsed. Several of its magnates, however, were allowed to purchase major league clubs, while others were partially reimbursed for their heavy losses. In 1920 continued dissatisfaction with the national commission culminated in a new national agreement, and the appointment of Judge K. M. Landis as commissioner of organised baseball with the powers of an absolute dictator. The rules, which are under the supervision of the commissioner and his advisory council, became enormously complicated.

Rules of the Game.—Organised baseball possesses an elaborate system of codified laws. Of these the reserve clause, introduced in 1879, is the most extraordinary and misunderstood. In brief, it allows a club a perpetual equity, subject to certain restrictions, in the services of a player who has contracted to enter its employ. This equity may be retained or sold to another club, with or without the player's consent. The player with a minor league club may thus be drafted, at stated intervals, to clubs of higher classification, on the payment of a fixed fee, or his services may be sold to the highest bidder, or he may be traded for another player.

This rule has been bitterly condemned on the assumption that it violates the established laws of the land which prohibit human slavery. In most cases, however, the players, though chafing under its restriction, recognise its necessity. The corner stone of organised baseball, it guarantees to a club the players whom it has obtained or developed and prevents the larger and wealthier clubs from destroying the balance which must be maintained in a well-organised league. Organised baseball decides internal disputes according to its own laws. An aggrieved player or club may appeal to a league executive and eventually to the commissioner. The latter's decision is final.

Spectators and Publicity.—The enormous growth of baseball as a public institution is best illustrated by the mammoth stadiums of steel and concrete which have been erected in every major league city and in many prominent minor league cities. The largest of these is planned to seat more than 60,000 spectators and represents an investment of several million dollars. The world's series games are often attended by the President and many other prominent officials, and while in progress they engross the attention of the entire nation. Hundreds of writers from all parts of the country visit the games. Every newspaper presents graphic accounts, numberless score boards record the progress of the play, and every event that occurs on the field is instantly broadcast by radio.

Baseball has become an enviable profession. There are major league players who derive from the sport an annual income greater than that of the President, and receive perhaps as much publicity. Increasing public interest has called into being a small army of paid writers. Every prominent newspaper has at least one man on its staff, often several, who devote most of their time to baseball. A literature on the subject has grown up, and many baseball terms are recognised additions to the everyday vocabulary. The records of baseball are carefully preserved and numerous statisticians elaborate these for the press.

The players are only baseball's field army. A far larger army of persons is employed in auxiliary operations. Every league has its trained staff of umpires: men who devote years to the mastery of the game and the quick interpretation of its elaborate rules. Every important club maintains scouts who scour the country in search of possible playing talent. The care of the huge grand stands and playing fields requires experienced ground keepers, ticket sellers and office workers. Large manufacturing industries have developed to supply the enormous amount of equipment: bats, gloves, balls, masks, shinguards, windpads, uniforms, shoes and miscellaneous articles.

Baseball in Other Lands.—Baseball is peculiarly American and is often called the national sport, but it has made decided progress as a world sport. In Canada it is played with much enthusiasm, while it has made strides in Mexico and in the West Indies. It has become popular in Japan, and Japanese college teams tour American cities. The Chinese and Koreans are also interested. Ambitious campaigns have been undertaken to introduce baseball to the whole civilised world. Groups of professional players have several times circled the globe.

To the uninformed observer the game appears to lack the elements of good sportsmanship. But without question it fosters a spirit of good fellowship. Rich and poor meet on an equality, and much of the verbal demonstration is a meaningless escape of pent-up emotion. Baseball's influence in America has been far-reaching and, on the whole, decidedly beneficial. It has fostered a rough but friendly spirit of fair play, developed quick thinking, and stimulated that evolution of athletic sport which is so notable a feature of the 20th century.

Bibliography.—See A. G. Spalding, *America's National Game* (1911); C. H. Claudy, *The Battle of Baseball* (1912); W. J. Clarke and F. T. Dawson, *Baseball* (1915). (F. C. L.)

BASKETBALL has become the national indoor game of the United States. It can be played in almost any space, at any time of the year, though adapted more for winter than for summer. It was invented in 1892 by Dr. James Naismith, at the Y.M.C.A. Training School, Springfield, Mass., in an endeavour to evolve an indoor game that would have the same appeal that baseball, football and other outdoor sports had already attained. Its growth in the United States has been phenomenal; and, although played professionally to some extent, it is essentially

amateur. The rules are formulated by a joint basketball committee comprising representatives of the National Collegiate Athletic Assn., The Young Men's Christian Assn. and the Amateur Athletic Union of the United States. Slightly adapted, it is also played at practically every woman's college and in every high school. Through the Y.M.C.A. it has been introduced into China, Japan, the Philippines and into the Latin-American countries; also into France and England, where it is much played in girls' schools.

It is played on a rectangular surface, the maximum measurements of which should not exceed 94 ft. in length by 50 in width, and may utilise a space as limited as 60 by 35 feet. There are two goals (the original goals were peach baskets, hence the name) consisting of bottomless nets made of twine suspended from metal rings 18 in. in diameter. The latter are fastened to surfaces 6 by 4 ft., made of wood, painted white, called backboards; these are placed at each end of the court. The height of the ring from the floor is 10 feet. The game is played between two teams of five members each, a round leather-covered inflated ball weighing from 20 to 23 oz., and not less than 30 nor more than 32 in. in circumference being used. The object of the players is to throw the ball into their own basket or goal. Time of play is divided into halves of 20 min. each, with a 10 min. intermission between. These periods may be shortened by agreement. The ball must not be kicked, nor hit with the fist, but may be passed or thrown to another of the player's own side. He may not run with the ball, but it may be dribbled, that is, bounced along the ground. Supervision of play by a referee and an umpire is strict, and fouls are called for any infraction of the rules. The penalty for a foul is a free throw for goal from a point 15 ft. from end of court. The successful completion of this throw scores a point. A goal from the field in active play scores two points.

The rules for women's basketball are supervised by a women's basketball committee of the American Physical Education Assn.—although some girls' teams adopt boys' rules. A team may comprise from six to nine players. The size of the court approximates that of the boys' game, but girls' rules call for two zones when teams are composed of six players, and for three zones for a greater number. Certain players are restricted to these zones. Points count two and one, as in the boys' game.

BIBLIOGRAPHY.—W. E. Meanwell, *The Science of Basketball* (1924); F. C. Allen, *My Basketball Bible* (1924); E. J. Mather and E. D. Mitchell, *Basketball* (1925). See also Helen Frost and C. D. Wardlaw, *Basketball and Indoor Baseball for Women* (1920) and Spalding's *Official Basketball Guides* (men's and women's).

BASLE (*see* 3.462) had a population in 1926 of 135,976. It is a great railway and distributing centre with large electric, metal, and chemical works and a ribbon-making industry. The old town is unspoilt, and its industries are carried on in the rapidly extending suburbs. The Kunsthaus, an unpretentious building in the Heimplatz, was opened in 1910 with exhibitions of pictures, sculpture, etc., and a library, and an interesting example of a nobleman's house close by, the Landolthaus, was arranged as an annex and museum in 1919. The Frau Münster Kirche, near the bridge of the same name, was restored and modernised in 1912, and offices for the *National Zeitung*, with painted façades, were built in the Market Place in 1915. The Baden railway station, one of the largest in Europe, was finished in 1922. A building for the Pestalozzium, which contains an educational exhibition and Pestalozzi's study, has been erected near the Urania bridge.

BASRA (*see* 3.489) has a population estimated at about 50,000. During the World War the port equipment was modernised by the inland water transport branch of the British Royal Engineers, and in 1925 there were 4,000 ft. of wharfage served by railway lines, shipbuilding yards, barge and coal depots, warehouses, etc. The port lies some 75 m. up the Shatt el'Arab, which is deep all the way, but in 1924 only vessels of less than 19 ft. draught could cross the Fao bar. In 1922 the 'Iraq Govt. took over the control of the port from the British Govt. pending transfer to a port trust. In 1924 an agreement was executed with the Anglo-Persian Oil Co. for the dredging of the bar at Fao; the company was to advance the money required and the 'Iraq Govt. undertook, through its port authority, to carry out the work, which was begun in the same year. Considerable progress was effected during the period 1922 to 1925 in the administration of the port.

During the World War Basra was connected by railway with 'Amara on the Tigris, but the lines were afterwards taken up and a line constructed alongside the Euphrates, and connecting the port with Baghdad. In 1922 an automatic telephone system was brought into operation, and in 1923 a wireless station, which is in regular communication with Cairo and Beirut, and accepts traffic for England and Germany, was opened. A short railway line to the Baghdad Gate, under two miles in length, was completed in Jan. 1923. (*See* MESOPOTAMIA, OPERATIONS IN.)

BASTIAN, ADOLF (1826–1905), German ethnologist (*see* 3.500), died Feb. 3 1905.

BASUTOLAND (*see* 3.503), a British territory in South Africa. The increase in population to 498,781 in 1921 and then to about 540,000 in 1925 led to the cultivation of areas, *e.g.*, the Maluti Mts., formerly used only as grazing grounds. Between 60,000 and 80,000 Basuto find employment outside the country, chiefly in the Transvaal mines.

Agriculture and stock-raising are the main occupations. Wool, mohair, wheat, and maize are the chief exports. The value of exports rose from £193,000 in 1908 to £958,000 in 1924. Imports rose from £239,000 in 1908 to £942,000 in 1924. The revenue, £108,000 in 1908–9, was £252,000 in 1923–4; the expenditure, £241,000 in 1923–4, in some years exceeded the revenue, but Basutoland is self-supporting. The accumulated surplus between 1908 and 1921 totalled £159,000, which sum was spent on public works. About 50% of the revenue is derived from a poll tax on adult males, which in 1911 was substituted for a hut tax. A Basuto (properly Masuto) with more than one wife paid additional taxes for the second and third wife, but nothing for wives in excess of three. Fully a fourth of the Basuto (incorrectly Basutos) profess Christianity. Education is mainly in the hands of missionary societies.

Government.—Basutoland is under the control of the British Colonial Office. Ownership of land by Europeans is forbidden, and the Basuto, a virile race of mountaineers, strongly opposed incorporation in the Union of South Africa. Their desire to remain under direct Imperial control was repeatedly expressed, as in 1921 to Prince Arthur of Connaught, then High Commissioner for South Africa, and in 1925 on the occasion of the visit of the Prince of Wales. The system of government which, under a resident commissioner, allows a measure of home rule to the Basuto continues to work well. The *pitso* or national council meets yearly, 95 out of its 100 members being nominated by the chiefs and the other five by the administration. It has advisory powers only, but its advice is often taken. Sir H. C. Sloley, who had been resident commissioner since 1901, was in Dec. 1917 succeeded by Sir E. C. F. Garraway. Letsie II., who had been paramount chief since 1905, died in Jan. 1913 and was succeeded by his brother Griffith. When the World War began Griffith and his people offered to raise regiments for combatant service. The offer was declined, but 1,400 Basuto served with the South African native contingent in France, and many were employed in Southwest and East Africa.

Maseru, the capital, population (1921) 399 Europeans and 1,890 natives, is the largest town. A branch line connecting Maseru with the South African Railway system runs for one mile in Basutoland, and is the only railway in the territory. Some four miles from Maseru is a leper settlement established in 1912.

Annual reports on the Basutoland are published by the Colonial Office, London. See also *The Official Year Book of the Union of South Africa, 1910–24* (Pretoria, 1925). (F. R. C.)

BATAILLE, HENRI (1872–1922), French dramatist, was born April 4 1872 at Nîmes. In early youth he thought of becoming a painter and, in 1890, entered the École des Beaux Arts. His first venture into dramatic work, *La belle au bois dormant* given at the Théâtre de l'Oeuvre in 1894, was a failure; but his reputation was definitely established by a book of verse *La chambre blanche* (1895), and when his Breton drama *La lépreuse* was produced in 1896, he stood revealed as a dramatist of real promise. From that time onwards he developed his gift for writing plays in which passion is shown to sway men's lives more than their beliefs, until he reached maturity with *Maman Colibri* (1904), *La marche nuptiale* (1905) and *Poliche* (1907). Among his other works are *La femme nue* (1908), *La*

vierge folle (1910), *La divine tragédie*, a book of war poems (1916) and *La chair humaine* (1922). He died March 2 1922 at Rueil, near Paris.

BATEMAN, KATE (1842–1917), American actress, daughter of Hezekiah Linthicum Bateman (*see* 3.508), conducted after 1892 a school of acting, appearing rarely on the stage. Her last appearance was as Kirjipa in *False Gods* at His Majesty's Theatre, London, in 1909. She died in London April 8 1917.

BATESON, WILLIAM (1861–1926), British biologist, was born at Whitby Aug. 8 1861. He was educated at Rugby and St. John's College, Cambridge, and became known for his biological investigations, which included important researches on Mendelism and the determination of sex. In 1894 he published *Materials for the Study of Variation*. In 1907 he gave the Silliman lectures at Yale University, from 1908 to 1909 was professor of biology at Cambridge, and in 1910 was appointed director of the John Innes Horticultural Institution at Merton Park, Surrey. From 1912 to 1914 he was Fullerian professor of physiology at the Royal Institution, and in 1914 was president of the British Association. He received the Darwin Medal of the Royal Society, of which he was a fellow and a Royal Medallist, in 1904, and was also the recipient of other British and foreign awards. His works include *Mendel's Principles of Heredity* (1902) and *Problems of Genetics* (1913), besides many short studies on biological subjects. He died at Merton, Surrey, Eng., Feb. 8 1926.

BATTLESHIP.—The subject of the principles of design of battleships was dealt with fully in the article SHIP (24.891), and probable changes were suggested. Since that article was written the authorities responsible for the defense of their respective countries have not thought it wise to introduce any serious variation from the line of progress then suggested. But everywhere a certain element of public opinion seems to distrust the judgment of responsible authority, and to fear that the new developments in aviation and in submarine service have rendered the accepted type of battleship obsolete.

Moreover, treaties for the limitation of armaments and in regard to the supply of munitions of war have projected the maintenance of navies beyond the limits of strictly domestic affairs. Henceforward, while the treaties run, the design and effectiveness of battleships are an international political matter. This article will offer an explanation of why responsible admiralties were not swerved from their course by the charges of undue conservatism founded on their adherence to the old type of battleship with only moderate changes.

Control of Sea Traffic.—The sea is the great highway of international traffic. Navies have existed and still exist only to protect their seaborne commerce in favour of their own national life and of their military forces overseas, and to use their power in detriment to the traffic of the hostile belligerent. They fight with this purpose as their final objective. A victory at sea is valueless which has no reaction on seaborne traffic.

With the growing specialisation of interrelated industries in far-distant regions, the control of ocean traffic in warfare is becoming more and more important, because national support to combatant forces is more and more dependent on supplies and raw materials drawn across the sea. War on property in transit on the sea is likely to assume even greater importance than it did in the World War.

With the domination of sea communications as the ultimate naval objective of either or both belligerents, shipping used for strictly combatant service hitherto always fell into three broad classes: (*a*) Supply craft for the fleet and overseas armies, for men must eat and arm before they can struggle; (*b*) types of reconnaissance craft depending on high speed for scouting, screening and information, because knowledge is a prerequisite for profitable employment of fighting strength; (*c*) heavy fighting craft whose duty is to beat down opposition after being supplied with munitions and with knowledge by the other two classes.

In all times, this last type, built to give and take the heaviest punishment possible under the general situation of the arts and science of the period, has been the battleship of the day. The battleship is by no means invulnerable; what the hand of man has made it can also destroy. Destruction may take place by administrative failure of duty, by traitorous sabotage, by battle with similar opponents and by attacks coming from the air and from beneath the surface of the sea. Like other combatants, the battleship will survive a battle only by her own hard fighting.

Granting that the control of surface-borne ocean traffic is, and will in the future be, the purpose of all warfare upon the seas, as it has been in the past, we are now asking ourselves where future predominance of type for naval warfare lies. Has the ultimate means of control passed away from the surface of the sea into the air or beneath the sea?

Surface ships of every type have one great advantage over the aeroplane and the submarine. The surface ship floats on the water with a reserve of buoyancy so great that very considerable injury to her structure is necessary to sink her. On the contrary, aeroplanes in the air, and submarines when under the water, have no reserve of buoyancy, and both must seek the surface as soon as injured, and there both are much handicapped. Yet their work, like the work of other combatant craft, is ultimately against surface craft.

Functions of War Vessels.—Combatant surface craft have always been divided into two broad classes, those whose chief military characteristic is fighting strength gained at some expense to mobility, and those whose distinction is speed and mobility gained somewhat at the expense of fighting strength but not altogether excluding it. The speed ships are primarily for scouting, screening and securing information, as well as to attack and defend commerce. The strength ships are to overcome the strongest opposition; yet need the support of the speed ships to guide and aid them in fleet battle. After successful fleet action, the speed ships may disperse to control commerce. But successful fleet battle is the result of co-ordinated effort of all types, and the speed ships, although comparatively weak in combatant strength, have yet a form of battle superiority over the strength ships. This rests on the tactical advantage of surprise which exists on shore as well as afloat. To meet a surprise time is the essential condition.

The Time Element.—Speed and superior mobility as combatant factors bring in the time element. Even if the attack is a weak one only, it may be driven home before the defence wakes up to utilise his strength, and the speedy assailant makes off before the stronger defendant can organise his counter-attack and pursue. This is as true of a cavalry attack as of a torpedo boat attack. The tactical answer to speed now as always is to oppose it by a counter-attack and pursuit no less speedy.

This time element also causes the success of the new weapons of every kind. The enemy does not know how to meet the novelty. When he learns how to do so, the novelty loses much of its effectiveness, for the parry is known. Such was the situation in the World War. Neither side was ready to meet the first hostile use of submarines, tanks, gas warfare and aviation. Now all are less important than they were because the novelty has disappeared. Methods of defence are known and are still developing. Public opinion lags and does not take note of the vital importance of this fact.

An Element of Surprise.—The considerations here summarised lead to the comprehension of a well-balanced fleet as one in which the commander-in-chief has the element of surprise available to him in two different forms. The first form lies in the use of the initiative through a tactical choice of weapons, as for instance the enemy forms for gun action but meets a torpedo attack under a smoke screen. The other form is, through superior mobility, to choose the time and place of attack and to break off action at pleasure, without fear of pursuit.

A wise combination of the activities of the two classes of surface ships—the strength ship and the speed ship—properly proportioned as to numbers, has hitherto constituted a well-balanced fleet. But now the proper balance is altered by the introduction of submarines and aircraft. In time of peace, as novelties, these necessarily excite relatively more public interest than they deserve in comparison with older types. The use of submarines by the Germans to the imperilment of the Allied

cause has the romance of crime about it, and that of aircraft has the romance of high adventure; but in any other war they will both be used according to the measure of their serviceability and will lose much of their romantic interest.

Submarines.—Compared with other classes of ships the submarine is weak except for her distinguishing characteristic of submergibility. Thereby she can lie in ambush and surprise the enemy, but she cannot escape surface craft by mobility; she can only hide. If detected she is lost. The reply to the submarine is found in high speed surface craft seeking the submarine by listening devices and then destroying her. The submarine will always be embarrassing to a surface navy, but not necessarily dominant over it. A surface navy with a well-balanced adjustment of types is perfectly competent to deal with the submarine arm. But with a given aggregate strength of the fleet, the proper balance of types to meet a navy using submarines is different from that required to meet an opponent without them.

Aircraft.—As for aircraft, they are not weapons but vehicles; they derive their importance from their ability to rise into the air and so to avoid obstacles; and also, under favourable conditions, altitude may increase their range of vision. Perhaps more of their value comes from the fact that they are the fastest vehicles known. By such mobility they confer upon their riders the choice of time and place of surprise attack. They can be brought under fully effective counter-attack only by equally speedy opponents; that is, by an opposing air force. The chief use of aircraft is where mobility is most important, in scouting, screening and observation information service. In combatant efficiency the aeroplane does not stand high: its defensive structure is weak, and it can deliver an attack effective only through its high speed, which enables it to strike its blow before its own destruction. But the aircraft loaded with weapons (*i.e.*, bombs) moves slowly among its fellows, and is vulnerable to faster aircraft.

As in the case of submarines, here also a well-balanced surface fleet will be one prepared to overcome aircraft. But whereas the slow-moving submarine menace is countered by fast surface submarine chasers, the menace of heavy bombing and torpedo aircraft must be met by more speedy opponents, which in this case can only be faster aircraft. The answer of a surface navy to aircraft attack is to have aircraft of its own in sufficient numbers, just as it must have enough torpedo boats and enough cruisers and other types to make resistance effective against surface enemies.

With regard to further development of aircraft as substitutes for other types of shipping, the responsible heads of all navies are against it. Although useful, aircraft did not decide the World War, and nothing since has shown they will decide any future one. The advocates of greater aeroplane development and reorganisation assert that the air service will replace other types and inherit the future, but since the War they have no new facts or arguments to adduce in support of their assertions. With aircraft opposed to aircraft as one of the elements in the fleet, victory will fall to the best all-round fleet; a few aeroplanes in excess will mean no more than a few more guns. or any other minor difference in material.

Limitation of Armaments.—The final question concerning the future of battleships regards treaty limitations as they affect armaments and the laws of war. The ostensible reasons put forward for such treaties are humanitarian and the reduction of expense. The public supports such treaties in the hope, scarcely a belief, that they tend to prevent wars. But an analysis of the minutes of the assemblies at which such treaties have been concluded shows that, from the first Hague Conference to the most recent, the delegates ever seek to establish their countries in time of peace in situations of strategic advantage for war. Limitation on exportation of arms throws each non-manufacturing nation as a client upon some manufacturing power, and a large manufacturing capacity in readiness to turn out war supplies permits a nation so situated to contemplate international agreements as to formal reductions in armaments or as to limitations upon the export of munitions with more equanimity than another.

The Washington Conference (*q.v.*) of 1922 did away with the threat to British naval supremacy of the growing American battleship fleet, and Britain accepted equality in future battleship and aircraft carrier strength as satisfactory to her, with a limitation on tonnage; but agreement as to limitations of strength in other types could not be reached, although the size and armament of individual battleships and cruisers were fixed.

Proposals to abolish submarines could not be put through, because on this point there was sharp divergence between France and England. For generations England has had the dominant navy, and in consequence has always been conservative. She wants no change; for successful novelties challenge her position. The submarine is the weapon of weaker powers, and if France accepted its abolition her diplomatic weight in a dispute with England might be reduced. On the other hand, the abolition of submarines would confer a measure of diplomatic and belligerent freedom upon Great Britain by freeing her shipping from a serious menace. The humanitarian point of view most affects the public; but admiralties may not take this as an exclusive guide, for it is their duty to be more far-seeing than the public.

As for aircraft, the situation is not altogether the same. Their production belongs to the manufacturing nations, and consequently their necessity in war aids the four great manufacturing Powers to dictate world policies if they can agree upon such. When such an air agreement is lacking, and war threatens, it has not yet been made apparent that war from the air favours one of the four great manufacturing Powers more than another; yet it is a serviceable auxiliary to all. So no Power objects to aerial warfare on national strategic grounds.

As for further treaty limitations:—

(*a*) If limitation or abolishment of present type battleships takes place predominance will tend to pass to modifications of the present authorised 10,000-ton cruisers, which will then embody the age-long idea of the type of ship capable of the greatest endurance against all forms of hostile attack combined with maximum striking power when supported by suitable auxiliary types of combatant craft.

(*b*) Should limitation be placed on the total of all classes of combatant shipping, sea-power and the consequent ability to dominate world commerce in the national interest will tend to pass to the nation possessing the greatest combined combatant and merchant fleet, and a certain proportion of merchant ships would no doubt be fitted for ready conversion to combatant use in war.

(*c*) Should a treaty provide for ratios in each type of shipping, the result would be to favour strategically some one nation whose standard is adopted for distribution of tonnage among types. For any navy whose types are well balanced has made an adjustment between them suitable to her own political and geographical situation, but best suited to herself only. And if other nations accept it they have incurred strategic waste of pre-War effort in order to sign a treaty. The only sound limitation on armaments is one proceeding from voluntary action of nations because they see no occasion for aggression by themselves and feel they offer nothing tempting to aggression by others. That day is distant. Until then battleships of some sort embodying the strength characteristic as discussed above will remain the ultimate reliance of navies.

Under current treaty limitations, it may be assumed without information as to details of design that the British "Nelson" and "Rodney" are such ships. It is probable that they differ not greatly in total power from the Japanese "Mutsu" and the American "Colorado," improvements probably lying along battery arrangements, better compartmentation under water, greater deck protection, perhaps a little more speed and other minor differences at the discretion of the designer, but about which it is impossible to guess.

These ships of three Great Powers are the answer of their responsible admiralties to unsupported assertions that the day of the battleship has passed.

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(W. L. R.)

BAUDRILLART, HENRI MARIE ALFRED (1859–), French ecclesiastic, was born in Paris Jan. 6 1859, the son of Henri Baudrillart. He was educated at the Lycée Louis-le-Grand, the École Bossuet, and the École Normale Supérieure, taking degrees in history, law, literature and theology. He became a priest in 1893, and next occupied the chair of history at the

Catholic Institute of Paris, of which he became rector in 1907. The following year he became vicar-general of Paris, and in 1915 founded the Catholic committee of French propaganda abroad. In 1918 he was made a member of the Académie française, and in 1921 was consecrated titular Bishop of Himeria. In Nov. 1925 he was made a papal count and bishop assistant at the pontifical throne.

Baudrillart's works include: *La politique de Henri IV en Allemagne* (1885); *Philippe V. et la cour de France* (1889–99), (Grand Prix Gobert); *L'église catholique; La renaissance et le protestantisme* (1905); *Quatre cents ans de Concordat* (1905); *La vie catholique dans la France contemporaine* (1918), etc.

BAUER, GUSTAV (1870–), German politician, was born at Darkehmen, East Prussia, Jan. 6 1870. He became connected at an early age with the German trade-union movement, and in 1908 was elected president of the general committee of the trade unions of Germany. In 1912 he entered the Reichstag as a Social Democrat, being appointed in Oct. 1918 Secretary of State for Labour in the Govt. of Prince Max of Baden. Appointed Minister of Labour under the Republic in Feb. 1919, on June 21 of the same year he became president of the Ministry formed to accept the Peace Treaty of Versailles, resuming shortly afterwards the former title of Chancellor. After the Kapp *Putsch* in March 1920, he fled with Ebert, the President of the Reich, to Dresden and later to Stuttgart. On his return he became Minister of the Treasury in Hermann Müller's Cabinet and shortly afterwards Minister of Commerce. From May 1921 until Nov. 1923 he held, conjointly, the offices of Vice-Chancellor and Minister of the Treasury in Wirth's Cabinet.

BAUER, OTTO (1881–), Austrian politician, was born at Vienna. Bauer was one of the founders of the Socialist Educational Movement, "Die Zukunft." He founded with F. Adler, the theoretical Socialist periodical *Der Kampf* and collaborated on Kautsky's journal *Die Neue Zeit*. He became secretary to the Parliamentary Fraction of the Social Democrat party in 1904 and at once proved himself the party's most brilliant theoretician. His first work *Die Nationalitätenfrage und die oesterreichische Sozialdemokratie*, treated the problem of nationality in the Dual Monarchy with deep historical insight and on lines entirely borne out by later developments. As a prisoner of war in Russia he studied Bolshevism at first hand, and on his return to Austria in 1917 became leader of the left wing of his party, which worked for a republic and self-determination for all nationalities. He was appointed under-secretary of state for foreign affairs by Victor Adler and became minister a few days later, on the latter's death (Nov. 12 1918). He retained this post under the Austrian Republic until July 1919. After 1918 it was Bauer's brain which really guided the international and internal policy of his party which he preserved as a non-Bolshevist but advanced Socialist organisation. He launched the few Socialist experiments in Austria (see his pamphlet, *Der Weg zum Sozialismus*, Vienna, 1920) and the Socialist agrarian policy (*Der Kampf um Wald und Weide*, Vienna, 1925; *Das Agrarprogramm der oesterr. S. D. Partei*, Vienna, 1926).

He wrote an important account of his own and his party's activities, *Die oesterreichische Revolution* (Vienna, 1923; English translation, London, 1925). His other chief works are *Bolshevismus oder Sozialdemokratie* (Vienna, 1920); *Der neue Kurs in Sovietrussland* (Vienna, 1921); *Das Weltbild des Kapitalismus* (in *Der lebendige Marxismus*, Jena, 1925).

BAUXITE: *see* ALUMINIUM.

BAVARIA (*see* 3.543), a territory and Free State of Germany, with which Coburg has been united since 1920. Its area, is 29,506 sq. m.; and the population (1925), 7,493,000.

Political History, 1910–8.—The prince regent Luitpold died on Dec. 12 1912. During the last years of his reign the Catholic-Clerical party, which was thenceforward to determine Bavaria's policy (the Bavarian People's Party or Volkspartei, is the new name of this party), had come into power after prolonged political struggles. When Podewil's Ministry, which had been in opposition to the Landtag, and finally dissolved it, was defeated in the elections of Feb. 1912, the prince regent instructed Baron von Hertling, a member of the Centre party in the Reichstag, to form a Ministry. He formed a Cabinet of officials, except for two posts, which he gave to members of his party.

The Ministry decided in Sept. 1913 to confer the royal dignity upon Luitpold's successor, Ludwig III., by making the necessary change in the constitution, but was immediately plunged into sharp conflict by the introduction of the bill for increasing the civil list. The World War brought a truce to party politics, but this was subjected to a heavy strain during the last year of the struggle, when the discontent of the population gradually assumed alarming proportions. Von Hertling became Chancellor of the Reich in Nov. 1917, and was succeeded as Minister-President by Von Dandl, who, in Nov. 1918, found himself confronted with the revolution.

The Revolution.—On the night of Nov. 7–8, before the fall of the Imperial Govt. in Berlin, the revolution broke out in Munich. The Wittelsbach dynasty was deposed, and Kurt Eisner, the Independent Socialist, placed himself at the head of the Revolutionary Government. He at once endeavoured to establish the new republic on a statutory basis by issuing an order for the re-election of the Diet, whose duty it would be to determine the new constitution. A provisional constitution of the Socialist Republic of Bavaria was set up in the interim by the Government. The Diet was to meet on Feb. 21 1919, but on that very day Eisner was shot dead. The result was the outbreak, on April 4, of a new revolution, inspired by the Bolsheviks. In Munich, the Councils Republic (*Räte-Republik*) was proclaimed, but its reign came to an end on May 1, amidst fierce fighting. Once more the Diet was assembled, and on May 5 1919 Hoffmann, the minister-president, laid before it the Government's scheme for the new constitution.

The New Constitution.—The new constitution, which came into being on Aug. 14 1919, was based on the assumption that Bavaria was still a sovereign state, although the Reich had laid claim to many of its former rights. Foreign policy, the army and railways became the concern of the Reich. Bavaria's economic policy also became severely restricted, as the financial legislation of the Reich had requisitioned her principal sources of income. The form of the state is prescribed by the Reich. Bavaria, like the Reich, is a democratic republic with parliamentary government; but it is a state without a president, and thus lacks the organ required to maintain the balance of power against Parliament. The controlling element is the Diet, which has no superior authority except that of the people, which elects its members and can dissolve it by a "popular demand" (*Volksbegehren*), and is also empowered to administer the laws directly by means of a referendum (*Volksentscheidung*).

The Diet is elected, like the Reichstag, by universal suffrage and secret ballot, based on the system of proportional representation. It consists of a single Chamber. There is no Upper House. A minister-president is appointed by the Diet, and the other ministers are selected by him by agreement with the Diet. Ministers and secretaries of state are responsible to the Diet for their administration. The Ministry as a whole, or any single member of it, may be forced to resign by a vote of non-confidence. The Diet is the legislative, its ministers are the executive authority. The necessary ordinances are issued by the Ministry as a whole, but the responsibility for administration rests upon individual ministers. Although the minister-president presides over the whole Ministry he has not the standing of a prime minister.

Direct legislation by the people, by popular vote, may occur in two cases: (1) when the Diet rejects a "popular demand" for the enactment of a law or accepts it only in an amended form, and (2) when the Diet has passed a law from which, within two months, an appeal is made by "popular demand" or a referendum called for by the whole of the Ministry. In so far as the people are able to legislate directly, Bavaria is, like the Reich, a direct democracy, but for the rest her constitution is based upon a system of representative democracy.

Political History under the New Constitution.—The policy of Bavaria since 1919 has been governed by (1) the risk of a conflict with the Reich and (2) the risk of a counter-revolution by Nationalist and Monarchist organisations. Relations with the

Reich were impaired by the view, held by the dominating parties in Bavaria, that the Weimar constitution involved excessive centralisation and uniformity. Bavaria therefore demanded greater independence for the individual states, and wished, not only to restore but to develop still further the Federal system of the old constitution of the Reich. On the question of the particular rights to be retained by Bavaria there were constant battles between the two Governments.

The rise of the Nationalist organisations was due, on the one hand, to a reaction after the temporary rule of Bolshevism in Munich, and, on the other, to the execution of the Versailles Treaty by the Entente. Events, such as the attempted counter-revolution in Berlin, the so-called "Kapp Putsch" (March 1920) could not fail to make their impression on Bavaria, especially as many of the participants found asylum there. Hoffmann's Socialist Ministry was forced to resign, and Kahr's bourgeois (non-Socialist) Cabinet took its place. On June 6 the bourgeois parties obtained a two-thirds majority in the elections, and the "law-and-order party" ("*Ordnungsblock*") began its rule. Herr Escherich founded the *Einwohnerwehr*, or "Orgesch" (Organisation Escherich), a voluntary militia, for protection against possible repetitions of a Bolshevik revolution. This organisation was, however, dissolved by order of the Entente Commission, and Von Kahr resigned in consequence on Sept. 12 1921. His successor, Count Lerchenfeld, had an equally good majority but was also obliged to go out of office in the following year on account of a conflict with the Reich Govt. (Oct. 27 1922). Von Knilling's new Ministry leaned still more to the Right and the Democrats left the Government.

Meanwhile, the Nationalist leagues had gained in strength and now began to defy the Government's orders. The most powerful of them were the National Socialists, an extreme militarist, nationalist and, above all, anti-semite body, nominally democratic in tendency, but actually largely used by the rich to break strikes and attack Socialism. This body was raised from obscurity by one Hitler, a good demagogue but no politician, and it wavered between Bavarian separatism and pan-Germanism in a bewildering fashion. It became dangerous in the autumn of 1923, when Ludendorff joined it and gave it the backing of all the secret military leagues which called him leader. But it aroused opposition in Bavaria by setting itself against a restoration of the Wittelsbach dynasty and against the Catholic Church. Herr von Kahr was appointed general state commissioner with full dictatorial powers.

On Nov. 8 1923 the counter-revolution broke out in Munich. It was suppressed with bloodshed, the Reich defence force having remained loyal to the constitution, and Hitler and other leaders were sent to prison or lunatic asylums. Von Kahr's task was now at an end, and on Feb. 18 1924 he retired. The elections for the Diet gave no party a majority; a coalition Ministry was therefore once more formed, consisting of the Bavarian People's party, the German Nationals and the Farmers' League (*Bauernbund*). Held, the leader of the Bavarian People's party, placed himself at the head. This Ministry offered a firm front to the National-Socialist party and strove to reach a settlement with the Reich Government. In the antisocialist and Federal tendency of its policy, it nevertheless follows in the track of its predecessors. The Monarchist (Wittelsbach) movement is still very strong (*see* GERMANY). (W. v. B.)

BEATTY, DAVID BEATTY, 1ST EARL (1871–), British admiral, was born Jan. 17 1871, the second son of Capt. David Longfield Beatty, of Co. Wexford, Ireland. In 1884 he entered the training ship, "Britannia," as a naval cadet. From 1896–8 he was with the Naval Brigade in Egypt and the Sudan, and later went to China to assist in the suppression of the Boxer rebellion in 1900. His conduct during these campaigns attracted much attention and explains why he reached the rank of captain before he was 30. He owed nothing to the purely civilian virtues of proficiency in examinations and technical efficiency. His mind was unhampered by non-military preoccupations and traditions, his predominating idea being that the purpose of war was a triumphant peace. He thus commended himself to Winston Churchill, who in 1911 was First Lord of the Admiralty. Beatty served two years at Whitehall as Churchill's secretary, a consultative and not an administrative post. In 1913 he was appointed to command the Battle Cruiser Squadron.

All doubts as to the wisdom of selecting an inexperienced junior for the leadership of a formidable proportion of Britain's naval forces were dissipated before a month of the World War had passed. In a raid into the Heligoland Bight in Aug. 1914, Beatty took his squadrons well within the range at which the German battle-fleet might have been expected to strike, a challenge the enemy did not take, and sank three cruisers and one destroyer without loss. A few months afterwards he intercepted the German ships under Von Hipper in his third attempt on the English coast towns. The Battle Cruiser Fleet was unfortunately reduced in numbers, and early in the engagement, the flagship "Lion" was disabled. Beatty's last signal, to pursue the enemy's capital ships and engage them more closely was regrettably misunderstood, with the result that the action was broken off and the German cruiser, "Blucher," alone was sunk. These two experiences of action bore fruit on May 30 1916 in the battle of Jutland (*q.v.*).

The debate over the German admiral's bold and skilful evasion of the traps set for him, the inability of the Grand Fleet, in conditions of acknowledged difficulty, either to bring and keep the enemy under effective fire till his business was done by daylight, or, on the morning of June 1, to intercept and destroy him in his headlong flight from the battle-field, when crippled and dispirited, does not involve Beatty's share in the action, and the commander-in-chief's despatch of June 15 1916 records a tribute unbesmirched by controversy.

Nevertheless, in the first grief and disappointment that followed on the news that the Germans had escaped, while "Indefatigable," "Queen Mary" and "Invincible" and other ships had been sunk with lamentable loss of life, Beatty did not escape censure. He was blamed for the "rash and impetuous" tactics that had been both costly and fruitless. Later, when it was known that the loss of the lightly armoured capital ships was not caused by exposure to overwhelming fire, but by their magazines being open to the blast of chance shells bursting in the turrets 50 ft. above them, opinion swung to the other extreme, and Beatty, who, like Nelson, missed no opportunity when attack was possible, became a national hero, the personification of aggressive and tenacious daring. If the censure was unmerited, the canonisation was for inadequate reasons. Beatty's record in three engagements, his drastic revision of the Grand Fleet's battle orders after taking command in Dec. 1916, and his no less drastic reorganisation of the guidance and control of the naval service on becoming First Sea Lord in 1919, remain permanent monuments to his clear insight into the essentials of fighting, of his firm grasp of the only principles by which fighting forces can be led and of his capacity to inspire others.

In 1921 he was the British delegate at the Washington Conference on the limitation of armaments. He received the K.C.B. in 1914. In 1919 he was raised to the peerage as Earl Beatty, Viscount Borodale of Borodale, Baron Beatty of the North Sea, and received a grant of £100,000 for his services during the War. He was also awarded the G.C.B. and the O.M. and was the recipient of numerous other British and foreign honours and decorations. In May 1901 he married Ethel, daughter of the late Marshall Field of Chicago, and has two sons. (A. H. P.*)

BEAVERBROOK, WILLIAM MAXWELL AITKEN, 1ST BARON (1879–), was born at Newcastle, N.B., May 25 1879, the son of the Rev. William Aitken, a Presbyterian minister, who subsequently became minister at Newcastle, where the boy's youth was passed. At an early age he started business in Halifax, Nova Scotia. His abilities attracted the attention of John E. Stair, a local financier, who made him a partner in his business. On the older man's death Aitken, who had made a considerable fortune, removed to the wider field of Montreal, where he continued his business operations and in 1907 acquired a seat on the stock exchange.

In 1910 he was suddenly plunged into a financial struggle of

the first magnitude and into national notoriety. He was asked by the Bank of Montreal to investigate the prospects of an amalgamation of three Canadian cement mills. As a consequence of his examination he slipped almost by accident into a scheme for the amalgamation of all the Canadian mills. The question was, Could this be done, and if so at what price should such a combined company be launched on the market? Aitken named the figure, and, though most of his associates disbelieved him absolutely, he proved right, and made at a stroke an immense fortune. Largely owing to his own imprudence, he found himself the object of an organised Press attack, and achieved a considerable unpopularity throughout Canada. Time has proved the finance of the Cement Trust to be sound, and it has always paid a good dividend to its shareholders.

At this point Aitken, having attained his predetermined aim of making £1,000,000, retired from business and entered English politics. He won a sensational victory at Ashton-under-Lyne in Dec. 1910, and in Parliament became private secretary to Bonar Law. His influence with that statesman, who, in 1911, became Leader of the Opposition, was suspect to many Conservative members. He played a part in making his friend leader against the rival claims of Walter Long and Austen Chamberlain, but this was hidden from the public at the time. His skill for political manoeuvre was first generally recognised in 1916, when, by bringing Mr. Bonar Law, Sir Edward Carson and Mr. Lloyd George together, he helped to engineer the overthrow of Mr. Asquith and the substitution of Mr. Lloyd George as a Premier pledged to a more vigorous conduct of the War. For this service he was raised to the peerage in Jan. 1917 as Baron Beaverbrook of Beaverbrook, N.B. and Cherkley, Surrey. He had been knighted in 1911 and created a baronet in 1916.

At the outbreak of the World War he had become Canadian "Eye-Witness" at the front. In 1915 he became a representative of the Canadian Govt. with the Expeditionary Force, taking charge later of the Canadian war records. In Feb. 1918 he joined the Cabinet as Chancellor of the Duchy of Lancaster and Minister of Information in charge of propaganda. Immediately after the Armistice he resigned from the Cabinet and abandoned politics.

For some years before this date Lord Beaverbrook had possessed a financial interest in *The Daily Express*, but had taken no active part in its direction. He now took over entire control and gave the newspaper his whole attention. In a short time he raised it from the somewhat depressed condition in which he found it and turned it into a flourishing and powerful organ. In 1921 he founded *The Sunday Express*, and after a prolonged struggle established it successfully as a popular Sunday journal. Later, when the late Sir Edward Hulton's newspapers were placed on the market, he secured a controlling interest in *The Evening Standard*—thus creating a kind of triple alliance. His published works are the first two volumes of *Canada in Flanders; Success*, a study of the ethics of business; and *Politicians and the Press*, (1925). Lord Beaverbrook married in 1906 Gladys Henderson, daughter of Brig.-Gen. C. W. Drury, of Halifax, Nova Scotia.

(M. W.)

BEBEL, FERDINAND AUGUST (1840–1913), German socialist (*see* 3.601). During Bebel's last years his views regarding the revision of the Social Democratic programme underwent a considerable change; he ultimately favoured revision in the sense of co-operation with other political parties in democratic reforms. In the Reichstag he continued to oppose Germany's official militarism; while strongly advocating resistance in the case of foreign aggression. His attitude towards imperial and autocratic Russia was throughout uncompromising. It would hardly be too much to say that he would have welcomed a rupture with Russia on almost any ground. His influence in this regard powerfully contributed to foster those sentiments in the Social Democratic party which led it to acclaim the declaration of war against Russia on Aug. 1 1914. One of his last public appearances was at an International Peace Conference at Berne in 1913. He died at a sanatorium at Passugg, in Switzerland, Aug. 13 1913.

BECHUANALAND (*see* 3.604), a native territory in South Africa under the control of the British Colonial Office. The population in 1921 was 152,983, of whom 1,743 were whites, compared with 120,776 in 1904, of whom 1,004 were whites.

The Protectorate is essentially a pastoral country and in 1921 the Bechuana possessed 495,000 cattle and 380,000 sheep and goats. Cattle, hides, and skins are the chief exports. The revenue, raised mainly from customs and a hut tax, first exceeded expenditure in 1915–6, when the figures were: revenue, £70,000; expenditure, £68,000. Previously deficits had been made good by the British exchequer. In 1924–5 the revenue was £99,000 and the expenditure £87,000. During 1922–5 a locust destruction campaign was carried out with marked success, over 37,000 swarms of *voetgangers* being destroyed.

Under the administration of a resident commissioner, the Bechuana tribes possess autonomy. They have made considerable progress and show a keen desire for education. Native and European advisory councils were established in 1920. Bathoen, paramount chief of the Bangwaketse tribe, died in July 1910 and Sebele, paramount chief of the Bakwena, died in Jan. 1911. Montsioa, chief of the Baralong, died in April 1911. All these chiefs were noted men in the early struggles between the Boers and British for the possession of Bechuanaland. A greater figure, Khama, paramount chief of the most important tribe, the Bamangwato, died in Feb. 1923, aged about 93. Khama, who had been converted to Christianity in 1860, had been paramount chief since 1875 and had been consistently friendly to the British. A stern, self-willed man, he was a great advocate of temperance and of education. When in June 1925 the Prince of Wales visited Bechuanaland, he unveiled a memorial to Khama at Serowe, the Bamangwato capital. Linchwe, chief of the Bakgatla, a wise and good ruler, the last surviving chief at the time when the country came under the British flag, had died in Oct. 1924. Sekgoma, Khama's son and successor, died Nov. 15 1925.

Among the white inhabitants, mostly farmers settled along the railway line, which links the Cape Province to Rhodesia, an agitation grew up for admission to the Union of South Africa. In Dec. 1924 Gen. Hertzog, Prime Minister of the Union, informed a deputation that in his opinion the time was ripe for considering the incorporation of the Protectorate, and also the Swaziland Protectorate, in the Union. For geographical reasons that part of Southwest Africa, known as the Caprivi Zipfel, was in 1922 transferred for administrative purposes to the Bechuanaland Protectorate.

Annual reports on the Protectorate are published by the Colonial Office, London. Consult also *The Official Year Book of the Union of South Africa, 1910–24* (Pretoria, 1925).

(F. R. C.)

BECKWITH, JAMES CARROLL (1852–1917), American portrait painter (*see* 3.610), exhibited at St. Louis in 1904 "The Nautilus" and a portrait of Mrs. Beckwith. The universities of Yale and Johns Hopkins and West Point Military Academy possess examples of his works, and the New York Public Library has a collection of his crayon and pencil drawings. He died in New York Oct. 24 1917.

BÉDIER, JOSEPH (1864–), French scholar, was born Jan. 28 1864 in Paris and was appointed professor of medieval French language and literature at the Collège de France in 1893. He won the degree of *docteur-ès-lettres* with *Les Fabliaux*, a work on early French poetry which was crowned by the Académie Française. The publication of his *Roman de Tristan et Iseult* (1900) set a European seal on his reputation. In *Les Légendes épiques* (3 vol., 1908) he developed, with a wealth of picturesque detail, his theory that the great cycles of romance grew up along the pilgrim routes of medieval France. He thus supplied an ingenious and romantic interpretation of the Charlemagne, Guillaume, and Quatre Fils Aymon cycles, which directly contradicted the theory of their origin from a primitive common epic material maintained by Gaston Paris and his successors. Bédier's exquisite and lucid style gained him innumerable admirers among scholars and laymen alike. Among his other works are *Les Crimes allemands* (1915) and *La Chanson de Roland* (1921).

BEEBE, CHARLES WILLIAM (1877–), American ornithologist and explorer, was born in Brooklyn, N.Y., July 29 1877. In 1899, after receiving the degree of Bachelor of Science from Columbia University and completing a year of graduate study there, he became honorary curator of ornithology of the New York Zoological Society and was later made director of its Dept. of Scientific Research. He originated the collection of living birds in the New York Zoological Park, and brought it up to the first rank with a census of 900 species and 3,000 specimens. His scientific expeditions took him to Nova Scotia, Florida, Mexico, Venezuela, British Guiana, the Himalayas, Borneo, China, Japan and Galapagos. In an expedition in 1924–5 which he organised to explore the Sargasso Sea, the Humboldt current, and the Galapagos Is., he made many observations of scientific value and secured many rare specimens of marine life. He published a monograph on pheasants in four volumes, the first of which (1918) won him the Elliot Medal of the National Academy of Sciences.

In addition to many scientific papers on birds and evolution and numerous magazine articles, he has written: *Two Bird Lovers in Mexico* (1905), *The Bird* (1906), *Log of the Sun* (1906), *Our Search for a Wilderness* (1910), *Tropical Wild Life* (1917), *Jungle Peace* (1918), *Edge of the Jungle* (1921), *Galapagos: World's End* (1923), *Studies of a Tropical Jungle* (1925), *Jungle Days* (1925) and *The Arcturus Adventure* (1926).

BEECHAM, SIR THOMAS, (1879–), British conductor and impresario, was born April 29 1879, the elder son of Sir Joseph Beecham, 1st Bart. He was educated at Rossall School and Wadham College, Oxford, and gave his first concert with the Queen's Hall Orchestra in London 1905. He founded and afterwards conducted the New Symphony and Beecham Symphony orchestras, and also the Beecham Opera Company. After producing operas by Delius and others at Covent Garden Theatre in 1910, he gave a brilliant season of Russian opera and ballet at Drury Lane in 1913, where Chaliapin took the title-rôle in *Boris*. In 1915 Beecham gave a season of opera in English at the Shaftesbury Theatre, London, followed by others at the Aldwych Theatre. In 1916 he was knighted, and succeeded the same year to the baronetcy. In 1917 and 1918 he produced Russian, German and Italian operas at Drury Lane Theatre, returning in 1919 to Covent Garden, where he gave a first performance of Massenet's *Thérèse*. In 1920 under the Grand Opera Syndicate, Ltd., Sir Thomas produced operas by Bizet, Debussy, Puccini and others. His work in promoting Grand Opera in English has been of great value, and contributed largely to the foundation of the British National Opera Company in 1921.

BEECHING, HENRY CHARLES (1859–1919), British divine and writer (*see* 3.640), was dean of Norwich from 1911 until his death at Norwich Feb. 25 1919.

BEER (*see* 3.642).—The output of the brewing trade of the United Kingdom in the year 1913–4 exceeded 36,000,000 standard barrels. At this time the beer duty was 7s. 9d. per standard barrel, but by 1920 it had been raised to 100 shillings. The yield of the duty at 7s. 9d. had been £13,623,000, and, although a reduction in consumption by 10,000,000 bar. took place, the yield in 1920–1 on 26,730,000 bar. had risen to £123,394,000—practically 4d. per pint. In 1923, by means of a rebate of 20s. per bulk bar., the tax was reduced to about £4 net, but consumption, which had once more fallen, stood in 1925 at little more than 22,000,000 standard bar., or over 26,750,000 bulk barrels. The yield of the duty was £82,000,000. The number of licensed breweries in that year was 1,996 as compared with 5,311 in 1905. The materials used in 1925, excluding Ireland, were about 360,000 cwt. of hops, 12,500,000 cwt. of malt and corn and 1,700,000 cwt. of sugar.

The average retail price and taxation of beer in 1924 in London, compared with other European capitals, was as given in the table in the next column.

	London	Paris	Brussels	Berlin	The Hague	Copenhagen
Price.	6d. per pint	0·70–·90 fr. per litre draught; 1·1 fr. per litre bottled	0·95–1·14 fr. per litre	32½ pf. per pint	48 cents per litre	29 öre per 0·35 litre (bottled)
Equivalent price per pint.	6d.	1–1¼d. draught; 1½d. bottled	1–1¼d.	4d.	5½d.	4¼d.
Proportion paid as tax	40%	(1)	(2)	10½%	7%	25%

[1] Beer is subject to a production tax of 1½c. with surtax of 50c. per degree-hectolitre, *i.e.*, per hectolitre of wort and per degree of specific gravity over 100 water at 15° Centigrade.

[2] No tax on beer as such; on malt used in manufacture of beer there is a tax of 20c. per kilogram.

The exports of beer from Great Britain in 1925 amounted to 290,000 standard bar. and the imports of foreign beer to 15,000 standard bar., excluding 1,610,000 from Ireland. In 1925, in order to protect English hop-growers, a customs duty of £4 per cwt. (with one-third preference to British Dominions) was imposed on imported hops for a definite period of four years. The expenditure on alcoholic beverages in Great Britain in 1925, estimated at over £300,000,000, provided the state exchequer with revenue amounting to about £175,000,000. *See* LIQUOR CONTROL.

No figures for the capital invested in brewing alone are available. In May 1918 Government committees reported that state acquisition of the liquor trade, including wholesale and retail licensed premises, but excluding hotels, restaurants, wholesale spirit stores, etc., would require more than £400,000,000 but less than £500,000,000. The number of persons employed in brewing and malting in 1907 was officially returned as 84,969, and probably that number held good in 1925. *The Brewers' Almanack* for 1926 estimates that a minimum of 700,000 persons are wholly engaged in brewing, distilling, bottling, the wholesale and retail sale of alcoholic beverages and in allied trades; that direct dependents on these employees number 440,000, and indirect dependents a further 500,000.

Irish Free State.—Prior to 1914 the production of beer averaged 4,000,000 barrels. The industry was greatly affected by the World War, and at one period production fell to one-third the pre-War figure, mainly owing to the limitations on output imposed by the Government. Up to the end of 1925, as in Great Britain, only a partial recovery had been recorded. In normal years the industry consumes one-half the Irish barley crop. Taxation in 1925 averaged 3½d. per pint and provided one-quarter of the total revenue of the country. In pre-War years about one-third of the output was exported; in 1925 the export figure represented approximately one-half the production, exports mainly being to Great Britain and Northern Ireland.

Czechoslovakia.—The brewing industry attained its maximum output immediately preceding the outbreak of the World War, when there were 666 breweries in operation with an annual production of 13,000,000 hectolitres. During the War period the industry suffered severely from the falling off of supplies of malt, and was in a most critical position when the new republic of Czechoslovakia was established in 1918. A brewers' commission was formed and all necessary steps taken for improving the condition of the industry. Production increased from 1,623,445 hectolitres in 1917–8 to 3,875,520 hectolitres in 1918–9, and by 1924 there were 663 breweries in operation with an annual capacity exceeding 13,000,000 hectolitres. Special attention is paid to the export trade, particularly by the breweries of Bohemia, including the well-known brewery of Pilsen. The industry employs some 20,000 workmen.

Germany.—Brewing production was greatly curtailed owing to war conditions, as is clearly shown by the following figures of the consumption of beer (production plus import minus export) during 1913, 1923 and 1924 in the present German area: 1913, 61,920,000 hectolitres; 1923, 28,590,000; 1924, 34,087,000.

The industry satisfactorily survived the post-War period of inflation, but suffered from the violent price fluctuations. Sales increased during 1924–5, and from Jan. 1 1925 the production of pre-War full strength beer has been permitted. Exports of beer fell from 941,342 hectolitres in 1913 to 413,568 hectolitres in 1923. A small increase was registered in 1924–5. The minimum working week is 48 hours. In June 1925 the average weekly wage for skilled workers in the whole of Germany was 44·45 gold marks. A strong movement towards concentration exists throughout the industry, particularly in the chief centres of Munich, Berlin and Dortmund.

The following table, based on figures given in the *Annuaire Statistique* (1924) of the French Govt., gives the average annual consumption of beer in litres per head in certain countries:—

	1911–3	1920–3
United Kingdom	124·0	83·0[1]
Denmark	86·2	72·0
Norway	21·3	32·0
Sweden	48·9	33·4
Austria	72·0	44·0
Hungary	14·7	7·0
Switzerland	80·0	33·0

[1] 1920–2 only. In 1923 the consumption in Great Britain was 77·5 litres per head; in 1925 it was 79·5 litres.

Germany	104·0	48·0
Holland	28·5	23·5
Belgium	226·0	177·0
France	33·6	25·2
Italy	2·2	3·2
United States	78·0	9·0[2]

[2] In the United States of America the 18th Amendment to the Constitution, ratified in 1919, prohibited the manufacture, sale and import of all "intoxicating liquors," later defined by Act of Congress as any beverages that contain more than 0·5% of alcohol by volume.

(P. C. Mo.)

BEERBOHM, MAX (1872–), British caricaturist and writer, was born in London Aug. 24 1872, a half-brother of Sir Herbert Beerbohm Tree, the actor. He was educated at Charterhouse and Merton College, Oxford. Before he had left Oxford, Beerbohm had made a reputation as an essayist of wit and polish, *The Yellow Book* offering him a congenial hospitality. This reputation was maintained, when he succeeded G. B. Shaw as dramatic critic to *The Saturday Review*, by the judiciously small amount of work which he published and its almost uniformly high accomplishment, in essays, fiction and parody alike. This includes *The Works of Max Beerbohm* (1896); *The Happy Hypocrite* (1897); *More* (1899); *Zuleika Dobson* (1911); *Seven Men* (1919); *And Even Now* (1920).

As a caricaturist, Beerbohm's fame followed a parallel line, and his skill as a draughtsman certainly increased with the years. Among his volumes of published drawings are *Caricatures of Twenty-five Gentlemen* (1896); *The Poet's Corner* (1904); *Fifty Caricatures* (1913); *A Survey* (1921); *Rossetti and His Circle* (1922), and *Observations* (1925). As a sophisticated commentary on the social and literary life of his time, Beerbohm's economical and often caustic drawings stand alone; his residence in Italy, at Rapallo, after 1910, gave him many advantages for the detached observation of personalities and tendencies, although once or twice it may have endangered his perspective; and he was certainly free from a certain fear of acid comment which has dimmed the art of caricature in England since the early Victorian age. (*See* CARICATURE.) (H. Mi.)

BEESLY, EDWARD SPENCER (1831–1915), British positivist (*see* 3.644), died at St. Leonards-on-Sea July 7 1915.

BEGAS, REINHOLD (1831–1911), German sculptor (*see* 3.652), died Aug. 3 1911.

BEHAVIOURISM is a direct outgrowth of studies in animal behaviour during the first decade of the 20th century. C. Lloyd Morgan, the British psychologist, must be looked upon as the founder, virtually, of the American school of animal psychology. His books, *Introduction to Comparative Psychology* (1894) and *Animal Behaviour* (1900), broke away from the traditional anthropomorphic interpretations of animal acts. He first emphasised the necessity of tracing all the steps in any act we see the animal performing before the interpretation of that act becomes possible. His actual experiments upon the learning of animals were few in number but rich in interpretative value. His studies emphasised the trial and error nature of all animal learning. Morgan's work undoubtedly inspired the American animal psychologist, E. L. Thorndike, who first instigated systematic experimentation upon chicks, dogs, cats and monkeys in the United States. There soon followed in that country a host of experimentation upon mammalian learning. We mention in passing the work of Small, Yerkes, Kinnaman, Davis, Allen, Porter, Carr, Franz, Johnson, Ulrich, Richardson, Yoakum, Haggerty and Watson.

The rich results coming from the study of infra-human mammals led to similar studies on man. During this same general period we find man studied for the first time as a member of the animal kingdom. We mention the work of E. J. Swift, W. F. Book, H. A. Ruger and K. S. Lashley. Acquisitions of skilful acts such as keeping three balls in the air, typewriting, solving mechanical puzzles, learning to shoot the English long bow, serve to illustrate the types of problems studied. The results of these human studies emphasised the *essential similarity between human and infra-human learning.*

Emergence of Behaviourism.—Up to the appearance of Watson's two papers, "Psychology as the Behaviourist Views It" (1913) and "Image and Affection in Behaviour" (1913), and his book *Behaviourism—An Introduction to Comparative Psychology* (1914), there was no crystallisation of the behaviouristic trend. None of the workers in the field of animal behaviour made any attempt to escape the implications of consciousness in their interpretation of human or animal acts. In these three publications the terms "behaviourism," "behaviouristic" and "behaviourist" were first used. Washburn's book, *The Animal Mind* (1907), represents very well the tendency of the time. She felt the need of interpreting all animal behaviour in terms of consciousness as defined in the introspective systems of W. Wundt and E. B. Titchener.

Behaviourism when first conceived was based largely upon the rather loose concept of habit formation. The work of Pawlow and his students on the conditioned reflex, while known to the behaviourists, played at first a relatively minor rôle in their formulations. This was due to the fact that his experiments were chiefly concerned with conditioned glandular reflexes, which at that time was a subject hardly touched upon by psychologists. Bechterew's work on the conditioned motor reflex, where human subjects were used, had from the first a very much greater influence upon behaviourism. The work of Lashley in conditioning the human salivary reflex and of Watson and Rayner on conditioning human emotional reaction (fear) showed the great range of application of the conditioned reflex methods to human behaviour. This work has led to an attempt to formulate all habit (organisation) in terms of conditioned glandular and motor reaction. In spite of the fact that behaviourism did not at first utilise to any extent the conditioned reflex methods, Pawlow and Bechterew must be looked upon as furnishing the keystone to its arch. During the period of the general formulation of behaviourism as a system rather than as an approach to psychology, or as a specialised method in psychology, the writings of E. B. Holt, A. P. Weiss and K. S. Lashley are noteworthy.

The Fundamental Viewpoint

The behaviourist takes the position at the outset that the total behaviour of man from infancy to death is the subject matter of (human) psychology. Behaviour can be observed like the phenomena of all other natural sciences, *e.g.*, chemistry, physics, physiology or biology. The same general types of methods used in the natural sciences can be used in behaviour psychology So far in his objective study of man no behaviourist has observed anything that he can call consciousness, sensation, perception, imagery or will. Not finding these so-called mental processes in his observations, he has reached the conclusion that all such terms can be dropped out of the description of man's activity.

All behaviouristic observations apparently can be presented in the form of stimulus and response. The simple schema used is S→R. A behaviouristic problem is solved when both the stimulus and the response are known. For a very simple example, substitute in the above formula for S, contact on the cornea, and for R, blinking. The behaviourist's problem is solved when this has been done as a result of verified controlled experimentation. The neurologist has a problem to solve in this same phenomenon, namely, in determining the neural connections involved, their course, their numbers, the timing and spread of the neural impulse, etc. The behaviourist does not encroach upon it. The physical chemist has a problem to solve here also. His problem is not encroached upon either by the behaviourist or by the neurologist.

His problem is the determination of the physical and chemical nature of the neural impulses, the amount of work done in the reaction and the like. In every human reaction there is thus a behaviourist's problem, a neuro-physiological problem and a physico-chemical problem. When the phenomena of behaviour are once accurately formulated in terms of stimulus and response, the behaviourist achieves predictability with reference to his phenomena and control over them—the two essentials every science demands. One might put it in another way. Suppose the behaviourist were given the problem of how to cause a human being to blink, he solves it by touching the cornea with a hair (control). In more complicated reactions, especially those labeled "social", the S→R relationships are not so easy to solve. For example, present the stimulus prohibition (S) to any given nation, what will the response (R) be? It may take years to determine R completely. Many behaviouristic problems have to wait for their solution upon the slow experimentation of science as a whole. Regardless of how complicated the stimulus-response relationships may be, the behaviourist does not admit for a moment that any human reactions cannot be so described.

The general goal of behaviourism, then, is to so amass observations upon human behaviour that in any given case, given the stimulus (or better situation), the behaviourist can predict in

advance what the response will be; or given the response, he will be able to state what situation is calling out the reaction. Looked at in this broad way, it is easy to see that behaviourism is far away from its goal. But while its problems may be difficult, they are not insuperable. The one thing that makes the approach of the behaviourist difficult is the fact that stimuli not at first calling out any given response can come later to call out a specified type of response. We call this a process of *conditioning* (earlier called habit formation).

The Genetic Method

This difficulty forces the behaviourist to resort to the genetic method. He takes the infant at birth and surveys his so-called physiological system of reflexes or, better, embryological responses. Having taken this inventory of unconditioned, unlearned responses, he next begins to try to condition them. When this has been done, two striking facts seem to appear. First, the number of complicated unlearned responses appearing at birth or at intervals thereafter is relatively small. *This leads to the rejection of the whole concept of instinct.* Most of the complex responses that the older psychologists called instinctive, such as crawling, climbing, cleanliness, fighting (a long list), are now believed to be built in or conditioned. In other words, the behaviourist no longer finds support for hereditary patterns of behaviour nor for special abilities (musical, art, etc.) which are supposed to run in families. He believes that given the relatively simple list of embryological responses which are fairly uniform in infants, he can build (granting that both internal and external environment can be controlled) any infant along any specified line—into rich man, poor man, beggar man, thief.

How the Building Takes Place.—Suppose one assumes that there are present at birth only 100 unconditioned embryological responses—there are many more of course. These appear in the form of breathing, crying, movements of arms, legs, fingers, toes, trunk, defaecation, urination and the like. If we assume that all of these can be conditioned and integrated according to the law of permutation and combination, the total possible number of built-in responses would be factorial one hundred—many millions more than any adult, even the most versatile one, is ever called upon to make even in the most complex social environment.

These embryological responses do not appear haphazard—they are not "random." Some definite stimulus calls them out. Let us call all such stimuli unconditioned stimuli, (U)S. Let us call all such responses unconditioned responses (U)R. The formula could be expressed thus $\frac{\text{(U)S}}{\text{A}} \rightarrow \frac{\text{(U)R}}{\text{1}}$.

After conditioning B, C, D, E, Etc. $\rightarrow$ 1

In the schema A is such an unconditioned stimulus, 1 is such an unconditioned response. Now if the experimenter takes B—and B so far as is known may be any object in the universe—and lets it stimulate the organism simultaneously with A for a certain number of times (sometimes even once is enough) it thereafter will also arouse 1. In the same way one can make C, D, E call out 1; in other words, one can make any object at will call out 1 (stimulus substitution). This shows how the stimulus side of our life gets more and more complicated as life goes on. In a similar way reactions become complicated as soon as a simple stimulus through the process of conditioning comes to call out a chain of reflexes (integration). In this way the behaviourist tries to take the vague concept of habit formation and to give it a new and exact scientific formulation in terms of conditioned responses. On this basis the most complicated of our adult habits are explicable in terms of chains of simple conditioned responses.

The simplification in psychological theory which comes through the application of behaviouristic principles is best seen in the realm of the emotions. Take fear. The works of Watson and Rayner, Moss, Lecky, Jones and others have shown that the fundamental unconditioned stimulus (U)S calling out a fear reaction is a *loud sound* or *loss of support.* Every child with only one exception, of approximately 1,000 infants examined, was found to catch his breath, pucker his lips, cry or, if older, crawl away, when a loud sound was given behind his head or when the blanket on which he was lying was suddenly jerked. Nothing else so far observed will produce the fear response in early infancy. Now it is very easy to make the child fear any other object in the universe. All the experimenter has to do is to show the object and strike the steel bar behind his head and repeat the procedure a few times. The schema of the situation follows:—

(U)S	(U)R
Loud sound Loss of support	"Start," crying, etc. (fear)

After conditioning:—

(C)S	(C)R
Rabbit, dog, furry objects	Fear

Conditioning of the emotions, (fear, rage, love, etc.) takes place very much earlier in the life of the infant than has hitherto been supposed; it is a process that brings complexity in response at a rapid rate. This means that an infant two or three years of age is already shot through with thousands of responses built up by the environment in which it lives.

The Process of Unconditioning.—The experiments of the behaviourists have shown that there is not only a process of conditioning or building taking place constantly from birth to death, but that there is also a process of *unconditioning* taking place as well. A simple experiment of the type described below best illustrates it. A conditioned negative response was set up in a 1½ year old child—that of drawing back from or running away from a bowl containing gold fish. We quote from a recent experiment:—

> The child, the moment he sees the fish bowl, says 'bite.' No matter how rapid his walk, he checks his step the moment he comes within 7 or 8 feet of the fish bowl. If I lift him by force and place him in front of the bowl, he cries and tries to break away and run. No psychoanalyst, no matter how skilful, can remove this fear by analysis. No advocate of reasoning can remove it by telling the child all about beautiful fishes, how they move and live and have their being. As long as the fish is not present, you can by this verbal organisation get the child to say 'Nice fish, fish won't bite'; but show him the fish and the old reaction returns. Try another method. Let his brother, aged 4, who has no fear of fish, come up to the bowl and put his hands in the bowl and catch the fish. No amount of watching a fearless child play with these harmless animals will remove the fear from the toddler. Try shaming him, making a scapegoat of him. Your methods are equally futile. Let us try, however, this simple method. Get a table 10 or 12 feet long. At one end of the table place the child at meal time, move the fish bowl to the extreme other end of the table and cover it. Just as soon as the meal is placed in front of him, remove the cover from the bowl. If disturbance occurs, extend your table and put the bowl still farther away, so far away that no disturbance occurs. Eating takes place normally, nor is digestion interfered with. The next day repeat the procedure but move the bowl a little nearer. In four or five such sessions the bowl can be brought close to the food tray without causing the slightest bit of disturbance.

The behaviourist concludes that by his experiments upon the conditioning and unconditioning of the responses of infants and children he has gotten a clear view of the way human beings are built up by the environment in which they find themselves. Man is a biological unit that can be studied like any other animal.

Does Thinking Offer Any Problem?—Many introspective psychologists agree up to this point with the behaviourist (Bertrand Russell, for example), but the subjectivist claims that there is something new in thinking (and let us include "imagination" under this term). What has the behaviourist to offer on thinking. The behaviourist's formulation runs somewhat as follows:—

The increasing dominance of language habits in the behaviour of the developing child leads naturally over into the behaviourist's conception of thinking. The behaviourist makes no mystery of thinking. He holds that thinking is behaviour, is motor

organisation, just like tennis playing or golf or any other form of muscular activity. But what kind of muscular activity? The muscular activity that he uses in talking. Thinking is merely talking, but talking with concealed musculature.

Take any child when he first begins to talk. Peep through the keyhole and watch him in the early morning. He will sit up in bed with his toys, talk aloud to his toys, talk about them. When a little older, he will plan out his day aloud, say aloud that his nurse is going to take him for a walk, that his daddy is going to bring him a car. In other words, he talks overtly when alone just as naturally as he works overtly with his hands. A social factor comes in. The father gets to the point where his own morning nap is disturbed. He yells out "Keep quiet." The child begins then to mumble to himself—a great many individuals never pass this stage, and they mumble to themselves all through life whenever they try to think. The father does not like the child's mumbling any better than his talking aloud, and so he may slap him on the lips. Finally, the parents get the child to the point where he talks silently to himself. When his lips are closed, it is nobody's business what is going on below. Thus we come to behave as we please if we do not give any external motor sign of it—in other words, our thoughts are our own.

A further question comes up for serious consideration: Do we think only in terms of words?

The behaviourist takes the position to-day that whenever the individual is thinking, the whole of his bodily organisation is at work (implicitly)—even though the final solution shall be a spoken, written or subvocally expressed verbal formulation. In other words, from the moment the thinking problem is set for the individual (by the situation he is in) activity is aroused that may lead finally to adjustment. Sometimes the activity goes on (*a*) in terms of implicit manual organisation; (*b*) more frequently in terms of implicit verbal organisation; (*c*) sometimes in terms of implicit (or even overt) visceral organisation. If (*a*) or (*c*) dominates, thinking takes place without words.

Words are thus the conditioned (C)S substitutes for the world of objects and acts. Thinking is a device for manipulating the world of objects when those objects are not present to the senses. Thinking more than doubles human efficiency. It enables the individual to carry his day world to bed with him and manipulate it at night or when it is a thousand miles away.

Strict behaviourism is making rapid progress in America. It however has not yet been universally accepted even there. The older subjective psychology is being profoundly modified by it. One sees very little of *introspection* and still less of *imagery* in the writings of the subjectivists.

See J. B. Watson, "Psychology as the Behaviourist Views It." *Psych. Rev.*, XX (1913); *Behaviourism* (1925); the articles by L. S. Lashley in the *Psych. Rev.* in 1925; A. P. Weiss, *A Theoretical Basis of Human Behaviour* (1925); George A. Dorsey, *Why We Behave Like Human Beings* (1925); Bertrand Russell, *Analysis of Mind*.

(J. B. W.)

BEILBY, SIR GEORGE THOMAS (1850–1924), British chemist, was born in Edinburgh Nov. 17, 1850 and educated at the university there. He joined the Oakbank Oil Co. in 1869, and later became a director of the Cassel Cyanide Co., the Castner-Kellner Alkali Co. and many other important undertakings. He invented a new process for retorting oil shale, a new synthetic method of manufacturing alkaline cyanides, and also carried out much important work on the economical use of fuel, establishing the Fuel Research Station at East Greenwich shortly before his death. Having served on several commissions and assisted the Govt. in an advisory capacity on many occasions, he was elected F.R.S. in 1906, and was knighted in 1916. He held office in many scientific societies, and was the author of a book on *The Aggregation and Flow of Solids* (1921), and of numerous important papers on chemical and metallurgical subjects. He died at Hampstead, London, on Aug. 1, 1924.

BEIRA (*see* 3.657), a seaport of Portuguese East Africa with a population (1921) of 11,871. Already the chief port for Rhodesia and Katanga, the completion in 1922 of a railway to the Zambezi made Beira also the port for Nyasaland. It has, in addition, a considerable trade in sugar and other produce of the territory administered by the Mozambique Co., of which it is the capital. The maximum depth of water in its harbour is 32 ft., the minimum 12 feet. The depth at the customs wharf varies from 20 ft. to nil. Ships are loaded and unloaded from anchorage by lighters; the wharf and railway piers had in 1925 a cranage power of 3,000 tons a day, but the facilities provided did not keep pace with the needs of shipping. The cargo handled in 1924 exceeded 1,000,000 tons. British ships constitute by far the greater part of the tonnage using the port; Portugal and Germany provide most of the remainder. The Pungwe and Buzi rivers, at the mouth of which Beira is built, are subject to serious floods, causing damage to the railway lines to Rhodesia and Nyasaland.

BEIRUT (*see* 3.658), now the most flourishing town in Syria, is the seat of the French High Commissioner for Syria and of the Government of the autonomous state of Grand Liban (Lebanon). The residence of the High Commissioner is in the Forest of Pines outside the town. A museum in the municipal buildings contains antiquarian remains found by the Service des Antiquités since the French occupation.

The production of silk began to revive in 1920, having fallen after the World War to less than one-tenth of its previous value, and the exports from Beirut were almost doubled in that year. In 1922 the exports of silk, oil, cotton, fruit, etc., were worth 36,392,000 fr., and the imports, largely manufactured goods, were worth 363,025,000 francs. Beirut is the most important port on the seaboard, though Tripoli may offer serious rivalry when its inland communications are improved. The harbour accommodation has been improved under the French régime, and traffic is increasing. There are 3 different anchorages: (*a*) inside the harbour with a depth from 25 to 45 ft., and 13 to 26 ft. along the quays; (*b*) outside the harbour, but sheltered by a breakwater, with a depth from 40 to 100 fathoms; (*c*) outside the harbour with depths of 100 fathoms and upwards, but exposed to the northwest winds.

The population of Beirut, largely Christian, is estimated at 140,000; after the bombardment of Damascus by the French in Nov. 1925 this figure was swelled by the arrival of numerous refugees. The town was bombarded in Feb. 1912, when a Turkish gunboat was sunk by an Italian squadron. After the Turkish collapse during the World War, in 1918, it was taken by the French Navy on Oct. 5, and occupied by British troops on Oct. 7.

BEKHTEREV, VLADIMIR MIKHAILOVICH (1857–), Russian neuropathologist, was born in the province of Viatka. He studied medicine in the medico-surgical academy at St. Petersburg (now Leningrad), graduated in 1878 and devoted himself to the treatment of mental and nerve diseases under Prof. Mergejevsky, a famous specialist of the time. He took the doctor's degree in 1881 and became *privat-docent*. In 1884 he went abroad to do research work under Dubois-Raymond, Wundt and Charcot, and was appointed professor at the University of Kazan, where he started clinical research of mental diseases and promoted the first psycho-physiological laboratory. In 1893 he became professor of the Military Medical Academy in St. Petersburg and was elected director in 1905–6. To foster psycho-physiological research, he founded in 1907 in St. Petersburg a psycho-neurological institute, which existed on private donations up to 1917, when an additional brain institute was formed and both were taken over by the government. He published more than 200 scientific papers on pathology and anatomy of the nervous system and founded a society of neuropathologists and the periodical *Nevrologitcheski Vestnik*. His work on *The Nerve Currents in Brain and Spinal Cord* appeared first in Russia in 1882; the second edition in 1896 has been translated into French and German. *The Functions of the Nervous Centres* appeared in Russia in 1909; his *Psychology, Objectively Demonstrated* was published in 1910; and his *General Diagnosis of the Nervous System Diseases* in 1911.

BÉLA KUN: *see* KUN, BÉLA.

BELASCO, DAVID (1859–), American playwright and theatrical manager, was born at San Francisco, Cal., July 25 1859. After graduating from Lincoln College, Cal., in 1875, and filling the position of stage manager at several theatres in San Francisco, he went to New York in 1880 to take charge of productions at the Madison Square Theatre. In 1885 he joined Daniel Frohman at the Lyceum Theatre in a similar capacity. He subsequently owned and directed the prosperous Belasco Theatre. He wrote or adapted some 200 plays, largely melodramatic, and owing to his mastery of stagecraft he was eminently successful

as a producer and stage director. He presented E. H. Sothern in *Lord Chumley* (1887); Mrs. Leslie Carter in *The Heart of Maryland* (1895) and *Du Barry* (1901); Blanche Bates in *Naughty Anthony* (1899) and *The Girl of the Golden West* (1905); Henrietta Crosman in *Sweet Kitty Bellairs* (1903) and David Warfield in *The Music Master* (1904), *The Return of Peter Grimm* (1911) and *The Merchant of Venice* (1922).

Among his numerous other productions may be mentioned: *May Blossom* (1884); *The Charity Ball* (1887, with H. C. De Mille); *Men and Women* (1890); *The Girl I Left Behind Me* (1893, with Franklin Fyles); *Madame Butterfly* (1900); *The Darling of the Gods* (1902, with John Luther Long); *The Governor's Lady* (1912); *The Temperamental Journey* (1913); *The Secret* (1914); *A Celebrated Case* (1915); *The Boomerang* (1915); *Polly with a Past* (1917); *Kiki* (1921); *The Comedian* (1923); *Canary Dutch* and *Salvage* (1925).

BELFAST (*see* 3.664) became the capital of Northern Ireland and the seat of its government in 1921. The first Parliament was opened by the King and Queen on June 22 1921. Since 1918 Belfast has sent nine members to the British House of Commons. The population in 1911 was 387,947, and was estimated in 1923 at 429,000.

During the World War the shipbuilding and repairing yards were very active, and aeroplane engines and sails were made in the city for all the Allies. In 1918 the two shipbuilding firms, Harland & Wolff and Workman & Clark, both extended their yards, which employ normally about 36,000 hands. There were 40,000 power looms and a million spindles in the spinning and weaving industry in 1920. A graving dock, one of the largest in the world, was opened in 1911 in the harbour, and a new deep-water berth has been built. The total area of docks and basins, including part of the river which is practically a dock, is 140 acres. The total tonnage of shipping entering the port in 1924 was 3,164,274, an increase of 147,587 tons on the 1923 figure. The harbour defences and facilities for defending the coast at Belfast Lough were left in British hands when the two Irish states were set up. In 1920 the model farm, Balmoral, an area of 90 ac., and also land at Legoniel, were presented for public use.

The London, Midland & Scottish Railway station has been rebuilt and enlarged. The foundation stone of the Irish Presbyterian Church War Memorial Hospital was laid in 1923. In 1924 large reservoirs in the Silent and Annalong valleys in the Mourne Mts. were in process of construction, and in the same year the Duke and Duchess of York laid the foundation-stone of the new art gallery. An Ideal Home, Housing, Health, and General Trades Exhibition was opened in Feb. 1925. Plans are being prepared for new Parliament buildings.

During the agitations against the Home Rule bill of 1912 several demonstrations and political and religious disturbances took place in Belfast, culminating in the signing of a solemn covenant by 500,000 people. Serious rioting also occurred intermittently for a week in July during the Sinn Fein campaign of 1920.

BELFAST, QUEEN'S UNIVERSITY OF.—This Irish university dates from 1909, before which time it was Queen's College, Belfast, a constituent college of the Royal University of Ireland. The municipal college of technology is connected with it. The university gives degrees in arts, science, including civil engineering, law, medicine, commerce, agriculture and applied science and technology. In the year 1923–4 the trustees of the Rt. Hon. J. C. White gave £60,000 to the university for the endowment of departments of bio-chemistry and bacteriology.

BELGIAN CONGO (*see* Congo Free State, 6:917), a Belgian colony in Equatorial Africa. Readjustments under conventions with Portugal, Germany, and Great Britain between 1910 and 1915, and the addition of the mandated areas of Ruanda and Urundi in 1919, increased the total area of the colony by some 19,000 sq. m. and added between 2,500,000 and 3,000,000 to its population, bringing the former to about 910,000 sq. m. and the latter to perhaps 10,000,000 in 1925. No accurate figures of native population are available; in 1923 there were 10,037 Europeans, of whom 5,853 were Belgians; 724 Portuguese, and 704 British, the latter mainly in the Katanga.

I. POLITICAL HISTORY

The annexation of Nov. 15 1908 transferred the Congo from the personal rule of the Belgian King to the control of Parliament, through the Colonial Minister. The death of Leopold and the accession of Albert in 1909 led to the removal of the restrictions on freedom of trade, and to reforms in native administration. The former land policy was reversed, recognition being accorded to the customary rights of user enjoyed formerly by the natives, and the principle of freedom in the disposal of their labour was recognised. Native government was reorganised in 1910; the chiefs were restored to their old authority, subject to tribal custom, provided that it did not conflict with public order or laws intended to supersede tribal usage; they were further required to enforce the laws, police their areas, promote public health, and carry out public works, for which purpose they might call upon their subjects for a limited amount of forced labour.

Freedom of trade as required by the Berlin Act was established by 1912; the Govt. withdrew from its close association with commercial companies, and from 1911 the Katanga placed under a vice-governor-general, with wide powers but without an independent budget, was opened to exploitation. A further subdivision soon proved necessary, and in 1914 the whole Belgian Congo was divided into four provinces: Congo-Kasai, Orientale, Equateur, and Katanga, each under a vice-governor-general aided by an advisory council, leaving the governor-general and his council to deal with general questions and finance. The provinces were further subdivided into districts under commissioners, and these into territories under administrators, authorised to supervise the native administration, subject to strict regulations to prevent abuse of power. A more impartial administration of justice was also secured by judicial reform.

The genuineness of the reforms was recognised by Great Britain, and the appreciation of the natives was shown by their loyalty in the World War. Congolese forces aided France in the Cameroons and Britain in Northern Rhodesia. They conquered and held from Sept. 1916 to March 1921 a considerable area of German East Africa. On the German surrender of East Africa under the Treaty of Versailles, and by an agreement with Great Britain in 1919 approved by the League of Nations in 1923, Belgium obtained under mandate the thickly populated cattle-raising areas of Ruanda and Urundi.

By the conventions of Saint-Germain-en-Laye (1919), the principles of the Berlin Act and of the Brussels Act of 1890, regarding freedom of trade and equality of opportunity for trade and industry, were reasserted in favour of members of the League of Nations; concessions might be granted, but differentiation on national grounds was forbidden, and the rule restricting customs duties was waived. Missionary enterprise was encouraged, and the liquor traffic further regulated. In 1920 M. Louis Franck, the Colonial Minister, on visiting the colony, had to contend with a partial strike in the Civil Service and native unrest due to war conditions. Order was gradually restored, and five years later the chief problem which confronted M. Henri Carton on his visit as Colonial Minister was that of transport. In 1925 Ruanda and Urundi were given provincial status, with a distinct budget, in terms of the mandate of the League of Nations.

II. ECONOMIC HISTORY

The abandonment of governmental exploitation of the rubber industry through the compulsory collection of wild rubber by the natives, which up to 1910 had provided 75% in value of the total exports, coincided with lower rubber prices in Europe, and thus furthered the development of other branches of agriculture. The exploitation of the oil palm was commenced, and in 1922 nearly 50,000 tons of palm nuts and over 10,500 tons of palm oil were exported. Successful efforts were made to develop cotton growing, the production of ginned cotton amounting to 1,100 tons in 1922. Cocoa cultivation was not very successful, but coffee increased in importance. The production of rice increased, some 9,000 tons entering into trade

annually; in 1922 about 600 tons were exported. A steady export of gum copal was maintained, nearly 14,000 tons being exported in 1922. Stock-raising was established in the north-east, and the tsetse fly was cleared from considerable areas in the Katanga; an increasing export business was developed in skins from Ruanda and Urundi. Some 300 tons of ivory continued to be exported annually.

The exploitation, partly by British capital, of the Katanga copper area is of fundamental importance, the output rising from 97 tons in 1911 to 56,577 tons in 1923; the diamond industry of the Kasai, first worked seriously in 1913, reached an output of 310,367 carats in 1923, while the gold production of Kilo and Moto rose to 3⅛ tons a year. In 1922, 238 tons of uranium mined at Chinkolobwe were exported to Belgium for the extraction of radium; in 1923 the export increased to 478 tons. The dependence of the Katanga on Rhodesian coal was greatly diminished by the exploitation of the Luena coal-field. Iron, tin and cobalt are also worked.

Communications.—Progress was essentially bound up with improved transport. The line from Kabalo to Albertville on Lake Tanganyika, affording connection with Europe via Dar-es-Salaam, was opened in 1915; that from Rhodesia, giving direct communication to Capetown and Beira, reached Elisabethville in 1910 and Bukama in 1918. The Colonial Minister in 1920 brought forward an extensive scheme of public works estimated to cost 638,000,000 fcs., and a law of 1921 approved a loan of 300,000,000 francs. Road construction was begun on a large scale, obstacles to river navigation removed, water, drainage and electric light systems planned for the towns, and the removal of the capital to Kalina Point, between Léopoldville and Kinshasa, decided on.

Harbour improvements were undertaken at Boma, Coquilhatville, Kinshasa and Matadi, and rapid progress made with a railway from Bukama to Ilebo, on the Kasai, to secure the Katanga trade and open up the Kasai area. A railway was begun from Chilongo on the Katanga line to meet the Benguella railway and link the Congo with Europe via Lobito Bay, saving 3,000 m. on the Beira route. A crisis arose in 1924 owing to the inadequacy of the Matadi-Léopoldville line; by great efforts its capacity was doubled by 1925, and plans were adopted to electrify the line and to lengthen the quays at Matadi and construct a port at Ango-Ango. An air service was installed between Kinshasa and Luebo, via Ilebo.

Labour Supply.—The scantiness of the labour supply under the new régime hampered progress. Efforts to combat it were made by ensuring fair terms of recruitment and employment both on private and public work, the code elaborated by the Labour Commission of 1924–5 being widely approved as a model. Great attention was also paid to the campaign to eradicate sleeping sickness and diminish venereal disease.

Trade and Finance.—The War diverted most of the external trade to Great Britain, and though after 1918 Belgium recovered much of her former predominance, imports from Great Britain of foodstuffs, spirits, clothing, machinery, iron sheets, cotton goods, etc., were 17·6% of a total value of 268,719,988 fcs. in 1922, and exports thither, chiefly copper, palm oil and palm kernels, formed 10·3% of a total of 294,579,315 francs.

The loss of revenue through the cessation of governmental exploitation led to constant deficits and, despite a considerable increase in customs duties, in 1924 ordinary revenue stood only at 141,603,640 fcs. as against an ordinary expenditure of 167,949,290 fcs.; there was also extraordinary expenditure of 103,000,000 fcs. and only 5,500,000 fcs. extraordinary receipts. But as against a debt of some 500,000,000 fcs. in 1924 the Colonial Minister claimed assets in the shape of the colony's share in the copper, coal, diamond, gold, radium and cotton industries of not less than 655,000,000 francs. At the same time Belgian investments in the Congo were estimated at 5,553,000,000 francs.

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BELGIAN LITERATURE, FLEMISH (*see* 10.495).—Although during the years immediately preceding the World War, Flemish literature was in a very flourishing condition, it continued to maintain the tradition inaugurated in the 'nineties by the review *Van Nu en Straks*. This latter movement had definitely liberated Flemish writers from antiquated traditions and was the beginning of the modern era in Flanders. Thus, apart from Cyriel Buysse (b. 1859), the most notable figures of this period were the poets and prose-writers born in the 'seventies; their only serious rival of the younger generation being Félix Timmermans (b. 1886).

On the whole—although there are certain exceptions, notably Karel van de Woestyne—the literature of this period is distinguished by its emotional intensity and vitality rather than by wealth of ideas, and this is probably the reason why it is still little known abroad. The best works are difficult to translate. None the less, the literature of ideas gained ground; criticism, in particular, was subject to more serious treatment. Moreover, when one takes into consideration the smallness of the country, the literary output is really remarkable. It is impossible in a short article to give every writer his due, and therefore only outstanding figures can be mentioned.

Poetry.—The poetry of René de Clercq (b. 1877) has a fresh and vivid spontaneity; his invocations of nature, his lyrics of pity or anger, with their warm democratic feeling, are full of vitality. His later works, however, show a falling-off; the poetic ideas have not been allowed to mature, and his style is sometimes too loose. The greatest modern Flemish poet is indubitably Karel van de Woestyne (b. 1878) who, from the appearance of his first volume in 1903, preserved a consistently high level of production. It is safe to say that his complex and sibylline personality has struck a new note in European literature. He is the poet of the soul, racked by suffering, torn by conflict and inspired by a passionate longing for the things of the spirit; and in the sublimation of the ego he has transfigured the heart and senses of man and shown the perpetual conflict between mind and matter, between reality and the soul's dream of eternity. Jan van Nÿlen (b. 1879) and Firmin van Hecke (b. 1884) by their rare purity of style, are closer to him than any other contemporary poets.

Prose Writers.—The masters of narrative prose, Cyriel Buysse and Styn Streuvels, are dealt with in separate articles; the former as an objective realist, has delineated most truthfully Flemish popular life; the latter, by his poetical treatment, idealises it. Maurits Sabbe (b. 1873), with his warm sensitive semi-tones, best reproduces the atmosphere of Bruges. Lode Baekelmans (b. 1879), whose humour is broader, brings to life the dock quarter and the picturesque characters of the Antwerp streets. The tales of Fernand Toussaint (b. 1875) are distinguished by a delicate nuance of technique. The novels of Herman Teirlinck (b. 1879) depart from strict realism; they are imbued with an individual fantasy, which delights in exquisite arabesques. In Van de Woestyne, who has also written several volumes of prose on symbolic themes, the creative imagination reigns alone, remote from reality.

New tendencies, however, are visible in the younger writers of the post-War era. Certain poets, as Urbain van de Voorde (b. 1893), remain true to traditional versification, but others such as Wies Moens (b. 1898) completely break with all tradition and proclaim absolute liberty of rhythm and image; while Paul van Ostayen (b. 1896), discarding all logical phrases and even all idea of "subject," endeavours to express himself by sound values alone.

Ernest Claes (b. 1885) may be mentioned amongst the vivid narrators of the present, but the novelist, Félix Timmermans, achieved the greatest popularity, and at the same time won the appreciation of literary critics. His bright, spontaneous style, full of unexpected images which surprise by their very aptness, is combined with delicacy of perception and the true tang of nature. His *Pallieter* (1916) expresses an exuberant joie de vivre, the equal of which would be hard to find. *Het Kindeken Jezus in Vlaanderen* (1918) and *De Pastoor mit den Bloeyenden Wyngaerdt* (1923) are among his most important works. They are essentially Flemish in their mixture of frank sensuality and mystical tenderness.

In the theatre, Gaston Martens (b. 1884) at times relieves the old realism by a picturesque fantasy and produces an almost extravagant effect. Hermann Teirlinck, of the former generation, however, made, in his later years, the most serious attempt toward a dramatic renaissance: drawing his inspiration simul-

taneously from the medieval moralities and the cinema, he released the drama from the confines of the unities. His characters are types and mainly allegorical, and thus present all the spiritual elements of action moving in visible form. (A. V.)

BELGIAN LITERATURE, FRENCH (*see* 3.680).—Belgian literature which was so flourishing at the beginning of the 20th century, suffered some severe losses during the next two decades. Charles van Lerberghe, the greatest Belgian poet after Verhaeren, whose correspondence with F. Séverin has appeared recently, died prematurely in 1907. The powerful novelist, Camille Lemonnier, succumbed to a grave illness, in 1913; his last works being a tragedy, *Edénie* (1912), and a symbolic story *Au Coeur Frais de la Forêt* (1913). Emile Verhaeren died in 1916. More recently Edmond Picard, a well-known lawyer and critic who exerted a considerable influence on the younger generation, and Ivan Gilkin, one of the founders of *La Jeune Belgique*, were lost to Belgian letters. To these names should be added those of several writers of great talent and promise who were killed fighting for their country. Some of their writings have been collected in *Les Ecrivains belges morts à la guerre*, an anthology that was published in 1912.

War Literature.—The War itself inspired a great amount of literature both inside and outside Belgium. Most of these productions have only an historical interest, others deserve to be considered as contributions to Belgian letters. Among the latter, must of course be included all the writings of Maeterlinck and Verhaeren. A soldier poet, disciple of Verhaeren, Maurice Gauchez came to the fore with *Les Rafales* (1917), and Emile Cammaerts published in London a series of poems, *Belgian Poems* (1915), *New Belgian Poems* (1916) and *Messines and other Poems* (1918), which attracted a great deal of attention.

The most interesting productions of War literature are, however, those which were written during the four years of German occupation (1914–8) or immediately after the deliverance of the country. A. Giraud, and M. Elskamp, published two notable books of poems, *Le Laurier* and *Sous les tentes de l'exil* (1923), and the historian, H. Pirenne, *Souvenirs de captivité en Allemagne.* Among other works of prose let us mention the anonymous *Lettres d'un provincial ou les propos du conseiller Eudoxe*, a satire on German administration after the style of Pascal, *L'oeil sur les Ostrogoths* by E. Verlant, the war memories of M. Lekeux, a Franciscan monk who fought as an officer of artillery, *Mes cloîtres sous la tempête*, and a collection of War impressions by two young writers, Lucien Christophe, *Aux lueurs du brasier*, and R. Vivier, *La plaine étrange.*

While, in former days, literature was practically ignored by the state, several institutions were founded in order to stimulate its activity. In 1920, a Belgian Academy of French language was established by royal decree which published critical studies on Belgian literature and awarded prizes for essays on set questions or for any book of verse or prose worthy of encouragement. Certain endowments were entrusted to it, such as that of the French Société des Auteurs et Compositeurs of a biennial prize for dramatic literature. The Academy passed resolutions which were acted upon by the Govt. and undertook an enquiry into the situation of the French language throughout the world.

Most of the 14 original members of the Academy formerly belonged to the group of *La Jeune Belgique*, and at the end of this period were already looked upon as the writers of the older generation. Among them were: G. Eekhoud, a story writer of Flemish peasant life, and the author of several translations and criticisms on the Elizabethan drama whose work *Perkin Warbeck* appeared in 1914; the Parnassian poet, Albert Giraud, who, besides *Le Laurier* mentioned above, published *Eros et Psyche* in 1920 and *Le concert dans un musée;* F. Séverin, who was particularly successful in his descriptions of Walloon countryside (*La source au fond des bois*); the poet essayist A. Mockel (*La flamme immortelle*, 1924), and two accomplished novelists and story-writers of Walloon extraction: H. Krains (*Mes amis*, 1921) and L. Delattre (*Du côté de l'ombre*, 1924).

The influence of art, so powerful on Belgian literature, reasserted itself in later years owing to the constant interest shown by the Belgian public in modern and ancient painting. Among the poets and playwrights who, more recently, devoted part of their time to art criticism are: G. Le Roy in *James Ensor* (1922) A. Goffin in *L'Art religieux en Belgique* (1924) and G. Vanzype in *L'Art Belge du 19ème siècle* (1923), *Henri de Braekeleer* and *Rubens.*

It has often been noticed that the delight they take in description had somewhat hampered the talent of Belgian novelists. This may account for the fact that, in the writers of this period, as in the former generation, poems and dramatic works were generally above the level reached by novels, though writers of Walloon extraction were less inclined than their Flemish colleagues to mistake their pen for the brush. Among the most distinguished works of the latter since the War, may be mentioned H. Stiernet's *Le roman d'un tonnelier*, H. Davignon's series of novels dealing with Anglo-Belgian relationship, L. Piérard's *Les trois borains*, G. Garnir's *La chanson de la rivière*, E. Glesener's *Les dytiques* and R. Dupierreux's *La certitude amoureuse;* among the former, the most original writers are: H. van Offel (*Les deux ingénus*), F. Hellens (*En écoutant le bruit de mes talons*), and A. t'Serstevens (*Le vagabond sentimental*).

Poetry and the Drama.—It is almost impossible to classify the various tendencies which inspired the work of the modern poets. We find, on one side, a remarkable group of religious poets such as V. Kinon (*L'âme des saisons*), P. Nothomb (*Portes du ciel*), Th. Braun (*Le beau temps*), P. Fierens and G. Raemaekers who illustrate the mystical side of the Belgian temperament; on the other, the group of "La Renaissance d'Occident," headed by M. Gauchez (*Hymne à la vie*) who exalt the joy of life, following the realistic tendencies of Verhaeren. A certain number of poets, like Marie Gevers, (*Missembourg-Antoinette*), and E. Cammaerts, *Poèmes intimes* (1922) insist on the intimacy of homelife, others, like E. Marcuse and L. Kochnitzky, *Elégies bruxelloises*, follow impressionist and humoristic tendencies. R. Verboom, M. Thiry and N. Ruet may be mentioned among the most promising poets of the younger generation.

When considering the drama, we have again to deplore the loss of Verhaeren whose last tragedy *Hélène de Sparte* was given in Paris in 1912. From Maeterlinck, we have had: *The Burgomaster of Stilemonde* (1918), produced in England by Sir Martin Harvey; *The Betrothal* (1918), a sequel to *The Blue Bird* (1910), played in London in 1921; and two plays in modern setting: *The Cloud that Lifted* and *The Power of the Dead* (1923). Maeterlinck's amazing success in Paris, 30 years ago, was almost repeated, in 1920, by a young Belgian playwright, F. Crommelynck, whose semi-grotesque, semi-tragic play, *Le cocu magnifique* (1921), created a sensation at the Théâtre de l'Oeuvre. This author, who seems strongly influenced by the biting humour of Pieter Breughel, published more recently two other plays: *Les amants puérils* and *Tripes d'or.* G. Vanzype, a writer of problem plays who remained steadfastly faithful to his high standard, added three more, *Les semailles*, *Les visages*, *Les autres* to his already lengthy list of works. The dramatic power of Belgian writers can also be clearly detected in the two plays of P. Spaak, *Malgré ceux qui tombent*, and G. Rency, *La dernière victoire*, while such works as H. Soumagne's *L'autre messie* (1924) and P. Demasy's *La tragédie de Faust* and *Jésus de Nazareth* (1924) showed that this power was by no means exhausted among the younger generation. There are few essayists in Belgium, but certain criticisms such as those of J. Destrée, L. Dumont-Wilden, G. Charlier, F. Ansel and C. Bernard are of real and permanent interest. (E. CA.*)

BELGIUM (*see* 3.668).—The eastern frontier of Belgium was rectified in 1919 and 1920; under the Treaty of Versailles Germany ceded to her neutral Moresnet and part of Prussian Moresnet; cantons of Eupen and Malmédy were provisionally ceded to Belgium by the same treaty, and the decision was confirmed by the League of Nations. The area of Belgium was hereby increased to 11,792 sq. miles. The estimated population (1923) is 7,666,055.

On Dec. 17 1909 King Leopold died at the château of Laeken. In 1908 the Congo, of which the King was the personal sovereign,

had been ceded by him to Belgium. The death of the King was followed under the Belgian constitution by a regency, of which M. Schollaert was President. On Dec. 23 1909 the King's nephew, Albert of Belgium, took the oath to the Belgian constitution and became King of the Belgians as Albert I.

I. POLITICAL HISTORY

Belgian political problems before the War arose from the constant increase of the highly industrialised population and the consequent need of economic development. The great urban centres of population were developing with prodigious rapidity, while emigration was practically non-existent. In 1910 the Belgian industrial population amounted to 1,710,161 out of a total population of 7,423,784; 120,000 persons were organised in the trade unions. This enormous importance of industry, as of commerce, largely determined Belgian policy. Belgium throughout maintained practical free trade. In 1900, customs dues only represented 2·3% of the value of imports, in 1913 1·4 per cent. Yet, important as commerce and industry are, agriculture represents an economic wealth not inferior to them. It is highly developed and its products constitute one of the principal branches of export. These two poles of the economic strength of the country, industry and agriculture, also determine the strength of the political parties.

Political Parties.—Industry, with its enormous man power, has furnished recruits for the Socialist party, while the agricultural population forms the basis of the Catholic party, and especially of its democratic wing, the Christian Democratic party. Both the Socialist and the Christian Democratic parties are parties of social organisation. Socialism has created enormous workmen's co-operative organisations, as the *Vooruit* at Ghent, the *Maison du Peuple* at Brussels and the *Travail* of Jolimont; in 1910 the Socialist party had organised 3,000,000 members in its co-operative undertakings, which had a turnover of more than 100,000,000 francs annually. Similarly, the Christian Democratic party created a number of trade unions and social organisations, often directed by the priests. The most important of these are the *Boerenbonden*, peasants' associations for co-operative purchase and sale through societies formed on the Raiffeisen system, which are organised in all the great rural districts in the Flemish districts. This vast federation of peasants' associations has its centre in Louvain, where it has established an important bank. These two groups of democratic organisations, which constitute two powerful and disciplined masses of electors and are backed by great material resources, exercise a decisive influence on politics, the trend of which is towards social and economic control.

The Socialist trade unions were to try their strength in the campaign which they undertook in 1912 in favour of unlimited universal suffrage. This campaign coincided with the violent educational struggle which now opened between the parties of the Left (Liberals and Socialists) and the Catholic parties. The latter, who had a majority in the Chamber, brought forward a bill in 1912 to place the free schools and the public schools on an absolute equality. Education, especially primary education, is largely in the hands of religious establishments, whose schools are recognised and subsidised by the state, and are in many parishes the only ones. For these religious schools the Government proposed a treatment similar to that accorded by the state to public education. The Liberals and Socialists united against the Right. Nevertheless, in the elections of 1912 the Catholic party retained a majority in Parliament. In order to prevent this education bill from becoming law, and to force the introduction of universal suffrage, the Socialist party organised a general strike in April 1913. Several hundred thousand workmen went on strike. The educational law was passed, but the Government agreed to introduce compulsory education as a concession to the Liberal party, and the laws of May 19 and June 15 1914 make attendance at schools compulsory between the ages of six and fourteen.

Important, too, were the linguistic and military questions. Belgium had enjoyed uninterrupted peace since 1830, and had interested herself little in military problems. In 1912, however, the threatening international situation obliged the Prime Minister, M. de Broqueville, to introduce legislation instituting the principle of compulsory military service. In 1913 the army was completely reorganised; the general staff received the most extensive powers, a superior council of national defence was instituted, and schools of artillery, cavalry and engineers were created. The École de Guerre and École Militaire were reorganised, and armament was brought up to date. These reforms were to be complete in five years.

The War, 1914–8.—The international crisis which came to a head in July 1914 found Belgium unprepared for war, in spite of her recent military laws. The neutrality of Belgium, and Luxembourg had been guaranteed by the five Great Powers (Great Britain, France, Prussia, Russia and Austria) in the treaties of 1839, which bound the guaranteeing Powers to intervene if either party to a war violated that neutrality. On July 30, following the precedent in 1870, Sir Edward Grey addressed a message to the French and German governments, drawing their attention to this point and asking for an assurance that Belgian neutrality would be respected. The German Govt. declared itself unable to answer this question; and on Aug. 2 invaded Luxembourg and sent Belgium an ultimatum calling on her to allow the German troops free passage across Belgian territory. If the request was refused, Germany would treat Belgium as an enemy. To this note Belgium, who had mobilised 15 classes of militia on July 31, replied by a formal refusal on Aug. 3. Parliament accepted war unanimously, and the Socialist party assured the Government of its unreserved support. The leaders of the Liberal and Socialist parties, MM. Goblet d'Aviella and Hymans and M. Vandervelde, joined the Government as ministers without portfolio.

The War Period

The Invasion.—In the night of Aug. 3–4 the German Army invaded the country. Liége fell on Aug. 7 and Namur on Aug. 23. The province of Namur was ravaged, the towns of Andenne, Tamise and Dinant were pillaged, and it is estimated that in the province of Namur 1,949 persons were killed and 3,000 houses destroyed. After their entry into Louvain the Germans set fire to the centre of the city, when the cathedral of St. Pierre, the famous library and 1,120 houses were destroyed. Seventy-nine of the inhabitants were shot. The town of Aerschot was almost destroyed. The Germans entered Brussels on Aug. 20. In the course of the occupation of Brabant 594 inhabitants were shot and in the Antwerp and Hainault provinces 665 persons. Antwerp was evacuated by the Belgians on Oct. 6, and with the withdrawal of the Belgian Army to the Yser the whole country, with the exception of the southwestern districts of Flanders, was under German occupation. (*See* World War.)

The German Occupation.—Germany sent General von der Goltz, Baron von Bissing, and General von Falkenhausen as successive governors-general. The governor-general, assisted by a central staff, exercised executive power. He legislated by promulgation of orders, except in the two Flanders, Hainault and South Luxembourg, where all power rested with the highest local military authorities. Provinces and districts were administered by German officials, with military commandants of cantons. The powers of the Belgian provincial councils were finally suppressed on July 6 1918. Many Belgian burgomasters were deported. The occupied territories paid a tribute, amounting finally to 60,000,000 fr. per month, for the maintenance of the German Army in Belgium. The legislative measures instituted by the German military tribunals were numerous and repressive (*see Législation et administration allemande en Belgique de 1914 á 1918*, J. Pirenne et M. Vauthier, Carnegie Endowment). Von Bissing also instituted, Feb. 5 1915, a new judicial system, with two courts of instance, that of the provincial governors and of the heads of arrondissements and of commandants. The executive and judicial power were not separated. On April 3 1917 the governors were empowered to pronounce total or partial confiscation of property. The Belgian judicial powers were suppressed by decree of April 7 1918. German *Kaiserliche Bezirksgerichte* replaced the Belgian *tribunaux répressifs*. The family was pronounced responsible for faults committed by a single member of

it. A sentence pronounced on an absentee could be served by a third person; general confiscation of all property, forbidden by the Hague Convention and the Belgian constitution, was introduced, as was deportation for refusal to work for the German authorities, or even for simple "undesirability." On April 7 1918 German tribunals of first instance and appeal (in Brussels and Namur) replaced all civil Belgian jurisdiction. The Belgian magistrates, bench of judges and court of appeal made frequent protests. Three presidents of the last-named were deported in 1918 in consequence of a conflict arising out of the arrest of certain "activistes" leaders.

In order to disorganise the country, Germany sought to exploit the linguistic differences between Belgium's northern and southern provinces with the help of the so-called *parti activiste*. From 1916 on, various decrees abolished the French language in the previous bilingual administration of Flanders. On March 21 1917 a decree was issued dividing Belgium into two distinct linguistic regions, with administrative centres at Brussels and Namur. All ministries were doubled, the Flemish remaining in Brussels, the Walloon moving to Namur. French became the only official language in the Walloon district, Flemish in the west. The use of German and Flemish was, however, authorised in Walloon territory. The *activistes* attempted to organise a new independent Flemish State under German protection. On Feb. 11 1918 an enormous demonstration was held in Brussels against separation. German troops dispersed the crowds, but, in face of the unanimous protests of the Belgian authorities, Germany did not dare recognise a legislative authority for the *Raad van Vlaanderen*. With ceaseless energy, however, she continued her efforts to foster linguistic differences, notably by flemicising the University of Ghent.

Industry suffered severely from the occupation. Raw materials were requisitioned, foreign enterprises put under sequester on Feb. 17 1915, together with all industrial concerns which might be useful or dangerous to Germany, especially great metallurgical businesses, quarries, mines, electricity works, etc. In 1915 central offices were set up for the coal, oil and grease, water, gas and electrical industries. The Government thus controlled all the essentials of industry.

The stoppage of overseas exports ruined Belgian industry. Unemployment increased enormously, reaching 650,000 in 1916. Germany desired to recruit these workmen for her own use, but met with obstinate refusals. On Aug. 14 and 15 1915 appeared the first decrees ordering severe penalties for persons who refused to work for Germany. At the same time, commissions were sent from Germany to take out of the Belgian workshops everything which could be used beyond the Rhine, and to destroy systematically all machinery which could not be transported to Germany. By June 30 1918, 167 factories had been completely destroyed, and 161 were on a list of the governor-general's for immediate destruction. Of the 57 blast furnaces, 26 had been rased to the ground, 20 put completely out of action. Only the mines necessary for Germany were spared. When the Germans retired, in 1918, they ordered these mines to be flooded, but the order was not carried out.

The process of destruction was hindered by the protests of the neutral powers, who threatened Germany with economic reprisals. On Feb. 18 and July 21 1917 work was forbidden in all factories and workshops except by special permission; the whole Belgian working population was thus thrown out of work. At this moment Germany ordered the stoppage of all public works undertaken by the provinces and communes for the relief of unemployment. These steps were preliminary to the plan of deporting the Belgian working population. In Nov. the military authorities requisitioned able-bodied men between the ages of 17 and 60 throughout the whole country. Inhabitants on the lines of communication were mostly sent to the Yser or North French fronts, to construct railways, prepare routes and dig trenches, often within the range of artillery. The other workmen were concentrated in great camps in Germany, whence they were dispatched to German factories or labour battalions; 57,718 were transported to Germany, 57,541 to the front; 2,531 died in consequence of ill-treatment.

Foodstuffs began to grow short in Nov. 1914. Immediately on occupation, the German Govt. had repealed all measures taken by the Belgian Govt. to insure rationing. Public authority had now no further power to intervene, and private initiative stepped in. Committees sprang up everywhere. A central committee was founded at Brussels under the title "Comité Central de Secours et d'Alimentation," under M. Ernest Solvay. The Committee desired to import foodstuffs from England, but the British Govt. refused. Finally, Von der Goltz having promised to exempt all imported foodstuffs from requisitioning, the British Govt. consented to allow their import under the supervision of the embassies of Spain and the United States. The "Commission for Relief in Belgium" was set up to organise the supervision (*see* RELIEF). The activity of the Comité Central acquired enormous importance, and extended throughout the country. It then changed its name to "Comité National de Secours et d'Alimentation." By Dec. 31 1918 it had distributed foodstuffs to provincial committees to the value of over 3½ milliard francs (2½ milliards for Belgium, 1 milliard for France). The profit made on the sale of foodstuffs was used to organise charitable works at an expenditure of 1,300,000 francs. After America's entry into the War Mr. Hoover resigned his post as president of the commission for relief in Belgium, and a Spanish-Dutch committee took over the work.

The Belgian Government during the War.—The German occupation forced the Government to retire, first to Antwerp, then to Ostend, then to Havre. At the same time, over 1,000,000 Belgians left the country, 200,000 fleeing to France, 100,000 to England and 700,000 to Holland. The Government in Havre immediately set about reorganising the army, which had never left the front. On March 1 1915, after having reorganised the necessary centres of instruction, the Government called to the colours all Belgians from 18 to 25. Numerous volunteers joined the forces. Thanks to the establishment of officers' schools, centres of instruction, munitions factories, gun foundries and hospitals, the Government managed to maintain an army in the field with a mean effective strength of 150,000.

PEACE AND RECONSTRUCTION

The Peace.—Belgium was represented by MM. Hymans, Vandervelde, and Van den Heuvel at the Peace Conference, but was not admitted to the deliberations of the Council of Ten. At the second plenary session of the Peace Conference the Belgian, Canadian and certain other delegates protested against the control assumed by the "Big Five;" and from that time more scope was given to the representatives of nations other than the Principal Allied and Associated Powers. M. Hymans played an important part in drafting the Covenant and M. Vandervelde in framing the constitution of the International Labour Office. The Treaty of Versailles did not restore to Belgium the Grand Duchy of Luxembourg and Dutch Limburg which had been alienated from her by the treaties of 1839. But at Versailles, she received again her own sovereignty and part of the Prussian Moresnet; while Germany renounced in her favour her rights over the Walloon cantons of Eupen and Malmédy. Belgium was confirmed in the possession of these two cantons by the League of Nations. The Grand Duchy of Luxembourg (*q.v.*), by a plebiscite held in Oct. 1919, voted for a customs union with France by 60,135 votes against 22,242 votes cast for Belgium. In 1920, however, France renounced her claim in favour of Belgium; and on July 25 1921 Luxembourg entered into a customs, railway and consular union with Belgium. In Africa, Belgium received the mandate for the Urundi and the Ruanda, representing part of the territories conquered by the Belgian Army, which was operating with the forces of the British Empire during the War.

After the War the problem of Belgium's international status took on a new form. Belgium was anxious to free herself of the restrictions on her right as a sovereign state to form defensive alliances, especially as the guarantee of neutrality which had been substituted for this right had proved ineffectual. The treaties of Versailles, Saint-Germain and Neuilly accordingly contained

the provision that Germany, Austria and Hungary recognised that the treaties of 1839 no longer conformed to the requirements of the situation, consented to their abrogation[1] and accepted in advance whatever arrangements might be made to replace these treaties by the Principal Allied and Associated Powers, or by any of them in concert with the governments of Belgium and of the Netherlands.

The logical consequence of the new position was a military convention concluded in Aug. 1920 between Belgium and France, after full consultation between the respective general staffs. In Nov. 1920 the two governments informed the League of Nations that the military alliance had been concluded, and that it was of purely defensive character, but no details were disclosed. It only comes into force in case of unjustified aggression on the part of Germany; and stipulates formally that each of the signatory governments shall decide finally in each case whether it is to be applied.

Belgium offered to conclude a similar agreement with Great Britain; indeed, her ardent hope was to see a Belgo-Franco-British Entente established. This could not be achieved; but Belgian foreign policy had a clear mission to maintain the traditions of the Entente and to reconcile the British and French points of view. Her representatives at the various international congresses, MM. Paul Hymans, Jaspar, Theunis and Vandervelde, did important work in this direction. Belgium's policy has naturally been mainly influenced by the two problems of security and reparations (*see* the articles under those headings). Under the influence of the latter problem she joined the French in their occupation of the Ruhr (*see* RUHR). On every occasion she has shown herself as conciliatory as possible, while insisting on the necessity of receiving due reparation. In order to arrive at a practicable settlement of the reparations question, Belgium repeatedly sacrificed her rights of priority for the benefit of her Allies (*e.g.*, July 1920, Aug. 1921, July 1922). Belgium became a non-permanent member of the Council of the League of Nations on its formation. M. Paul Hymans was elected the first President of the League.

The Treaty of Versailles guaranteed Belgium priority for the sum of 2,000,000 gold marks on Reparations account. In addition her allies declared themselves ready to transfer Belgium's war debt (5,600,000,000 fr.) to the German reparations account. In 1925 the United States required from Belgium recognition of her war debt, although the remission of this debt had been foreseen by the treaty. An arrangement was concluded with America regarding this debt on Aug. 18 1925 (*see* section on national finance).

The question of the Schelde was not solved by the Treaty of Versailles. Belgium attempted to reach a *modus vivendi* on this subject with Holland; but no arrangement could be reached, as Holland laid claim not only to the sovereignty of the waters of the Schelde, but also to the sovereignty of the Wielingen channel which would have made possible the complete isolation of Belgium from the sea. On April 3 1925 a new treaty was signed settling the relationship between the two countries.

Reconstruction.—After the conclusion of peace the government was chiefly occupied with the problem of feeding the country, which necessitated various measures prohibiting export and authorising the requisitioning of home-grown foodstuffs. In consequence of the destruction of industry, there were 800,000 unemployed in the country and 2,400,000 persons, or one-third of the population, were dependent on public assistance. The state was obliged to create relief works immediately. The number of persons organised in trade unions rose from 200,000 in 1914 to 600,000 in 1919. By the end of 1919 the 2,000 km. of railway which had been destroyed were reconstructed. Thanks to the recovery of the 24,000 Belgian machines brought back from Germany and to the huge orders for material placed in England and America (which were made possible by the credits granted to industry by the banks, these having enlarged their capital considerably for this purpose), industry recovered rapidly.

[1] In the Locarno Pact Oct. 16 1925 Germany, Belgium, France, Great Britain and Italy took note of the adoption of the treaties for the neutralisation of Belgium. A treaty signed in Paris May 22 1926, by Great Britain, France and Belgium confirmed the abrogation of these treaties. Germany, Austria, the Netherlands and Soviet Russia were to be asked to give their adhesion.

The economic and social problems were rendered much more complex by reason of the difficulties which faced the Government; the reconstruction of the devastated regions, valued at over 35 milliard francs, called for very great sums; military pensions, indemnities for damage caused by war, unemployment doles swelled the budget disproportionately. In 1919 the public debt had risen from 4 milliard francs before the War to 13 milliards, and passed 30 milliards in 1921. At the same time the fall of the exchange continually increased the cost of living. In 1925 the Belgian francs seemed stabilised at 106 francs to the £ and the index cost of living at 500. This rise of prices naturally necessitated a great increase of salaries and readjustment of wages. At the same time the demand for social legislation increased greatly. On June 1 1919 the working day was reduced to 8½ hours, and on Dec. 1 to eight hours. This great victory of democracy brought a series of industrial crises. To prevent or diminish conflicts, national councils, formed by delegates of the masters and the workmen in equal numbers, with an official as president, were set up after the Armistice. The action, although devoid of any legislative backing, was often successful. Similarly in the mining industry, especially in the basins of the Centre and Borinage, a whole system of arbitration was set up, freely organised by the masters and workmen. The financial measures of the Government were also democratic in tendency, including income tax, super-tax and an increase in succession duties.

The fall of the exchange impoverished the middle classes, holders of state papers and mortgages and small house owners. This was further accentuated by the housing law, permitting tenants to continue to occupy their dwellings, limiting the rent to a sum not exceeding 125% of the pre-War rents, while building costs had increased by 700%. On the other hand, the quick recovery of industry, speculation on the exchange and in shares, and the great orders necessitated by reconstruction contributed to enrich the industrial and commercial classes. The high price of living also improved the conditions of the peasants, who spent enormous sums on acquiring land. Thus the middle classes were in a difficult situation between the rich capitalists on one side and the workmen and peasants on the other. The activity of the banks drained out all the free money in the country, and gave real power to the great financial establishments.

The considerable improvement in the condition of the working classes increased the power of the trades unions. The Socialist party formed the *Banque Belge du Travail*, while the increased wealth of the peasants gave the *Banque des Boerenbonden* very great financial and political power. The political result was the weakening of the Liberal party, which was recruited from the middle classes, an access of strength for the Socialist and Catholic parties, and an increase of the democratic element. The passing of a law which re-established the legal personality of associations not aiming at profits (June 27 1921) also deserves mention. This law met a real demand, and the country is now covered everywhere with charitable, scientific or social associations. The religious establishments are all under this form.

The intellectual life of the country revived. The *Association Internationale des Académies* chose Brussels as the centre of its activity. On Aug. 19 1920 an *Académie de la Langue Française* was formed at Brussels. The status of legal personality benefited the free universities of Louvain and Brussels and the universities of Ghent and Liége. The profits realised by the commission for Relief in Belgium went to constitute a university fund, with a capital of 80,000,000 fr., for the development of the sciences in Belgium. Each university was further endowed with a capital of 20,000,000 francs. A war archives department was established to collect all documents bearing on the history of the War between 1914 and 1918. The period of restoration was blessed with a truce in the political struggle, unlimited universal suffrage from the age of 21 was introduced at the demand of the Socialist party; female suffrage, which was claimed by the Catholic party, was granted for communal elections.

The elections of Nov. 16 1919, under the new franchise, resulted in the Catholic party's losing the majority which it had held since 1884. At first the country was under a "concentration"

Government, presided over by M. Delacroix, and later by M. Carton de Wiart; afterwards by a coalition between Catholics and Liberals under M. Theunis; then, after the elections of April 1925, in which Socialists balloted 818,852 votes, Catholics 751,011 and Liberals 305,032, by a democratic Catholic-Socialist coalition under MM. Poullet and Vandervelde. In May 1926 M. Henri Jaspar, as prime minister and minister of the interior, assumed office with the support of all parties in the Chamber and the Senate, except a handful of extremists.

But the most acute political question in Belgium became the language question. Official statistics in 1910 showed that of Belgians over 15 years of age 2,198,296 spoke French only, 2,136,022 Flemish only, while 805,012 were bilingual. From the linguistic point of view the country may be divided into three zones: (*a*) the Walloon districts of Liége, Namur, Luxembourg, Hainault and South Brabant, with a minority in 1910 of 23,531 speaking only Flemish, (*c*) the Flemish districts of East and West Flanders, the province of Antwerp, Limbourg and the northern districts of South Brabant, with a minority in 1910 of 56,232 speaking French only; (*b*) the *arrondissement* of Brussels, situated between the Flemish and Walloon zones, in which the languages are fairly evenly balanced. An inquiry made in the city of Brussels in 1920 gave 15% Flemish-speaking, 33% French-speaking and 50% bilingual inhabitants.

Defence.—According to the Military Law of 1923, the Belgian Army is partly conscript, partly volunteer. Compulsory service with the colours is 12 months in the infantry, fortress artillery and engineers; 13 months in the cavalry, horse field artillery and horse transport corps. Military service lasts for 15 years in the regular army and reserve, 10 years in the territorials. Reserves are only called out in case of danger of war. The strength of the army with the colours in Dec. 1924 was 5,410 officers, 10,849 N.C.O.'s 63,181 men and 6,303 gendarmerie, total 85,743. The field army consists of 4 regular and 2 reserve corps, besides a heavy artillery brigade, air and miscellaneous units at the disposal of the Grand General Staff. The navy is small, consisting of the ex-British sloop "Zinnia," 14 ex-German torpedo boats and 22 motor launches.

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II. THE FLEMISH MOVEMENT

The Flemish movement took clear shape as early as 1830. In the nineties the extension of the suffrage strengthened the movement, and the law of 1898 proclaimed the Flemish language officially on an equality with the French. The progress of democracy, the growing riches of a very fertile literature, the rise of a Flemish upper class side by side with a French-speaking upper class, were destined from now on to multiply the causes of conflict and to necessitate many readjustments.

The census of 1910 established the numerical strength of the linguistic groups: the northern half of Belgium is Flemish; the southern half is Walloon, while the population of Brussels at the present time is mixed. The Flemish minority in the Walloon districts is composed of peasants and unskilled workmen, whilst the French-speaking minority in the Flemish district forms a great part of professional, financial, industrial and commercial circles, and has, therefore, a much higher social coefficient. In the capital, where the population is mixed, French is predominant. The Flemish movement is, therefore, faced with two obstacles: on its own territory, a large fraction of the bourgeoisie, numerically small but socially important; in Parliament, a coalition composed of most of the Walloon deputies, a majority of the Brussels deputies and certain Flemish deputies, this coalition being usually in the majority.

The Flemish point of view is that the extension of culture in Flanders is only possible if the free development of the popular language is assured. A certain number of citizens maintain that it is impossible to carry this process too far without endangering the unity of Belgium. The Walloon case is briefly this: if the Walloon is to know both languages in order to gain a public position in the central administration or a rank in the army, he is at an immediate disadvantage, since the Flemish have a much greater general interest in learning a widespread language, whereas the Walloon finds it difficult to learn Flemish in a practical fashion; besides which the Walloons are disquieted by the fact that the Flemish birth rate is something like three times as high as their own.

In the years before the War, the struggle centred chiefly round the University of Ghent. There are four universities in Belgium:- two state-maintained at Ghent and Liége, and two independent, at Brussels and Louvain. A bill was brought forward in 1911 by representatives of the three great political parties for the progressive Flemicisation of the University of Ghent. The question had not been settled when war broke out. On the other hand, Parliament in 1913 voted a Law demanding from army officers a sufficient knowledge of the two languages; it was unfortunately too late for this arrangement to take effect during the World War. The Education Act of 1914 provided that the language habitually spoken by the child should be the vehicle of instruction. In the course of these years, the Separatist idea began to strike root especially among the Walloons and chiefly for political reasons: annoyance at seeing a Catholic government, which rested mainly on the Flemish rural masses, remaining in power since 1884.

During the War the German authorities tried to exploit the linguistic question to destroy national unity. Their efforts were helped by some Walloons and by larger groups of Flemish "activistes," some of whom believed in a German victory, while others expected a peace by agreement which would leave the measures taken by the occupying authorities untouched in a free Belgium. They had no support from the population, and the recognised leaders of the Flemish movement opposed activism resolutely. In 1916 the Germans Flemicised the University of Ghent; in 1917 they decreed administrative separation. At the same time a Flemish Parliament, or "Raad van Vlaanderen" constituted itself, and proclaimed the autonomy of Flanders in Dec. 1917. Nothing of this survived the armistice.

After the War, the linguistic problem was more urgent than ever. A law of 1921 established equality between the two languages in internal administration. The plan of Flemicising the University of Ghent, first broached in 1911, passed the Chamber of Representatives in 1922 by a very small majority, but was thrown out by the Senate. A compromise was necessary, and in 1923, a fresh bill established a bi-lingual régime in the University of Ghent: one-third of the courses was given in French; one-third in Flemish, and the student might choose for the last third between a Flemish and a French section. This compromise satisfied no one. Pro-Flemish students saw in it the official consecration of a principle which they refused to admit, that is, the equality of the two languages in Flemish districts, and therefore boycotted the Flemish section. Extremist ideas gained much ground; they are represented in the first instance by the "party of the front" which was originally composed of soldiers of the Yser, but which ended by incorporating the whole Flemish nationalist movement. Their aim is autonomy of Flanders under the Federal régime, and they are the most vigorous advocates of the manifesto in favour of the condemned "activistes." The great majority of Flemings, however, remain neutral in the traditional political parties, and refuse to acknowledge any separatist aims, especially in view of Belgium's international situation.

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(A. V.)

III. NATIONAL FINANCE

Pre-War Situation.—The Belgian Budget in the pre-War years presented the following results:—

	Ordinary Receipts Fr.	Ordinary Expenditure Fr.	Balance Fr.	Extraordinary Expenditure Fr.
1910	682,487,000	672,954,000	9,533,000	156,502,000
1911	695,252,000	689,186,000	6,066,000	121,760,000
1912	755,463,000	749,254,000	6,209,000	146,517,000
1913 (provisional)	788,614,000	787,385,000	1,229,000	142,947,000

To appreciate these results, it must be remembered that the receipts and expenditure of the railways are included in the state accounts. Of the extraordinary expenditure which was financed by loans, about one-half was allocated for the railways. The remainder was used for productive purposes.

Public Debt.—The public debt was apparently high (five milliard gold francs on the eve of the War), but it had been largely contracted for railways, telegraphs and telephones. Directly productive state property was worth at least 3½ milliard fr.; it yielded about 120,000,000 fr. in 1912, when the public debt absorbed only 160,000,000 francs. The provision for the public debt moreover included a sinking fund. In 1913, the sum of 20,000,000 fr. was devoted to its reduction.

This provision for the extinction of the debt, together with the surpluses of the Ordinary Budget, compensated for the abuses of the Extraordinary Budget; Belgian finance may therefore be said to have been healthy. Taxpayers were not heavily burdened. The total national income was estimated at 6½ milliard fr., and in 1913 the yield of the taxes amounted to 345,000,000 fr.; that is to say, they only absorbed 5% of the national income, as against 11% in France.

Post-War Situation.—War expenditure was incurred without any legislature control, and no account had been drawn up by the end of 1925. During the occupation, the Germans levied war contributions on Belgium amounting to 2,620,000,000 gold fr.; in addition, they exacted 68,000,000 fr. from the communes. Belgian indebtedness to the Allies amounted to 5,600,000,000 gold marks. This was placed to German account by the Treaty of Versailles, but the United States were not signatories of the treaty. The Treaty of Versailles further allotted to Belgium a priority of 2 milliard gold marks on Reparation account.

Upon the German evacuation, the Belgian Govt. decided to redeem the marks in circulation on the basis of 1·25 fr., as German currency had been imposed on the people. A sum of 7,592,000,000 fr. was required to effect this redemption, and this was the beginning of Belgian inflation. The Government never printed notes to cover the Budget deficit; it even repaid 600,000,000 fr. of the advances received from the National Bank for the exchange of marks. The Allies did not agree to place to German account the cost incurred for the redemption of German marks circulated during the occupation, but Belgium did not lose all hope of, at any rate, a partial indemnification for the losses she had sustained during the struggle.

In 1919 the fiscal system, which had been in force for a century, was recast. The previous direct taxes were replaced by an income-tax modelled on the English income-tax. It comprises three direct taxes—the tax on land, the tax on investments and the tax on salaries and earnings—together with a supertax.

Financial Situation.—The financial situation of Belgium was very serious for years, so serious that the public debt increased by 40 milliard francs. This state of things was due to the German invasion and to the cost of the reconstruction of devastated areas, completed in 1924–5. By June 30 1924 Belgium had advanced on German account 20,719,000,000 fr., excluding the cost of the redemption of the mark. But the crisis was passed in 1923. Compensation for war losses was nearly completed in 1926; after this the payments made under the Dawes Plan could be devoted entirely to the reduction of the public debt, the normal reduction of which still continued. This was calculated to absorb 300,000,000 fr. in 1926.

In view of the incompleteness of the public accounts, the best means of judging Belgian finance since the Armistice is to follow the progress of the public debt, external debt being calculated at the same rate of exchange. The figures for the financial years, beginning in Sept. of each year, are as follows:—

1919–20	Increase of 5·5 milliard fr.
1920–1	Increase of 6·0 milliard fr.
1921–2	Increase of 2·5 milliard fr.
1922–3	Increase of 1·0 milliard fr.
1923–4	Increase of 0·2 milliard fr.
1924–5	Increase of 1·0 milliard fr.

These figures exclude the American debt, reinstated in the Belgian National Debt in accordance with the agreement of 1925. The increase of one milliard registered in 1925 is compensated by balances accumulated at New York to meet the fluctuations of the exchange.

Summary.—Since 1923 the Belgian debt remained stationary, in spite of expenditure in two years of 600,000,000 fr. for railway construction, and still more considerable sums for public works, such as the port of Antwerp and the devastated areas. The budget of 1925, from which the accounts of the state monopolies are excluded, is as follows:—

	Receipts Fr.	Expenditure Fr.
Ordinary	4,268,007,000	4,526,390,000
Extraordinary	115,821,000	611,711,000
Reparations	976,707,000	928,345,000
Total	5,360,535,000	6,066,446,000

The deficit of 706,000,000 fr. is explained by the important works undertaken by the state, and the indemnification for war losses. Ordinary expenditure includes the whole service of the debt, even that incurred in Reparation account. The estimates for 1926 foresaw a deficit of not more than 200,000,000 fr., more than covered by receipts from arrears of taxation and the reduction of debt.

On Sept. 30 1925 the position of the public debt was as follows: Consolidated, 28,770 millions of francs; floating, 16,120 millions of francs; total 44,890 millions of francs. Of this, 13,925,000,000 fr. were external debt, the dollar being reckoned at 22·50 francs.

On Aug. 18 1925 Belgium concluded with the United States an agreement on the debt. This is to be repaid by the year 1987, by means of annuities reaching the sum of $12,700,000 from 1936 onwards. The War debt is not subject to interest, while the debt incurred since the War bears a rate of interest calculated at 1·35% up to 1934, and at 3½% in subsequent years. By an agreement made with Great Britain, Dec. 31 1925, the total debt of Belgium and of the Belgian Congo to that country (£12,600,000) is to be paid within 30 years, the interest being 5%. At the end of 1925, Belgium was preparing a currency reconstruction, on the basis of the stabilisation of the franc at 100 fr. to one pound sterling or slightly more.[1]

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IV. ECONOMIC HISTORY

Belgium is more highly industrialised than any country on the continent of Europe, with the exception of Saxony. In the second half of the 19th century, *i.e.*, between the two great censuses of 1846 and 1900, the industry of the country underwent a fundamental change through the immense increases which took place in the numbers of the working class, and, more especially, in the amount of motive power employed. Leaving the transport industries out of account, the total steam power increased more than tenfold in this period, namely, from 40,000 H.P. to 430,000 H.P.

In the period 1911–25 Belgian industry continued to progress in the same direction, in spite of the World War and the military occupation. Since the War, the amount of available energy has been increased by means of various improvements, so that comparison is difficult; but it is probably not an over-statement to put the increase in the aggregate motive power of industry at not less than 50%, the most noteworthy additions being in the coal mining, metallurgical, glass-making and textile industries, and in the power-producing industries themselves. The increase in the power used in, and produced for certain industries is as follows:—

[1] For six months (Oct. 1925 to March 1926), the Belgian currency remained steady but a hitch in the foreign loan negotiations and internal difficulties has caused a breakdown. The new three-party Government proposed drastic measures and the stabilisation of the franc at a higher rate.

Industry	Power in kilowatts	
	1910	1923
Coal-mining	208,200	351,929
Metallurgical industries	146,941	158,873
Glass, glassware and plate glass industries	18,225	28,548
Textile	107,196	113,726
Special electricity works	91,815	250,380
	572,377	903,456

Mining.—In the southern coal-fields, which have been worked for a long time, production tends to decrease, as the following figures show:—

Year	Thousands of Tons	Year	Thousands of Tons
1911	23,054	1923	22,115
1913	22,842	1924	22,243
1919	18,343		

The exploitation of the northern coal-field, the Campine district, is, on the contrary, of very recent date, and this area has a great future before it.

In 1872, just after the trial borings in Dutch Limburg, the Belgian geologists, Lambert and André Dumont, asserted the existence of coal in Belgian Limburg. A first partial investigation was undertaken by J. Urban, who made borings at Lanaeken in 1897. His venture was unsuccessful, as was that of A. Dumont at the end of Jan. 1899; but in Aug. 1901 two further attempts by Dumont established the existence of coal in this region. It is now known that the Campine coal-field occupies an area of more than 100,000 hectares, and the coal content is estimated at 8,000 million tons. The beds consist chiefly of excellent gas- and coking-coal, *i.e.*, the very kind which is becoming exhausted in the southern coal-field, and, failing fresh supplies, would eventually have had to be brought in from abroad. The Campine beds lie at a great depth, the distance from the surface varying from 475 to 620 metres for different kinds of coal. The earliest concessions in the area, and the first companies formed to exploit them, date from the first decade of the present century. Up to the end of 1923 the total costs of production in the Campine district had amounted to 550,000,000 francs. Extraction only began in 1917, but in that year 11,640 tons were raised and the subsequent increase has been very rapid; in 1919 the amount had risen to 140,000 tons and in 1924 to 1,116,670 tons.

In all the Belgian mines machinery is being increasingly employed. In 1923, 49·2% of the coal in the southern coal-field was mechanically hewn and 59% in the northern. The yield from the metal mines, which had greatly diminished since the middle of the 19th century, showed in 1926 signs of increasing vitality. Several factors have been responsible for this new development, which, however, is still in the preliminary stage.

Quarrying.—The comparative positions are indicated by the following figures:—

	1911	1923
No. of quarries at work	1,558	891
Value of the production (in gold francs)	64,700,000	83,000,000
Number of workmen employed	35,809	28,427

The output of the industry is mainly in squared porphyry and sandstone, but includes also lime and the raw material of the cement industry, which has considerably increased its equipment since the War.

Iron and steel were greatly injured by the destruction due to the War, but, like many other industries, it is actually in a better position than before, owing to the replacing of the equipment destroyed by new and improved kinds.

	1911	1924
Blast furnaces in operation	49	54
Pig-iron production (thousands of tons)	2,046	2,808
Average No. of workers employed in iron and steel works (blast furnaces, steel works, and rolling mills)	32,935	35,086(1923)
Production of rough steel (thousands of tons)	2,128	2,780
Production of finished steel (thousands of tons)	1,655	2,379

Similarly, in the metal construction and machinery industries—although here, again, precise statistics are lacking—it is evident that resources have been considerably developed, and various kinds of work are now done in Belgium for which recourse had formerly to be had to foreign countries. The development of the electro-technical industry is especially remarkable.

Zinc and Lead.—New mineral industries have arisen, namely, tin, cobalt, electrolytic copper and radium production. These are all comparatively new in Belgium; the raw materials are obtained from Belgian Congo, the mineral wealth of which led English consul to say that Katanga would prove another Rand, as far as copper was concerned; the supply of uranium discovered in the same province of Katanga has given Belgium a decisive preponderance in radium production. The drop in prices which followed the opening of the Oolen works (Campine district), which deal with the Katanga minerals, has led to the closing of a number of foreign undertakings of a similar kind.

Glass Making—The use of mechanical methods is being rapidly developed, the processes employed being those invented respectively by the Americans, Libby and Owens and the Belgian Fourcault. The present production of glass is over 41,000,000 sq. metres, or very nearly that of the pre-War period; 26% of this is made by machinery which the industry formerly did not possess. Owing to especially favourable conditions the plate glass industry has been exceedingly prosperous since the War. Plant has been greatly extended and many foreign factories are now under Belgian control (in Germany, Czechoslovakia and Poland).

Textile Industries.—In this group the number of working-class factories grew very greatly after 1910. The " Filatures et Tissages " of the celebrated co-operative organisation " Vooruit " is the largest business of the kind in Belgium.

The cotton industry possessed 1,492,000 spindles in 1914, and 1,764,500 at the beginning of 1925. The pre-War production of yarn was 51,000 tons; in 1924 the production was 49,264 tons, classified according to the place of origin of the raw material. The amounts of raw cotton consumed are: America, 25,213 tons; East Indies, 22,065 tons; Egypt, 1,220 tons; miscellaneous, 766 tons. Here again, efforts are being made by Belgian industry in conjunction with certain colonial undertakings, the colonial Government, and Belgian financial interests to secure that as much of the raw material as possible is drawn from Belgian Congo.

The linen industry, which drew its supplies very largely from the Baltic provinces of Russia, suffered in an especial degree from the scarcity of raw material. These difficulties are now less acute; the industry has been able to establish relations with Latvia and Esthonia and is making a rapid recovery. Belgium's artificial silk industry was the most important in the world before the War. It has now been outdistanced by those of the United States, England, Italy and Germany, but still occupies an important place in the world's markets. The industrial equipment has increased by approximately 75%. Moreover, Belgium, through her factories at home and abroad (in the United States, Poland and Hungary), has a practical monopoly of the Chardonnet process (collodion silk).

Diamond Cutting.—The specifically Belgian industry of diamond-cutting is carried on in Antwerp, which in 1926 was the leading city of the world in this respect, having outstripped Amsterdam and the German, French and American centres of the industry. Antwerp handles a very large part of the output of the diamond mines of the Congo and of Portuguese Angola.

Summary.—To sum up, the chief features in the development of Belgian industry, regarded as a whole, are as follows:—

1. Concentration and integration, especially in the iron and steel, machine construction, quarrying, cement, ceramic (tile-making), chemical, sugar and cotton industries;
2. Development of mechanical processes in the coal, iron and steel, ceramic and glass industries;
3. The Belgianisation of certain undertakings—iron and steel, zinc, metallurgy and chemical products—through the liquidation of the foreign, and especially the German, interests;
4. The introduction of new kinds of manufacture machinery, chemical products, artificial silk (acetate process), radium, etc.;
5. A considerable increase in the interest of the Banque Belge in the national industries, and, as a result of its influence, a tendency towards concentration and combination, both vertical and horizontal;
6. An extended use of electrical motive power.

Electricity Supply.—The following table indicates the advance made in the supply of electricity by private undertakings in

Belgium (communal undertakings are not included), as shown by the generating capacity of the central station, the capital employed, the number of units sold and the development of main and secondary systems.

	1911	1922
Population served	1,476,000	4,146,000[1]
Generating capacity (kilowatts)	79,325	388,749
Capital invested (thousands of fr.)	71,117	410,089
K.W. hr. sold (thousands)	85,170	389,401
Secondary systems (kilometres)	1,938	7,876
Main systems (kilometres)	500	4,681

[1] More than 6,100,000, if the large public undertakings are included.

Various schemes are in existence for the electrification of Belgian railways, but the immense amount of capital required and political considerations have deferred them.

Labour.—Before the World War, Belgium was essentially the land of low wages. After the War the standard of living of the working classes changed very greatly. The eight-hour day became the general rule, in spite of various legalised exceptions and modifications. Wages rose, owing to the power now possessed by the trade unions. Albert Thomas, director of the International Labour Office, stated in 1925 that Belgium was probably the country where working-class status had been most conspicuously raised since the War. The result of this is that the owners of industrial undertakings can no longer make up for inferior equipment by low wages; and this is one of the most important factors of the technical progress indicated by the facts and figures set out in this article. See the monthly *Bulletin* of Belgian Chamber of Commerce in London, continued as *The Anglo-Belgian Trade Journal.* (E. Va.)

BELGIUM, INVASION OF.—The military rôle of Belgium in 1914 was determined by two considerations of fundamental importance: the geographical situation of the country, which, seated astride the direct road from Berlin to Paris and Calais, had become the cockpit of Europe, and her international political situation as defined by the guarantee of perpetual neutrality.

The Strategical Situation

In Article 7 of the treaty with Holland of 1839 it is laid down that "Belgium, within its territorial limits, shall form an independent and permanently neutral state, and is required to observe this same neutrality with regard to all other states." Of this treaty "all articles are drawn up under the guarantee of Austria, France, Great Britain, Prussia and Russia." This neutrality clearly implied that Belgium was under an obligation to use her military forces, not to repulse an aggressor at all costs—a task beyond her means and one for which there could be no justification—but in such a manner as to prevent that aggressor from obtaining any anticipated advantage in his operations against a third party, *i.e.*, to suspend for an adequate period free passage along the great international strategic highway of which the axis is defined by the Meuse, the Sambre and the Oise. The mission of the Belgian Army was essentially to gain time for itself and cause the enemy delay.

To this end the foremost and best position to occupy, supposing the enemy to come from the east, was the Meuse, its steep scarped slopes and its two road and railway junctions, Namur and Liége. These two towns had been encircled by a ring of armoured and concreted forts by Brialmont in Leopold II.'s reign. The forts lay beyond the firing range of the area built over, and acted both as bridgeheads and as "points d'appui" of fortified positions, from which, with the support of their guns, the field army could easily hold up enemy forces of equal strength. It might be that the enemy would bring up very superior forces in front of the Meuse. In this case the Belgian Army would avoid being engaged in a battle which it was foredoomed to lose. It would retire fighting, step by step, on Antwerp—its base of operations and the national citadel—holding itself in readiness to move out again for the counter-offensive in co-operation with any relief force the Powers guaranteeing Belgium's neutrality should send to its assistance.

Such was the plan of campaign drawn up by King Albert; but unfortunately Belgium was in the throes of military reorganisation when the World War broke out. The country had been slow in realising that the rivalry between its powerful neighbours constituted a menace to itself. In 1913 Parliament had voted a compulsory military service system which was to produce 340,000 men in 10 years' time. Actually, on mobilisation, only 117,000 men were available for the field army and 60,000 for the fortress troops. The field army, grouped in six army divisions and one cavalry division, was without any reserve drafts whatever; the fortress troops, composed of men aged 28–35 years, were weak in cadres and poor in quality. The plan of concentration had been revised, but there had not been time to make out the time-table for rail transport.

Belgian Preparations.—On the evening of July 31 mobilisation was ordered. On Aug. 2 it became known that the Germans had invaded the Grand Duchy of Luxembourg, and at 7 P.M. the ultimatum was presented to the Belgian Minister of Foreign Affairs by the German ambassador in Brussels: "If Belgium behaves in a hostile manner to German troops, and particularly if she impedes their march forward by resistance on the part of the Meuse fortifications, or by the destruction of roads, railways, tunnels or other works, then Germany will be compelled to regard Belgium as an enemy." Belgium's reply to this injunction was the categorical refusal which her sense of honour and of her duties toward Europe demanded.

Since it was definitely from the east that danger threatened, and since France had officially declared that she would respect the integrity of Belgian soil, the place of concentration indicated for the army was on the Meuse between Maastricht and Namur. But, as has been said, transport arrangements were still incomplete and a modification had to be adopted. The King ordered that the 3rd and 4th Divs., mobilised at Liége and Namur, should remain in those fortresses with instructions to defend them to the last man. The remaining four divisions and the cavalry division were to make their way—the former by rail, the latter by road—toward the zone Tirlemont-Perwez-Louvain, whence they were to proceed together toward the Meuse with all possible speed.

The Attack on Liége

As already stated, Liége and Namur were not designed to withstand a regular siege, but consisted of a ring of forts (12 at Liége, 9 at Namur) which controlled the free use of the Meuse bridges and marked a favourable line of battle. Constructed about 1890, these forts, of triangular or rectangular design, had vaulted casemates of 2 m. 50-cm. concrete and were armed with two 15-cm. guns in cupolas, two 12-cm. guns and two 21-cm. howitzers, besides some pompoms in "éclipse" cupolas.

Strength of Liége.—With the help of the 3rd Div. the Liége garrison was brought up to about 30,000 men. Gen. Leman was in command. While he hastened to have trenches dug between the forts, his main concern after Aug. 3 was to blow up the railway tunnels and barricade the roads leading from Germany. It was well that he did so, for on the 4th, at 8 A.M., six German columns crossed the frontier on the line Aix-la-Chapelle-St. Vith, and at noon gun and rifle fire were heard at Visé.

The importance of the fortress lay in the fact that it controlled the lines of march of the German I. and II. Armies. Now the success of the plan of campaign conceived by the general staff in Berlin depended upon the rapid crossing of the Belgian plains by these armies, and Gen. von Moltke, to avoid being held up in any way by Liége, had planned to carry the position during the concentration period (while troops were being carried up by rail) with a special army composed of six brigades at peace strength and the three divisions of Gen. von der Marwitz's cavalry corps. Accordingly, Gen. von Emmich, with his "Army of the Meuse" (consisting of 25,000 riflemen, 10,000 cavalrymen and 124 guns) was ordered to carry the place by a handstroke. The forts were to be masked by a few companies and their artillery neutralised by his batteries while six brigade columns would penetrate the intervals. This assault was to take place by night, and the columns were to make their way independently toward the town and storm this at daybreak. The aim of the whole enterprise was to secure the bridges before they could be destroyed. As regards the temerity of this scheme, it is only fair to say that Von Moltke expected to find merely the normal garrison of 6,000 men in Liége.

German Advance.—On the morning of Aug. 4 the 4th Div., followed by cyclists and chasseurs conveyed by motors, made its way rapidly along the Dutch frontiers to Visé. The roads had been barricaded with felled trees and it was noon before the cavalry reached the Meuse, only to find the bridge submerged and the opposite bank lined with riflemen. On Aug. 5 a *coup de main* aimed at Fort Barchon was severely punished by the short-range fire from the fortress guns. At 10 P.M. the various brigades, having completed their reconnaissances and the installation of their batteries, proceeded concentrically to the attack.

The onset of the battle was marked by great tension on either side and heavy thunder showers accompanied it. Of the five brigades which attacked on the right bank, four were completely repulsed. In the south the 38th and 43rd in particular suffered severe losses round about Sart Tilman; they retreated over five miles the next day. The 34th Bde., which attacked alone on the left bank after crossing the Meuse near to the Dutch frontier, was held up for several hours on the outskirts of Herstal by street fighting and left 400 prisoners in the hands of the Belgians, as well as a colour of the 87th Mecklenburg Regiment.

By a strange chance a half-company of Jägers, detached as a flank guard, made their way quite unopposed into the town, reaching the Rue Sainte Foi about 7 A.M., where the garrison headquarters were situated. An aide-de-camp of Leman and the captain of the company killed each other on the spot, and the escort, snatching up their rifles, put the Jägers to flight. This extraordinary incident led the commander of the defence to believe that the enemy had brought over considerable forces to the left bank. Fearing that the troops defending the right bank might be cut off, he at once sent them an order to recross the river, a decision by which the last of the German brigades was to benefit considerably. This brigade, the 14th, marching from east to west, was entrusted with the attack between Forts Fléron and Evégnee, but had been stopped short by rifle and gun fire in the intervening village, its advanced guard being decimated, its general and one colonel killed. It would probably have come to a definite standstill but for the arrival at this critical moment, by another stroke of fortune, of Gen. Ludendorff, who was watching the operations on behalf of the German II. Army and was the very author of the plan of attack.

Attack under Ludendorff.—Taking over the command he ordered a renewal of the attack and, as Leman had sent all his reserves to Sart Tilman, succeeded in pushing back the three weak battalions opposed to him in an all-night street battle. Toward 10 A. M. he arrived on the heights over Liége with his brigade reduced by half and almost without munitions, uneasy rather than proud of his success, for there was no sign of the other attacking troops. A few small columns were visible in the distance turning westward; these were the victorious Belgian troops, recalled to the other bank by the order to retreat. They were, however, so exhausted that once they had left the trenches they were incapable of engaging in a fresh battle. Leman, acting on belief that the whole of the German VII. and X. Corps were against him, gave orders to the 3rd Div. to rejoin the field army. He himself would continue to hold off the enemy with forts alone.

Thus Ludendorff was able to enter the town of Liége without further opposition on the morning of Aug. 8. Most of the bridges had been destroyed. The forts, all of which were still intact, kept watching roads and railways, their guns making the use of either impossible. Urged by Ludendorff's energetic representations, the German general staff now formed a new siege army, under Gen. von Einem, which comprised, in addition to Von Emmich's group, all the troops of the VII., IX. and X. Corps—taken as they detrained—and some powerful heavy artillery, including several battalions of 21-cm. mortars and four 42-cm. howitzers. A new mode of attack was tried. One by one the forts were isolated, closely invested and bombarded with concentrated fire, which blew them to pieces and at the same time threatened to asphyxiate the garrisons.

Fall of the Forts.—The defenders came through their ordeal with honour, and would certainly have held out longer but for the irresistible effect of the 42-cm. shells. Pontisse, Fléron and Chaudfontaine only gave in when they had reached the limit of human endurance. On Aug. 15, at 5 P.M., the fort of Loncin sprang into the air, lifted by the explosion of a powder magazine hit by a 42-cm. shell, 350 men being buried under the débris. By a stroke of luck Leman was picked up, unconscious, on the rim of this enormous crater by the Germans, who were themselves horrified by the spectacle. The last of the forts surrendered on the 16th, leaving the way clear, at last, for the Germans to whom the passage meant so much.

While these events were taking place at Liége the 1st, 2nd, 3rd and 6th Divs. and the Cav. Div. were assembling in the region Tirlemont-Perwez-Louvain. The plan of marching towards the Meuse was perforce abandoned on the information that the Liége position was broken and the 3rd Div. in retreat.

Consequences of the Fall of Liege

Belgian Position Outlined.—On the morning of Aug. 4, when the crossing of the frontier by German troops had become an established fact, King Albert had sent a note to the British, French and Russian governments announcing the violation of Belgian neutrality, and proposing "a concerted and common action by the guaranteeing powers in order to resist Germany." In reply Gen. Joffre sent one of his staff officers to say that the French troops, amounting to four army corps, could not reach the region of Namur before about the 15th. Help from England would necessarily take still longer to come. Under these conditions the King decided that the army should remain in its positions, which were: (1) the forts of Liége, acting as isolated works, under Leman; (2) the fortress of Namur, reinforced by the 4th Div; (3) the entrenched camp of Antwerp, guarded by about 40,000 fortress troops; and (4) the field army, 90,000 strong, entrenched behind the river Gette, forming a link between Antwerp and Namur, covering Brussels and excellent railway lines which could be used by any French or British troops that came to the rescue.

Unfortunately, the Allies were not to profit by these arrangements. The French would not think of anything except their attack in Lorraine and the Ardennes; the British did not arrive at Mons before Aug. 22. As fast as the Liége forts fell to the superguns the Germans commenced to push their troops across the Meuse without intermittence. As early as Aug. 10 Marwitz's cavalry corps had thrown itself on the Belgian front at Tirlemont. On the 12th he tried to turn that front through

Haelen near Diest. Here he met the small Belgian cavalry division, supported by four battalions and was completely routed, leaving 500 killed and wounded and 1,000 horses on the field. On the evening of Aug. 17, the German I. and II. Armies having reached the front Hasselt—St. Trond-Huy, the Kaiser ordered the general advance. The next day, at 9 o'clock, Gen. von Kluck attacked the Belgians on the Gette between Tirlemont and Diest with seven divisions of the IX., IV., III. and II. Corps, while one division of the II. Corps and the 2nd Cav. Div. turned the left flank on the north to cut off the retreat on Antwerp.

Retreat to Antwerp.—This attack was no surprise to the King. For several days reports had been coming through that greatly superior forces of at least 200,000 men were approaching. Gen. Lanrezac's French troops had got only as far as Philippeville and the British Expeditionary Force as far as Le Cateau. To avoid useless and complete destruction, the Belgian Army began to retire slowly on Antwerp, fighting rearguard actions at Tirlemont on the 18th and at Aerschot on the 19th, and taking up its position on the line of the Antwerp forts on the 20th. On this day, the Germans entered Brussels.

The Siege of Namur

The Belgium 4th Div. remained at Namur. The moment it lost touch with the bulk of the Belgian Army, it became part of the fighting system of the Franco-British forces.

German Plan of Attack.—On the morning of Aug. 18 Joffre issued a succession of orders in which it was laid down that the French III. and IV. Armies should advance into the Ardennes and the French V. Army and the British Expeditionary Corps take the offensive west of the Meuse in the direction of Gembloux-Nivelles. The two last-named armies were not in a position to execute this order; it was not until Aug. 23 that they assembled on the line Mons-Charleroi-Namur. Meanwhile, the Germans having discovered—through the reconnaissances of their airmen—the French columns marching northwards between Maubeuge and Dinant, gave Von Bülow—already in command of the I. and II. Armies—authority over the III. Army, which was to strike the Meuse between Namur and Givet, and made up their mind to overwhelm the Allied left by a converging attack delivered by 15 corps. It was essential to the scheme that the fortress of Namur should be carried with the least possible delay.

The task was entrusted to a special army detachment under von Gallwitz. It included the Guards Res. Corps, the XI. Corps, three pioneer regiments, five battalions of 21-cm. howitzers, two battalions of heavy guns, one battery of 42-cm. howitzers and four of 30·5 Austrian howitzers. These troops came into position northeast of the fortress. To complete the investment the III. Army detached the 24th Res. Div. north of Dinant and the II. Army the 14th Res. Div. south of Gembloux. Thus during the two days of the battle of Charleroi the 30,000 men of the Namur garrison drew upon themselves six enemy divisions and 500 guns.

Bombardment of Namur.—The attack on Namur was quite different from that on Liége. There was no longer any question of a surprise. Von Gallwitz, who in peace time was inspector-general of artillery, aimed at an artillery preparation so devastating as to render the defence incapable of resistance to the assault. All his batteries concentrated their fire upon three forts, Maizeret, Marchovelette and Cognelée, and on the interval between the two last named, where he intended to make a breach. The bombardment commenced at 10 A.M. on Aug. 21, continued throughout the night and the whole of the following day, and reached its height on the morning of the 23rd. The trenches and the wire—at that time very slight—had disappeared. The forts were reduced to shapeless ruins; all their cupolas were put out of action.

Surrender of Namur.—Three French battalions had arrived in the fortress. A counter-attack, half Belgian, half French, attempted to repulse the enemy artillery, but failed. The defending troops suffered steady extermination without being able to fire a shot. Finally, at 11 A.M. the German infantry masses made a sudden onrush—three divisions of them to a front of 4½ km., held by what remained of nine battalions of 700 men. The defenders were swept off their feet. At many points, although enveloped, they put up a desperate resistance; and as a result it was not until evening that the assailant reached the outskirts of the town.

Gen. Michel, commanding the fortress, had disposed a brigade facing northwest to co-operate in the French offensive which he was impatiently expecting. At about 1.30 P.M. he heard, however, on the one hand that the French on his left had been driven back southward instead of advancing to the north; on the other that the Germans, far behind his right, had crossed the Meuse between Namur and Dinant. With their front broken the garrison ran the risk of being enveloped and surrounded. Michel therefore expedited the order for an immediate retreat toward the southeast.

By dint of 48 hours of forced marches—coming after a three days' battle—the greater part of the garrison succeeded in rejoining the French troops and a fortnight later in reinforcing the Belgian army at Antwerp. Five or six thousand men of the rearguard were trapped between the flank corps of the German II. and III. Armies, and after several skirmishes were forced to surrender. The six forts which were still active at Namur were able to hold up Von Gallwitz's forces two days longer. Suarlée and Andoy only surrendered on the evening of Aug. 25 after having offered a memorable resistance to the enemy's mortars, which bombarded them simultaneously from all sides. *See* also Antwerp, Siege of; Frontiers, Battles of the.

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BELGRADE (*see* 3.681d) had a population of 111,740 in 1921. The town is rapidly losing what remains of its Oriental appearance, though the side streets are still cobbled and muddy, with small single-story dwellings and shops, as the Serbs are building extensively to cope with the acute shortage of houses. The tropical diseases research laboratory has been amassing data as to the danger threatened by malaria in the district. The National Bank was enlarged in 1925, and a new high road completed to Cattaro. The city is connected by rail with the Adriatic ports of Spalato and Sebenico.

Belgrade suffered two severe bombardments and changed hands four times early in the War. The World War began with the bombardment of Belgrade by the Austrians on July 29 1914. In 1914 it was taken by the Austro-Germans, but the Serbs made a brilliant return, and in Dec. King Peter made a triumphant entry into his capital. Large numbers of prisoners were taken, but both they and their captors fell victims to a terrible plague of typhus. In Sept. 1915 a general attack was made by Austrians and Germans on the river frontier. Continuous bombardment for more than a fortnight made Belgrade untenable and it was partly evacuated by the Serbs. There was bitter fighting in the streets, but on Oct. 9 the town fell. It remained in the enemy's hands until the end of the War, and when the Serbs returned to Belgrade, the Austrian Empire had fallen and the Kingdom of Yugoslavia was already in existence.

BELL, ALEXANDER GRAHAM (1847–1922), American inventor (*see* 3.684), died Aug. 2 1922 at his summer home near Baddeck, Nova Scotia.

BELL, CHARLES FREDERICK MOBERLY (1847–1911), British journalist, was born in Alexandria, Egypt, April 2 1847. Educated privately in England, he returned to Egypt in 1865, and there took up journalistic work, becoming *The Times* correspondent and founding *The Egyptian Gazette*. In 1890 he returned to London as assistant manager of *The Times* and to the end his great energies were devoted to the service of that paper. Although in some ways rather out of touch with technical developments, his strong will, indomitable courage and tremendous industry were instrumental in keeping *The Times* alive during some very difficult years. This was the time when he was associated with Mr. H. E. Hooper in publishing and selling *The Encyclopædia Britannica* and founding the Times Book

Club. This dominating personality again asserted itself in 1908, when, in spite of much opposition, he brought about the sale of *The Times* to Lord Northcliffe. He then became managing editor, a post he retained until his death in his office chair on April 5 1911. While in Egypt, Bell wrote several books, including *Khedives and Pashas* (1884); *Egyptian Finance* (1887); *From Pharaoh to Fellah* (1889).

See F. Harcourt Kitchen, *Moberly Bell and his Times* (1925).

BELLEAU WOODS, a tract of forest land, in area less than a sq. m., 5 m. northwest of Château-Thierry, and 42 m. east of Paris, where a fiercely contested battle took place between the United States and German forces in June and July 1918. When the third German offensive was launched on the Aisne front, the 2nd Div. of the American Expeditionary Force under Gen. Bundy was rushed to the assistance of the VI. French Army and deployed across the Paris-Château-Thierry road west of the latter town. On its front lay Belleau Woods and the villages of Torcy, Bouresches and Vaux, all occupied by the enemy. The Germans had been halted at Château-Thierry but were consolidating themselves at Vaux and in Belleau Woods in preparation for a renewed advance west of Château-Thierry. The task of dislodging them was entrusted to the marine corps brigade under Gen. Harbord.

The attack was made on June 6, and the woods were penetrated but could not be held. The ground was extremely difficult, almost impenetrable underbrush covering a rugged outcrop of rock. Three days later the attack was renewed. The fighting was bitter, but, after a struggle lasting over a fortnight, the woods were finally taken by the marines; Bouresches and Vaux were also captured and the German advance was effectively blocked. In this engagement the Germans lost 24 guns and 1,654 prisoners, but the United States losses were severe, amounting to 285 officers and 7,585 men killed, wounded and missing. The battleground was in 1923 dedicated as a permanent memorial to the United States officers and men who lost their lives there, and the French Govt. ordered the name to be changed to that of Bois de la Brigade de Marine. (*See* GERMAN OFFENSIVE.)

BELLOC, JOSEPH HILAIRE PIERRE (1870–), British author, was born at La Celle, St. Cloud, France, July 27 1870, the son of a French barrister, Louis Swanton Belloc. His mother, Bessie Rayner Parkes (1829–1925), was prominent in the early days of the woman suffrage movement. Belloc was educated at the Oratory School, Edgbaston, then, as a French citizen, served with the artillery at Toul, afterwards entering Balliol College, Oxford, in 1893. He was naturalised in 1902. He was elected M.P. for Salford from 1906 to 1910, first as a Liberal then as an Independent.

Verses and Sonnets (1896) launched Belloc on a varied, not to say tempestuous, literary voyage. Historical studies of *Danton* (1899) and *Robespierre* (1901) first proved his lively historical sense and compelling prose style. His independence of mind in politics showed itself at Oxford, later as a staunch "pro-Boer," and again in the circumstances of his retirement from parliamentary politics; it was shown too, in his association with Cecil Chesterton in conducting *The Eye Witness*, and in writing *The Party System* (1911), and *The Servile State* (1912). Books of nonsense rhymes, such as *The Bad Child's Book of Beasts* (1896); *The Path to Rome* (1902); satires such as *Mr. Clutterbuck's Election* (1908) and *The Mercy of Allah* (1922); numerous volumes of essays and travel sketches; collected poems (1924); military and topographical studies; and *The Cruise of the Nona* (1925)—these are samples of a great versatility of talent. As an upholder of nationalism and the Catholic tradition, Belloc has summed up his attitude best in two of his works, *The Jews* (1922), and *Europe and the Faith* (1920).

BELLOWS, GEORGE WESLEY (1882–1925), American artist, was born in Columbus, O., Aug. 12 1882. Educated at Ohio State University, he moved in 1904 to New York, where he studied art under Robert Henri. In 1910, 1918 and 1919 he was an instructor at the Art Students' League in New York City, and in 1919 taught also at the Chicago Art Institute. His work is distinguished by dignity of composition, vitality and intense interest in life. His drawings and lithographs include many notable illustrations of sporting subjects, and his painting showed at first a preference for sable shades. Later, however, he added to the distinction of his drawing a rich, vibrant use of colour. Among his paintings may be mentioned "Jean and Anna," in the Albright Art Gallery, Buffalo, N. Y.; "Emma and Her Children," in the Boston Museum of Fine Arts; "Portrait of my Mother," in the Chicago Art Institute; "Polo Game," in the Columbus Gallery of Fine Arts; "Stag at Sharkeys," in the Cleveland Museum; "Men of the Docks," owned by Randolph Macon Woman's College, Lynchburg, Va.; "Up the Hudson," in the Metropolitan Museum, New York City; and "North River," in the Pennsylvania Academy of Fine Arts, Philadelphia. He died in New York City Jan. 8 1925.

BELMONT, AUGUST (1853–1924), American banker and financier (*see* 3.710), died in New York City Dec. 10 1924.

BENAVENTE Y MARTÍNEZ, JACINTO (1866–), Spanish playwright and critic, was born in Madrid Aug. 12 1866, the son of a physician. He entered the law faculty of the university there, but, preferring literature, left without taking a degree. His first critical work was *Letters of Women* (1893) which he followed up with the comedy *El Nido Ajeno* (1894). He came under the influence of the French theatre for a brief time but soon distinguished himself by originality, imagination and classic purity of style. His light and elegant comedies were at first criticised as deficient in action, merely satirical dialogues aimed against society and its most sacred traditions. But he soon received encouragement from both the public and the critics and his various experiments in theatrical production never once resulted in serious failure. When his first comedy was produced, the Spanish stage was monopolised by the Basque, José Echegaray (*see* 8.870), but Benavente soon proved his superiority and took his place. His dialogue is always brilliant, his characters true to life and the action never flags.

Several of Benavente's plays have been translated into various foreign languages and produced in remote parts of the world. He himself travelled through the United States and Spanish America superintending the execution of his plays by a company formed under his own eye. In 1922 he received the Nobel Prize for literature.

Among his most notable plays are *Invested Interests* (1907), *Saturday Night* (1903), *Brute Force* (1908), *The Vulgar* (1901), *The Mistress of the House* (1901) and *The Rose of Autumn* (1905).

BENCKENDORFF, ALEXANDER, COUNT (1849–1917), Russian diplomat, was born in 1849. He entered the diplomatic service in 1869 and began his career as an attaché in Florence, proceeding thence to Rome. In 1897 he was appointed minister in Copenhagen, and remained there until 1903. The Copenhagen post gave him an exceptional opportunity for watching the principal moving powers of European politics from a point of vantage, as the matrimonial alliances of the Danish Royal Family occasionally brought together in a friendly family circle the widow of Alexander III., Nicholas II. and the Prince of Wales, who was to become King Edward VII. In this way Count Benckendorff received his initiation into the spirit of an Anglo-Russian *rapprochement* even before it actually resulted in an Entente. When he was promoted, in 1903, ambassador to the Court of St. James, the atmosphere seemed anything but favourable to an Anglo-Russian *rapprochement*. The rivalry of the two Powers in the East was growing more and more acute. But when the storm had discharged itself in the Japanese War, Count Benckendorff had an important share in bringing about a change for the better. On the conclusion of the secret convention at Björkö (1905) between Wilhelm II. and Nicholas II., which was likely to disrupt the Franco-Russian Alliance and so involve Russia in a continental league against England, Count Benckendorff was invited to Copenhagen and served as a confidential intermediary between Russia and Great Britain. The Björkö intrigue evaporated without leaving any tangible result, and the historic *rapprochement* between Great Britain, France and Russia took its course. Benckendorff made his home in London where he died Jan. 11 1917.

BENEDICT XV. (1854–1922), Pope, was born at Pegli, in the diocese of Genoa, Nov. 21 1854, his name being Giacomo della Chiesa. In contrast to his immediate predecessor Pius X., who was of humble origin and whose ministerial experience was mainly pastoral, Benedict XV. was descended from one of the oldest families of Italy, and his work had been chiefly in the official or diplomatic service of the Holy See. His ancestors in the Middle Ages were enrolled in the patricians of Genoa, while other branches of his family followed the popes to Avignon in the 14th century.

Giacomo della Chiesa was educated in the seminary and at the University of Genoa, where he took his degree as doctor of law in 1875. Afterwards he went to Rome and studied for the priesthood in the Collegio Capranica, from which he passed to the Accademia dei Nobili Ecclesiastici, the usual training school for those who devote themselves to the *carriera*, or diplomatic service, of the Vatican. Here he became the friend of Cardinal Rampolla, who, on being sent in 1883 as papal nuncio, to Madrid, took Chiesa with him as his private secretary. He remained in Spain four years, and in 1887, when Leo XIII. recalled Rampolla to make him his Secretary of State, Chiesa also returned to Rome and was made minutante in his department. His work was the summarising and inditing of the official letters and dispatches of the Holy See, combined with the functions of confidential secretary. As he discharged these duties for 13 years, he was able to acquire a unique knowledge of the international relations of the Church throughout the world.

In 1903, when Cardinal Merry del Val succeeded Rampolla as Secretary of State, Chiesa was retained in his post. On Dec. 16 1907 Pius X. appointed him Archbishop of Bologna, and on May 25 1914 raised him to the dignity of cardinal. The outbreak of the World War in Aug. of that year, and the death of Pius X. a few weeks later, found him in the midst of the pastoral duties of his great diocese. At this time, as Cardinal-Archbishop of Bologna, he delivered a remarkable address on the attitude and duty of the Church during the War, and strongly emphasised the paramount importance of the Holy See observing strict neutrality, while leaving nothing undone to restore peace and goodwill and to mitigate suffering. The address caused a deep impression, and was no doubt much in the minds of the cardinals when they assembled in conclave for the election of a new pope on Aug. 31 1914. On Sept. 3, after 10 scrutinies, or votings, Cardinal della Chiesa was elected by a large majority, and was proclaimed from the balcony of St. Peter's as Benedict XV.

During the War he preserved an attitude of strict neutrality, and made several attempts to effect peace. Official relations between France and the Vatican were resumed, and a British representative was accredited to the Papal Court for the first time since the 17th century. He died Jan. 22 1922. *See* PAPACY.

BENEŠ, EDWARD (1884–), Czechoslovak statesman, was born May 28 1884 in the village of Kožlany, Czechoslovakia. His parents were poor peasants, but the boy was educated in the faculty of philosophy at Prague University, where fees are small and are wholly remitted in the case of poor students. He continued his education at the Sorbonne and the École de Science Politique in Paris, then at Dijon, where he graduated as doctor of laws (1908). In 1909 he was appointed professor of economics at the Prague Academy of Commerce; in 1912 lecturer, and in 1922 professor in sociology at the University of Prague. When the World War broke out he was still a young man of 30, but was already one of the leaders of the Czechoslovak nationalist movement, and soon became Dr. Masaryk's right-hand man in the work of intensive nationalist propaganda which was precipitated by the World War. In 1915 he went to Paris to work as a journalist and diplomat in the cause of Czechoslovak liberation from the Habsburg yoke. There he collaborated with Dr. T. G. Masaryk and Gen. Stefanik in support of the Allied cause. In that same year he was made general secretary in the Czechoslovak National Council, the executive body of the national movement, which in 1918 was recognised by the Allies as the Czechoslovak Provisional Government.

Place in European Politics.—Dr. Beneš became Foreign Minister in the newly formed government, and himself formed one government (1921–2). He was the head of the Czechoslovak Delegation to the Paris Peace Conference (1919–20), and a signatory of the Peace Treaties. He was appointed Czechoslovak representative at the League of Nations in 1920; was elected a member of the League Council in 1923, and re-elected in 1925. He was co-founder of the Little Entente in Aug. 1920, part-author and keen advocate of the Geneva Protocol of 1924, and represented Czechoslovakia at the many diplomatic conferences to which she was a party after the War. On behalf of his country he initialled the Locarno Treaties on Oct. 16 1925, and signed them in London, on Dec. 1 1925.

The outstanding personality of Beneš in the post-War years was, not unnaturally, the cause of controversy among students of affairs in western Europe, especially in Great Britain. British opinion of the Left criticised him on the occasion of several Franco-British diplomatic crises between 1920 and 1924, especially those created by the Genoa Conference and the Geneva Protocol, on the ground that his orientation was toward Paris rather than toward London. Others criticised him on the alleged ground of "interference" between Paris and London; and yet again, that his policy was that of an opportunist. The view, however, that is supported by the evidence of Dr. Beneš' public statements and by his record of action, appears to be that he regarded Czechoslovak political independence, in the first instance, as due largely to the Franco-British Entente and was therefore anxious to preserve the continuance of that Entente. Franco-British diplomatic quarrels caused him anxiety, both for the particular interests of Czechoslovak security and for the general interests of European stability. At the same time, he showed himself to be an unsentimental realist, holding the view that a negative attitude in diplomacy was a blunder, irrespective of the merits of the case.

His object was the political and economic consolidation of Czechoslovakia, to be effected through the regional method of the Little Entente and through a general European stabilisation. He adopted a most progressive policy toward Russia, Czechoslovakia being the first country in Europe to restart trade with that country. In common with the statesmen of most of the small nations in Europe, Dr. Beneš wished to see the principle of universal compulsory arbitration enshrined in international law. He partly evolved and subsequently advocated the Geneva Protocol of 1924. To Dr. Beneš the main attraction of the protocol was that it would, in his view, safeguard the interests of the small states, and best serve the interests of Europe.

It was not till the eve of the Locarno Conference in 1925, that he abandoned his public appeals on behalf of the principles of the protocol (even though the protocol itself was a dead letter by then); and he made it clear, when the Locarno Treaties were initialled, that he regarded them as an instalment of the protocol idea. Dr. Beneš never concealed that in his view and in that of his Yugoslav and Rumanian colleagues it was an important function of the Little Entente to prevent any Hungarian or Habsburg coup against the 1919 settlement. It was largely due to his influence that the two attempts of April and Oct. 1921, to restore the Habsburg régime at Budapest, failed. Dr. Beneš has shown himself to be progressive in policy, and exceptionally well informed. His unbroken period of office, his work for the League of Nations and the close touch he has maintained with European affairs during seven years make him one of the most influential of post-War statesmen in Europe. After the Locarno Treaties were negotiated he at once began laying the diplomatic foundations for a "Locarno" treaty for the east of Europe, to which Hungary should be a party on the analogy of Germany's participation in the western pact. He is the author of some 12 vol. on political and sociological subjects. His published works are mainly concerned with political economy and social conditions in Central Europe (*see* LITTLE ENTENTE).

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BENN, WILLIAM WEDGWOOD (1877–), British politician, was born May 10 1877 in London. He entered Parliament in 1906 as Liberal member for St. George's, Tower Hamlets, which he represented until 1918. He was a Lord of the Treasury from 1910 to 1915, being an efficient and popular junior whip, and was acting chairman of the National Insurance Commission. A promoter of the National Relief Fund, he was chairman of the executive committee when it was reorganised in 1914. He volunteered for service in the World War and had a distinguished record, receiving the D.S.O. for his services in the R.N.A.S. His liaison work with the French and Italian forces earned him the Croix de Guerre and the Italian Bronze Valour Medal and War Cross. After the War, Capt. Benn returned to politics, being elected for Leith as an Independent Liberal in 1918 and re-elected at subsequent elections. He was one of the small Radical group formed within the Liberal party after the general election of 1924 and, as such, was an extremely active member of the Opposition.

BENNETT, CHARLES EDWIN (1858–1921), American classical scholar (*see* 3.740), died May 2 1921 at Ithaca, New York. His later publications include *Syntax of Early Latin*, 2 vol. (1910, 1914); *New Latin Composition* (1912) and an English translation of Horace's *Odes and Epodes* (1914) in the Loeb Classical Library.

BENNETT, ENOCH ARNOLD (1867–), British author, was born in the district of Shelton, northeast of Hanley, one of the "Five Towns" in Staffordshire, May 27 1867, was educated there, and entered the offices of a local solicitor. In 1893 he abandoned law, and came to London, where he successfully practised journalism. His first novel of any distinction was *Anna of the Five Towns* (1902). By *The Old Wives' Tale* (1908) he definitely established his reputation as the French realists' most eminent and faithful disciple who, moreover, could draw on rich memories of the manners of the middle classes in the English Midlands and who could exercise an inimitable humour.

Meanwhile this humour found other vents than through his more ambitious work. *Anna of the Five Towns* is contemporary with the wild extravaganza, *The Grand Babylon Hotel*, and he interrupted the composition of *The Old Wives' Tale* to write *Buried Alive*, a gay trifle not properly appreciated until it was dramatised. If *The Card* (1911), followed by *The Regent* (1913), devoted to the career of the adventurous Denry, best illustrated Mr. Bennett's humour, it is in the *Clayhanger* series that his imagination reaches the highest point. *Clayhanger* itself was published in 1910, and its sequel *Hilda Lessways* in 1911. In these novels Mr. Bennett not only created characters of unusual vitality and implicated them in an absorbing plot, but he also interpreted to the world the life of the Pottery towns, the 19th century to the 20th. A well-known cartoon by Max Beerbohm expresses the impatience of the public at the delay in the appearance of the third volume of the trilogy. But *These Twain* (1916) was disappointing.

Thereafter it seemed that the novelist, having exhausted his memories of the Five Towns, had also exhausted his talents. Such books as *The Pretty Lady* (1918), and *Mr. Prohack* (1922) are vivid, expert, but seem intended rather to express the vulgar delight of a provincial in metropolitan luxury than to reflect the genius of a great artist. But *Riceyman Steps* (1923), the study of a miser and his loyal servant, although the scene is set in London and not in the Five Towns, again displays the psychological subtlety, the grim humour and the honest pathos of the earlier Bennett.

As a playwright Mr. Bennett has been content to exercise his lighter talents. *Milestones* (1912), in which he collaborated with Edward Knoblock, remains his most notable work, though *What the Public Wants* (1909), a comedy of the modern newspaper, *The Great Adventure* (1913), the dramatic version of *Buried Alive*, and *The Title* (1918) have been deservedly praised. His sense of the theatre has proved too strong to enable him to put forward there original ideas, or to confuse the audience by new devices.

Similarly, in the short story, Mr. Bennett seems primarily to have ensued technical efficiency. The volume of stories called *The Grim Smile of the Five Towns* (1907) belongs to the best period of Mr. Bennett's earlier manner, but contains nothing of enduring merit, and *Elsie and the Child* (1924), apart from its title story, a sequel to *Riceyman Steps*, is little more than good journalism. Mention must also be made of the works of popular philosophy. In them common sense is more conspicuous than profundity of thought or literary elegance. Nor should the descriptive sketches, of which *Paris Nights* is an early example, be forgotten. Rough and at times garrulous, they nevertheless show gusto.

In a fantasy of Mr. Wells, the following notes from an undelivered address appear: "Arnold Bennett as an aborted Great Man, would have made a great Victorian and had a crowd of satellite helpers. Now no one will treasure his old hats and pipes." If indeed Mr. Bennett's hats and pipes are not collected by posterity, the spirit of the times will be principally to blame. Like Dickens, Mr. Bennett is an unsophisticated and occasionally exasperating novelist, but like Dickens he has learnt how to command at once the applause of the few and the favour of the many. The few find in his serious work the fruits of a memory and observation even more precious than an exuberant fancy, a sanity and humaneness eminent in contemporary fiction, and a striking intelligence. (H. C. Ha.)

BENNETT, JAMES GORDON (1841–1918), American newspaper proprietor (*see* 3.740), died May 14 1918 in Paris, whence he had long directed the policies of *The New York Herald*. In his will he provided for the establishment of the James Gordon Bennett Memorial Home for New York Journalists in memory of his father, the founder of *The New York Herald*.

BENSON, ARTHUR CHRISTOPHER (1862–1925), British man of letters (*see* 3.745), died at Cambridge June 17 1925. After 1910 he published several books, mostly essays and sketches of people he had known; and in 1926 a posthumous novel, *The Canon*, appeared. His best work, however, was probably done in biography, but the true force of his personality was never fully preserved in his writings; it was given to Eton, his college, and his friends.

His brother, Robert Hugh Benson (1871–1914), died at Salford, Lancs., Oct. 19 1914.

BENSON, FRANK WESTON (1862–), American artist (*see* 3.745), in addition to his reputation as a painter, achieved marked success with his etchings and wash drawings of wild fowl, a field in which his talent is especially spontaneous and happy. As in his painting, his work combines manliness and delicacy and is pervaded with a sense of gaiety. He has few equals in the reproduction of flying birds and waterfowl.

BENSON, WILLIAM SHEPHERD (1855–), American naval officer, was born at Macon, Ga., Sept. 25 1855. He graduated from the U.S. Naval Academy in 1877, and after various promotions became captain in 1909 and rear-admiral in 1915. He had been commandant of the Philadelphia Navy Yard for two years when, in 1915, he was appointed chief of naval operations. He was a member of the commission appointed to confer with the Allied Powers in 1917, and was appointed naval representative for preparing the terms of the Armistice (1918), and naval adviser to the American Peace Commission. He was retired automatically in 1919 with the rank of rear-admiral. In 1920 he was appointed chairman of the U.S. Shipping Board and was made a permanent admiral for life.

BENZ, KARL (1844–), German engineer, was born at Karlsruhe Nov. 26 1844. He studied under Redtenbacher and Grashof at the Karlsruhe Polytechnic and after working in various workshops on locomotive and bridge construction set up independently at Mannheim in 1871. From his earliest youth he had aimed at "putting the locomotive on the street," having no knowledge of the English and French road locomotives of the 1820's and 1830's. His interest in gas engines was awakened by Lenoir's gas machine. He constructed a two-stroke engine model of his own, and founded an engine factory. As, however, the group financing him would only deal with fixed engines, he left it. He founded the firm Benz and Co., Rheinische Gasmotorenfabrik, and began to construct fixed engines; then developed a light high speed four-stroke engine (300 revolutions, 2/3 H.P.)

He discovered the differential, special electrical battery ignition with spark induction, surface carburetter. He completed his first car in 1885, speed 10–16 km. per hour, and took out the patent in 1886 (D.R.P. 37435). He sold the first car to the Frenchman, Roger, and then joined the firm of Panhard and Levassor. In England he encountered difficulties owing to the Locomotives Act (not abolished till 1896); and in 1893 he took out a patent for steering gear with triple axle and steering rods tangential to the wheels. Later, he took up his residence in Mannheim.

BERCHTOLD VON UND ZU UNGARSCHITZ, LEOPOLD, COUNT (1863–), Austro-Hungarian statesman, was born April 18 1863, and entered the Austro-Hungarian Foreign Office in 1893. In 1903 he went as councillor of legation to Petrograd and in Dec. 1906 was appointed ambassador there. With the Russian court and the aristocratic society of Petrograd he maintained the best relations, but failed entirely in his efforts to accommodate the obviously increasing differences between Russian and Austro-Hungarian policy. He took a leading part in the negotiations preceding the crisis caused by the annexation of Bosnia-Hercegovina, which aimed at securing common action of the two Powers in the Balkan question. It was at his château of Buchlov, in Moravia, that the fateful conference took place between Izvolsky and Aehrenthal (Sept. 15 1908). In March 1911 Count Berchtold was recalled from Russia, and on Feb. 17 1912 he was, against his own will, appointed Aehrenthal's successor as Foreign Minister.

His efforts were directed toward securing the position of Austria-Hungary in the Balkan Peninsula. At this time he considered possible a peaceful solution of the Balkan question by agreement with Russia and the Western Powers. But the obvious efforts of Russian statesmen to weaken the influence of Austria-Hungary in the Balkans, the aggressive activities of the Serbs and the ambiguous behaviour of Bulgaria forced him to change his attitude, especially as he failed to receive from the Western Powers the support which he had sought.

During the three Balkan wars, Oct. 1912 to Aug. 1913, Berchtold's attitude was characterised by weakness and indecision. He repeatedly took steps toward active intervention, but drew back when the Entente Powers used threats, and the other members of the Triple Alliance intervened with counsels of moderation in Vienna. His efforts at the close of the third Balkan War to secure a revision of the Treaty of Bucharest (Aug. 10 1913), which was unfavourable to Bulgaria, were as unsuccessful as his attempt to secure an accommodation between Bulgaria and her rivals by way of direct negotiation. The prestige of Austria-Hungary in the Balkans noticeably declined. Serbia's endeavours to extend her power to the Adriatic and to win recruits for the ideal of Great Serbia among the kindred Slav races of Austria-Hungary became more and more evident. For these reasons, at the conferences at the Ballplatz which followed the murder of the heir to the throne, the Archduke Francis Ferdinand, on June 28 1914, Berchtold maintained the view that a definitive settlement with Serbia was essential, even at the risk of war with Russia and France.

After the outbreak of the World War he directed his efforts to inducing Italy and Rumania to carry out their obligations and to securing new allies for the Central Powers. These efforts were, for the most part, unsuccessful. Turkey alone joined the Central Powers. Rumania and Italy declared their neutrality; even Bulgaria dragged out the negotiations, though Berchtold offered great concessions in return for her active intervention on the side of Austria-Hungary and Germany. Italy's demands for compensation were acknowledged in principle by Berchtold, under pressure from Germany, but he embarked on the negotiations with hesitation, and to the day of his resignation (Jan. 13 1915) he refused to listen to any proposal for the cession of Austrian territory. In March 1916 Berchtold was appointed Obersthofmeister (lord high steward) to the heir to the throne, Charles Francis Joseph, whom he subsequently served as Oberstkämmerer (lord high chamberlain). After the fall of the dynasty he took no further part in politics. (*See* AUSTRIA.) (A. F. PR.)

BÉRENGER, RENÉ (1830–1915), French politician (*see* 3.769), died Aug. 29 1915.

BERESFORD, CHARLES WILLIAM DE LA POER BERESFORD, 1ST BARON (1846–1919), British sailor (*see* 3.770), long known as Lord Charles Beresford, was made a peer in 1916 and died Sept. 6 1919, when the title became extinct.

BERGEN, NORWAY (*see* 3.772), had a population in 1920 of 91,443. The central part of the town was burnt down in 1916, but is being carefully replanned and rebuilt. A new road has been made from the old German quay to the street above, and the old warehouses, with their dark courts and alleys, are disappearing. A garden suburb has been laid out at Finbergaasen by the municipality. The public library was removed to new buildings in 1917, and a post-office built behind the Exchange. The Rasmus Meyer collection of Norwegian paintings, old interiors and furniture, presented to the town, has been placed in the Art Gallery. The port has extensive quays and three large, and several smaller, engineering works, with shipbuilding yards attached. There are six patent slips and three dry docks.

BERGIUS, FRIEDRICH (1884–), German chemist, was born Nov. 11 1884 at Goldschmieden near Breslau. He studied at the universities of Breslau, Leipzig and Berlin and at the technical schools in Karlsruhe and Hanover. Later he founded a private technical research laboratory in Hanover, and devoted himself chiefly to the study of the influence of high pressure on chemical actions. This is described in his book *The Use of High Pressure in Chemical Actions* (1913). These studies led up to his work in connection with the conversion of coal into liquid products. Through the action of hydrogen under high pressure and at high temperature, he succeeded in converting a high percentage of coal-dust into oil, direct, without first obtaining intermediate products. The oil is equivalent in value to crude mineral oil. An experimental plant was erected at Rheinau near Mannheim.

BERGSON, HENRI (1859–), French philosopher, was born Oct. 18 1859 in Paris, of Anglo-Jewish parents. After a brilliant career at the Lycée Condorcet, he hesitated for some time between literature and science, being equally gifted in both directions, and then decided for the former. He became naturalised as a Frenchman, and entered the École Normale Supérieur where he was the contemporary of Jaurès. He taught philosophy first at the Lycées of Angers and Clermont, and then in Paris at the Lycée Henri IV., the École Normale Supérieur and the Collège de France. In 1918, he succeeded Émile Ollivier at the Académie Française. From that time he gave up teaching and devoted himself to politics and to international affairs, as head of a mission to America, and after the World War, as president of the committee of intellectual co-operation.

Bergson's Philosophy.—This account of the appointments held by him is, however, of small importance as compared with the history of the development of his mind, revealed in the books which have gained him a world reputation. He is the most highly esteemed of contemporary students of philosophy. Bergson the philosopher is not, like Hegel, Schopenhauer and Spencer, the creator of a great system, conceived as a whole in youth, and gradually expressed in later life. There is, nevertheless, in his philosophy one outstanding idea which is said to have come to him during a walk at Clermont-Ferrand, when he was 25 years old. Since Plato, philosophy had consisted in eliminating duration, in regarding time as an illusion, and finite being and eternity as one, and Bergson asked himself whether, on the contrary, the being, of which the philosopher took cognisance by reflection, might not be one which endured, might not be time itself. For the phrase of Descartes, " Je suis une chose qui pense," he substituted " Je suis une chose qui dure," and for the *sub specie aeterni* of Spinoza, a *sub specie durationis*. Just as he substituted durational for non-temporal values, so for static values, he substituted values of motion and change. This was the true Bergsonian revolution, which may be related to the German and English historical and evolutional philosophies characteristic of the 19th century.

All Bergson's work is thus concerned with duration and movement. He does not proceed by general speculation. Each of his

books is a study of one particular question, and this illustrates his second characteristic, originality of method. In his opinion, philosophy, like science, can only progress by disregarding general theories and universal systems, and devoting attention to particular problems, each of which demands its own point of view. The solution of any one of these does not necessarily involve an analogous solution of the others. Bergsonism implies continued striving after a precise adaptation to reality. The aim of each of his works is the elucidation of a detailed problem, though each is also part of a general philosophy, the philosophy of duration and change. Those who discover in Bergsonism an apotheosis of intuition and of mystical values and a depreciation of intelligence are mistaken as to the true substance of his theories.

The *Essai sur les données immédiates de la conscience* (1889), which was Bergson's thesis for the doctorate, is primarily an attempt to establish durational values, where the necessary illusions of the mind situate the appearances of space, and thence to proceed towards an original solution of the problem of free-will which was at that time the principal occupation of French philosophers. *Matière et mémoire* (1896) contains a detailed consideration of the problem of aphasia leading to a profound study of the means, namely the memory, by which existence is made continuous. In *L'évolution créatrice* (1907), he attacks the whole problem of existence. Whilst Spencer merely supported evolution by evidence derived from fragments of the evolved, Bergson takes as his material the essential motion of the being changing, or rather of the being which is itself both change and movement. This is his most famous and influential work, and that which has most fully expressed his ideas as to the secret of the universe.

An important part of Bergson's philosophy is to be found in his minor works, such as the essay *Le rire* (1900), his lectures at Oxford entitled *La perception du changement* (1911) and the volume *Durée et simultanéité* (1922), in which he discusses Einstein's theories. Except for the articles which have been collected under the title *L'énergie spirituelle* (1919), he has published nothing of late years, though he has been engaged in the study of moral and religious problems.

We must, in conclusion, refer to his position as a teacher and a writer. His lectures at the Collège de France were models of clearness and grace of expression and enjoyed great popularity. It was, however, probably as a master at the Lycée Henri IV. that his influence was most strongly felt. His style is modelled on that of the great philosophers, restrained and concise, like that of Condillac and at the same time full of colour and imagery, like that of Plato and Bacon. (*See* PHILOSOPHY.) (A. TH.)

BERI-BERI: *see* VITAMINES; also 3.774.

BERLAGE, HENDRIK PETRUS (1856–), Dutch architect, received his technical training at Amsterdam and Zürich and eventually settled at The Hague. As his career progressed he broke away from the Renaissance and Gothic styles which he had originally followed and finally succeeded in expressing the conception of beauty prevailing in his own time. Under the influence of these new ideas architecture in Holland reached an important stage of development. The chief characteristics of Berlage's style are simplicity of form, severity of line and a preference for brick as a material. In later years he was actively concerned with urban extension, and in this connection became architectural adviser to Amsterdam, The Hague and Rotterdam.

BERLIN (*see* 3.785) is the capital of the German Reich. The population of Greater Berlin (area 332 sq. m.) was 3,803,770 in 1919. The birth-rate in 1921 was 14·6 per 1,000, and the death-rate 12·8, making an excess of births over deaths of 1·8. It is now the second largest city in Europe, the population being estimated at 4,042,000 in May 1925. The birth-rate in 1925 was 11·6 per 1,000 and the death-rate 11·2, making an excess of births over deaths of 0·4 per 1,000.

Berlin has undergone a very considerable development in respect of the form of its municipal organisation. The rapid growth of the suburbs, which were independent communities, necessitated the adoption of certain main lines of procedure, applicable both to them and to Berlin, in order to prevent conflicting action on the part of the authorities on one side and the other. This led, in 1911, to the creation of Greater Berlin, as, in the first instance, an association of the city with the more important outlying districts for special objects. It embraced the city of Berlin and the towns of Charlottenburg, Schöneberg, Neukölln, Wilmersdorf, Lichtenberg and the administrative circles of Teltow and Niederbarnim. Its objects were to institute a common control of streets, roadways and the elevated railway, also of building and street alignment plans, the uniform co-ordination of police regulations and the acquisition of large tracts of forest and of land for building. This special union came into force on April 1 1912. It soon became manifest, however, that beyond co-operation for special purposes, a further co-ordination of the administrations of these places was requisite. It was only in the year 1920 that it was possible, after long negotiations, to form a new municipality of Berlin, embracing all the suburbs under a single united administration. A law to this effect was carried through the Prussian Constituent Assembly on April 27 1920, and was put into force on Oct. 1 of the same year. This law effected the centralisation of Berlin and all its suburbs into one uniform municipal region (*Stadtbezirk*), but nevertheless left large powers of local self-administration to the individual communes (*Gemeinden*).

Varied Developments.—On May 15 1912 the former secretary of state for the treasury, Wermuth, was elected chief burgomaster of Berlin in place of Kirschner, who had resigned. Under his administration, which lasted till Nov. 25 1920, the city experienced notable developments. The first municipal crematorium was opened in 1912. In June 1914 the ship canal uniting Berlin with Stettin was inaugurated. In the same year the city acquired the estate of Lanke, thus securing extremely valuable land for settlement purposes. In Oct. 1915 the city purchased the Berlin Electrical Works. The years of the World War necessitated the vigorous intervention of the municipal administration in order to keep the population supplied with food and other necessaries of life. A special commission for food supplies was appointed as early as 1914. In 1915 the supply of meat, vegetables, milk, etc., by the municipality was instituted. The management of all these supplies necessitated the appointment of a host of officials. The establishment of the war departments of the Empire and of Prussia as well as of the city thus entailed an accession of population which by 1917 had caused a great dearth of house accommodation, a scarcity which constantly increased up to 1921, so that special offices for enabling the public to obtain dwellings had to be established under municipal supervision. Even in 1921 it was almost impossible to find a flat. The general necessities arising out of the World War demanded vast expenditure on the part of the city.

The Revolution.—The city of Berlin suffered severely from the effects of the revolution of Nov. 9 1918. The revolution itself was practically bloodless, so far as Berlin was concerned, although the stormy sittings of the Workmen's and Soldiers' Councils, held in the Reichstag building, occasionally led to minor collisions. It was not till Christmas 1918 that serious fighting took place, when the Independent Socialist party, supported by the Sailors' Division, tried to seize power. After several days of sanguinary combats in the neighbourhood of the castle and the royal stables, where the sailors had established themselves, the division was ultimately compelled to surrender. Early in March 1919 the Spartacist insurrection broke out; it began in the suburb of Lichtenberg and spread over the whole centre of the city. The number of those who were killed in the street fighting was 1,175. The last victims of the revolution met their death on Jan. 13 1920 when a mass of people, incited by Spartacist propaganda in connection with the parliamentary debates on the Industrial Councils bill (*Betriebsrätegesetz*), attempted to storm the Reichstag building. There were 42 killed and 105 wounded. The Kapp *Putsch* in March of the same year was likewise attended by some casualties, but the decisive episode was a general strike imposed by the Socialist parties and the working-class leaders in order to put an end to Kapp's usurpation of power.

Since the revolution of 1918 the police force has been recruited

from the army, housed in barracks and clothed in military uniform, in spite of many protests from the Allies. It reverts to a military footing at once in times of disorder, as when a fresh communist outbreak was feared owing to the inflation collapse and the high cost of living in 1923, when a minor state of siege was put into force. During 1921–3 there were frequent strikes in the municipal services, with demands for higher wages, and food riots, with looting of shops. The population were nervous and exasperated, but the prevalent discontent was allayed with the fall of the government and the coming into power of Stresemann.

The Prussian State Library, opposite the palace of the Emperor William I., was finished in 1914, and two north wings of the Frederick Wilhelm University, in Kaiser Franz-Josef Platz, were built between 1913 and 1919. In the latter year a new branch of the National Gallery was installed, with a collection of modern pictures, in the Palace of the Crown Prince in the Zeughaus Platz, and a portrait gallery in the Academy of Architecture in the Schinkel Platz. The Schloss Museum was opened in the Schloss in 1921 with exhibits of pottery, silver, furniture, etc. The important Pergamon sculptures are housed in the Neues Museum, but a new museum is being built to the west of it to take the Pergamon antiquities and those from Western Asia, and as a German museum. The Hohenzollern Museum, containing personal possessions of the Prussian rulers, in Schloss Montbijou, is at present (1926) closed. A second large exhibition hall was built on the Kaiserdamm for the motor show of 1924, to obviate the overcrowding which previously existed.

The North-South (N.S.) tube, begun before the World War, was opened in Jan. 1923, and a new harbour, called the "West Harbour," in Sept. 1923. It is situated in the northwest of Berlin, between the Ring stations of Putlitzstrasse and Brusselstrasse. For some distance it is contiguous with the permanent way of the Hamburg-Lehrter Railway. The northern basin of the harbour is 655 metres long, 55 metres wide; the southern basin is 448 metres long and 55 metres wide. The two basins together have quays about 2,500 metres long, at which 68 large Elbe ships of 600 tons can be dumped down and loaded simultaneously. The harbour has the most modern arrangements for loading and unloading.

BERLIN, IRVING: *see* BALINE, ISRAEL.

BERNHARDI, FRIEDRICH VON (1849–), German soldier and writer, was born in Petrograd Nov. 22 1849, and he entered the German Army in time to take part in the Franco-Prussian War. From 1891 to 1894 he was German military attaché at Berne and later he took charge of the military history department of the General Staff in Berlin. In 1907 he was given command of the VII. Army Corps, but he retired in 1909 and turned his whole attention to writing on military subjects. Following Treitschke, Bernhardi held that war must come, that Germany must conquer or fall and that she is entitled therefore to secure victory at any cost. His gospel of force, thus proclaimed outside his own country, was a factor (possibly exaggerated at the time) in creating a belief that Germany was in an aggressive mood. His chief book was *Deutschland und der nächste Krieg* (1912), the translation of which into English caused a great sensation. In 1914, Bernhardi commanded an army on the western front.

BERNHARDT, SARA (1845–1923), French actress (*see* 3.801), in 1909 played Jeanne d'Arc in Paris. In 1910 she toured in America. In 1913 she was given the Cross of the Legion of Honour. Though lame as the result of an operation, she appeared in Nov. 1920 in Paris in a new play, *Daniel*, by Louis Verneuil, and repeated this performance in London in April 1921. She died March 26 1923.

BERNSTEIN, EDUARD (1850–), German politician and writer, was born in Berlin Jan. 6 1850. In 1872 he joined the Social Democrats and from 1881–90 edited, with Bebel the *Sozialdemokrat* in Zurich and later in London, where he lived in exile until 1901. It was during this latter period that he became intimate with Friedrich Engels and Karl Marx. In 1902 he entered the Reichstag as deputy for Breslau. He led the revisionist or right wing section of the Social Democrat party, but when the split in the party occurred in March 1916, his pacificist convictions forced him to associate with the Independents or extreme left wing. He rejoined the Majority Socialists, however, in 1919. Bernstein is, however, better known as a writer than as an active politician. His works include: *Die Voraussetzungen des Sozialismus und die Aufgaben der Sozialdemokratie* (first pub. 1899, latest ed., 1920); *Zur Geschichte und Theorie des Sozialismus* (1901, 1904); *Sozialismus und Demokratie in den grossen Englischen Revolution* (1922); *Erinnerungen eines Sozialisten* (1918); *Die deutsche Revolution, ihre Entstehung, ihr Verlauf und ihr Werk* (1921).

BERNSTORFF, JOHANN HEINRICH, COUNT VON (1862–), German diplomatist, was born in London Nov. 14 1862, the son of the Prussian diplomatist, Count Albrecht von Bernstorff, who was Prussian minister and German ambassador in London, 1854–61 and 1862–73. He entered the diplomatic service in 1899, was secretary of legation successively at Belgrade, Dresden, St. Petersburg and Munich, and (1902–6) councillor of the embassy in London. He then went as consul-general to Cairo, whence he proceeded as German ambassador in 1908 to Washington, and remained there until America's declaration of war against Germany, in April 1917. He made great efforts to facilitate mediation by President Wilson, but he did not receive the support he expected from authoritative quarters in Berlin. On the American declaration of war he returned to Germany and was sent as ambassador to Constantinople, where he was employed until 1918.

In various publications and in his reminiscences on his term of office as ambassador in Washington, he endeavoured to prove that Germany, if she had followed the proper policy, could have avoided war with America. This statement of his views excited much controversy in his own country. When the revolution broke out in 1918 Bernstorff left the diplomatic service, but later took an active part in parliamentary politics as a member of the Democratic party in the Reichstag, and also maintained a close connection with the international Press, and with pacific post-War propaganda, especially with League of Nation matters and as chairman of the German League of Nations Union.

BERTHELOT, PHILIPPE (1866–), French diplomat, son of the eminent chemist, Marcellin Berthelot (*see* 3.811), was born Oct. 9 1866 at Sèvres. Entering the diplomatic service in 1889, he went, in 1904, to the Foreign Office, where he remained throughout his career. In 1913 he became assistant in the political and commercial department. In this position, during the absence of his chief, who had accompanied MM. Poincaré and Viviani to St. Petersburg, he did much useful work during the early days of the international crisis of July 1914. Head of the political department in 1919, he became, in 1920, Secretary to the Ministry of Foreign Affairs with the rank of ambassador. In 1922, on the advent to power of M. Poincaré, he was suspended because of his intervention in favour of the Industrial Bank of China, controlled by his brother. In 1925 he was restored to the secretaryship. Exceptionally cultured, experienced and possessing a most retentive memory, M. Berthelot has played a most important part in the direction of French foreign affairs, particularly during the War, the Peace Conference and ensuing years.

BERTILLON, ALPHONSE (1853–1914), French anthropometrist (*see* 3.812), died in Paris Feb. 13 1914.

BERTOLINI, PIETRO (1859–1920), Italian politician, was born at Montebelluna July 24 1859. He began his career as a barrister and entered Parliament in 1891 as member for his native town, eventually becoming under-secretary at the Ministry of the Interior in the Pelloux Cabinet (1898–1900). Later, after the fall of Gen. Pelloux he went over to Giolitti, who appointed him Minister of Public Works in the Cabinet of 1907, and he proved a capable administrator. In the autumn of 1912 Sig. Giolitti, who had returned to power in 1911, entrusted him with the new Ministry of the Colonies. He was *rapporteur* for the extended suffrage bill which came into force in 1913 and must be given credit for the ingenious machinery which he devised for enabling illiterates to vote and for avoiding electoral corruption. Throughout the World War he remained in retirement as

a confirmed neutralist. Sig. Nitti appointed him senator and president of the Italian delegation on the Reparations Commission. He died at Turin Nov. 28 1920.

BERZEVICZY, ALBERT DE (1853–), Hungarian politician and writer, was born June 7 1853. After studying law and politics at Budapest University, he travelled extensively in Europe. He was professor of law in the University of Eperjes and in 1881 was returned to the Hungarian Parliament by the same town. He became Minister of Education in 1903, having held various posts in the department since 1884. From 1910–2 he was president of the House of Deputies. He is chiefly known for his works on history, art and politics. Berzeviczy published numerous historical and other works, among which may be mentioned *Absolutism in Hungary*, vol. 1 (1925); *Landscape Painting in the 17th Century* (1910). In 1904 he was elected a member and in 1905 president of the Hungarian Academy of Sciences, over whose centenary celebrations he presided in 1925.

BESANT, ANNIE (1847–), British theosophist, was born in London Oct. 1 1847, the daughter of William Page Wood. She married in 1867 the Rev. Frank Besant (d. 1917), afterwards vicar of Sibsey, Lincs., but obtained a separation from her husband in 1873. She had become an ardent freethinker, and from 1874 to 1888 she worked in close association with Charles Bradlaugh, both in politics and in freethought propaganda, as a lecturer and a writer of pamphlets over the signature of "Ajax." Her increasing tendency towards socialism of the more revolutionary type occasioned a divergence between them after 1885, which was completed in 1889 by her adhesion to the Theosophical Society. She became a devoted pupil of Mme. Blavatsky (*see* 4.48), and threw in her lot very largely with India. She founded the Central Hindu College at Benares, and was elected president of the Theosophical Society in 1907; she established the Indian Home Rule League, and became its president in 1916, and in 1917 she was president of the Indian National Congress, but later dissociated herself from the extreme wing of the Nationalist party. It was her marked gifts of oratory and organisation which carried her to the position, unique for an Englishwoman, of leader in a Hindu political movement. In addition to her numerous freethought pamphlets and works on theosophy, she published an *Autobiography* (1893); and *The Religious Problem in India* (1902).

BESSARABIA (*see* 3.821), a province of Rumania lying between the Prut, the Dniester and the Black Sea. Its area is 17,350 sq. m. and the population in 1919 was 2,625,000.

Political History.—In 1912 Russia celebrated the completion of a century since her annexation of Bessarabia. The loss of that province, however, had always remained a sore point with Rumanians, and the Russian celebrations served to arouse Rumanian national sentiment. Meetings held in Bucharest were attended by representatives of all the Rumanian cultural societies and of Bessarabian emigrants settled in Rumania. Among the most vehement critics who denounced the imperialistic tendencies of the Tsarist Govt. was Dr. G. C. Rakovsky, who at that time was a Rumanian subject and the leader of the Rumanian Socialist party.

In spite of the radical measures adopted by the Russian Govt. for the denationalisation of the Moldavian (Rumanian) element in Bessarabia, such as the suppression of the Rumanian language in schools and churches, etc., the province had not become Russified nor altogether submissive to the rule of the Tsar, and certain liberal-minded elements there, as in other parts of the empire, gravitated toward the democratic *zemstvos*. To these popular organisations may be traced the origins of a powerful liberal movement amongst the Rumanian population which set in at the outbreak of the Russian revolution in 1905. This movement, however, was ruthlessly suppressed.

When in 1917 the Russian revolution proclaimed the right of peoples to decide their own fate, Bessarabia declared herself autonomous (on Nov. 3 1917) and a National Council (*Sfatul Tsarei*) was elected. On Dec. 2 1917 the "Sfatul Tsarei" proclaimed Bessarabia a "Moldavian Democratic Republic," forming part of the Federation of Soviet Republics, equal rights and liberties being granted to all its citizens.

On the collapse of the Russian front, the Sfatul Tsarei made an appeal to the Rumanian Govt. at Jassy for Rumanian army detachments to guard the railways and keep order in the province. On Jan. 24 1918 Bessarabia, following the example of the Ukraine, declared herself the "Independent Moldavian National Republic," thus detaching herself from the Federation of Soviet Republics, and on March 27 of the same year the Sfatul Tsarei formally and unconditionally voted for political union with Rumania subject to certain conditions for local autonomy, and the proposal was accepted by the Rumanian Government. The union of Bessarabia with Rumania was not acknowledged by Russia, nor at that period even by the Allied Powers. On Nov. 27 1918 the Sfatul Tsarei accepted a new motion under which Bessarabia was incorporated unconditionally in Rumania. In the following year elections on the basis of universal suffrage were held, and for the first time Bessarabia sent representatives to the Parliament in Bucharest.

The union of Bessarabia with Rumania was recognised by the Supreme Council of the Allies on March 3 1920, and formally and explicitly by the Treaty of Paris (Oct. 28 1920) signed by England, France, Italy and Japan. England and France ratified the treaty, but Italy and Japan delayed its ratification. The United States stood aside from the treaty signed at Paris on the ground that there was at that time no Russian Govt. to state the Russian side of the case. Rumanian treaties with Yugoslavia and Czechoslovakia do not involve these countries in the defence of Bessarabia, but the treaty between Poland and Rumania signed at Bucharest on March 3 1921 declares that the two states should come to one another's assistance in the event of an unprovoked attack on their eastern frontier. The union is still a matter of controversy between Russia and Rumania, and the negotiations between Russian and Rumanian delegates which took place at Genoa in 1922 and at Vienna in 1924 led to no settlement.

Administration.—On assuming the charge of the administration of Bessarabia the Rumanian Govt. took steps to ensure public order which had been disturbed by armed bands of Bolshevists. Pickets of troops were posted all along the Dniester in order to exclude Red bands and Bolshevist agents. By the agrarian reform law passed by the Parliament in Bucharest all private estates over 100 hectares were expropriated and turned over to the peasants. Thus, more than 340,000 peasant families became the owners of over 1,000,000 hectares of land. The administrative system of the province was changed by replacing the *zemstvos* (district councils) and *volosti* (sub-district councils) by prefects and sub-prefects appointed from Bucharest. For administrative purposes Bessarabia was divided into nine districts, each district being in charge of a prefect.

Population.—In 1919 the population was estimated at 2,625,000 inhabitants, of which the Rumanians numbered 1,585,000, the rest being composed of Russians (45,000), Ukrainians (225,000), Jews (138,000), Germans (72,000), etc. Owing to Bolshevist agitation and a large influx of refugees and Bolshevist agents who continuously try to cross into Bessarabia, the province has been in a state of siege ever since the War. The commander of the army corps at Chisinau (Kishinev) is virtually the military governor of Bessarabia.

Economic Development.—The disorganisation of the ways of communication, which even in normal times were very restricted in the province, the parcelling out of large estates and the adoption of a new currency have hindered the normal economic development of Bessarabia. Rumania being herself an agricultural country, she cannot provide a market for the products of Bessarabia (cereals, fruit and wine). Under the Russian rule Odessa was her natural outlet, and her fruit and wine found a ready market in Russia. The export trade of Bessarabia can only develop when her railways have been reorganised as part of the Rumanian system and converge toward the Rumanian ports of Galatz and Braila. (*See* RUMANIA.)

See *British White Paper Cmd. 1747 of 1922; Les quatre Décrets du gouvernement roumain en Bessarabie* (Paris, 1919); *The Roumanian Occupation in Bessarabia*, Documents (Paris, 1919). (G. Bo.)

BETHLEN, STEPHEN BETHLEN DE, COUNT (1874–), Hungarian statesman, was born on Oct. 8 1874 at Cornești (Gernyeszeg), Transylvania. His father, Count Stephen Bethlen, was a member of the famous family that gave Gabriel Bethlen, Prince of Transylvania, to Hungarian history. His mother was Countess Helen Teleki. The son went to school at the Theresianium in Vienna, then studied law at the University of Budapest and also obtained the diploma of the academy of agriculture at Magyaróvár. After finishing his studies he

travelled in Europe and the United States. On his return home he took charge of the management of his large estates—estates which were sequestrated after the Treaty of Peace by the Rumanian Government.

He soon began to take an active interest in domestic politics, and in 1901 was elected to Parliament as a member of the Liberal Opposition. His speeches always attracted attention and particularly impressed that famous statesman Count Tisza, who, when in power prior to the World War, offered Count Bethlen a portfolio in the Cabinet, an honour which Count Bethlen declined. The Emperor Francis Joseph appointed him a privy councillor and this, with the exception of the degree of doctor of laws conferred, in 1922 by the University of Cluj (Kolozsvár), now removed to Szeged, was the only distinction Count Bethlen ever accepted. Until he became Prime Minister in 1921 he had never held office. By the end of 1925 he had been longer continuously in power than any other European Prime Minister of that day.

The 20 years that elapsed between the day Count Bethlen entered political life and the day he became Prime Minister although not marked by Cabinet responsibility, were full of activity in relation to domestic affairs and of service to the state. After the Hungarian revolution of Nov. 1918, and during the ensuing régime of Count Michael Károlyi, Count Bethlen took a leading part in creating the counter-revolutionary organisation which, when the Bolshevists came into power, took shape as the emergency Govt. of Szeged. (*See* HUNGARY.) As the chief representative in Vienna of this anti-Communist Govt. Count Bethlen did much to keep up the courage and the hopes of his fellow-countrymen and to create throughout the rest of Europe the determination to end the excesses of Soviet rule as enforced in Budapest by Bela Kun.

When the Hungarian Peace Delegation went to Paris Count Bethlen was one of the principal delegates, and it was under his personal direction that the Hungarian memorandum in relation to Transylvania was drafted. Ten months after the Treaty of Trianon had been signed, and a few days after King Charles had made his first fruitless effort to regain the throne of Hungary, Count Bethlen accepted the invitation of the Regent, Admiral Horthy, to form a Cabinet in consequence of the resignation of Count Paul Teleki.

As Prime Minister.—On April 14 1921 Count Bethlen became Prime Minister. Few men in the political history of Europe had so often and for so long refused high office: few had ever taken it under such thankless and discouraging conditions. The Succession States, with overwhelming armies, threatened the occupation of Hungary on the ground that the recent attempt of King Charles to regain the throne endangered the Peace Settlement. The great Allied Powers were in much the same mood. On the other hand the Hungarian people were seething with indignation over what they considered to be the injustice and humiliation of the dictated Treaty of Peace. In this crisis, with no Cabinet experience, relatively ignorant of official procedure, bitterly opposed both by Royalist and Socialist extremists, Count Bethlen dared to lead his country. He succeeded at home because of his unquestioned patriotism, moderate views and political sagacity: abroad his powers of reasoning, fairness and flair for negotiation received quick recognition.

By Oct. of his first year as Prime Minister he had achieved a notable diplomatic success in concluding at the Conference of Venice an amicable agreement with the Austrian Chancellor regarding western Hungary (Burgenland). For months Austria and Hungary had been on the verge of hostilities over the ownership of this territory which under the Peace Treaty had been allotted to Austria. In consequence of the Venice conference the important town of Sopron and its environs, after a plebiscite, were ceded back to Hungary. In the same month—Oct. 1921—Count Bethlen had to face another national crisis when King Charles for the second time, but on this occasion with armed forces, endeavoured to regain his throne. The firmness shown by Count Bethlen in concert with the Regent, after all avenues of negotiation with Charles had been exhausted, undoubtedly saved Hungary from national extinction.

The elections rendered necessary by the expiration of the mandates of the existing Parliament returned Count Bethlen to power in June 1922. This enabled him to substitute for his previous coalition Govt. a new Cabinet supported by a united "Government party." This second Govt. of Count Bethlen can scarcely fail to be one of the most important, if not the most important, in Hungarian history. By the end of 1925 it had completed the scheme of land reform, created a new basis of suffrage, approved radically new standing orders for Parliament, ratified agreements settling outstanding political and economic difficulties with neighbouring states and last but most important of all had achieved the financial and economic salvation of Hungary. The courage of Count Bethlen in accepting office in his country's darkest days had been rewarded. There were several occasions between 1921 and 1925 when it appeared impossible for him to weather the political storm and when his defeat seemed only a matter of days or even hours. That he survived, and not only succeeded, but obtained ascendancy was due to his unswerving devotion to the principle of national consolidation and his skilful policy of the "golden mean."

The economic salvation and reconstruction of Hungary became possible almost solely owing to Count Bethlen's personality and to his individual efforts. In the spring of 1923 he appealed in Paris to the Reparation Commission so to suspend the Reparation sword of Damocles as to permit Hungary to remain alive. At that time the state was faced with bankruptcy and the people with ruin. Count Bethlen took his political fortune in his hand and pledged his proud countrymen to accept the financial control of the League of Nations. Most of his opponents and many of his supporters thought that would be his political death. The Reparation Commission, by the casting vote of France, refused Count Bethlen's request. He went on a desperate pilgrimage to London, Paris and Rome to get that decision reconsidered. He was a stranger to practically all the Allied Ministers, yet thanks to his transparent integrity and reasonableness he succeeded. Within 18 months the Reparation Commission had suspended the Reparation charges, the League of Nations had arranged all the intricate details of a plan of reconstruction, the Hungarian Parliament had agreed to all the league's demands of control, and a loan of about £11,000,000 was floated successfully on the money markets of the world—principally in London and mainly through British support. That would never have been achieved if Count Bethlen had been a man of less patience or less determination.

By the end of 1925, thanks to the self-sacrifice of the Hungarian people and their willingness to follow the lead of their Prime Minister, the reconstruction scheme was assured of a success far beyond the anticipation of the league or of the outside world. The Hungarian budget showed a surplus instead of a deficit, the currency was stabilised, and instead of £11,000,000 only £3,000,000 had been required to meet deficits in the earlier stages. It was not surprising that the chairman of the financial committee of the league said that body were "glad to convey their very sincere congratulations to you, Count Bethlen, who have directed the fortunes of your country through so many difficult years and are still guiding it through the present effort of reconstruction."

Count Bethlen married Countess Margit Bethlen, a talented poetess. He belongs, like his ancestors who raised armies for Calvinism, to the Reformed (Calvinist) Church. (W. Go.*)

BETHMANN HOLLWEG, THEOBALD VON (1856–1921), German statesman, was born Nov. 29 1856 at Hohenfinow, near Berlin (*see* 11.898). He was descended from the Frankfort banking family of Bethmann, which attained great prosperity in the 18th century, and a branch of which was founded by his great-grandfather Johann Jakob Hollweg, who had married a daughter of the house.

Having risen through the regular legal and official stages of promotion, in 1905 he was appointed Prussian Minister of the Interior and in 1907 Secretary of State for the Imperial Home

Office and vice-president of the Prussian Ministry. At the time of Bethmann Hollweg's appointment to the chancellorship in 1909, internal affairs, under his predecessor, Prince Bülow, had reached a deadlock in the Reichstag owing to the revolt of a section of the Liberal-Conservative *bloc* against the proposal to establish death duties as part of the reform of the finances of the empire. It was not until the general elections of 1912 had transformed the situation by bringing a great accession to the strength of the moderate National Liberals and the Left, especially the Social Democrats, that the Government was able to reckon upon a more amenable majority.

In the interval Bethmann Hollweg endeavoured to conciliate the Catholic Centre by a policy of compromise in matters which had threatened to lead to a renewal of the *Kulturkampf*, such as the denunciation of the Reformation in the Papal Encyclical of 1910 and the Catholic demand for the modification of the Jesuit law. He secured the final abrogation of this law under stress of war conditions in April 1917. Bethmann Hollweg was likewise the sponsor of the new constitution for Alsace-Lorraine (*q.v.*) which in 1911 established the government of that territory of the empire upon the basis of popular representation in a territorial assembly and admission, though without full state rights, to the Federal Council. He was less successful with the vexed question of the Prussian franchise, which, in 1910, he attempted to solve by proposing a direct system of election while retaining in a modified form the local division of the electorate according to income-tax assessment into three classes. His bill was ultimately rejected by the reactionary Chamber of Deputies.

He was equally unsuccessful in dealing with an outbreak of militarism in Nov. 1913 at Zabern in Alsace where the population, exasperated by the truculence of a young officer, was subjected to the arbitrary exercise of martial law by the colonel in command of the garrison. Bethmann Hollweg's treatment of the incident satisfied neither the reactionaries nor the advanced parties, and, for the first time in the history of the Reichstag, a vote of censure was passed upon the Chancellor.

In 1914 Bethmann Hollweg became famous by his remark to Sir Edward Goschen, British ambassador in Berlin, that the Belgian guarantee was " a scrap of paper." Over unrestricted submarine warfare he divested himself of responsibility, having declared in Jan. 1917, " I can give Your Majesty neither my assent to the unrestricted submarine warfare nor my refusal."

By the middle of July 1917, Bethmann Hollweg had lost all support in the Reichstag. The Conservatives and National Liberals were alienated by his Prussian franchise policy and his conflicts with the higher command. The Left and the Catholic Centre in which Erzberger with his so-called Peace Resolution (adopted by the Reichstag on July 19) had acquired the upper hand were convinced that the Allied and Associated Powers would place no confidence in the overtures of men with the past of Bethmann Hollweg and Zimmermann. Finally, on the morrow of the publication of the second Prussian Franchise Edict, on July 14 1917, Hindenburg and Ludendorff came to Berlin in order to hold conferences with the chiefs of political parties regarding the terms of the " Peace Resolution." The Chancellor could not tolerate this military interference with his own department, and the Emperor, confronted with an ultimatum from his two indispensable military leaders, accepted the Chancellor's resignation. Bethmann Hollweg retired to Hohenfinow and took no further part in politics beyond writing his *Reflections on the World War* (vol. 1, 1919). He died at Hohenfinow on Jan. 1 1921, after a brief illness.

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BETTING TAX.—In some countries revenue is raised by a tax on betting. This is so in the six states of Australia, in Ontario, the Union of South Africa and New Zealand, as far as the British Empire is concerned, and in France, Germany, Italy, Austria and Belgium. The method adopted is to put an *ad valorem* tax on the amount staked. To collect the money machines known as the totalizator and the pari mutuel are used. The totalizator is a machine operated by electric power, which, working on almost the same principle as a cash register, registers every bet made with it and shows publicly the amount of money staked on each horse in the particular race and the total amount staked on all the horses in the race. The pari mutuel system, used in France and elsewhere, is practically the same as the totalizator, but is worked in the main by human instead of mechanical agency.

In 1923, in view of the demand that betting should be taxed in Great Britain, the House of Commons appointed a committee to report upon the subject. A majority of the committee reported in favour of such a tax and made various suggestions for levying and collecting it. Bookmakers and their premises were to be licensed or registered and betting in the street was to be made illegal. The duty proposed was 2½% on the amount staked and it was estimated that from it, £5,000,000 would be obtained each year. For small bets books of tickets would be issued to bookmakers, whose books would be examined by the officials of the Board of Customs and Excise. In the Budget of 1926, the Chancellor of the Exchequer (Mr. Winston Churchill), proposed to impose a tax on all legalised betting and suggested that this should be at the rate of 5% of the amount staked. In the same year a tax on betting was imposed by the Irish Free State. (A. W. H.*)

BEYERS, CHRISTIAN FREDERICK (1869–1914), South African soldier, was born in the Cape Colony, but went in early life to the Transvaal. He took a prominent part in the South African War, reaching the rank of general. On the grant of responsible government to the Transvaal in 1906, Beyers was elected Speaker of the House of Assembly, and commended himself to the Opposition by his tolerance and impartial conduct in the chair. On the establishment of Union, in 1910, he was appointed commandant-general of the South African Defence Force and in that capacity visited England in 1912. On the outbreak of the World War, he showed determined opposition to the loyal policy of Botha and Smuts, especially in regard to the campaign in German Southwest Africa. His ultra-patriotic views and strong religious feelings gave him much influence with the backveld Boers and helped to foment the rebellion. After conducting an acrimonious correspondence with Smuts, he resigned his post and shortly afterwards went openly into revolt. After various vicissitudes his forces were harried and broken, and Beyers himself, in trying to escape across the Vaal river, was drowned Dec. 8 1914. At first some doubts were entertained as to the manner of his death, but on Dec. 10 these were dispelled by the finding of his body. (H. Gu.)

BHOPAL, BEGUM OF.—Nawab Sultan Jahan (1858–) was the fourth woman in succession to rule Bhopal, a state of about 7,000 sq. m. in Central India. Sprung from an ancient stock of Afghan invaders, she was married in 1874 to a member of her own family, and had three sons. She succeeded her mother in 1901. Of an energetic, warm-hearted and industrious disposition, she also was renowned among the Indian princes as a just and progressive ruler and as a sage and scholarly personality. She took particular interest in the education and medical care of the women of her State, and encouraged agricultural improvement and industrial development. She visited Europe in 1911, and again in 1925 went to London where she secured the nomination of her son as her successor. She maintained a regiment of Imperial Service Cavalry, and was entitled to a salute of 21 guns within, and 19 outside, her own territory. On May 18 1926 it was announced that the Viceroy had approved her decision to abdicate in favour of her son.

BIBLICAL CRITICISM.—During the period 1910–25 biblical criticism has made notable advances marked by new orientations and the reopening of many subjects believed to be closed.

Historical Background.—A generation ago little could be said with security regarding human history before 1600 B.C.; now we have in *The Cambridge Ancient History*, vol. 1 (1923), 600 packed pages of detailed information, while another such volume is required to carry on the record to 1000 B.C. Thus the dark story of Hebrew origins is read to-day not merely by the aid of

analogies from ancient Arabia, but in the new light shed by the advanced contemporary civilisations of Babylonia, Egypt, Crete and the Hittites (*see* ARCHAEOLOGY); and whatever influence that civilisation may have had on the characteristic religious ideas of the Hebrews, it drives us to consider afresh our views on the possible antiquity of their history and their documents. An obscure period in later Jewish life (5th century B.C.) has been illumined by the discovery of the Elephantine Papyri (ed. A. E. Cowley, 1923).

As regards the New Testament, instead of construing Christianity merely in contradistinction to a legalistic Judaism or a bankrupt paganism we now recognise the various strands of thought and aspiration to be traced in pre-Christian Judaism and the eager gropings after life and light expressed in the heathen mystery-cults, while by the help of innumerable ostraka, papyri and inscriptions the terminology of the New Testament is studied in relation to the "common Greek" of the time. "New Light" may bewilder as well as illumine; but as useful correctives we may note the increasing attention paid (*a*) to religious psychology: a passionate faith, whether in communities or in individuals, is something far subtler than a synthesis of derived religious ideas, and allowance must be made for the influence of a dominating and original personality like Moses, Jesus or Paul; (*b*) to the Jewish background of the New Testament; it is folly to trace to heathen sources anything that can be equally well explained from Jewish antecedents.

I. The Old Testament

The Hexateuch.—Despite reactionary tendencies (*cf.* M. Kegel's *Away from Wellhausen*, Eng. Trans., 1924) the general critical position regarding the literary sources J E D P[1] of the Hexateuch has been consolidated. The line of advance depends upon our reconstruction of Israel's religious history. Stressing the influence of the prophets, S. A. Cook (*Camb. Anc. Hist.*, vol. 3, 1925) dates even J and E, as well as D, in the 6th century B.C., whereas Sellin carries back J and (in its primary form) E to the time of David and Solomon, and traces the Book of the Covenant (Exodus xx. 23–xxiii. 19) and even, in a simple form, the Decalogue, to Moses himself. As regards D, R. H. Kenneth (*Deuteronomy and the Decalogue*, 1920) and G. Hölscher see in it a purely idealistic reconstruction dating from the Exile, while A. Welch (*The Code of Deuteronomy*, 1924) denying that it demands a centralised worship, and stressing the primitive character of many of its enactments, dates it near the rise of the monarchy. We may doubt if either of these suggestive theories will displace the established view connecting Deuteronomy with the book found in the Temple (2. Kings xxii. 8) in 621 B.C. P was probably never a continuous document, and much of its material may be pre-exilic in origin.

The Prophets.—While the criticism of a generation ago rediscovered the sublime figures of the Old Testament prophets, we must not forget that they were seers rather than teachers; they had links with the earlier nebi'im, and their function in part was to discern *in advance* Yahweh's forthcoming judgments, even though their essential value lay, not in their predictions, often falsified by events, but in their spiritual insight into eternal principles. Did they too, like the nebi'im, receive their message mainly in ecstasy? G. Hölscher and T. H. Robinson assert this even of the greatest prophets, but in many of their "visions" some part was surely played by deep sober reflection on the facts of experience. We may, however, with advocates of the ecstatic theory, agree that the prophetical books consist not of long coherent harangues but of short unconnected utterances (there seem to be five such in Isaiah i.) set side by side with indifferent editorial skill. Perhaps in the case of most of the prophets much anonymous matter has been mixed up with their genuine utterances, which become more fully intelligible when it is removed.

[1] J, the earliest source, is marked *inter alia* by the almost exclusive use of the name *Jahveh*, preferably written *Yahweh* (Jehovah); in E, the second source, we find the name *Elohim;* D is the basis of our Deuteronomy; and P stands for a priestly source compiled after the destruction of the Temple. The Pentateuch in its present form may be taken as the work of Ezra and his associates.

A vital problem is the interpretation of their thought in relation to the religious history of the nation. Many critics regard their vigorous denunciations of sacrifice as denying any valid place whatsoever to it in the true worship of Yahweh. In his sublime conception of "the Suffering Servant" (chs. liii., etc.) has the "Great Unknown" whom we call Deutero-Isaiah been influenced by the sufferings of Jeremiah, perhaps even (as Sellin thinks) by the tradition of the martyrdom of Moses in Shittim?

The "Writings," and the Apocrypha and Pseudepigrapha.—Recent work on the later books of the Old Testament and on the Wisdom and Apocalyptic literature of the period between the Testaments has made possible a more credible account of the rise both of Talmudic Judaism and of Christianity. We see how conceptions such as predestination and free will, and the suffering of the righteous, begin to find expression as dogmas.

II. The New Testament

Text.—As regards the text, much more value is now attached than by Hort to the so-called "Western" authorities. The text of Von Soden's monumental edition appeared in 1913, but his critical theories, like his notation, have not commanded acceptance. B. H. Streeter has advanced considerably the work of regrouping texts according to local centres. Of special interest among new discoveries are a "Western" Gospel book (Codex W, ed. by H. A. Sanders, 1912), of date not later than the 5th century; and a Coptic version of St. John's Gospel (*c.* 400 A.D., see *Expositor*, 1924, p. 203). The discovery of the Gallio inscription (see A. Deissmann, *St. Paul*, Eng. Trans. 1912, appendix 1) enables us to date Paul's arrival in Corinth in 50 or 51 A.D.

The Synoptic Gospels.—The Gospels are primarily collections of reminiscences current in the Christian communities because of their value for edification, missionary-preaching and apologetic, and arranged on a plan which is not wholly chronological. Luke's framework has been shown by Streeter to be a special source (edited by Luke himself?) into which excerpts from Mark are interpolated. One of Matthew's sources was a collection of anti-Jewish proof-texts ("testimonia") from the Old Testament, traces of which are found throughout the New Testament and frequently in early Christian literature (see J. Rendel Harris, *Testimonies* 1916 and 1920).

The Johannine Literature.—C. F. Burney's arresting work on *The Aramaic Origin of the Fourth Gospel* (1922), the attempt to link up the Logos-doctrine with the Memra of the Jewish Targums (so now even Ed. Meyer), or with the Wisdom literature (so J. Rendel Harris, *The Origin of the Prologue to St. John's Gospel*, 1917), the recognition of affinities with Jewish apocryphal literature, the greatly increased value placed (notably by Jewish scholars) on the historical value of much both in the narratives and in the discourses, all point to the conclusion that the background of the Fourth Gospel is Jewish, and probably Palestinian, rather than Hellenic. The question of authorship is secondary to that of atmosphere, and dogmatism here is folly. Behind the Gospel looms the figure of a Jerusalemite of priestly stock, whom some would identify with the son of Zebedee, a few (including Burney) with the seer of the Apocalypse, though the weight of critical opinion, distinguishing him from both of these, connects him with "John the Presbyter," possibly a disciple of John the Apostle.

The Epistles.—Working to-day in a freer atmosphere, criticism is questioning many of the accepted views regarding the origin of the New Testament Epistles. Dictation to a (shorthand?) scribe may explain some of their peculiarities of vocabulary and style (*cf.* G. Milligan, *New Testament Documents*, 1913). Before the Epistles were formally collected, fragments of genuine correspondence may easily have been combined into one letter—is this true of 2 Corinthians, of Romans (as regards ch. xvi.), of Philippians? Galatians, now generally accepted (though Lietzmann demurs), as addressed to the South Galatian churches, is dated by many (as it was by Calvin) before the Jerusalem Council—the earliest of Paul's letters. Romans may in that case have been originally composed as a treatise in the same controversial period, and adapted later to serve as a circular letter.

The arresting thesis that some, if not all, of the Ephesians-Colossians-Philemon-Philippians group were written during one or more imprisonments at Ephesus not recorded in Acts xix. (date *c.*52–5) is supported by A. Deissmann (see his contribution, with bibliography, to *Anatolian Studies* presented to Sir W. M. Ramsay, 1923). As regards the letters to Timothy and Titus, P. N. Harrison's argument (*The Text of the Pauline Epistles*, 1921) that their vocabulary is un-Pauline and has close affinities with that of second-century writers, will appear to many conclusive; but undoubtedly genuine Pauline fragments are embedded in them, and on any view of their authorship difficulties of historical setting would be greatly relieved if 2 Tim. iv. 9-20 were transferred to 1 Tim. (of Acts xx.). Hebrews has generally been interpreted as an appeal to Jewish-Christian reactionaries, but its significance is greatly enhanced if with many recent editors (*e.g.*, H. Windisch, J. Moffatt; *cf.* E. F. Scott, *The Epistle to the Hebrews*, 1922) we discount its title as a misnomer and read it as demonstrating the finality of a religion that knows neither Jew nor Gentile.

Acts of the Apostles.—The main critical battle of the future is to range round Acts. Loisy argues that about the year 130 Luke's careful narrative was falsified beyond recognition in the interest of church theory, but with him the apologetic colouring of history is almost an obsession. In chapters i.–xv. the atmosphere is largely that of the primitive community; C. C. Torrey (*Harvard Theological Studies*, i, 1916) has made a good case for their close, even literal, dependence on an Aramaic document. The date of Acts is generally placed after 75; but there is force in the contention (accepted by A. Harnack, *The Acts of the Apostles*, 1911), that the book's abrupt conclusion implies a date before the issue of Paul's trial (*c.*62), and Plooij holds that Luke's purpose in writing was to assist Paul's defence by showing the claim of Christianity to be a *religio licita* within the empire. This date if accepted *simpliciter* would imply a still earlier date for the Gospels of Mark and Luke.

Two Main Issues

The two main problems (and they are ultimately one) to which all New Testament criticism leads are the personality of Jesus, and the rise and development of the Church.

The Personality of Jesus.—It is now recognised that the Gospels are in no sense "lives" of Jesus, and do not provide the material for a "life." There is material, however, for a portrait; and even the Rationalist Press (F. C. Conybeare, *The Historical Christ*, 1914) has ably refuted the fantastic attempts of A. Drews, P. Jensen, J. M. Robertson and W. B. Smith to deny that Jesus ever lived. (*Cf.* M. Goguel, *Jésus de Nazareth, Mythe ou Histoire?*, 1925.) But that portrait is not to be obtained merely by adding psychological finishing-touches to Mark's bare outline, and the Fourth Gospel must be drawn on for many important features. Instead of interpreting Jesus as pre-eminently a teacher with a "sane and well-poised mind" criticism now tends to believe that He shared in some measure the apocalyptic conceptions of His time, seeing the present age in the light of an imminent new world-order which it was His divine mission to inaugurate; but the validity of His religious and ethical message is independent of the apocalyptic form in which it is expressed, securely based as it is on the Son's revelation of the Father.

Beginnings of the Church.—The centre of gravity in criticism is shifting from the Gospel-story to the origin and development of the Christian Society. Liberal critics, recognising the chasm that separates their so-called "historical Jesus" from the "Son of God" of the early faith, have interpreted Paul as a daring innovator who, indifferent to the truth about the Galilean prophet (so Wrede), adulterated the simple gospel of Divine Fatherhood with Jewish Messianic conceptions and rites and doctrines of the mystery-cults. But a more intimate study of the soul of Paul shows rather that he loyally adhered to the traditions of the faith, that in countless ways he reflects as in a mirror the mind and spirit of his Master, and that his doctrine of the Church, far from being a conscious transference to Christianity of the conception of a cult-fellowship based on magical rites, follows naturally from his essentially religious conception of the relation of the Son of God to the individual believer and to the fellowship which he founded, and may even go back to a mystical strain in the teaching of Jesus Himself.

Studies like W. Scott's *Hermetica* (1924, 1925) remind us further how slender are many of the alleged affinities between Christianity and the heathen cults. Thus more and more the storm-centre of criticism is found in the religion of the primitive communities. While there is truth in the contention that even the Gospels are evidence primarily for the Church's conception of Jesus and only secondarily for the historical truth about Him, the converse is no less true, that conceptions and practices which criticism reveals as essential elements of the primitive faith (*e.g.*, the Lord's Supper, and the recognition of Jesus as *Kyrios*, Lord) are most likely to have their roots in the life and teaching of Jesus Himself.

The War robbed Biblical study of many of its foremost representatives on both sides of the conflict, but stirred many others to appreciate as never before that surging religious life of which the Scriptures are the literary deposit. "When I personally," A. Deissmann has written (*Review of the Churches*, Jan. 1925), "compare my understanding of the Gospel to-day with the understanding of it I thought I had ten years ago, I can only speak of a real inner growth. The task of the present generation is to add to all the latest philological and historical investigation a truer and deeper spiritual appreciation of the vital forces of the New Testament."

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BIGELOW, JOHN (1817–1911), American diplomatist and journalist (*see* 3.922), died in New York Dec. 19 1911. In 1909 he published three volumes of *Retrospections of an Active Life*, covering his career to 1866. Two additional volumes, ending with 1879, were issued by his son (1913).

BIKANER, SIR GANGA SINGH, MAHARAJA OF (1880–), Indian soldier and statesman, was born Oct. 3 1880, and succeeded by adoption his elder brother, Dungar Singh, in 1887 as 21st ruler of the state, being invested with full powers in 1898. The first of his many visits to England was made in 1902, when he attended King Edward's coronation, and became A.D.C. to the Prince of Wales, an appointment continued by King George. In the World War the Maharaja served in France as a staff officer and in 1915 he took part in the fighting to withstand the Turkish invasion of Egypt. In 1917 he was made a member of the Imperial War Conference and assisted the Secretary for India at the Imperial War Cabinet. He represented the Indian states at the Peace Conference, 1919, and the Indian princes at the League of Nations Assembly, Geneva, 1924. It was largely due to his personal influence that the constitution of the Chamber of Princes, as a deliberative, consultative and advisory body, was secured under Royal Proclamation in 1921. His appointment as Chancellor was indicative of the intellectual prominence he had acquired in the deliberations of the rulers. (F. H. B.*)

BILHARZIASIS or SCHISTOSOMIASIS.—A disease caused by the fluke parasite schistosoma.

Distribution.—One of the widest spread endemic diseases of the world, schistosomiasis is endemic throughout Africa, has spread to South America and the West Indies, China, Japan, the Philippines, Formosa and Burma. One European country only, south Portugal, is known to be infected by schistosomiasis (1925). Indigenous cases have been reported in India and Western Australia. Cases have been recorded of persons infected in England, and there is probably there a species of mollusc capable of serving as intermediary host if climatic conditions and the hygienic standard of Great Britain were less rigorous.

History.—The disease is one of great antiquity. Armand Ruffer found calcified bilharzia ova in mummies of the 20th dynasty (1250–1000 B.C.). It is probably of equal antiquity in China. In 1799–1801 many cases were noted in Napoleon's army in Egypt—and in more recent times expeditionary armies have suffered considerably from "Egyptian Haematuria."

Causation.—Schistosomiasis is caused by certain metazoal parasites of the family Schistosomidae Looss-1899 (type genus Schistosoma Weinland 1858) belonging to the trematode class of the phylum Platy-helminthes. In the schistosomidae the sexes are separate, and the alimentary canal is united posteriorly into a single tube. In the known human species the egg is furnished with a characteristic spine (point) or knob. A ventral (gynaecological) canal for carrying the cylindrical female worm is formed by the infolding lateral margins of the leaf-shaped male.

There are three known human species:

Schistosoma haematobium, the chief African species and the most commonly known, infects principally the bladder. *Schistosoma mansoni*, also found in Africa, the only species infecting the New World, affects the large intestine. *Schistosoma japonicum*, the Asiatic species, affects the large intestine and liver and spleen.

The adult worms inhabit the portal venous system, reach maturity in the liver and pass in the portal tributaries to the pelvic veins in the bladder and large intestine to lay their eggs, which reach the exterior world in the urine and faeces.

In fresh water with favourable conditions of climate and environment, the ovum hatches the ciliated embryo (miracidium) which

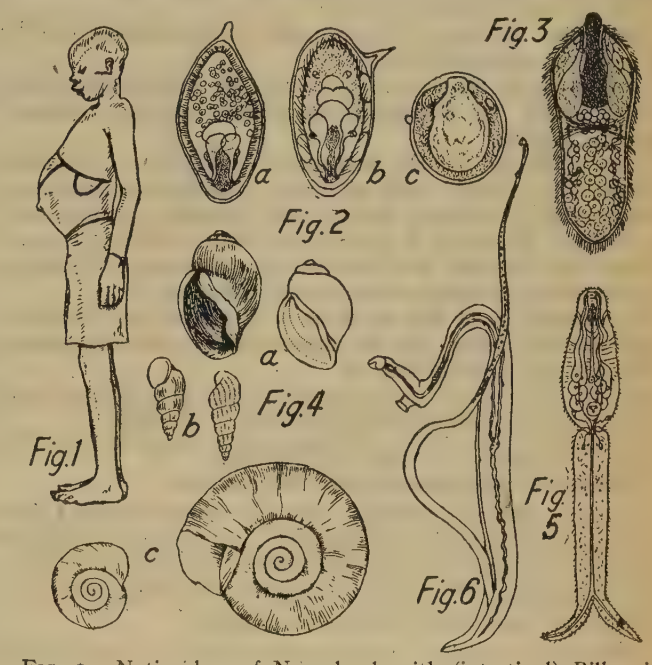

FIG. 1.—Native boy of Nyasaland, with (intestinal) Bilharzia. (*After photo, W. H. Dye.*)

FIG. 2.—Ova of human Bilharzia: (*a*) with terminal spine (vesical); (*b*) with lateral spine (intestinal); (*c*) smaller than (*a*) or (*b*), with blunt lateral nob (Asiatic).

FIG. 3.—Free swimming miracidium hatched from the ovum (*after Looss*).

FIG. 4.—Intermediate hosts of Bilharzia: (*a*) Isidora (Bullinus) genus; (*b*) Oncomelania genus; (*c*) Planorbis genus.

FIG. 5.—Cercaria from snail; free swimming ciliated larva, which, piercing the skin, passes to the liver and becomes the adult worm.

FIG. 6.—Mature male and female worm of Schist. Japonica (*after Faust and Meleney*).

escapes. If during its short active life it approaches an appropriate water-snail, it is attracted to it, penetrates and bores its way to the pancreatico-hepatic gland and encysts. The gland is tunnelled and converted into a mass of ramifications. Bifid larvae (cercariae) develop within the daughter cysts and escape when the snail ruptures. The parasite again becomes free swimming.

Cercariae survive not longer than 36 hours. They are attracted by and penetrate human skin and mucous membranes immersed in the water. They discard the tail and are carried by the blood and lymph to the lungs and from thence to the liver where they mature.

Definite symptoms of schistosomiasis may be expected two months or later from the time of contact with infected water.

In 1851 Theodor Bilharz discovered the worm in the portal vein. In 1913 Miyairi and Suzuki in Japan traced the life cycle of Schistosoma japonicum through the snail Katayama nosophora. In 1915 R. T. Leiper discovered the intermediate host of the two Egyptian species and proved their separate entities.

Treatment.—In 1917 J. B. Christopherson in Khartoum found that antimony tartrate administered intravenously was an infallible parasiticide for both species of Egyptian schistosomiasis, and worked out the method of treatment by antimony which has since been adopted. Later Cawston, Tootell, Faust and others found that antimony tartrate was an equally trustworthy parasiticide for Asiatic schistosomiasis.

The potential longevity of schistosoma haematobium in the human body is longer than 28 years (Christopherson). Schistosoma mansoni has a recorded duration of 15 years in man. The longevity of schistosoma japonicum is unknown.

Clinical Notes.—Clinically schistosomiasis is divided into three stages:—

(1) The period during which the parasite reaches maturity in the body.

(2) The period when symptoms are due to the deposition of the eggs in the organs (bladder and intestine).

(3) The period of structural change and permanent damage of the tissues.

Recovery is the rule provided re-infection is obviated. Death takes place from toxaemia due to a heavy infection, from intercurrent disease, from impairment of liver function, from complications caused by the damaged organs and cancer.

Preventive Measures.—Theoretically schistosomiasis can be stamped out of a locality by:—

(1) Curing all the cases. (2) Killing the intermediary hosts (water snails). (3) Preventing the mollusc infecting man, and man the mollusc.

This is effected by the intravenous injection of antimony tartrate (Pot. or Sod.) daily for five days, afterwards three times a week until the necessary total (adult) amount—25-30 grains—is reached. Antimony is contraindicated in cardiac and renal disease and when the liver is extensively disorganised. Emetin is given when antimony tartrate is not tolerated.

Extermination of the snails is accomplished by chemicals which kill the mollusc but are beneficial to or do not interfere with the fertility of the soil, as

slaked lime (CaO), calcium cyanamide (CaN, CH.). calcium phosphate (Ca_3 $(PO_4)_2$ and ammonium sulphate (NH_4) $2SO_4$.

Chlorinated lime (CaCl OCl) and copper sulphate (Cu SO_4) though efficacious are detrimental to the crops.

Sulphate of copper ꝏꝏꝏ dilution kills cercariae.

In Egypt, where irrigation is under government control, Leiper recommended the periodical drying up in rotation of irrigation canals for 15 days. The natural enemies of the snail (ducks) are to be encouraged. Water contaminated by bilharzia, if kept for two days, is innocuous for domestic purposes.

Educational measures (lectures, cinematograph demonstrations and systematic instruction in schools) are of the greatest importance.

The prophylaxis of schistosomiasis is largely a matter of national character and social conditions which vary according to racial and political history in each infected area.

Education in hygiene and mass (universal) treatment by antimony tartrate are the best general means of eliminating schistosomiasis. *See* PARASITOLOGY.

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BILLIARDS (*see* 3.934).—During the first four years of the period 1910–25 the Australian prodigy, George Gray, revealed the possibilities attaching to the in-off strokes, played in series from hand. His array of four-figure breaks, headed by a memorable effort of 2,196 (unfinished), gave rise to much controversy as to the leniency of the rules in permitting an unlimited chain of these red ball losing hazards. Attention was called to the restrictions imposed upon the remaining "key" shots, the close cannons and the almost completely effaced spot-stroke play. But no legislative action was taken and the radius of Gray's activities, like that of his copyists, was widened. The desire not to place obstacles in the path of the ordinary amateur player accounts in great measure for the decision of the authorities to leave the rule relating to red ball in-offs untouched.

Gray's displays so caught the public fancy that he was considered invincible and a wave of surprise greeted the publication of his name among the list of entrants for the 1914 championship. There were those, however, who realised what a difficult task the newcomer to championship contests had undertaken; he would now have to play with the ivory ball, the standard match ball, and not with the composition one which he knew so intimately. Gray was beaten quite easily in his opening heat. The ivory ball, with its minute subtleties, its inner life and powers of expansion and contraction, reduced the master of composition balls to comparative ineffectiveness.

Greatest of all championships in the interest it evoked, the 1914 competition not only burst the bubble created by George Gray, but brought about a change in the established order. For a decade H. W. Stevenson had borne out all the high predictions made for him by John Roberts, and become the accepted master of the billiard cue. In 1914, however, this brilliant exponent was unexpectedly defeated in the second round of the championship, after having apparently gained a winning advantage. Stevenson made way for another and not quite so spectacular a performer, although certainly a more doggedly insistent one, Melbourne Inman.

The Game During the War.—The World War brought about a tremendous increase in the popularity of billiards. Every Y.M.C.A. hostel, every sanatorium, every military mess, called for billiard tables. Thousands of young men became intimate with a game of which many of them had only vaguely heard. A leading form of entertainment for soldiers home on leave was the displays at Thurston's Hall, Leicester Square, London, W. C. Many of the professionals, and a good proportion of the leading amateurs continued to play during the War period, and the Annual Amateur Championship, competed for by veterans, was regularly decided during those years.

Changes in the Laws.—Very few changes have taken place in the laws since 1910. An amendment to the Rimington-Wilson code of rules, which have worked so smoothly since their innovation, was adopted. This gives the non-striker, whose opponent has committed a technical foul or breach of the rules, a double option, instead of the single one which did not fairly meet the offence. Now the non-offending player may either have the balls set up in their spotted positions, according to rule, or play at the balls where they rest upon the table. After many years of vexatious double control, with two differing sets of rules, an amalgamation of the older Billiards Assn. with the more recent Billiards Control Club has brought the government of the game under one body, known as the Billiards Assn. and Control Club. Following this amalgamation came the decision to use composition balls for the 1926 championship.

CHAMPIONSHIPS, 1910–25

Professional Champion	Amateur Champion
1910 H. W. Stevenson	1910 H. A. O. Lonsdale
1911 H. W. Stevenson	1911 H. C. Virr
1912 M. Inman	1912 H. C. Virr
1913 M. Inman	1913 H. C. Virr
1914 M. Inman	1914 H. C. Virr
1915 No contest	1915 A. W. T. Good
1916 No contest	1916 S. H. Fry
1917 No contest	1917 J. Graham Symes
1918 No contest	1918 J. Graham Symes
1919 M. Inman	1919 S. H. Fry
1920 W. Smith	1920 S. H. Fry
1921 T. Newman	1921 S. H. Fry
1922 T. Newman	1922 J. Graham Symes
1923 W. Smith	1923 W. P. McLeod
1924 T. Newman	1924 W. P. McLeod
1925 T. Newman	1925 S. H. Fry

T. Newman holds the record break of 1,274 points with ivory balls. The Australian, W. Lindrum, has scored a break of 1,879 with composition balls. These are the two highest breaks scored under the present code of rules. J. Davis, of Chesterfield, holds the snooker pool break record of 95.

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United States.—William F. Hoppe dominated the balkline game in the United States from 1910 to 1925. The death of Schaefer, the elder, in March 1908, opened the way for Hoppe in tournament and match. The championship tournaments were of international character, Horemans (Belgium), Conti (France), Hagenlacher (Germany), Yamada (Japan) and others unsuccessfully competing. Toward the close of the period Schaefer, the younger, son of the old champion, upheld the family tradition, threatening Hoppe and twice lowering his colours owing to the brilliance of his play.

Horemans came to the United States at the close of the War. The Belgian developed a new balkline system largely employing the masseé. Other professionals copied it, producing amazing runs such as Schaefer's 400 unfinished from spot in the 1925 tournament, and a match record average of 51½ for 4,000 points. In a special contest he counted a run of 436. In a professional exhibition W. W. Spink counted the high figure of 1,009 in a single inning. A Junior Championship was established in the United States in 1923 and won by Tado Suganuma (Japan). In turn A. Cutler, K. Suzuki and A. Bos held the title.

The National Assn. of Amateur Billiard Players maintained an unbroken line of championship contests. Like the professional records, their performances improved, J. A. Clinton, Jr., of Pittsburgh, creating the American record of 154 for high run, high average of 37⅛, and grand average of 18·33 in the 1923 tournament.

CHAMPIONS 18·2 BALKLINE

Professional	Amateur
1910 W. F. Hoppe	1910 E. W. Gardner
1911 W. F. Hoppe	1911 E. W. Gardner
1912 W. F. Hoppe	1912 M. D. Brown
1913 W. F. Hoppe	1913 J. Mayer
1914 W. F. Hoppe	1914 E. W. Gardner
1915 W. F. Hoppe	1915 J. Mayer
1916 W. F. Hoppe	1916 E. W. Gardner
1917 W. F. Hoppe	1917 N. Hall
1918 W. F. Hoppe	1918 C. Huston
1919 W. F. Hoppe	1919 D. McAndless
1920 W. F. Hoppe	1920 P. N. Collins
1921 J. Schaefer	1921 C. H. Heddon
1922 W. F. Hoppe	1922 E. T. Appleby
1923 W. F. Hoppe	1923 P. N. Collins
1924 W. F. Hoppe	1924 E. T. Appleby
1925 J. Schaefer	1925 F. S. Appleby

Amateur international championship contests were held, C. F. Conklin winning in 1910; J. F. Poggenburgh, 1912; E. T. Appleby, 1922.

Professional and amateur national championships were decided at pocket billiards and at the increasingly popular three cushion caroms. Ralph Greenleaf was outstanding at the pocket game among professionals, and J. Howard Shoemaker among amateurs. At three cushions De Oro, Layton and Cannefax proved masters among professionals, and F. I. Fleming the best amateur.

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BILLING MACHINE: *see* OFFICE APPLIANCES.

BINGHAM, HIRAM (1875–), American explorer and Senator, was born at Honolulu, Hawaiian Is., Nov. 19 1875, and educated at the universities of Yale, California and Harvard. He became professor of South American geography and history at Yale in 1915, where he had previously been teaching those subjects, and devoted much of his time to exploration. His expeditions took him over the Spanish trade route from Buenos Aires to Lima in 1908–9, and, in 1911, 1912 and 1914–5, to Peru. In April 1917 he organised the U.S. Schools of Military Aeronautics, and was commissioned lieutenant-colonel in the Air Service. He was later chief of the Air Personnel Division at Washington and also in France from March to Aug. 1918. From August to December he commanded the Allies' flying school at Issoudun. In 1924 he was elected Governor of Connecticut, and, having resigned from Yale, was inaugurated Jan. 7 1925. The following day he resigned to become U.S. Senator, having been chosen at a special election to fill the unexpired term of Senator Frank B. Brandegee. He has published *Journal of an Expedition Across Venezuela and Colombia* (1909); *Across South America* (1911); *Vitcos, the Last Inca Capital* (1912); *In the Wonderland of Peru* (1913); *An Explorer in the Air Service* (1920), and *Inca Land* (1922).

BIOCHEMISTRY.—Biochemistry may be defined as the study of the chemical or physico-chemical processes which play a part in the life phenomena of plants and animals. The subdivision of the mother science of chemistry into a number of special branches, physical, inorganic, organic, biological, etc., has been the natural consequence of the rapid advances in knowledge which have been made since about 1870. Although the study of the chemical aspect of the physiology of living organisms has only been generally termed biochemistry for some 20 years, it is actually one of the oldest branches of chemical science.

Lavoisier.—Disregarding events which occurred before the birth of modern chemistry at the end of the 18th century, we find that Lavoisier, the creator of the new science, himself spent no small portion of his time in prosecuting biochemical research. He showed clearly for the first time that the life-processes of the animal body can be investigated by chemical means, for he proved by quantitative methods that the body temperature is maintained by the combustion of foodstuffs just as the heat generated in the burning of wood or a candle is produced by the oxidation of organic matter. The first half of the next century produced three outstanding figures, whose united labour extended widely the foundations on which the modern study of biochemistry is based. In the first place Liebig, carrying back with him from Paris to Germany the inspiration gained by contact with those who had been students or colleagues of the great Lavoisier, not only established the study of organic chemistry, on which biochemistry is dependent, but actually opened up wide avenues of research on problems of plant and animal chemistry.

Liebig.—In 1837, at the request of the British Association for the Advancement of Science, he undertook to prepare a report on the state of knowledge in organic chemistry. This led to the publication in 1840 of his memorable work *Die Chemie in ihrer Anwendung auf Agrikultur und Physiologie*, followed in 1842 by *Die Thierchemie, oder die organische Chemie in ihrer Anwendung auf Physiologie und Pathologie.* These two classics mark quite clearly the point at which the study of plant and agricultural chemistry on the one hand, and that of animal chemistry on the other, first attracted wide interest amongst scientists in general and chemists in particular. Hofmann speaking of this great man said, " In the study of biology, vegetal and animal, Liebig was the first to disentangle intricacies that had before seemed problems beyond the grasp of human intellect to solve; and it was one of the grandest results of his philosophical and experimental investigations that he traced amidst the multitudinous and apparently ever-varying manifestations of life, in its countless modifications of kind and degree, the operation of a few simple laws, physical and chemical, affording, by their determinate combination, the precise and proved conditions of vital development, nutrition, growth and perpetuation from generation to generation, in unaltered individuality."

Claude Bernard and Pasteur.—At this time progress in this field of thought was still hampered by the persistence of ideas regarding the existence of a *vital force.* The first blow to shatter these theories was dealt by Wohler in 1828 when he announced the synthesis from inorganic materials of urea, a typical animal product for the formation of which some influence exerted by the vitality of the organism had, until then, been considered essential. The belief in a *vital force* or *vital principle* would have died slowly had it not been for the brilliant series of researches in experimental physiology that have made the work of Claude Bernard immortal. The third figure is the illustrious Pasteur, whose researches on fermentation, putrefaction and disease revealed not only the organisms that gave rise to these conditions, but also, in many cases, the chemical or physico-chemical changes that occurred.

During the second half of the 19th century researches in plant and animal chemistry were prosecuted with increasing vigour. Unfortunately, however, there was a tendency for the studies in each field to be kept apart from the other, and there were comparatively few investigators of that period who were sufficiently broad in their outlook to attempt to view the problems from the standpoint of the cell rather than from that of the animal or plant. Much progress was made in both animal chemistry or, as it was usually termed, physiological chemistry, and in plant and agricultural chemistry, but there were few attempts at correlation.

The Twentieth Century.—The more general appreciation of the need of a wider outlook seems to have become apparent at the opening of the 20th century, when the term biological chemistry or biochemistry began to displace the older terms. In Great Britain the Biochemical Club, now the Biochemical Society, was founded in 1905 and published the first volume of *The Biochemical Journal* in 1906. The corresponding scientific journals in the United States and Germany, namely, *The Journal of Biological Chemistry* and *Biochemische Zeitschrift*, also appeared for the first time in that year. The rapid advance of the new branch of chemistry can be illustrated by the growth of *The Biochemical Journal*, of which the first volume (1906) contained 32 papers, amounting in all to 495 pages of printed matter, whereas the volume for 1924 contained 188 papers and a total of 1,428 pages.

Chemical Processes in the Cell.—The study of the chemical processes occurring in living cells or brought about in the external medium by their action has all along been dependent to a very large extent on the rate of advance in our knowledge of organic and physical chemistry. The contents of the cell, known generally as protoplasm, represent to the chemist a mixture of such complexity that despair of ever gaining any clear conception of its actual composition might well be pardoned. Not only is the task one of great difficulty by reason of the wide variety of substances which are to be found present in cells, but also because a large proportion of those compounds exist in the cell in the condition known as the colloidal state (*see* COLLOIDS).

Conditions of Progress.—Progress in biochemistry has, therefore, been dependent to a large extent on the rate of advance of knowledge in the neighbouring fields of organic and physical chemistry. One example may make this clear. A large proportion of the solid material of cellular contents is composed of complex nitrogenous substances termed collectively the proteins. No satisfactory theory regarding their significance in living cells could be advanced until information concerning both the molecular structure of the proteins and their physical properties as colloids had been obtained. The former was provided by the classic researches of the great German chemist Emil Fischer, who revealed, by his analytical studies, that the proteins are large, complex molecules formed by the intercombination of a number of amino-acids by virtue of their basic and acidic groupings. Although it is still uncertain whether the only form of linkage between the constituent amino-acids in the protein molecule is that described by Fischer, it is apparent that it is by far the most common and a very important one. His work has given us a general picture of the internal structure of the protein molecule that is in agreement with the vast majority of known facts concerning their chemical properties.

Parallel with these researches in the field of organic chemistry on the constitution of the proteins, extensive investigations were being made in many quarters on the colloidal properties of these remarkable substances. As a result of this work it has at last been possible to attack with reasonable chances of success the major question concerning the rôle of the proteins in the living cell, a most remarkable achievement.

In general it can be seen that advance in biochemistry has followed much the same path that can be traced in the growth of other branches of experimental science. Broadly speaking, its development can be divided into two phases, the descriptive phase and the quantitative phase. In the former period the efforts of investigators were devoted mainly to the isolation of the substances present in living tissues and to the investigation of their nature and properties, whilst in the later phase attention has gradually become diverted towards elucidating their significance in the organisms and to the quantitative examination of the dynamics of the reactions in which they are concerned.

The study of biochemistry may be regarded as having very definitely entered the second phase about 1910, for in almost any journal devoted to this branch of science the great proportion of the papers published at the present time are devoted to the study of the dynamics of cellular reactions. The importance of pursuing this line of study must be apparent when it is borne in mind that it is particularly by reason of the extraordinary complexity and variety of the energy exchanges that occur in even the simplest cell that one differentiates living from non-living matter.

Definition of Life.—From the earliest time philosophers have attempted to define life, without one wholly satisfactory definition having been advanced. To-day the difficulties of their task can be appreciated because it becomes increasingly evident that there is no clear line of demarcation between the living and the non-living. Nevertheless, as Claude Bernard indicated in his striking essay on the " Phenomena of Life," there are a number of properties of living matter which, taken collectively, serve as a rough and ready means of differentiating it from systems relatively inert. These outstanding phenomena are: (1) Assimilation and respiration. (2) Reproduction. (3) Growth and development. (4) Movement. (5) Secretion and excretion.

Considered singly it is obvious that no one of these is in itself characteristic of living matter alone, but as yet no system that could be considered in the light of present opinion a non-living one has been found to exhibit all together. It may serve to show the scope of modern biochemistry if examples be given of the application of the new branch of science to the study of the chemical aspect of these phenomena of life.

Assimilation Processes.—The biochemical study of assimilation has somewhat naturally fallen into two sections, depending upon whether plants or animals are being considered. The power possessed by green plants to synthesise complex organic substances from carbon dioxide, water and simple inorganic salts, such as nitrates, sulphates and phosphates, places them in a class apart from other beings and calls for particular study (*see* PHOTOSYNTHESIS). The essential difference is, of course, that for the synthesis of organic matter from carbon dioxide a supply of energy is necessary—the reaction being an endothermic one. Comparatively long ago it was recognised that the source of this supply of energy is the sun, but only recently has the knowledge of the nature of the pigments in the leaf, of the absorption of energy in the form of light by these pigments, of the mechanism of absorption of carbon dioxide by the leaf and of the nature of the substances formed during assimilation, enabled biochemists to construct reasonable theories as to the process of photosynthesis in green plants. In this field much remains to be done. In spite of many strong indications that the first step in carbon assimilation is the photochemical reduction of carbon dioxide to formaldehyde, precise confirmation is lacking. The efficiency of the process is also undetermined. Early investigators believed it to be of the order of 3–5%, but Warburg has recently recorded values as high as 80%.

Chlorophyll.—There is also the question of the origin of the chlorophyll pigments in relation to their rôle as energy absorbers and transformers. Obviously so complex a molecule as Willstätter's researches revealed chlorophyll to be must have an exceedingly long evolutionary history. From what type of substance is it descended? At a very early period in the history of living organisms it is probable that supplies of energy for assimilation of carbon dioxide and formation of organic substances were derived not from the absorption of solar radiation by suitable pigments, but from simple exothermic chemical reactions of the type exhibited by the existing species of autotrophic bacteria (*see* BACTERIOLOGY). These remarkable organisms, amongst which are grouped certain of the sulphur bacteria, the nitrite bacteria, and the hydrogen bacteria, possess the power to carry

out simple reactions, such as the oxidation of sulphur to sulphates, ammonia to nitrites and hydrogen to water, and to use the energy liberated by these reactions to effect the conversion of carbon dioxide into organic matter. It is also interesting to note that certain of the sulphur bacteria contain a pigment, bacteriopurpurin, which appears to function somewhat in the manner of chlorophyll in higher plants, when the bacteria are exposed to the light, whereas in the dark these organisms satisfy their energy requirements by the oxidations referred to above. Possibly these species represent the transitional forms that ultimately led to the evolution of the assimilatory system of the green plant.

Plant Synthesis of Carbon.—Little as is our knowledge regarding the synthesis of the compounds of carbon in the green plants, it is profound when compared with that concerning the formation of substances containing other elements; in particular nitrogen. We are, to all intents and purposes, entirely ignorant of the mode of formation in the plant of the great groups of substances, the proteins, alkaloids and plant bases.

Animal Assimilation.—The outstanding fact that the animal organism is essentially analytic and not synthetic as is the green plant, has, of course, been recognised for many years. The study of assimilation by the animal becomes, therefore, to a large extent, the study of the breakdown, or metabolism, as it is termed, of the foodstuffs that are ingested by the organism to supply, on the one hand, the energy for heat production or work and, on the other, the molecular units required to construct or keep in repair its tissues.

Biochemical investigations of assimilation in the animal world have made rather more rapid progress than corresponding efforts in the field of plant chemistry. To a large degree this is due to the fact that, in the higher animals at least, it is to some extent possible to follow the fate of substances by examining the body fluids, the individual organs, or, more particularly, the excretions.

Food Metabolism and Enzymes.—The study of the metabolism of foodstuffs in the animal body represents a large and important branch of biological chemistry. It entails in the first place an examination of the mode of action of the remarkable catalytic agents possessed by the living cell and termed enzymes, by means of which the complex molecules of the proteins, polysaccharides and fats are broken down so that the simpler molecules of amino-acids and sugars can pass through the absorbing membranes of the alimentary canal.

Mechanism of Absorption.—The actual mechanism of absorption of substances into the tissue fluids must then be studied, after which we must enquire into the fate of the molecules that have been assimilated. Some of these go to form tissues that are being constructed, especially during the period of growth; of the others, the great majority are in due course oxidised so that the energy liberated by their oxidative degradation may be available for maintaining body temperature, or for the performance of work. A whole field of biochemistry is concerned with the mechanisms by which organic molecules are oxidised in the living cell to carbon dioxide and water, for a large proportion of the substances that are rapidly and fully oxidised in the tissues at temperatures below 40° C. are only oxidised by drastic treatment with chemical reagents and by the employment of high temperatures when subjected to experiment in the test tube.

Respiration Processes.—It was discovered by the researches of Mayou, Priestley and Lavoisier that living creatures support life by the process of respiration, in which oxygen is taken into the system, and the product of oxidation of organic matter, carbon dioxide, is given off. To-day it is recognised that respiration is in no way peculiar to living tissues, for many non-living systems can be constructed that will absorb oxygen and eliminate carbon dioxide under conditions more or less comparable with those under which the living cells respire. The very striking experiment described in recent years by the distinguished German chemist Otto Warburg may be taken as an illustration. The oxidation of certain substances which are oxidised in the body, *e.g.*, certain amino-acids, will take place along apparently similar paths, at any rate leading to the formation of carbon dioxide and ammonia, when their aqueous solutions are shaken with carefully prepared charcoal in a fine state of division. A measure of the oxygen absorbed and of the carbon dioxide evolved in such cases is as truly a measure of the respiration of the charcoal as a determination of the respiratory quotient is an indication of the oxidative activity of a living tissue. The parallel becomes even more remarkable when it is learnt that the respiration of the charcoal particles can be depressed by the addition of narcotics or poisons in a manner absolutely comparable with the influence of these substances on the respiration of living yeast cells, red blood corpuscles or muscle tissue.

Origin of Circulatory System.—The biochemical study of respiration is, however, a problem presenting many aspects. Primarily it is necessary to investigate the means by which the oxygen is brought to the cells, a task that widens on every hand and takes us into many fields. The cells of the simpler forms of life draw their supplies of oxygen direct from solution in the surrounding fluid, but for more complex organisms this would not suffice, and methods of distributing the oxygen to tissues more remote from the external medium have evolved. Thus arose the circulatory system of animals. Simple air-breathing species dependent on the diffusion into the tissue spaces of oxygen from a more or less complicated system of tracheal tubes, gave rise to more complex organisms leading to the evolution of the lung with its enormous diffusion surface. Even this would have been insufficient to supply the oxygen requirements of the majority of animals if oxygen carriers of the type of haemoglobin had not been evolved to enable the circulating fluid to carry round to the tissues ample oxygen for their needs.

Haemoglobin.—The evolution of haemoglobin and other so-called respiratory pigments, their functions as oxygen carriers are widely studied problems of the biochemist, but his interest cannot stop with the study of the mechanisms by which oxygen is brought to the cells, he must enquire how the oxygen is made available in the cell for oxidations.

Action of Oxygen.—Atmospheric oxygen, whether obtained direct from solution in the surrounding medium, or by the dissociation of oxyhaemoglobin is relatively inert as an oxidising agent. Of the foodstuffs oxidised in living cells only very few are appreciably attacked by oxygen in the molecular form O_2; the unsaturated fatty acids present in such oils as cod liver oil and linseed oil are examples of compounds that take up molecular oxygen, but the extent to which they are oxidised is very small when compared with the complete degradation to carbon dioxide and water that occurs with such ease in the animal body. Early in the 19th century Schönbein in his studies of ozone pointed out that oxygen must in some manner be activated before it is able to effect the majority of oxidations, and this view, in one form or another, has formed the basis of the many theories of oxidation that have been advanced since his time. We are still without clear ideas regarding the mechanism of activation of molecular oxygen which the living cell possesses, but the studies of Warburg on tissues and on the charcoal model to which reference has been made suggest that the presence of iron plays an important part in the process.

Oxidative Mechanisms.—This brings us in a natural sequence to refer to the oxidative mechanisms which the living organism possesses. In the first place there are the oxidising enzymes, the oxidases, a group of catalysts, many of them of a highly specific character, capable of oxidising with great rapidity under suitable conditions a wide variety of substances. The biochemical examination of the oxidases has been extensive, and has, particularly in recent years, given us considerable information how molecules such as those of tyrosine, xanthine and uric acid are oxidised. According to the recent work of Thunberg and Baltelli and Stern the cell possesses, in addition to the recognised type of oxidase, other types of oxidative catalysts of a thermolabile nature. It would appear, however, from the results of the researches of Sir Gowland Hopkins and of Meyerhof that there are also present in the cells of plants and animals oxidative-reductive systems which are thermostable. The remarkable substance

glutathione, discovered a year or two ago by Hopkins, probably plays an important part in these last-mentioned systems. In no field of research in biochemistry at the present time are activities so vigorous as in that devoted to the study of oxidations in living tissues.

Reproduction.—Turning now to the second characteristic of life in our list, namely, reproduction, we find we are considering a phenomenon which might well, at first sight, appear to be outside the scope of experimental attack by biochemists. Surely, in the processes underlying reproduction, if anywhere in the realm of biology, might be traced the "vital force" or "entelechy" that would at almost every turn frustrate our efforts. The clear demonstration that such is not the case, and that the problems of fertilisation and reproduction are no less open to experimental biochemical investigation than those of digestion or respiration, we owe to the remarkable work of the great experimental biologist Jacques Loeb. His investigations on the influence of the composition of the surrounding medium on the reproductive cells of certain marine animals dispel any doubt that many of the problems of fertilisation, of specificity and of inheritance will in time be solved, and to a large extent by biochemical methods (*see* CYTOLOGY; EMBRYOLOGY).

Control Experiments.—Can this be doubted when we recall that the migration of the sperm to the egg has been shown to be directed by the physico-chemical action of certain substances derived from the latter; that the penetration of the ovum by the sperm can be controlled by altering the composition of the surrounding fluid, even to the extent of permitting the admission of a sperm cell foreign to the egg; that the mechanical act of penetration performed by the sperm, and resulting in the almost explosive outburst of oxidative activity that marks the initiation of fertilisation, can be reproduced by perforation with needles so successfully that numbers of male frogs have been reared to adult size from eggs so fertilised? Considering these striking facts, and at the same time bearing in mind the mass of evidence that is accumulating on every side to show how the development of the reproductive cells is under chemical control in the body and how these tissues themselves exert by chemical means a far-reaching control on the development and functions of other tissues, no reasonable doubt can be entertained that the phenomena associated with reproduction are open to biochemical investigation.

Genetic Problems.—Many of the closely associated problems of genetics are also well within the biochemist's purview, as can readily be judged by giving one or two examples. The inheritance of colours, whether we are thinking of the blue, red or purple colours of flowers or the black and brown markings of animals, has been shown to depend on the inheritance of a physico-chemical system capable, under ordinary conditions, of producing the colour. Some of these systems and the mechanism of their action are fairly well understood. The systems may be more or less complex in character, but unless they are complete the mechanism for the production of the colour cannot function normally. Thus, for example, two white flowers from different plants of the same species may lack colour because one component of the colour-producing system is absent. If the missing factor is the same in both cases, crossing will not result in the production of coloured flowers, but if, on the other hand, their deficiences are complementary, a proportion of the seeds produced on cross fertilisation will yield plants with coloured flowers. The mechanisms concerned in the production of both animal and plant colours have been extensively studied *in vitro*, and they are to some extent understood.

Growth and Development.—The biochemical study of growth and development has been followed along many paths. The influence of the composition of the soil on plant growth has attracted wide attention ever since the classic researches of Liebig were published. To-day the agricultural biochemist not only studies the significance of the more obviously essential constituents of the soil, such as nitrates, phosphates, etc., but is concerned to no little extent with the influence which apparently insignificant amounts of other substances may have. The curious fact that the broad-bean plant will not grow to full maturity without a minute amount of the element boron being present in the soil is an example of what has already resulted from investigation in this direction.

Chemical Control.—The biochemical study of the growth and development of animals provides many examples of both these aspects of the chemical control of growth. On the one hand the energy requirements of animals during the period of growth have been investigated in great detail, whilst on the other, it has been ascertained that a normal development is dependent on the satisfaction of a number of more or less clearly defined requirements.

A small but definite amount of the amino-acid tryptophane, a constituent of some, but not all, proteins, is necessary for growth of young animals, and the provision of any amount of a protein deficient in that particular building stone will fail to induce growth unless the missing unit is provided from some other source. Many biochemists at the present time are engaged in investigating the remarkable influence which the substances known as the vitamins have on the growth and nutrition of animals. The number of these substances that are generally accepted as being clearly differentiated is already five, and probably more exist as yet undiscovered. Their chemical nature remains unknown in spite of considerable study, and we are also regrettably ignorant as to the actual part they play in the economy of the organism. (*See* VITAMINES.)

Growth Factors.—Lastly, there is a chemical aspect of growth in the investigation of the influence of inorganic elements on animal development. Problems such as the rôle of traces of iodine in inducing normal development of the thyroid gland, and the manner in which lime salts are deposited in growing bone illustrate the type of question in this field that calls for an answer from biochemists.

Movements.—Study of the chemical or physico-chemical factors inducing the movements of plants and animals covers a wide field of experimental research, ranging from control of the movements of free-swimming unicellular organisms to the unravelling of the complex series of events that occur during a muscle twitch in higher animals.

Regeneration.—Little is yet known of the factors determining the growth movements of plants beyond Loeb having shown by his researches on regeneration in Bryophyllum that chemical factors probably play a part in the directional growth of shoots and roots. The movements of many forms of simple animals can be to a certain extent controlled by making alterations in the composition of the medium in which they exist, as, for example, when the water flea, Daphnia, which normally swims away from the light moves in the reverse direction when carbon dioxide is bubbled through the water. Another remarkable example also described by Loeb, is that of the larvae of Porthesia which in the starving condition are attracted toward light and climb high up the stems of the plant on which they customarily feed, but which, having fed on the leaves, become negatively heliotropic and at once descend again to the darker regions. By starving them or by feeding on the leaves of the plant they can in the laboratory be made at will to move toward or away from a source of light.

Mechanism of Muscular Movement.—Turning to what we may regard as the other corner of this field, namely, the biochemical investigation of the mechanism of muscular movement in animals we find one of the most complete chapters of modern biochemistry. The long series of researches of outstanding merit by Hopkins and Fletcher, Meyerhof and A. V. Hill have taught us how the glycogen of muscle is broken down to sugar; how the sugar, passing through the intermediate stage of being combined with phosphoric acid, gives rise to the lactic acid that initiates the contraction, and how these anaerobic changes are followed by an oxidative phase of recovery during which part of the lactic acid passes back into its precursor, whilst the remainder is oxidised to carbon dioxide and water. These changes have been followed with such precision by chemical and physical methods that the heat production of the muscle during the

whole cycle has been accounted for with considerable exactitude by a knowledge of the heat exchanges of the chemical reactions which are believed to occur. In spite of these carefully compiled results we are as yet ignorant of the actual processes involved when the muscle fibre shortens in contraction. Without doubt it is a physico-chemical mechanism of which the nature will soon be revealed by future research.

Hormones.—The processes of secretion and excretion have been the subject of extensive biochemical research, although mainly on animal tissues. The discovery by Starling and Bayliss of the agents known as hormones indicated for the first time how important a part such chemical messengers play in the co-ordinating mechanisms of the higher animals. Their discovery of secretin, the substance of, as yet, undetermined nature which is produced in the mucosa of the upper part of the small intestine under the stimulus of the entry of acid food material from the stomach, and which, passing into the blood stream, invokes, in a very short space of time, the secretion of the digestive juice of the pancreas, has paved the way for the discovery by Banting and Best of the internal secretion of the pancreas itself, and more recently of that of the internal secretion of the parathyroid gland by Collip. Viewed as a whole, the regulatory action (*see* ENDOCRINOLOGY) exerted by the secretions of the various glands and tissues of the higher animals is seen to be one of the most delicately balanced nature, but it is one that is quite definitely open to chemical investigation.

Excretory Processes.—The processes of excretion by which living organisms rid their tissues of waste products have, as yet, been scarcely investigated at all in plants. In animals, more particularly in the mammals, they have been extensively examined from the biochemical standpoint. The secretion of urine, the work done by the kidney in this process, the chemical and physico-chemical principles underlying the concentrations of waste products that appear in the excreted fluid, all these have been the subject of prolonged and fruitful investigation during the period under review.

Secretory Processes.—Of no less interest are problems concerning the secretion by living cells, such as the gastric mucosa of animals, of fluids containing appreciable concentrations of free mineral acids. These questions are intimately bound up with the very general one concerning the mechanisms by which the reaction of the body fluids is maintained within narrow limits. The study of the system of amphoteric colloids and simple electrolytes that constitute the tissue fluids of animal or plant tissues has, from the standpoint of physical chemistry, been almost exhaustive, and the analysis, step by step, of the influence of the many factors playing a rôle in the cycle of changes that occurs in blood during its circulation in the bodies of animals stands as one of the most impressive tributes to the application of the rigid, quantitative methods of modern physical chemistry to problems of outstanding biological importance. Many other spheres of extensive biochemical work might be mentioned, but it will be sufficient if brief reference be made to the chemical investigations of fermentation and bacterial changes on account of their enormous economic importance.

Fermentation Processes.—To-day, as a result of the researches of Harden and Young in Great Britain, of Fernbach in Paris, and of C. Neuberg in Germany, we are in possession of a reasonably clear idea of the stages by which the sugar molecule is broken down to yield alcohol and carbon dioxide when fermented by yeast. Most of the intermediate products have actually been isolated and their part in the process proven beyond question. Of particular interest is the fact that the most recent work on the fermentation of sugar by yeast and on its degradation in the cells of the animal body points to the essential steps in the breakdown of the carbohydrate molecule being the same in both cases.

Probably in no other field of research in biochemistry have so many striking examples been found as in that of fermentation chemistry, of the course of a reaction being changed by alterations in the conditions of the experiment. Certain of these diversions of the normal course of events have proved of considerable economic value as, for example, when, during the World War, German scientists were able to prepare considerable quantities of glycerol from sugar by causing inhibition of the fermentation at a certain stage in its progress by the addition of sulphites.

Apart from the alcoholic fermentations there are numerous other processes, many of them of considerable technical importance, in which the action of the bacteria (*see* BACTERIOLOGY) or other forms of micro-organisms are the subjects of biological research.

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BIOLOGY (*see* 3.954) is the general science of organisms, plants and animals alike. It includes botany and zoology, and the study of man as organism; but it is at once more and less than the sum of these: more, because it is the science of organisms in their general aspects as living individualities; less, because it has not to do with the detailed descriptions given by the zoologist and the botanist, except in so far as these may throw light on the problems of the nature and continuance and evolution of life. In other words, biology is a general science, including the special sciences of botany and zoology, protozoology and bacteriology, anatomy and physiology.

Divisions of Biology.—There are various general questions that may be, and must be, asked in regard to organisms: and the answers to these are the biological sub-sciences. First, there is analysis of structure, both macroscopic and microscopic; that is to say, histological as well as anatomical; and this inquiry leads towards an understanding of what may be called the principles of organic architecture. This is the sub-science of morphology. Second, there is analysis of function or activity; how does the organism "work" and keep going? This is the sub-science of physiology. As in morphology, so in physiology, the analysis may be at different levels, passing from the intact creature to its organs, its tissues, its cells and its living matter or protoplasm. Historically, as a matter of fact, these two complementary sub-sciences—morphology and physiology—have developed *pari passu* and logically along the lines of this gradually deepening analysis. The organism, which is always an individuality, may also be regarded as a correlation of organs, a woven fabric of tissues, a vast city of cells and an integrate of protoplasmic whirlpools, to use Huxley's metaphor.

The third biological sub-science is embryology (*q.v.*) which inquires into the development of the individual organism; not merely describing the successive stages of "ontogeny," but investigating the factors that are operative in the process of individual becoming. Thus, besides descriptive embryography, there is physiological embryology, often nowadays experimental. To give an example, it is a characteristic modern inquiry to trace the influence that the hormones of various ductless or endocrinal glands (*see* ENDOCRINOLOGY) exert on the developing embryo of which they form a part. As embryology deals with the individual organism in its time relations, it is obviously difficult to draw a hard and fast line indicating where it should stop. It must obviously include larvae as well as embryos; yet why not adolescents as well as larvae? This is a familiar difficulty that has many illustrations, and it means that these sub-sciences merely represent the diverse ways of looking at organisms. It is common sense, however, to keep the term embryology for the study of the developing organism, before it assumes in great measure the character of its adult.

The fourth sub-science is palaeontology (*q.v.*), which inquires into the past history of the race to which a type belongs. It relies on the fossilised remains, the history written in the rocks, and it aims at working out pedigrees. How did the modern type of horse arise, or what was the ancestry of flowering plants? No doubt a fossil may be anatomised as regards its hard parts; and there cannot be any strict separation between dissecting an animal recently alive and one that lived a million years ago. Part of morphology has to do with fossils, but the specific inquiry of palaeontology is historical. The anatomy of the fossil is utilised in the reconstruction of extinct organisms. But with this there must also go a reconstruction of the environment in past ages, so that the organisms of long ago may be seen as players on a definite stage, as Kowalevsky showed almost picturesquely in his classic studies of fossil Ungulates.

Ecology.—But just as palaeontology is distinctively concerned with the races of organisms, and embryology with the becoming of the individual, so physiology must rise beyond the functions of the single organism to a study of the activities of the pair, the family, the herd, and so on, not only in themselves, but also in their inter-relations with their environment, animate as well as inanimate. This is what Semper called "the physiology of organisms" or general physiology; it is now called ecology or bionomics, and is largely concerned with the behaviour and inter-relations of organisms. It is in great part the old-fashioned "Natural History."

Taxonomy.—Similarly, we may pass from the morphology of the single individual to its place in the general scheme of classification. That is to say, we may study the grouping of plants and animals in species, genera, families, orders, classes and phyla; and this in a word is taxonomy, which is to morphology what ecology is to physiology.

Aetiology.—But there is another great question which looms behind all the others: How have these organisms come to be as they are, both as regards themselves and as regards their inter-relations? This is what Huxley called aetiology, an inquiry into the causes or factors that have been operative in the great process of organic evolution. This inquiry concerns not only the past and the present, but the possible, the variations and the siftings of to-day as well as those in the distant past, to which we argue back partly from the data of palaeontology and partly by analogy from what is of present occurrence. When palaeontology rises to the height of its calling and becomes causal as well as palaeontographical, it passes into phylogenetic aetiology. And similarly when embryography becomes physiological and experimental embryology, it passes into what may be called ontogenetic aetiology. This implies more than the physiology of the embryo at different stages of its ontogeny, it is an inquiry into the behaviour of the germ-cells and the embryonic cells in so far as this throws light on the historic process of phylogeny. Thus everyone will grant that such a fact as the early segregation of germ-cells from body-cells (*see* CYTOLOGY), or, to take another example, the reducing division in the maturation of the germ-cells, has a very important bearing on the general theory of organic evolution. While it is impossible to separate biology into self-contained sub-sciences which can be profitably studied and advanced in isolation from one another, there is convenience and stimulus in a map which indicates the eight possible approaches.

PALAEONTOLOGRAPHY (Race)	TAXONOMY (Groups)	ECOLOGY (Groups)	PHYLOGENETIC AETIOLOGY
EMBRYOGRAPHY (Individuals)	MORPHOLOGY (Individuals)	PHYSIOLOGY (Individuals)	ONTOGENETIC AETIOLOGY

The stiff abstractness of this map may be counteracted by keeping in mind the obvious fact that biology is not a departmental elaboration of knowledge, but itself a growing organism, correlated through and through.

Position of Biology among the Sciences.—In a survey of the world without there is much to be said for recognising three main orders of facts—the inorganic, the organic, and the social; or, in other words, the domain of things, from dew-drops to stars; the realm of organisms, from microbe to mammal; and the kingdom of man, with its many societary forms. Thus, if the terms are permissible, we may recognise the cosmosphere, the biosphere and the sociosphere, which overlap and intersect in interesting ways. When coral-polyps build a reef, or beavers construct a dam, they are including part of the cosmosphere into the biosphere, just as a man brings the earth into his sociosphere when he makes a great dam or breakwater, or when he transforms organisms into his service by domestication or cultivation. For each of these three great spheres there is a distinct mode of evolution, for the genesis of a solar system and the history of a social institution are *very* different from one another, and *very* different from the process of organic evolution among plants and animals.

Sociology.—A further reason for thinking of three great orders of facts is that it has become practically impossible to separate chemistry and physics, and it is becoming, in the judgment of many, increasingly impossible to separate biology and psychology (*q.v.*). The science of the nature and origin and activity of societary forms stands by itself as sociology (*q.v.*). The question is whether there are three or more great orders of facts which require distinctive concepts for their formulation. Chemistry and physics are concerned with matter and energy; biology faces the peculiar kind of activity that we call life; sociology has to do with human integrates that act in some measure as unities. It is much more than a problem of convenience; the question is how many large departments of knowledge can be regarded as autonomous.

Psychology.—But there is also much to recommend the retention of the familiar Spencerian grouping of five great concrete sciences—chemistry, physics, biology, psychology and sociology. One advantage of this scheme is that it gives emphasis to the central position of biology. Since organisms are material systems specially adapted for the transformation of energy, biology must rest on a foundation of chemistry and physics. One needs only to think of the step of progress that was made when Lavoisier brought the oxidations of the living creature into line with the combustion of fuel in air. Or, looking in the other direction, the linkage of mental activity with bodily, of psychosis with neurosis, is so intimate that psychology without physiology is unthinkable. And some would reverse the statement, and say: *Nemo physiologus nisi psychologus.* Similarly, it is evident that sociology requires all the help that it can get from the psychologists and the biologists. Classifications of the sciences are means, not ends; and while a recognition of three great orders of facts is useful for some purposes, there are also advantages in recognising five. Thus when psychology is thought of mainly as the positive science of mental processes, its separateness from biology stands out; yet it joins hand with biology when it is regarded as the science of behaviour.

Legitimate and Illegitimate Materialisms.—The contributions of chemistry and physics to an understanding of the organism are fundamental, for organic activity is bound up with the reactions of complex chemical substances in a colloidal state. The metabolism of the body is a concerted chemical routine, and if fermentation is a chemists' business there is plenty of it in the organism. The organism may be more than an engine, to our thinking much more, yet an engine it is; and it cannot be understood apart from the properties of colloids, the phenomena associated with surfaces, and many other physical facts. This is what Comte called a "legitimate materialism," using the concepts of a lower science to elucidate the phenomena which occur in the subject-matter of a higher. That laws of chemistry and physics apply in some measure to the life of organisms, is proved up to the hilt by the history of biology.

Biological Categories.—The question is whether there will be any biology left when chemistry and physics have said all they have to say? Will bio-chemistry and bio-physics swallow up biology? The negative answer given by many biologists, who believe in the autonomy of their science, may be supported in various ways, but the strongest position is probably that the chemical-physical formulations do not actually describe what we see and know. If complete, they would afford a ledger of all

the chemical and physical transactions that go on in the body, but that would not describe the organism's apparently unique qualities as an integrated living individuality, such as its power of enregistering its experience within itself so that subsequent behaviour is influenced. As science is at present, it is necessary to use special biological categories describing the life of the organism—notably its growing, reproducing, developing, varying, endeavouring. For isolated transactions in corners of the body, the chemico-physical descriptions may suffice, but not at present for anything like behaviour. Much has been discovered in regard to the movement of muscle, *e.g.*, the contraction of the living threads in presence of lactic acid, but it cannot be said that we can as yet give a chemico-physical account of the twinkling of an eye. As everyone allows, there is a chemistry and a physics of the organism, absolutely indispensable and full of promise, but when they are added up they do not give biology. Perhaps they will change, but at present the chemico-physical formulae are inadequate for the complete description of distinctively vital activities; and, from the nature of the case, they must still more egregiously fail to grip when "mind" is an appreciable factor. But without saying that it is "mind" that makes all the difference, the position of the psychological vitalists, and without postulating any "vital force" or "entelechy"—the position of other positive vitalists, we are content to state the case for "methodological vitalism," that the organism, compared with a non-living material system, is a new synthesis or emergence, requiring distinctive concepts for its description (*see* EVOLUTION).

Illustrations of Modern Biological Methods and Results.—(1) A great simplification was effected when it was shown by Hardy and by Fischer that the cytoplasm of the cell has no visible structure. For the reticular, fibrillar and other appearances, described in so much detail in the later years of the 19th century, are artefacts due to the fixing and staining. They may be mimicked in homogeneous white of egg, and the same kind of cell will show a different structure according to the way in which it is treated. Yet the typical cell remains a microcosm, with its mitochondria and chromidia, its Golgi apparatus and its centrosomes, and there is almost certainly an interpenetration of the cytoplasm with an ultra-microscopic filming which separates off different areas in the colloidal substance. Many different kinds of particles and immiscible droplets quiver in suspension in the fluid medium, and in the centre there is the nucleus surrounded by a semi-permeable membrane, through which a regulated exchange is effected between the nucleoplasm and the general cytoplasm. But the nucleus is itself a little world. When it is active it shows a definite number of readily stainable rodlets, the chromosomes, bathed in a complex nuclear sap or karyolymph. In some cases a chromosome appears as a linear series of minuter units, "microscomes," fixed on ribbon of "linin," and in indirect ways it is becoming possible to discern the topography of a germ-cell chromosome. Thus it is said that the hereditary "factors" or "genes" for vermilion eye and rudimentary wing lie together in a certain stretch of the first of the four chromosomes of a particular race of the fruit-fly, drosophila.

Chromosomes.—Increasing attention is being given, especially from the botanical side, to the number of chromosomes in particular organisms, and a discovery has been made which appears to be full of promise. It is a familiar fact that every kind of embodied organism has a definite number of chromosomes, which is in most cases rigidly adhered to, except that the ripe sex-cells have half the normal number, and that the number in the female may be one more accessory than that in the male. Thus one form of the threadworm (*Ascaris megalocephala*) common in the food-canal of the horse has two chromosomes, a very small number, while the horse itself has 66, which is a very large number. Man's number is 48, and that of the mouse 24, but it will be clearly understood that it is not the number itself that is of primary importance, since the same may occur in quite unrelated types. Thus man's number, 48, occurs in some snails and bananas. What is of chief interest is the constancy of the number, and that it bears some relation to the groups of linked hereditary characters.

Specific Characters.—In the genus Rosa the fundamental number is 7, and a series of species can be arranged which have in their body-cells 14, 21, 28, 35, 42 and 56 chromosomes. It is clear that the evolution of rose species has been associated with a multiplication of the chromosomes in septets or sets of 7. Prof. R. Ruggles Gates has been one of the most successful demonstrators of the correlation between chromosome peculiarities and specific characters; and chromosome-series have been demonstrated in a considerable number of plant genera. It has been supposed that a rose species with, say, 28 chromosomes (tetraploid) was the outcome of a duplication of the chromosomes of a species with 14 (diploid); and similarly in other cases. But Dr. C. C. Hurst finds that the tetraploid (28) species of rose shows the combined characters of 2 distinct diploid (14) species. Similarly, the hexaploid species (42) shows the combined characters of 3 distinct diploid (14) species; the octoploid (56) shows the combined characters of 4 distinct diploid (14) species. Thus it appears that the increase in the number of septets means in these roses something more than a mere duplication and re-duplication of chromosomes; it means different combinations of the different septets which are known to occur in the various diploid species of Rosa, of which 5 are known. Given 5 diploid (14) species with differential septets of chromosomes and of characters, numerous new species, say, with the tetraploid, hexaploid or octoploid numbers, may arise, and have arisen, by diverse combinations. This is an important biological discovery with far-reaching applications.

Biochemical Data.—(2) One of the great milestones in modern biochemistry was the discovery of glutathione by Prof. Sir F. Gowland Hopkins in 1921. This organic substance, widely distributed in plant and animal cells, acts as an "oxygen transporter," an intermediary between the oxygen of the air and the food-materials of the tissues. It is a chemical fact that glutathione is a compound of two amino-acids (glutaminic acid and cystein), and that it alternates between an oxidised form (acting as a hydrogen-acceptor) and a reduced form, but we are here concerned with the biological fact, which is of fundamental importance, that this transporter and liberator of oxygen accounts for the energy-yielding combustions that take place at a low temperature within the living cell. It explains how the cell burns and yet is not consumed. In this connection should be noticed Dr. D. Keilin's discovery of a widely distributed uncoloured cell-pigment, which he calls "cytochrome" which seems to have something important to do with the control of oxygen within the cell. It contains the chemical nucleus "haem," that forms the coloured portion of the red-pigment (haemoglobin) of the blood of many kinds of animals.

Cell-culture.—(3) Another very interesting method, particularly associated with the names of Ross G. Harrison and Alexis Carrel, is the isolation and culture of single cells or groups of cells. A single nerve-cell can be watched for many days under the microscope, and the amoeboid nature of the tip of its growing fibre can be demonstrated. A few cells from the heart of an embryo chick can be kept alive for days in an artificial medium, and by their spontaneous rhythmical contraction they corroborate the conclusion that the heart muscle of a higher animal contracts of itself by reason of an ingrained rhythm, apart from stimuli from the central nervous system. If care is taken to give the isolated fragment appropriate food, a supply of oxygen, a suitable temperature, and aseptic conditions, there seems little in the way of limit to the life of a piece of tissue in a glass tube, or on a glass plate, or in some other such arrangement. The life of isolated fragments of tissue from a chick embryo has been prolonged for 10 years—a longevity not less than that of the hen into which the embryo might have grown. By this culture method it is possible to study the behaviour of tissues under various conditions, and to distinguish between intrinsic potentialities and reactions to extrinsic stimulants, such as hormones or extracts of other tissues. By it investigators can detect or delimit the factors that inhibit or stimulate the growth of tissues; and this may assist, not only in the transformation of embryography into embryology, but in the control of pathological changes.

Micro-dissections.—Here should be recognised the great promise of the ingenious micro-dissection methods which have been recently elaborated, by Prof. Robert Chambers in particular. The object to be micro-dissected, such as an egg-cell or a protozoon, is included in a "hanging-drop" suspended from the under-side of a cover-glass firmly fastened on the stage of the microscope and forming, as it were, the roof of a moist chamber that has no floor. Into this space there protrude the exquisitely fine tips, straight or curved, of glass needles which are fixed in holders attached to an ingenious system of screws fastened to right and left on the under-side of the stage of the microscope. The object cannot be seen with the naked eye, but it is quite clear in the centre of the field of the high-power microscope, and the needles can be manipulated through the screws so that their very delicate tips meet where desired. By working the screws it is possible to move the needles in a vertical as well as in a horizontal plane; thus one tip may be used to press the object against the cover-glass while the other is used to cut a piece off, or to remove a nucleus or even to effect an intra-cellular injection. The method has been found fruitful in studying the physical properties of protoplasm, in separating particular portions of a cell, and in isolating a single micro-organism, so that an absolutely pure culture or "pure line" can be secured. In connection with new biological methods, prominence must be given to the use of the ultra-microscope, and to the micro-analytic methods invented by Prof. Pregl of Graz for dealing with extremely minute quantities of a particular substance. With only a fiftieth of what has usually been regarded as a minimum, he is able to effect analysis more rapidly and not less accurately than before.

Photosynthesis.—(4) To take another instance of a very different nature, there seems to be great biological interest in Prof. Baly's discovery of artificial photosynthesis (*see* PHOTOSYNTHESIS). The most important organic process in the world is obviously that on which all life depends, the building up of carbon compounds in the green leaf. This is what Prof. Baly and his collaborators have been able to mimic. Using the light of a mercury-vapour lamp, which has a very short wave-length, Prof. Baly was able to build up formaldehyde from water and carbon-dioxide, which is precisely what the green leaf does. Light of a somewhat longer wave-length caused the molecules of formaldehyde to unite to form simple sugars. The experimenters also succeeded in bringing about a union of nitrites and formaldehyde in a test-tube subjected to the light of a quartz-mercury lamp. Here it may be noted that a discharge of lightning through the air might lead in Nature to a fixation of nitrogen, which man now achieves with his powerful electric arcs (*see* NITROGEN, FIXATION OF). Rain might bring the fixed nitrogen to earth in the form of nitrite of ammonia or the like. In other words, the materials Prof. Baly used are such as might be readily available on the surface of the earth, and this consideration makes the possible origin of the living from the not-living more plausible. In any case, all theory apart, the ingenious chemist has been able to build up formaldehyde, sugars and nitrogenous organic substances from very simple inorganic materials with only light to help him. In some later experiments Prof. Baly was able to bring about the reactions referred to by using ordinary sunlight in the presence of certain "photo-catalysts" which probably play a part comparable to that of chlorophyll in the plant.

Luminescence.—(5) Considerable progress has been made toward an understanding of organic luminescence. Some luminous organs, as in certain cuttlefishes, seem to owe their photogenic power to colonies of "phosphorescent" symbiotic bacteria. This might be called extrinsic animal luminescence in contrast to intrinsic animal luminescence, where the light is due to the metabolism of the animal itself. In his treatise on *Animal Light* (1919) Prof. Newton Harvey distinguishes among intrinsically luminescent animals (*a*) those in which the photogenic material is oxidised within the cells where it is formed, as in fire-flies; and (*b*) those in which the material is secreted to the exterior and oxidised outside the cell. Of the latter a clear example has recently been discovered (1925) by Mr. C. F. Hickling in a Macrurid fish (*Malacocephalus laevis*) which emits an abundant luminous secretion into the water. In all other luminous fishes as yet recorded, the luminescence is produced within the living cells. Dubois and Harvey have produced strong evidence in support of the conclusion that in the fire-flies, the small crustacean Cypridina and the piddock or Pholas a photogenic substance luciferin is oxidised to oxyluciferin in the presence of a ferment luciferase, the result being cold light, *i.e.*, without any heat-rays. But while the physiological aspect of bio-luminescence has been elucidated, there remains a paucity of facts in regard to its significance in the everyday life of the animal, *e.g.*, whether it serves as a lure or as a scare, a lantern or a sex signal, or for kin-recognition in darkness. It is probable that an unimportant side-track in metabolism has been utilised in different ways in different types, and may sometimes have no use at all.

Symbiosis.—(6) In illustration of recent ecology reference may be made to the great extension of our knowledge of internal partnership or symbiosis. Additions have been made to the list, long since begun, of unicellular algae (Zoochlorella and others) living in mutually beneficial partnership within the cells of Radiolarians, freshwater sponges, hydra, various Alcyonarians and sea-anemones, and, most vividly of all, in the little Turbellarian worm Convoluta. But the researches of Buchner and others have proved the frequency of yeast-like organisms in the food-canal of insects like cockroaches, which live on very dry food, or in the larva of the death-watch which thrives on the fine sawdust it eats out of the wainscot. It seems that the symbiotic yeast-plants and other micro-organisms are intermediaries between the unpromising food-material and the insect's alimentary tract, and that they are able, in some cases at least, to set up very useful fermentations.

Termite Symbionts.—Very convincingly worked out by L. R. Cleveland of Baltimore is the partnership between wood-eating termites, *e.g.*, Reticulitermes and certain remarkable Infusorians (*e.g.*, Trichonympha) which live in the intestine, and serve as the middle-men between the dry-as-dust food and the intestinal epithelium. By incubating the termites for 24 hours at 36° C., it is easy to kill the Infusorians without hurting the termites, and it is found that the defaunated individuals die in 10–20 days though copiously fed with their normal diet of wood. But if they are re-infected with their partner Infusorians they live on indefinitely. A colony of termites well provided with symbiotic Infusorians can thrive for many weeks on an exclusive diet of filter-paper.

Orchids and Fungi.—Or, again, many, perhaps all, orchids have a partner root-fungus or mycorhiza which penetrates the superficial layers and contributes greatly to the success of the plant. In some of the root-cells the fungoid threads seem to feed; in other cells, less superficial, the threads and their products are digested. It is a mutually beneficial partnership. The French botanist, Noel Bernard, showed that the germination of the orchid seeds is closely dependent on the presence of the partner fungus. The orchid seeds are small and the embryos are slow of developing, but even if they get a start they cannot go far unless infection from the soil takes place, and in some cases the infection is specific. Only one kind of fungus will serve. How the fungus promotes development is not quite clear, but there is no doubt as to its being a "benign disease." Orchid-growers are now able to provide the suitable fungus, and thus secure the germination of seeds that baffled them before. In some parts of the world with unready moorland soil, the most outstanding biological fact is the exuberant success of the heather; but this depends on its being interpenetrated, even to leaf and flower, with a partner or symbiotic fungus.

Pigmy Parasites.—Very remarkable on another ecological line is Mr. Tate Regan's account of pigmy parasitic males in three Cerativid Angler-fishes which frequent the "mid-waters" of the ocean between 250 and 500 fathoms. In the Arctic *Ceratias holbolli* a female about eight inches in length carried on her ventral surface two males of two-and-a-half inches. The snout and chin region of the dwarf male was permanently attached to a papilla of the female's skin, and the blood-vessels of the two were confluent. The male is without teeth and without the lumines-

cent " lure " borne by the female; the mouth is useless; the food-canal is degenerate. In *Photocorynus spiniceps* from the Gulf of Panama, the female about two-and-a-half inches in length bore a male under half an inch long on the top of her head in front of her right eye. In *Edriolychnus schmidti* from the western Atlantic, the dimensions were about the same as in the last case, and the female carried the pygmy male fixed upside down on the inner surface of her gill-cover. Pygmy males are well known among some invertebrates as in Bonellia, some barnacles, some parasitic crustaceans and some of the Myzostomes that live attached to crinoids. But Mr. Tate Regan's cases are unique among vertebrates. The Cerativid anglers seem to be of sparse occurrence, hence perhaps the survival value of these remarkable arrangements which secure the fertilisation of the eggs when they are shed into the sea. It may be by hormones that the presumedly synchronous liberation of the germ-cells in the two sexes is secured. We cite this case as a good instance of the progressive study of inter-relations.

Flowers and Birds.—Yet another line may be illustrated by the work of Otto Porsch on the pollination of flowers by birds. He finds evidence of over 1,600 tropical and sub-tropical flower-birds which habitually visit flowers, carry pollen on their head feathers, and more or less depend on the nectar of flowers for their food and drink. They tend to be small in size, as in humming-birds and honey-birds, and strong in wing, able to flutter before or poise themselves on the blossoms. They usually have a fine-pointed bill, sometimes elongated, and a long slender tongue, which sometimes bears processes like a brush. The habit has been acquired in no fewer than 31 different families. The " ornithophilous " flowers are usually conspicuous in their colouration (including white) and usually scentless. They produce large quantities of watery nectar and many of them have special capillary arrangements around the mouth of the nectar-receptacle which tend to prevent wasteful overflow. Good examples are to be found among fuchsias, mallows, aloes, tropaeolums, verbenas, honeysuckles, gardenias, cactuses, cannas and irises. They must be so built that the stamens dust the bird's head with pollen, and that the stigma of another blossom is in turn dusted. If the birds are effective pollinators, they will be, for several reasons, better than such insects as bees, *e.g.*, in having a longer year and a longer life; and it is significant that over 16% of the families of flowering plants in Java have bird-flower representatives. Fully 50 genera have species that are pollinated by birds, belonging to 22 different species. Ornithophily is not a new thing, but we cite Porsch's work as an instance of the kind of biological progress that is rewarding more intensive investigation.

Artificial Parthenogenesis.—(7) Very striking, again, on another line, was the discovery of the possibility of artificial parthenogenesis by Prof. Yves Delage of the Sorbonne and Prof. Jacques Loeb of New York, who were experimental biologists of great achievement. In several starfishes and sea-urchins, some worms and molluscs, and even as high up in the scale as the frog, it has been found that various modes of treatment, which alter the chemical and physical character of the water, will bring about artificial parthenogenesis. That is to say, an egg-cell which normally requires to be fertilised by a sperm-cell may be launched on aspermic development. In the case of the frog, Bataillon's quaint method is to prick the eggs with a fine needle of glass or platinum and then wash them with blood. The development, as in the other cases, is quite normal, and several fatherless frogs—of both sexes—have been successfully reared. These experiments are not only of high interest in themselves, they have led to a theory of fertilisation, which is full of promise, though still somewhat incipient. (*See* EMBRYOLOGY.)

Sex Studies.—(8) Another article will deal with the general subject of *sex;* what is admissible here is merely an illustration of modern biological methods, Baltzer's study of Bonellia viridis, a green worm not uncommon in the Mediterranean and occasionally occurring in the North Sea. The female has a body about the size of a prune, bearing a string-like, terminally bifid, very contractile proboscis which may be two feet long and is used in probing about in search of food. But the male is microscopic and lives in what may be called the reproductive duct (modified nephridium) of the female. It has no mouth and depends on what it absorbs parasitically through its ciliated surface. In 1914 Baltzer discovered that when the free-swimming larvae that emerge from the eggs settle down on the substratum they develop into females, while those that settle on the proboscis of the adult, begin to absorb from the skin, suffer an arrest of development, and become the pigmy males. Sometimes Baltzer shook off the young males before they had been long on the proboscis, and in this way he obtained inter-sex forms, intermediate between males and females. At a certain stage the males leave the proboscis and enter the mouth of their bearer and undergo a final change. After this they emerge and enter the reproductive duct, where they remain for the rest of their life, fertilising the eggs before these are set free. In his last paper (1925) Baltzer has shown by intra-vitam staining that the young males absorb nutritive material from the skin of the proboscis, and an extract of that skin is found to have a poisoning effect on small animals, such as slipper-animalcules, threadworms, water-fleas and tadpoles, as well as on the male larvae themselves. As an extract from the wall of the reproductive duct is not injurious, it becomes practically certain that the arrest of development exhibited by the larvae on the proboscis is due to the absorption of some specific substance from the female skin.

Endocrine Glands.—(9) No biological outlook at the end of the first quarter of the 20th century can fail to take notice of the discovery of the rôle of the ductless or endocrinal glands, such as thyroid, supra-renals and pituitary in the body of vertebrates. (*See* ENDOCRINOLOGY; PHYSIOLOGY.) As shown by Bayliss, Starling, Shafer and others, these endocrine glands produce stimulating hormones and soothing chalones which are distributed throughout the body by the blood and exert specific influences on particular parts, now activating and again inhibiting. These chemical messengers are like keys that open certain doors and close others, and they exert a regulative action on many of the functions of the body, securing their orchestration or correlation. To nervous and other forms of integration has now to be added this chemical integration, and it is hardly too much to say that the discovery has changed the whole face of physiology. Biologically regarded, the hormones, such as adrenalin and thyroxin, enable the biologist to understand not only everyday events such as the cat's hair standing on end before the intruding dog, but the changes that come about in adolescence when hormones from the reproductive organs saturate throughout the body, and activate the growth of the stag's antlers, the swelling of the frog's first finger, and scores of other adolescent novelties.

Of fundamental importance also is the part that hormones play in the processes of development, in quickening and slowing rates of growth, and in securing the proportions of different parts. Unhealthy dwarfs and giants are expressions of disturbance in the normal activity of the endocrine glands. The discovery of hormones among backboneless animals and in plants has begun. Thus there is a hormone in the leech, and it seems to have been satisfactorily proved that diffusing hormones are operative in the striking movements of the Sensitive Plant. In reference to man there is no doubt as to the pervasive influence of the endocrine glands on the health of the mind and body, but there has been a tendency to exaggerate this. In pathological cases, no doubt, a disturbance of hormone-production, in a plus or minus direction, may be disastrous, but the inborn variations in the majority of cases are within relatively narrow limits, and can be in some measure counteracted by nurture. It must be kept in mind that there are other not less important factors in the normal inheritance—the nimble brain, the strong heart, the active liver, not to speak of goodwill and power of control. Biologically, as well as psychologically, it seems to be an unwarranted exaggeration to speak of the ductless glands dominating and determining the personality, except, as we have said, in extreme pathological cases.

Pigmentation.—(10) Some important work has been done of recent years on rapid colour-change in animals (*see* COLOUR OF ANIMALS), and a convenient balance-sheet of investigation is to

be found in Dr. L. T. Hogben's *Pigmentary Effector System* (1924). The contraction or expansion of the chromatophores in a frog's skin used to be referred to the control exercised by the fine branches of the sympathetic nervous system, but the researches of Hogben and Winton have shown that the control is due to a hormone secreted by the pituitary body in fluctuating quantities. In reptiles like the chameleon and the Phrynosome, most of the colour-change is due to the up-and-down movement of the dark pigment granules in the branched melanophores, and this is mainly under the control of the adrenalin hormone secreted by the supra-renal bodies. In flat-fishes, such as plaice and flounder, where the colour-change is very rapid, the control is effected by branches of the sympathetic nervous system. There is sometimes an enveloping of the pigment-cell with fine terminal branches of nerve-fibres, an innervation which has never been demonstrated in amphibians. It is striking, then, that in three classes of vertebrates, the predominant control of the colour-change is effected in three different ways, though the possibility is not excluded that there are auxiliary controls besides. The impression of variety would be increased if invertebrate types, such as crustaceans and cuttlefishes, were also considered, and no one can doubt that this is a very promising line of biological research with far-reaching implications.

Metabolic Gradients.—(11) One of the most suggestive of new biological ideas is Prof. C. M. Child's hypothesis of "metabolic gradients," but in brief compass it is not easy to do more than give a glimpse of it. In the simple planarian worms that are common in brooks, creeping on stones and water-weed, there is a frequent asexual multiplication by transverse fission. At a certain distance behind the head a transverse constriction appears, but there is no structural peculiarity to mark the place. Eventually the tail-end is separated off and grows a new head; the original head-end develops a new tail; and after a period of growth the process repeats itself. In his profound study of the planarian worm, Prof. Child found that its maximum rate of chemical change or metabolism, measured for instance by the output of carbon dioxide, occurs in the head-region; it gradually falls off posteriorly; but the curve rises again to a lower peak far down the body and then falls again to the tip of the tail. Now the site of the second, smaller peak is the place where the transverse constriction will occur, and where the future head-end of the coming offspring will be formed. The head-end seems to exert a graduated sway or control over the body and when this wanes to a minimum, a hitherto somewhat suppressed individuality may assert itself. In a similar way the growing point of a shoot exerts a control on the buds beneath it, which are not activated until the apex has been carried by growth to a certain distance. The structure of the body is the equipoised result of many controls, both quickening and restraining.

Biology and Psychology.—Many will disagree, but psychology may be conveniently described as primarily the study of the subjective aspects of the organism. As some of these are correlated objectively with behaviour and, in man's case, with conduct as well, a contact with biology is obvious. For the ecologist is also concerned with animal behaviour, though in a synthetic rather than in an analytic way. He is not so much interested in the inner activity of the animal as in the objective outcome (*e.g.*, in courtship, nesting, nurture, co-operating, competing) and its rôle in securing the continuance and advancement of life. But the ecologist is bound to join hands with the comparative psychologist.

Another contact between the two sciences is implied in the unity of the organism. Whatever view be taken of the relation of "mind" and "body," there is no doubt that these two abstract terms refer to aspects of the organism which are equally real and cannot be studied in complete isolation from one another. There may be mental processes which can be adequately described in psychological terms without any reference to the body, and there may be bodily processes which can be adequately described in physiological terms without any reference to the mind, but between these two limits or extremes there is a large stretch of behaviour which requires dual treatment. In dealing with the activities of plants the botanist does not find any need to postulate a subjective aspect, though he might not be bold enough to deny its possibility; but many naturalists who study the ways of birds find an apsychic description quite inadequate.

The Inclined Plane of Animal Behaviour.—Among unicellular animals there are numerous reactions to stimuli, and some of these are hereditary like Paramecium's reversal of cilia, retreat, change of direction, and re-advance; a simple concatenation that often enables the creature to circumvent some obstruction or injurious stimulus. In Stentor and other forms there is clear evidence of a "trial and error" procedure of a simple sort. To a microscopic shower of dust the animal responded by reversing its cilia, by bending to one side, by contracting into its sheath, and finally by loosening itself and swimming away. In Prof. H. S. Jennings' case of an amoeba pursuing a smaller amoeba, capturing it, losing it, recapturing it after change of direction, and finally losing it again, there seems to be evidence of purposive behaviour at a low level. Some of Heron Allen's cases of foraminifera that build up beautiful and effective extrinsic encasements, of sponge spicules and the like, are, to say the least, very suggestive of mentality.

In regard to multicellular animals the facts are more abundant. There are many simple reflex actions which depend on inborn linkages of certain nerve-cells and certain muscle-cells, usually involving four links:—(1) sensory neurons, (2) adjustor or associative neurons, (3) motor neurons, and (4) the effector muscle-cells. But even here there is an inclined plane, for in sponges there is neuro-muscular reaction, although there are no nerve cells; in hydra there are nerve-cells at once sensory and motor; in the earth-worm and even in man there may be simple reflexes that do not involve more than sensory and motor neurons; and then in the opposite direction there is an evolution of compound reflexes, as when nestlings react to the parent-bird bringing them food.

Experimental Behaviour.—On a different line is what may be called tentative or experimental behaviour—the search for food, the exploring of a corner, the behaviour of a brainless starfish in attacking and disarming an equally brainless, but very formidable, sea-urchin. This is far below the level of intelligent behaviour in the ordinary sense. In the early life of many animals, especially birds and mammals, there is a period of association-forming, as when a chick learns to connect a particular maternal cluck with a rapid seeking for shelter, a linkage that is inborn or instinctive in some other creatures. The forming of useful associations leads on to more difficult achievements in the way of non-intelligent learning. Thus even a frog will "learn" to find its way out of a maze and a rat may become very expert after a short course of lessons. There is certainly a profiting by experience, though it seems too generous to credit the animals with judgment.

Tropisms.—Of great importance and of widespread occurrence are "tropisms," which are engrained constitutional obligations to adjust the body so that the two sides—it may be the two eyes, ears, or nostrils—are equally stimulated. In this way a physiological equilibrium is automatically secured. Thus the young eel or elver goes straight up-stream, the male mosquito finds the buzzing female, and the moth flies into the unnatural stimulus of the candle. Somewhat higher is the persistent way in which newly hatched loggerhead turtles make for the more open horizon, as Prof. G. H. Parker has shown, which usually and happily means finding the sea.

Instinctive Behaviour.—On the same line of hereditarily pre-established reflexes are the various grades of instinctive behaviour, the purest expression being found in ants, bees and wasps. Physiologically regarded, they are concatenations of reflex actions, but in many cases, at least, it seems necessary to suppose that they are suffused with awareness and backed by endeavour. To say that this endeavour is nothing more than the physiological urge of hunger or of sex seems inadequate when the subtler instances of instinctive behaviour are kept in view.

The Hive-bee.—A glimpse of the subtlety of animal behaviour in its lower reaches is afforded by Prof. K. von Frisch's careful

studies of hive-bees in connection with their discovery of nectar. It is well known that when a bee discovers a rich treasure of nectariferous blossom and returns laden to the hive, the flowers are soon afterwards visited by considerable numbers of bees whose comings and goings continue until the supply is exhausted. The old theory was that the original bee-discoverer guides her comrades to the feast. But this is not what happens. Frisch found that when a bee (carefully marked) returns full of nectar to the hive, she executes a peculiar "round dance" on the comb. This excites the resting bystanders who issue forth to search for themselves. But they are not without a clue, for they have sampled the floral fragrance lingering on the discoverer's body, and they search for flowers with that particular scent. If the nectariferous flower has no scent, a clue is afforded by the body-scent which the discoverer-bee leaves on the blossom. Bees have on their posterior body a protrusible glandular organ which secretes a scent recognisable even by man, and when an exploring bee finds a very profitable flower she excitedly protrudes the scent-organ, and thus sprays the petals with a scent which gives the other searching bees a clue. When supplies are exhausted, the returning bees execute no dance, and no fresh explorers issue forth. All this has been worked out with convincing care, and it is also shown that when the bees are collecting pollen, with a specific fragrance which helps in the search, there is again a dance on the comb that tells the tale, though it is quite different from the nectar-dance.

Intelligent Behaviour.—In sharp contrast to instinctive behaviour, in the view of many biologists, is intelligent behaviour, where there is some learning, some profiting by experience, some understanding of a situation, some appreciation of relations so that a slight change of circumstances does not lead to bewilderment, as in instinct, but is met by a fresh adjustment. To use Romanes' terminology, intelligent behaviour is psychologically dependent on a "perceptual inference." Thus, to take some recent instances, a chimpanzee will piece together two bamboo rods so that they make a double stick long enough to reach a fruit outside the bars of the cage; or an orang having discovered how to use a wooden lever will proceed to make and use others of different sizes and strengths, and will even use its trapeze bar to enlarge the space between the first upright of its cage and the iron partition wall so that the opening becomes large enough to allow of the gratification of a long-cherished desire to look into the next compartment. The recent studies on chimpanzees by Dr. Yerkes and Mrs. Learned, and even more those by Prof. Kohler, show conclusively that the intelligence of apes (*see* INTELLIGENCE, ANIMAL) though strikingly limited in certain directions, has been hitherto underestimated. When the doings of these predominantly intelligent animals are compared with the highest achievements of ants and bees, the contrast corroborates Sir Ray Lankester's view that "the little brain type" rich in instincts and far from educable, is on a line of evolution quite different from "the big brain type," with few instincts in the strict sense, but eminently educable. In many cases, however, as in birds, there may be an intricate mingling of intelligent and instinctive behaviour in varying proportions.

Development of the Brain.—Of great biological interest is the cerebral series worked out by Prof. Elliot Smith showing the graduated improvement in the anterior region of the fore-brain in jumping shrew, tree-shrew, spectral tarsier, marmoset, monkey, ape and man. The demands of arboreal life favoured cerebral variations in the direction of controlled agility, the seeing eye and the understanding ear. There was a reduction of the snout, a bringing forward of the eyes, an enlargement of the brain case. In particular there came about a great reduction of the olfactory region of the fore-brain and a progressive increase of the centres for sight, touch, hearing, and dexterous movements. Soon there was added the power of stereoscopic vision, and the outgrowth of a pre-frontal or neo-pallial lobe of the cerebrum that made delicate eye-movements possible and a focusing of attention as well as vision. There is anatomical evidence of an evolutionary trend which gave increased scope to the centres for vision, hearing, touch and skilled movements. It has been part of the tactics of evolution among the highest mammals to reward improved visualisation (*see* MAN, EVOLUTION OF).

The Inclined Plane.—Much has to be done in analysing the various grades of behaviour, but biology has contributed to comparative psychology a wealth of observational data which suggest the idea of a long inclined plane, on which there are diverse evolutionary lines variously ramified, rather than any linear succession. But another general conclusion may be drawn, that there are two main modes of behaviour: (*a*) the expression of enregistered capacities for effective response, as in reflexes, tropisms, constitutional rhythms, instincts and habituations; and (*b*) the expression of a capacity for initiative, tentatives and experimenting, as in "trial and error" procedure, non-intelligent new departures, experiential and associative "learning," and clear-cut intelligence. Of reason in the strict sense, involving what Romanes called "conceptual inference," and of conduct, involving the control of behaviour in the light of general ideas, the only convincing illustrations are human.

Definition of Instinct.—The largest contribution that biology has to make to psychology is this disclosure of the inclined plane of animal behaviour, which implies, of course, applications to man, who has his reflexes and urges, his intelligent experiments and his habituations. It is to be regretted, however, that many psychologists used the terms "instinct" and "instinctive" very vaguely when discussing human behaviour and conduct. The term "instinctive" has been defined in a thoroughly clear way by Prof. Lloyd Morgan and most modern zoologists use it in his sense. Confusion has arisen through the psychologists' loose application of the term to a medley of promptings—urges, appetites, inborn reaction-tendencies, racial pre-dispositions, and so forth. Here it may be said that biological studies on what Galton called "ancestral inheritance" have thrown a useful light on the racial enregistrations which form part of the "Primary" (as distinguished from the "Freudian") Unconscious.

Dominance of Mind.—The study of animal behaviour in its many gradations brings into prominence two great facts, (1) the increasing emergence of the mental aspect of organisms in the course of the age-long process of Becoming (*see* EVOLUTION), and (2) the increasing importance of the mental factor as a *vera causa* in organic evolution (see E. S. Russell, *The Study of Living Things*, 1924). Indeed one of the largest results of Biology is the evidence it has brought forward of the increasing dominance of the mind in evolution. Through many grades of animal individuality there has been an advance towards human personality.

Biology and Sociology.—The three sides of the biologist's prism are Organism, Function, and Environment, and they are obviously the same as the sociologist's Folk, Work, Place—Le Play's Famille, Travail, Lieu. In scientific discussion and in practical endeavours there is often a loss of time and energy because the three complementary aspects are not kept equally in view. As the unit in sociology is not the individual, but some societary integrate, the old misleading analogy between the animal organism and the "social organism" should be abandoned. The true analogy is between animal societies and human societies, and this has been utilised far too little. In the ant-hill, the bee-hive, the termitary, the rookery, the beaver-village, the herd of antelopes, and so on, there are valuable hints for the sociologist; and Dr. W. Trotter's *Instincts of the Herd* (1919) requires a sequel. That may be found indeed in *Tier-Soziologie* (Leipzig, 1925) by Prof. F. Alverdes.

Tradition and Human Society.—In this incipient, comparative sociology, the interesting parallelisms must not be allowed to weaken the emphasis on the differentia between Wild Nature and Man. For in human societies there is not only the uniqueness implied in man's reason and language, there is the maintenance of an extra-organismal heritage which may be as supreme as the germ-plasmic or Natural Inheritance is fundamental. In traditions and customs, institutions and laws, literature and art, permanent products and external registrations, there is a persistent social heritage, or, from another point of view, environment, which is only adumbrated in the ant-hill and the beaver

village. Moreover, there is great apartness implied in man's consciousness of his own history and in his occasional but characteristic endeavours to control the future in the light of general ideas. It is mistaken to suppose that animals may not actively share in their own evolution, but it is obvious that they cannot do so with man's clear purpose.

Biological Applications.—Just as chemistry and physics have their applications in biology, so has biology its application in sociology, as is plain when we think of such facts as health and disease, variation and heredity, fertility and length of life. But it is unscientific to try to force social phenomena into biological frames, and to make things that are very different appear, by analogous terminology, as if they were the same. Thus there arises a biological section of sociology concerned with such problems as the relation of individuation and reproduction (see Spencer's *Principles of Biology*, 1895), the import of inbreeding and outbreeding (see East and Jones), the transmissibility of acquired characteristics and the complementariness of hereditary " Nature " and environmental " Nurture " (see Galton and Pearson). More distinctively sociological, and yet with its hand on biology, is an inquiry into the differential significance of a societary unit, for instance in allowing the survival of individual variations and modifications which could not persist without some such shield. What, in other words, is meant by social variations, social heredity, social selection and the like. Just as it is an illegitimate " materialism " to force the facts of organismal life into the frames of chemistry and physics, so it is an illegitimate " biologism " to force the facts of human social life into the frames of pure biology.

Biotechnics.—This term, proposed by Prof. Patrick Geddes, may be usefully applied to man's control of organisms for his own ends. Thus the domestication of animals and the cultivation of plants are pre-historic instances, and though few important additions have been made to either list within recent times, there has been much progress in breeding, especially since the Mendelian clue was discovered. The production of astonishing egg-layers among poultry or of the Marquis or Garnet wheat among cereals may be cited as two examples out of a hundred. This art of breeding may aim at establishing subtle qualities, such as wheat immune to the disease of " rust," or collie-dogs that are almost rational in their handling of sheep.

Applications of Biotechnics.—What is sought after is often a more economical or more permanent exploitation of the resources of nature, as in the fishing industry and in farming, as well as in minor matters such as bee-keeping and ostrich rearing. Some of the improvements of most promise rest on a biological understanding of the facts of the case. To the interesting problems of forestry (*see* FORESTRY), which are of so much importance from the occupational as well as from the economic side, the methods of genetics and ecology are beginning to be applied. On a similar line one may refer to what Prof. Oliver and others have done towards the utilisation of waste places, like sandy heaths, pit-heads and salt marshes; or to Prof. Bottomley's experiments on the utilisation of peat; or to Prof. Scott Elliot's study of the ways of checking the spread of bracken, which is annually encroaching very seriously on pasture land.

The Balance of Nature.—Man's struggle with his animal enemies, which was doubtless of incalculable importance, in the early days of his ascent, has succeeded so far that in regard to the larger forms the danger now is that he push his victory too far. Even in regard to snakes, which still bite man's heel, there is a tax to pay for their elimination, namely the increased multiplication of rats and mice and other small rodents. There is reason to hope that a clearer realisation of Darwin's central ecological idea of the web of life (the multiplicity of vital interrelations in Animate Nature) is lending greater subtlety to man's attempts to check those organisms that are prejudicial to his interests and to foster those that are in his favour. Thus golden eagles are no longer shot at sight as they once were, and, apart from aesthetic and other reasons, birds are being spared because of the beneficent part that many of them play in keeping down injurious insects, the unchecked increase of which would in a few years bring everything to destruction. A respect for the Balance of Nature rests on the soundest biological foundations.

Preventive Medicine.—A recognition of bionomical linkages has reaped a rich reward in connection with human parasites (*see* MALARIA; PARASITOLOGY). Thus the conquest of malaria in many places has depended on pouring a little petrol on the stagnant pools where the larval mosquitoes live. The film of oil makes it impossible for the larvae to hold on to the surface by their posterior respiratory tube, and they drown. But the distribution of the malaria organism (Plasmodium) depends on the vagaries of the adult mosquito, and thus the petrol method works wonders. When account is taken of the importance of malaria in human history, the value of biotechnics receives signal confirmation. The same holds in regard to many other diseases.

Further Examples.—One would not seek to put to the credit of applied biology what clearly belongs to preventive medicine, yet in many cases the latter has been effectively supplemented by the former. Thus while it is a medical discovery that carbon tetrachloride is extraordinarily potent in expelling from man's food-canal the small threadworms (ankylostomum and necator) which cause one of the commonest and most serious diseases of tropical countries (*see* HOOKWORM), it is a question for natural history how the larvae of the hookworms behave in the soil, and how the natives become cutaneously infected by walking with bare feet on ground that has become hopelessly contaminated. Now these hookworms, which suck blood from the wall of the intestine, are responsible for widespread weakness, depression and despair, forming, according to some authorities, the heaviest pathological cloud that has ever rested on the human race. The campaigns undertaken by the Rockefeller Institute have shown conclusively that this cloud may be dissipated in a relatively short time, and health secured as long as simple sanitary precautions are respected. Part of this triumph may be fairly placed to the credit of biotechnics.

The same may be said in regard to our knowledge of the part that many insects and some Acarines (mites and ticks) play as the carriers of microbic diseases. Thus in addition to the case of mosquitoes and malaria already referred to, one may recall the tsetse flies which carry the micro-organisms (Trypanosomes) of sleeping sickness, and the fleas that spread the bacterium of Bubonic Plague from rat to man. Many of these knots in the web of life are of great importance, a signal instance being the part a minute mite plays, according to Rennie and White, in bringing about " Isle of Wight " disease in bees.

Eugenics, Eutechnics and Eutopias.—There is a growing inclination to bring biological facts and ideas to bear on three of the great *objective* human problems, the betterment of the stock (*see* EUGENICS), the amelioration of occupational conditions (Eutechnics), (*see* INDUSTRIAL PSYCHOLOGY; INDUSTRIAL WELFARE) and the improvement of the environment (Eutopias). Even the conviction that these three aspects must be correlated is a biological commonplace of the first magnitude. Much that is being done to lessen occupational diseases (many of them already conquered) is frankly to the credit of medicine, but the biological note is sounded in the investigation of industrial fatigue and in the study of economy of movement. It may be said that modern dietetics has passed from a basis of experience to a basis of experiment, and has become subtly biological. Or again, while the value of exercise in the open air and sunlight has been recognised, as a pious opinion at least, for ages, it has now acquired a quite new biological authorisation (*see* HELIOTHERAPY; PUBLIC HEALTH). Similarly, very much that is being done to make surroundings more wholesome and more beautiful is not directly actuated by biological considerations, yet there is no doubt that endeavours in this direction are being invigourated by what is biologically known in regard to the influence of the environment on the individual organism especially in its early life. The Proteus newt of the Dalmatian caves has a pigmentless skin in its native haunts, but it soon becomes dark when brought into the well-lighted laboratory. In the caves it is blind, and the arrested eye never comes to the surface; but the young ones reared in the light may receive their sight.

Eugenics.—Eugenics was defined by Sir Francis Galton as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally." The theoretical soundness of the study is obvious. The difficulty is in regard to practicable eugenics. Thus, whether sound or unsound biologically, it is socially impracticable to return to "the purgation of the state" which Sparta to some extent practised and Plato approved. It might be a kindness that weakly infants, whose life must be more or less miserable, should be allowed a euthanasia, but it has to be admitted that many weaklings have been makers and shakers of the world, that eliminative methods are apt to outrun our present secure knowledge, that their operation would in some instances remove the results of evil without touching the causes, and that we cannot at present go far in social surgery without outraging social sentiment.

As regards positive eugenics, it may be suggested that greater enthusiasm for health and a heightened biological patriotism will lead (1) to more careful selection of partners in life, (2) to well-considered forms of social selection that will favour the increase of the fitter types and the decrease of the undesirables, (3) to a more conscientious "criticism of consumption" which will favour occupations that are wholesome and handicap the reverse, and (4) to an enlightened and moralised practice of medically authorised methods of birth control (*q.v.*) that will probably tend to raise the health-rate. The probability is that a diffusion of biological education will steadily work towards the eugenic ideal, which is, after all, one of the oldest man has cherished.

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(J. A. T.)

BIPLANE: *see* AEROPLANE.

BIRDS, MIGRATION OF.—No longer do dwellers in Great Britain believe that the cuckoo spends the winter with them in the guise of a hawk, and that the swallow tribe seek refuge in horse ponds, or holes in sand pits and cliffs, till the winter is past and the summer is at hand. It is now a matter of common knowledge that they leave, when the summer is spent, for the more congenial climes of Africa and return in the spring.

But the movement embraces a large number of species unrecognised by the world at large, and there is an autumn movement which is unsuspected by the uninitiated. With the spring come the cuckoo, the swallows, the swifts, the warbler tribe, wagtails and wheatears, the red-backed shrike and many others. In the autumn, as these leave, come the redwing, fieldfare, snow-bunting, shore-lark, woodcock, shorteared owls and yet others. They leave with the advent of spring.

Results of Observation.—To explain these seasonal changes many theories have been advanced. For the most part they rest on a postulated instinct, engendered by conditions imposed by the glacial period, ages ago. When observation is substituted for mere guesswork some pertinent facts present themselves. In the first place migration is possible only to such species as can find food wherever they go. The hornbill and the toucan, the bird-of-paradise and the peacock cannot migrate, because they have become adjusted to a food supply having a relatively restricted distribution. Should famine overtake them they must as certainly die if they fare forth in search of food as if they stayed in the stricken area. Hence, such species are relatively limited in regard to their individual numbers. Chimney-swallows and sedge-warblers vastly outnumber hornbills or birds-of-paradise, for example.

Since the insectivorous and carnivorous species can count on an almost universal source of food, the impression is gained that migration is purely a matter of food supply; that the cuckoo, the swallows and the warblers must, perforce, leave in the autumn because flies and caterpillars are hard to come by in the winter.

This simple explanation, however, is demonstrably untenable. We are misled by concentrating too much on the insectivorous species. Every autumn the home-bred thrushes and woodcocks leave Britain and their places are presently filled by other thrushes—redwings and fieldfares—and woodcock, which come from more northern regions to escape the rigours of their native land. Evidently, then, our thrushes do not leave because the British Islands are no place for thrushes in the winter.

Again, if these movements were simply conditioned by the food supply why should the swallows, warblers and other spring migrants leave the genial climes of Africa to pass the summer in Britain? The journey is full of perils, many fall by the way and many perish on arrival from a sudden return of wintry weather. Further, as the native-bred birds are returning, those that came in the autumn leave for their breeding grounds in Northern Europe; they leave, in short, just when food is growing more plentiful.

The Real Reason.—A careful survey of the phenomena of bird migration seems to show that the primary cause of these movements is not the need of finding food so much as an optimum temperature for the offspring. That this is the key to the problem seems to be shown by the fact that during any spell of really hot weather the native birds, whether incubating in a sun-baked hedgerow, a shadeless heath or a ledge of rock 200 ft. above the sea, all alike show signs of evident distress, sitting with open mouths apparently panting for breath. With the advent of the young the same distress is seen; the fledglings sometimes hang over the edge of the nest exhausted by the heat.

Such facts show that had these birds remained in their African winter quarters they would have reared no young. And similarly, if the redwing and fieldfare had not left in the spring, they too would have met with a like disaster. These birds, in short, have each and all become tempered, or adjusted, by natural selection to certain more or less definite ranges of temperature, a general average of heat and cold, beyond which they cannot range with impunity. If this interpretation is correct, then it would seem that these migrants must, at some remote past, have been forced out from an area where they were resident the year round, as are so many native birds.

Need for Migration.—The necessity for migration came about as these species, increasing in numbers beyond the limits of their food supply, were forced, in each succeeding generation, farther and farther from the ancestral centre. Let us suppose this to have been true of the swallows, originally of African origin. There came a time when those which had been forced northward found themselves in a temperate climate, where the winter

was uncongenial. They would be driven back towards their ancient centre of dispersal; but now they could no longer stand the summer temperature of their winter quarters, and as a consequence would be forced to return to the land of their birth. Since it is the custom, for obvious reasons, for the adults to drive their young away as soon as they can fend for themselves, the birds hatched last year, returning to their birth-place, will find their prospective breeding sites occupied by their parents. Hence they would be forced still farther northward. Thus is the range of a species gradually extended. Thus it has come about that the migratory species are vastly more numerous in individuals than resident species.

Migratory species become as much "local-races" as the resident species. The pair of swallows which reared their broods in a barn in Ripley, Surrey, in 1925, will, if both survive, return to that village, and to that nest for the same purpose. But for this wonderful homing instinct, disaster would overtake the species. As the migrating hosts set out on their migration to their native land, which is their birth place, they spread, as it were, fanwise, each to his appointed place. Thus they spread evenly. But for this, vast hordes might elect to stay in one small area, anywhere on their route, when disaster would inevitably follow. The males, as a rule, are the first to arrive for on them falls the necessity of seizing upon a breeding territory, which is held at all costs against rivals, perhaps their own offspring. The females follow about a week later, and pair up as they meet with the successful males.

The Sense of Direction.—Finally, there is one aspect of migration for which no satisfactory interpretation is yet forthcoming. With some species, as with the common cuckoo, the adults leave for their winter quarters some considerable time in advance of their young. How then do these find their way? We can only postulate some subtle sense of direction, inherited from their parents, which, earlier in the year, made their way unaided from Africa, that land of plenty and genial warmth, whither they had gone to escape the rigours of the winter months in the north. So long as it was assumed that migration was merely a matter of food supply, the appeal to "inherited habit," forced on the migrating hosts by the severities of the last glacial epoch, had a certain superficial plausibility. But since this glacial grip of the land lasted several thousands of years, it becomes untenable as a serious solution of this problem.

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(W. P. Pv.)

United States.—During recent years, the migrations of North American birds have been the subject of much intensive study. Spring and autumn routes, as well as the territory in which the winter is spent, are now well known for most species, the principal lanes of flight following the valleys of the great rivers, such as the Mississippi and the Hudson, as well as the sea coasts.

There are three main routes by which birds pass from the United States into the countries to the south. The most obvious one leads through the mainland of Mexico, directly into Central America. The second uses northwestern Florida as a jumping-off place, followed by a flight directly across the Gulf of Mexico to Yucatan. The third takes the travellers down through the peninsula of Florida, thence across the Caribbean Sea to South America, with resting places in Cuba, Jamaica and other islands of the West Indies. Closely related species, probably because of inherited habit, may use widely different routes, and a few, such as the redstart, use all of them. In most cases, however, the line is closely restricted.

In general, the direction followed in the southward and autumnal flight is used for the return in spring. However, there are some striking exceptions, which serve to increase our wonder at the ability of the birds to find their way. The much-quoted case of the golden plover will serve as an example. Those that nest near the Arctic Ocean, gather in Labrador in July. Here they acquire a considerable reserve of fat and finally cross to Nova Scotia. Thence, they strike out over the sea, directly for the northern coast of South America, more than 2,000 m. away. If fair weather prevails, they seem to make no stop until the goal is reached, though fogs or head winds may drive them ashore. The winter is passed in Argentina. On the return journey to their northern nesting grounds, some 8,000 m. distant, the birds follow an entirely different course, through Central America and up the Mississippi Valley. The problem of the origin of migration routes is a difficult one at best, and such cases as this have so far baffled solution.

Probably the most important recent contribution to the study of migration, is the development of bird banding. Light aluminium rings, bearing a serial number and a return address, are placed on the legs of young birds in the nest, or on those of adults, which are trapped and released. This work, at first carried on by scattered individuals, has now been taken over by the Bureau of Biological Survey, at Washington. With the help of interested naturalists, in all sections of the country, some thousands of birds are marked yearly. Out of this total, many returns are made to the central office, and from the mass of data gathered in this manner, much valuable information concerning migration routes is being obtained. (L. S. C.)

BIRDWOOD, SIR GEORGE CHRISTOPHER MOLESWORTH (1832–1917), Anglo-Indian writer (*see* 3.979), died at Ealing, London, June 28 1917.

BIRDWOOD, SIR WILLIAM RIDDELL (1865–), British general, was born Sept. 13 1865. He joined the 12th Lancers in 1885 and was in the following year transferred to the Indian Staff Corps, joining the cavalry. After service in several frontier expeditions, and in the South African War (1899–1902), he was closely associated for several years with Lord Kitchener in India, acting as his military secretary. Lord Kitchener, in Dec. 1914, selected him for the command of the Australasian forces which were being assembled in Egypt, and in the following April he commanded this army corps in the memorable landing at Anzac. He was in charge of the troops clinging to this patch of the Gallipoli Peninsula until Aug., and his personality won the confidence and regard of these Australasian troops in a unique degree. Birdwood carried out the masterly withdrawal of the Dardanelles forces from their dangerous positions in the following December and January. After a short period in Egypt he took his Australasian troops to the Western Front, where they played an important part in the last phases of the British advance in the autumn. For his services he was made a baronet, besides receiving a grant of £10,000. He paid a visit to the Antipodes a year after the War. In 1920 he took up command of the northern army in India, and in 1925 was promoted field-marshal and appointed commander-in-chief in India.

BIRKENHEAD, England (*see* 3.982), with an area of 3,909 ac. and a population of 145,952 in 1921, is a thriving city, which has increased largely in importance during and since the World War. It has now a great trade in cattle, coal and grain, and numbers of warehouses and works have been built. Birkenhead is one of the chief meat markets of the empire, and (with Wallasey) the largest milling centre in Europe. The biggest cattle market in Great Britain is held at the Mersey Cattle Wharf, and there is a special landing stage for cattle. A clock tower, a memorial to King Edward VII., was unveiled in 1912, and a war memorial cenotaph in Hamilton Square in 1925. An art gallery and museum was opened in 1912.

In 1923 the docks covered an area of 170 ac., and improvements were being considered. A new deepwater entrance has been built and a passage made to Bidston Moor, so that this undeveloped land may be made a manufacturing centre. Birkenhead is also a large shipbuilding centre; the yards, which cover over 100 ac., had a very large output during the World War. A water undertaking, begun in 1911 and involving the construction of a reservoir three miles long at Alwen in Wales, was completed in 1921; the corporation became the sole water authority for the borough in 1925.

BIRKENHEAD, FREDERICK EDWIN SMITH, 1ST EARL OF (1872–), British politician and lawyer, was born at Birkenhead July 12 1872. Educated at Birkenhead Grammar School and Wadham College, Oxford, where he was a scholar, he took

a first-class degree and in 1894 was President of the Union. As an undergraduate he impressed his contemporaries by his force of character, oratorical power and mordant wit. He won the Vinerian law scholarship in 1896, and secured a fellowship at Merton College. He lectured both at Merton and Oriel, and became a university extension lecturer in modern history.

Choosing the law as a career, Mr. Smith was called to the bar at Gray's Inn in 1899. Skilfully gathering round him his old connections in the north of England, he attached himself to the local bar at Liverpool, where his natural abilities swiftly gained him a considerable practice. Audacious intrepidity was his main characteristic as a youthful pleader. Following his Oxford tradition as a Conservative, he was adopted as candidate for the Walton Division of Liverpool and made a speech at a public meeting which greatly impressed Joseph Chamberlain. Elected M.P. for Walton in 1906, he held that seat until raised to the Lord Chancellorship in 1919. He signalised his entry into the House of Commons by delivering, from the broken ranks of the Opposition, a maiden speech of brilliant mockery which made his reputation.

A rapidly growing practice at the London bar, where he took silk in 1908, hindered him from pursuing the regular routine of Parliamentary opposition. The achievement that brought him prominently before the public as a barrister was his success in an action brought in 1908 by Lever Bros. against *The Daily Mail* for describing that company as a "Soap Trust." He also appeared for Miss Le Neve in the Crippen case and against Lord Alfred Douglas in a case arising from the disputes about Oscar Wilde. His forensic style differed from his method of public oratory. He inclined to be quiet, dispassionate and deadly in cross-examination. A tremendous worker at the bar, he undertook tasks which would have overwhelmed most men in combining his legal and political careers.

His chief political strength lay in captivating and mastering mass audiences. After the retirement of Chamberlain popular Conservatism found in him its most telling exponent, and in the art of the platform even Lloyd George had to reckon with him. The qualities which won his early success also made him enemies, not always in the rival political fold. He brushed opposition or prejudice brusquely aside, and he never restrained his wit from playing over any object it fancied. At the same time he was much loved by his intimate friends and subordinates, to whose feelings and interests he always gave marked consideration.

Mr. Smith took a prominent part in the struggle over the Parliament bill. He moved its rejection on the third reading, May 1911, and threw in his lot with the Die-hards, who desired the peers to reject the measure. His growing position was recognised by a Privy Councillorship in 1911 and he became an accepted member of the Conservative "shadow" Cabinet. The Irish question was now becoming acute and Mr. Smith was Sir Edward Carson's principal lieutenant in the resistance organised in Ulster.

The War of 1914–8 closed the original Irish controversy. He accepted the task of controlling the Press Bureau, went to France as eye-witness with the Indian corps, and did valuable work in the administration of army law. He was recalled from France to become solicitor-general in the first Coalition of 1915, and succeeded Sir Edward Carson as attorney-general in Nov. of that year. In this year he was knighted. The Defence of the Realm Act threw on the law officers of the Crown a great burden of anxious work including the prosecution of Sir Roger Casement for high treason. As attorney-general Sir F. E. Smith's most important success was the case in which he succeeded in getting the rights to the unoccupied land of Rhodesia reserved to the Crown instead of passing to the British South African Company.

When Lloyd George reconstructed his Ministry after the election of 1918, the attorney-general was offered the Lord Chancellorship, and was raised to the peerage as Viscount Birkenhead in 1919. The appointment, though quite in the normal order of promotion, was subjected to considerable criticism, partly owing to the new Chancellor's comparative youth, but chiefly to his vehement partisanship in earlier years. His chief legislative achievement during his term of office was the Law of Property Act of 1922. This reform, long overdue but perpetually held up by the inertia of the various legal authorities and interests, revolutionised the whole system of holding landed property. Among Lord Birkenhead's most notable judgments were (1) Director of Public Prosecutions *v.* Board, dealing with drunkenness as an excuse for crime; (2) Wakeford *v.* The Bishop of London; (3) The Rhondda Peerage case before the Committee of Privileges, laying down that women could not sit in the Upper House by right of peerage; (4) Admiralty *v.* S.S. "Volute"—a judgment on the law of negligence in collision cases. Of this fourth deliverance Lord Finlay said "I regard the judgment to which I have just listened as a great and permanent contribution to the law on the subject of contributory negligence, and to the science of jurisprudence."

The fall of the Coalition Government of 1922 was brought about by the desire of the rank and file of the Conservative party to regain its independence. Lord Birkenhead and some other Conservative ministers opposed this movement in vain at the Carlton Club meeting. As a consequence he was not included either in the administration of Mr. Bonar Law or in that of Mr. Baldwin, and he assumed an attitude of marked independence. On vacating the Lord Chancellorship he had been made an earl. Mr. Baldwin prudently healed the breach in the Conservative ranks on assuming office again in 1924, and Lord Birkenhead became Secretary of State for India.

Lord Birkenhead, as an Oxford scholar, had a natural taste for letters and his libraries were filled with carefully selected volumes. He himself writes well and profusely. His work on International Law has gone through several editions. He published a collection of Essays on Unionist Policy in 1913, the story of his American visit during the War in 1918, and two volumes of Collected Essays in 1922. The Essay on Lord Salisbury, originally published in *The Times*, is his best historical work and the short sketches of his young friends who died in the War reveal the human side which he always shows to youth. He married in 1901 Margaret Eleanor, daughter of the Rev. Henry Furneaux of Oxford, the editor of *Tacitus*. They have one son (Viscount Furneaux) and two daughters, the ladies Eleanor and Pamela Smith. (M. W.)

BIRMINGHAM, Ala., U.S.A. (*see* 3.983), diversified its industries until, in 1924, its factories were producing 1,640 kinds of articles. Pig-iron and steel remained the basic products. Others of importance were cast iron and clay pipe; wire, nails, steel cars, car wheels, rails, stoves, cotton gins; sugar-mill, coal washing and mining machinery; cement, brick, lumber, cotton-seed oil and meal and fibre; corn meal, meat, cotton goods and chemicals. By 1920 the old beehive coke-ovens had given way to by-product ovens with an annual capacity of 4,500,000 tons of coke, yielding also vast amounts of coal-tar and 17,000,000 ft. daily of by-product gas, which supplied the city mains. Hydroelectric power in ample quantities was already available, and the Muscle Shoals (*q.v.*) development is well within the limits of economical transmission. On Jan. 1 1910 the city's boundaries were extended, incorporating several suburbs, including Ensley, and increasing the area to 49 square miles. The population in 1920 was 178,806, of whom 70,230 were negroes and 6,410 foreign born; in 1925 (census bureau estimate) 205,670. Bessemer, Fairfield (a model industrial city), and other suburbs, which, though politically independent, are an integral part of the economic unit, would increase the population by 60 or 65%.

The commission form of government was adopted in 1911. Transportation facilities were augmented by the construction of the Birmingham Belt, encircling the city and connecting with all of the nine trunk lines; and by the opening (1920) of a terminal at Birmingport, on a branch of the Warrior river, 17 m. from the switching limits of the city, giving access by water to Mobile and other Gulf ports. In 1922 the Board of Education undertook a thorough examination of the school plant and mapped out building programmes to relieve the worst conditions immediately, make adequate provision by 1930, and, after that, provide for the anticipated normal growth of the population up to 1940. By 1924 six new buildings had been completed and four

more were under construction. A municipal market house was completed in 1923; a municipal auditorium, seating 6,000, in 1924. The cost of living in Birmingham is relatively high (110·9% of the average for 31 American cities, Dec. 1924). Birmingham-Southern College, created in 1918 by the consolidation of Birmingham College, founded in 1898, and Southern University, founded at Greensboro, Ala., 1859, had a total enrolment for 1925–6 of 2,086, of whom 876 were in the college proper.

BIRMINGHAM, ENGLAND (*see* 3.983), has increased largely in size since 1910. The primary cause of its growth in area was the extension of the municipal boundaries by an Act of Parliament, though manufacturing developments and industrial enterprise before the World War, as well as the influx of munition workers in 1914–8, contributed materially to the increase in population, which had reached 919,444 in 1921, making Birmingham the third largest city in Great Britain. Twelve members have been returned to Parliament since 1918.

The Greater Birmingham scheme became an accomplished fact in 1911, when Aston Manor, Erdington and Handsworth, almost the whole of Norton and Northfield, and the rural district of Yardley were added to the city. King's Norton and Northfield, as parts of Birmingham, ceased to be portions of Worcestershire from the geographical as well as the administrative aspect, and came nominally within the boundary of Warwickshire, as did Handsworth from Staffordshire. The area of the city was increased to 43,537 ac., or about 68 sq. m., and the membership of the city council to 30 aldermen and 90 councillors.

Housing.—In 1918 a policy for dealing with the housing question was formulated, and by 1921 the corporation was in possession of about 1,930 ac. of land for housing purposes. In 1925, 8,279 houses had been built, and provision made for a total number of 21,873. Birmingham was the first large town in England to prepare a comprehensive scheme of town planning. No definite steps to carry it out were possible until the extension of the city in 1911, when 24,000 ac. of undeveloped land in the suburbs were brought under the control of the council. The first scheme authorised referred to Harborne and Quinton, to the west of the city; no factories were provided for in this area, but considerable space was reserved for them in the East Birmingham scheme, where the greater part of the property is already industrial. These schemes were approved in 1913, those for North Yardley and South Birmingham in 1916, and that for Southwest Birmingham after the War. Much work has been done on the widening of roads, and the construction of new arterial routes. A scheme was under consideration in 1926 for improving the canal system between Birmingham and the Mersey, to make it navigable for barges of 100 tons, instead of for those of 30 tons, as at present.

A large number of parks and open spaces have been acquired by gift or purchase. Among the largest are Perry Reservoir, of 95 ac. (1919); Selly Park, of 20 ac. (1910–4); Barr Beacon, of 148 ac. (1919); Pype Hayes Park, Erdington, of 76 ac. (1920); Swanshurst Park, Sparkhill, of 44 ac. (1917–23); King's Norton site, of 25 ac. (1920); Rose Hill, Rednal, of 129 ac. (1920); Staple Hall Farm, Northfield, of 90 ac. (part of which is to be used for housing). An Elizabethan house called the "Golden Lion," was moved from Deritend and re-erected in Cannon Hill Park in 1911. The total area of parks, recreation grounds and open spaces was 2,645 ac. in 1925. The village and estate of Bournville are now managed by a body of trustees.

Improvements.—Considerable improvements were in progress in the central part of the city in 1926, especially in New street and Bull street. An area was being cleared in the neighbourhood of the "Hall of Memory," the Birmingham War Memorial, a circular temple off Broad street, which it is hoped to make the civic centre of the city; a War Memorial Masonic temple is to be built here, and it is hoped in the future to erect further municipal buildings, in addition to those finished on the Colmore estate in 1912, to house the different departments which are still scattered about Birmingham. Picture galleries and a museum of casts were built over the new municipal buildings and connected with the old art gallery by a bridge over Edmund street. The natural history museum was established at the same time. In 1925 it was also decided to reconstruct the interior of the town hall to provide further accommodation.

Ambitious schemes for road widening and improvements of traffic conditions are in hand, notably one for the construction of a north-south road, 80 ft. wide, which will be carried over New street station on a viaduct. New churches include St. Benedict's, Bordesley (1910); St. Basil's, Deritend (1911); St. Germain's, Edgbaston (1917); and a Roman Catholic church in Sparkhill. Birmingham became the seat of a Roman Catholic archbishop in 1911. In 1914–6 a new parcel post-office was built on the site of the old inland revenue office in Paradise street, and the inland revenue transferred to Empire House, Great Charles street. The Repertory Theatre in Station street was built in 1913. "Highbury," Moor Green, formerly the residence of Mr. Joseph Chamberlain, and the adjoining house, the home of Mr. Richard Cadbury, used as orthopaedic hospitals during the War, afterwards reverted to the corporation as gifts. The old children's hospital in Broad street, used for government purposes during the War, was moved to larger premises in Ladywood Road. The Princess Mary Centre for Disabled Soldiers is at Rednal, and a hospital for nervous diseases has been opened at Edgbaston.

After the War the chamber of commerce entered into possession of the Colonnade hotel in New street. The enormous structure erected by the Government on the corporation playing fields at Castle Bromwich, for use in connection with the aerodrome established there during the War, provided in 1921 accommodation for the Birmingham section of the British Industries Fair. Other large buildings erected during the War facilitated the development of local industries. Fort Dunlop is a new suburb, occupied by the makers of rubber goods. The output of shells, fuses, etc., during the War was very large; although the output of shells produced in Birmingham was not a record, the number and variety of articles manufactured for the use of the army, navy and air force was greater than in any other part of the country. The city is now second only to Coventry in the manufacture of motor-cars. (O. J. R. H.)

BIRMINGHAM, UNIVERSITY OF (*see* 3.986).—The wise modern policy of insisting that universities, such as this, should aim at the highest standard in every department has been followed with conspicuous success. The problems of industry are admittedly dependent upon the application of scientific principles and the institution in 1922 of a Dept. of Petroleum Engineering is significant of the importance of this subject. Contact with the active life of commerce and industry is maintained very closely. The Coal Owners' Mining Research Laboratory is now associated with the university. The Asylums Committee of the city is associated with the university on the Joint Board for Research in Mental Diseases. A chair in town planning gives evidence of the interest in important social problems, while the establishment of a Dept. of Legal Studies brings the university into close relationship with the needs of this important profession. Honour schools, including that in geography, have been instituted; new, ampler and more adequate accommodation is being provided; extramural activities are being developed and the interests of the working classes are carefully provided for.

In response to an appeal issued in 1920, over £250,000 was raised, of which approximately half was ear-marked for special purposes. The Treasury grant has been increased and local support augmented. In addition there have been a number of benefactions for various purposes—scholarships, research funds, memorials, for the endowment of chairs, such as that in Italian, in law, in finance, and for special purposes, such as the development of the Dept. of Oil Engineering and the erection of new buildings for the Biological departments. A donation of £100,000 was made by Sir Charles Hyde without restriction.

The number of students at the university is stabilised at about 1,400 to 1,500 for full-time degrees. Economic conditions affect the entry considerably, and with an improvement of trade in the Midland area the entries should increase. It is notable that women out-number men considerably in the faculty of arts.

A much higher proportion of the students have come through ultimately from public elementary schools, particularly those who are in the pure science departments. Sir Oliver Lodge, the distinguished scientist, was principal of the university till 1919, being succeeded by C. Grant Robertson, C.V.O., who came from Oxford.

BIRRELL, AUGUSTINE (1850–), British writer and politician (*see* 3.989), continued to be Chief Secretary for Ireland till the Dublin rebellion of Easter 1916, a period of over nine years. The cattle-driving agitation died down, and Irish politics, save for labour troubles, were comparatively quiet, till the two general elections of 1910 had once again made retention of office by the Liberal leaders dependent on the Irish vote. A third Home Rule bill was now inevitable, and Mr. Birrell spent much of the autumn of 1911 in preparing it. The main conduct of the measure was, however, taken out of his hands in the sessions of 1912, 1913 and 1914, by Mr. Asquith, the Prime Minister.

When resistance was organised in Ulster, when volunteers were enlisted and drilled in the province, and a provincial government constituted, Mr. Birrell adopted the *laissez-faire* attitude which had throughout been the mark of his Irish administration; and he applied the same treatment to the Irish volunteers who were raised in the Sinn Fein and Nationalist interest. With the outbreak of the World War the Home Rule controversy was left in abeyance; and the danger with which Mr. Birrell had to cope came from extremists of the Sinn Fein, Irish-American and Irish Labour parties of whom Casement and Larkin were the apparent leaders. They promoted a strong and largely successful propaganda against enlistment in Ireland, which culminated suddenly in open rebellion at Easter 1916. Immediately after the suppression of the rising, Mr. Birrell resigned; and he left Parliament and political life in 1918. Resuming his literary work, he published in 1920 a life of his father-in-law, the poet Frederick Locker-Lampson; in 1922, *Collected Essays* in 3 vol.; and in 1924 *More Obiter Dicta*. His originality, satire and ripeness put him at the head of English men of letters on the critical side.

BIRTH CONTROL.—Birth control is the popular name for control of conception, the deliberate restriction of births by chemical and mechanical means, instead of by abstention from intercourse. The term was first used by Mrs. Margaret Sanger in *The Woman Rebel* (April 1914).

The use on a large scale of contraceptives is a modern phenomenon. The prosecution in 1877 of Charles Bradlaugh and Annie Besant, for selling, in order to establish freedom of publication, a pamphlet by Dr. Charles Knowlton entitled *The Fruits of Philosophy*, gave enormous publicity to birth control methods, and a Malthusian League, with Dr. Drysdale as president, was immediately established to continue the propaganda in favour of small families. The League started a periodical, and Dr. Drysdale and his wife, Dr. Alice Vickery, devoted their lives to writing and lecturing on the need of spreading the knowledge of contraception, especially among the poorest classes.

They maintained that the two fundamental needs of food and love could be satisfied only through contraception, and that poverty, sex starvation, and promiscuity could only be avoided by early marriage and small families. In 1881, by their assistance, a Dutch Neo-Malthusian League was established followed by similar leagues in Belgium, France, and Germany. In 1921 the League opened a clinic in South London, where a doctor instructs poor mothers in the Mensinga method. In 1922 it held in London the Fifth International Neo-Malthusian Conference. In 1925 it distributed over 500,000 leaflets proposing that the Ministry of Health should allow the welfare centres to give contraceptive instruction if they wished to do so.

Decline in the Birth-Rate.—The results of these and similar efforts, of course in addition to other causes, quickly showed themselves in a declining birth-rate. Before the 18th century there was nearly a population equilibrium. Between 1750 and 1800 the population of England and Wales rose from 6,500,000 to 9,000,000. In the 19th century, influenced by great national prosperity and the development of preventive medicine, the population rose from 9,000,000 to over 32,500,000. This amazing advance reached its height in 1876. Thereafter a decline in the birth-rate set in which still continues. That decline is exhibited in the census returns particularly in the report on the "Fertility of Marriage," vol. 13, 1911. One example may be given: Table 44, which relates only to wives over 45 years of age at the census date, shows that, when necessary allowances are made, children born to 100 couples fell from 738 for marriages entered into between 1851–61, to 632 for those of 1881–6, the latest date to which this particular investigation was made. This shows a decline of over 14%. Later returns show a much greater decline. In 1881, in round figures, 883,600 children were born to 26,000,000 persons, but in 1924 only 729,900 children were born to 38,746,000 persons. Table 42 in the 1911 report also shows the changes in the fertility of each social class from 1851–61 to 1906–11. The effect of the differential decline there recorded is shown as follows:—

England and Wales, 1911	*Social Class*	*Legitimate Birth-rates in Social Classes per 1,000 married males*
I.	Upper and Middle	119
II.	Intermediate Class (exc. scholars)	132
III.	Skilled Workmen	153
IV.	Intermediate Class	158
V.	Unskilled Workmen	213
VI.	Total Population	162

This effect may be illustrated in another way from the upper classes. "Taking Burke's Peerage," says Professor Whetham, "and considering only those families which have held an hereditary title for at least three generations, we exclude the more modern middle-class commercial element in the present peerage, and get more homogeneous material. Marriages which took place during the 10 years ending in 1840 gave an average of 7·1 births to each fertile couple. For the next 10 years the average sank to 6·1, at which figure it remained constant till after 1860. From 1871 to 1880 the average was 4·36, while from 1881 to 1890 the corresponding number was 3·13."

These data, said the report of the National Birth-rate Commission, amount to a complete statistical demonstration that fertility is closely correlated with social status, the more prosperous the social class the lower is the fertility. This initial difference is not removed by subsequent differential mortality upon the offspring in favour of the more wealthy classes.

Every rise in the condition of the artisan tends at present to lower the birth-rate in his class. Whenever political and social conditions bring a man into a position in which he hopes to rise or fears to fall, the family will be restricted. That kind of motive which we may blame as love of comfort, snobbishness, timorousness, or praise as proper pride, desire for self-improvement, and prudence, is the most potent cause of family restriction.

America and Australia, like Europe, have the same problem to face, and there is evidence that the same phenomenon can be observed in India. No doubt, special causes play a part in each case. In France the provisions of the Code Napoléon, which insist on the division of property, make in the same direction. Social difficulties connected with religion operate in India.

Thus a differential birth-rate has arisen as a consequence of the practice of restriction by the higher social classes. For a population to maintain its numbers unaltered it is necessary, Professor Whetham estimated, that families should consist of "not less than four children." A nation which produces three children to the fertile marriage has, therefore, a birth-rate of three-quarters of that necessary on this basis to maintain its position. Whetham says:—

> If the death-rate be taken at 15 in 1,000 per annum, the birth-rate will be $\frac{3}{4}$x15, or about 11; that is, about four less than the 15 needed to replace the dead. At the end of a year the 1,000 will have become 996, while at the end of a century, 687, and in two centuries 472 of their descendants will alone be left. The birth-rate of other sections of the people is still about 33, or 13 more than their higher death-rate of about 20. In a year each 1,000 will become 1,013; in a century, 3,600; and in two centuries, about 13,000. Thus the less prolific stock, if originally equal in number to the other, would be but one in six at the end of 100 years, and in 200 years it would be but 1 in 30 of the population. It would be lost in the descendants of the stocks of predominant fertility.

A Public Enquiry.—In 1916 the National Council of Public Morals established the National Birth Rate Commission (some of whose findings have already been quoted), with the recognition of the British Govt. which allowed Dr. T. C. Stevenson, the superintendent of statistics, and Sir Arthur Newsholme, its principal medical officer, to serve as members.

The Commission, which consisted of 43 members representing medicine, science, economics, statistical, educative and religious interests, issued its first report in 1916, entitled *The Declining Birth Rate: its Causes and Effects.* A second appeared in 1920, on *Problems of Population and Parenthood;* a third in 1921, on *The Prevention of Venereal Disease;* and a fourth in 1923, entitled *Youth and the Race.* The commission heard over 70 expert witnesses on all aspects of these problems and published for the first time the views of the Roman Church, the Church of England, and the Free Churches on the ethical aspects of birth control. The Commission's enquiry was made in four directions: (1) the extent and character of the decline; (2) the alleged causes; (3) the effects; (4) the economic and national aspects. These reports were presented to the various departments concerned, the Ministry of Health and the Board of Education; and extensively circulated and reviewed throughout the British Empire and America. Dr. Sydney Webb described the report thus:

The Commission has produced the most candid, the most outspoken, and the most impartial statement that this country has yet had as to the extent, the nature, and the ethical character of the voluntary regulation of the married state which now prevails over the greater part of the civilised world.

In dealing with the wider problem of birth control, the Commission said that when we look beyond our own shores the possibility of an increase along with improvement of the population becomes manifest. There are vast territories in Canada and Australia which are very sparsely peopled, and are not yielding in food for human sustenance and raw material for human industry what they might. The rise of prices throughout the world can be met only by a much fuller development of the incalculable natural resources of such lands, a development which is waiting an increase of population. Can we resist the pressure of Asiatic immigration without provoking antagonism, if not worse, while we are not making full use of the lands which we are resolved to keep "white"? If we value our national type should we not desire its diffusion, for the sake even of the backward types, that they may be advanced by our influence to a better standard of life and thought? Britain must, in view of these considerations, regard with gravest concern her falling birth rate, and take such practical steps as may be within her power to arrest the decline, and, if possible, restore the rate to a higher figure. That an increase in quantity is desired is clear, but it must be an increase in quality as well. The crux of the problem is to increase the supply from good stocks, precisely the stocks which possess the important qualities of foresight and control. It cannot be supposed that the Dominions will accept emigrants from feeble stocks, which there, as here, become a burden on the industrious. Their statesmen are anxious to avoid that catastrophic condition in which—

> By filching all the substance of the fit
> We make the rotten multiply on it.

The Commission concluded that there is no evidence that the world's population is outrunning the natural resources: but on the contrary the presumption is that for their fuller utilisation a larger population is necessary, and thereby could be maintained with a higher standard of living.

Propaganda.—Birth-control propaganda received another impetus from the enormous sale of the writings of Dr. Marie Stopes and from her libel action against Dr. Halliday Sutherland. A Society for Constructive Birth Control, with the mother's clinic for birth control, was established by Dr. Stopes and her husband. In 1923, Dr. Stopes published an exhaustive treatise on birth control entitled *Contraception, its Theory, History and Practice: A Manual for the Medical and Legal Professions and All Social Workers,* which has been largely used by doctors and medical students.

In 1924, The National Birth Rate Commission established a special committee, consisting of representatives of medicine, public health, education, sociology, and religion, under the presidency of the Bishop of Winchester to investigate further the ethical aspects of birth control. This report was published in May 1925, together with the evidence taken. Four of the conclusions of the committee may be quoted:—

(1) The use of contraceptives is a symptom of the artificial character of our civilisation whereby for large numbers of people a simple, healthy, normal married life is difficult, and in some cases all but impossible. (2) There are numerous cases in which control of conception, considered in itself and apart from the question of the methods employed, is medically necessary and economically advisable, but in every such case all the circumstances should be weighed in the light of the best available scientific and ethical counsel. (3) The ideal method of birth control is self-control. Such self-control must be agreed upon by husband and wife and be carried out in a spirit of service and sacrifice. Therefore, so far from giving any general approval to the use of contraceptives, the line of real advance lies in a deeper reverence, a return to greater simplicity of life and, not least, a drastic reformation of our social and economic conditions. (4) The weightiest argument for birth control is found in the economic circumstances (wages, grossly inadequate housing, and the like) of many persons. While in many instances birth control by contraceptives may be the lesser of two evils, the ultimate remedy lies in the amelioration of those conditions.

The report has been widely circulated and reviewed and is now being followed up by a strictly medical and economic enquiry promoted by the same body.

The American Birth Control League was organised in 1921 under the presidency of Mrs. Sanger. Due to her efforts similar leagues have since been organised in Japan, China, and India. The main activity of the American League is directed toward the removal of federal and state statutes prohibiting instruction in contraception under the direction of duly licensed physicians, and aims at the eventual establishment of clinics for scientific and hygienic instruction of parents. It has also established a Research Department for the scientific investigation of contraceptive methods.

Under the auspices of the American Birth Control League, Inc., the Sixth International Neo-Malthusian and Birth Control Conference was held in New York City, March 1925. Delegates from fifteen countries including China, Japan, and India as well as the leading nations of the Occident presented reports concerning the status of birth control propaganda and practice throughout the world. The whole question was treated in its ethical, psychological and medical aspects as well as in its relation to economic and international politics. *See* POPULATION.

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BIRTH RATE: *see* POPULATION.

BISON (*see* 4.11).—During the period 1910–26 there was a rapid and continuous increase in the number of bison on the North American continent. This is shown by the census taken by M. S. Garretson, secretary of the American Bison Society. As on Jan. 1 1924 this gave a total of 14,369 head for all North America. Of captive buffalo there were 4,167 in the United States and 8,877 in Canada. In addition there was a herd of 100 head running wild in the Yellowstone National Park, U.S.A., and another of over 1,000 near Great Slave Lake in Northern Canada, these latter being known as wood bison. The greatest herd of bison in the world in 1926 was the Canadian national herd at Wainwright, Alberta, numbering, in 1924, 7,489 head. About 1,200 head of young animals from Wainwright were turned loose south of the wood bison region and the two species are now mingling. Experiments have been made both in the United States and Canada in crossing the bison with domestic cattle, with the object of introducing into range cattle a hardy strain of bison blood. A cross-breed, known as "cattalo," was produced, but practical difficulties developed, resulting in the abandonment of further efforts.

BISSELL, GEORGE EDWIN (1839–1920), American sculptor (*see* 4.12), died Aug. 30 1920 at Mount Vernon, N.Y.

BISSOLATI-BERGAMASCHI, LEONIDA (1857–1920), Italian politician, was born at Cremona Feb. 20 1857. The son of Demetrio Bergamaschi, he was adopted by, and took the name of his stepfather, Prof. Bissolati, the philosopher. He was an active member of the Italian Socialist party from its foundation in 1892, and he exercised considerable influence as a journalist, editing the official organ of the party, *L'Avanti*. In 1897 he entered Parliament as member for Pescarolo, and was afterwards elected for the second division of Rome (1908) which he represented until his death. Although a confirmed Socialist, Bissolati became dissatisfied with certain aspects of the policy of the party, notably with its anti-patriotic attitude at the time of the Libyan War. In 1912 he seceded from the party and founded the Reformist Socialist group. At the outbreak of the World War Bissolati declared himself an interventionist, whereas the "official" Socialist party was frankly neutralist. In June 1916 he was minister without portfolio in the Boselli national Cabinet. He resigned in Dec. 1918, owing to disagreements with Sig. Orlando's Govt. over the Treaty of London. He opposed the annexation of the Alto Adige because of its German population, and of north Dalmatia with its Slav majority; but he advocated the annexation of Fiume as a purely Italian town. His attitude on the Alto Adige and Dalmatian questions lost him much of his former popularity, but his undoubted honesty and patriotism caused wide regret for his death, which occurred at Rome on May 6 1920.

BITTER, KARL THEODORE FRANCIS (1867–1915), American sculptor (*see* 4.13), died in New York April 10 1915. In 1911 he finished a model designed for the Henry Hudson monument. He was director of sculpture at the San Francisco Exposition (1912–5), and at the time of his death was president of the National Sculpture Society.

BJERKNES, VILHELM (1862–), Norwegian physicist, a son of Carl Anton Bjerknes, professor of mathematics in the University of Christiania (Oslo), was educated at the university of that city. At an early age he gave an experimental confirmation of his father's prediction, on theoretical grounds, of the remarkable apparent actions at a distance between pulsating and oscillating bodies in a fluid, and their analogy with electric and magnetic actions at a distance. From 1890–1 he studied electric waves at Hertz's Laboratory at Bonn in Germany, and in 1895, after carrying out much valuable work at Oslo (Christiania) and at Stockholm, where he was appointed lecturer in the university in 1893 and professor of mechanics and mathematical physics in 1895, he gave a complete theory of the phenomenon of electric resonance which has contributed much to the development of wireless telegraphy.

Bjerknes subsequently returned to hydrodynamics and particularly the problems of meteorology, in which he was supported by the Carnegie Institute of Washington. Two introductory volumes of a larger work, *Dynamic Meteorology and Hydrography*, were published in 1910–1, under the auspices of this Institution. In 1917 he went to Bergen, where, as professor of physics, in the new Geophysic Institute there, he was the originator of an improved and more scientific weather service, afterwards controlled by his son and collaborator, Jakob Bjerknes (b. 1897), which occasioned a new view of cyclones and anticyclones. His papers on electric oscillations were published in *Annalen der Physik* (1891–5). In his *Vorlesungen über Hydrodynamische Fernkräfte nach C. A. Bjerknes' Theorie* (1900–2) he gave the first complete exposition of his father's discoveries, and in a later book *Die Kraftfelder* (1909), he stated the same theory in a generalised form according to methods of his own.

BLACHE, VIDAL DE LA (1845–1918), French geographer, was born at Pézénas, Hérault, Jan. 22 1845. He was educated at the École Normale Supérieure in Paris, and entered upon the study of geography by way of that of history. The relations between geographical causes and historical effects were with him the subject of a life-study, the results of which are seen in one of his best-known works, the *Tableau Général de la Géographie de France* prefixed to Lavisse's *Histoire de France* (1903) and later republished separately; but he always refrained from pressing the theory of geographical "control" to an extreme. He joined the French school at Athens in 1867, and was thus enabled to travel extensively in Mediterranean lands. From 1872 to 1877 he was in charge, latterly as professor, of the department of history and geography at Nancy; from 1877 to 1898 he taught geography in the higher grades at the École Normale Supérieure, and from 1898 to 1909 he held the chair of geography in the Faculté des Lettres at Paris. He lectured widely and among his publications is the monumental *Atlas Général: Histoire et Géographie*, first published in 1894; he founded in 1891, and edited until his death, the periodical *Annales de Géographie*, and contributed constantly to its pages. He died at Tamaris-sur-Mer (Var) on April 5 1918.

BLACKBURN (*see* 4.20) had a population of 126,630 in 1921. It was estimated at 129,000 in 1923 and the area of the borough is 7,420 acres. It is proposed to make it a diocese, taken from that of Manchester, as soon as the necessary funds are raised. An electrical generating station was opened in 1921; and in 1924, 27 of the large textile mills had adopted electric power and others were on a waiting list. The Town Hall has been extended and all municipal departments were transferred there in 1915. The county court was enlarged in 1912. An annex to the Blackburn and East Lancashire Royal Infirmary was finished in 1915, and a large war memorial block was in course of construction in 1924. Three public halls were opened in 1921. St. Jude's church was built and its parish formed from that of St. Thomas in 1914; St. Silas, Preston New Road, was finished in the same year, and the Church of the Saviour, Longshaw road, was given a separate parish in 1922.

BLACKPOOL, England (*see* 4.24), has increased largely in population, the figure in 1911 being 60,746 and that in 1921 99,640. It was made a parliamentary borough in 1918, and in the same year the urban district of Bispham with Norbreck and part of the civil parish of Carleton were incorporated. The Princess Parade, extending from the North Pier to Cocker street, was opened in 1912. A considerable amount of building has been done, particularly on the north shore, rising toward Fleetwood. In 1911 a central free library and reading rooms were erected in Queen street, and in 1912 a large opera house in connection with the winter gardens was built. In 1922, 274 ac. of undeveloped land behind the town were bought for a park, and an ambitious scheme of development, including a "social centre," a restaurant, a lake, a county cricket ground, a golf course, etc., was prepared. The Indian Pavilion on the North Pier, burnt down in 1921, was rebuilt in 1923 to seat 1,750 people.

BLACK SEA (*see* 4.25).—The political changes which have taken place on the shores of the Black Sea since 1911 have not been great, and result chiefly from the enlargement of Rumania. After the Balkan Wars in 1912–3 that state obtained territory in the Dobruja region at the expense of Bulgaria. The reason assigned for this rectification of the frontier was that the old line, which ran from Silistra on the Danube to the coast, exposed the railway from Bucharest to the port of Constantsa to attack. The value of the territory thus transferred is small, but the change which was confirmed after the World War meant the loss to Bulgaria of the two small ports of Balčik and Cavarna and brings the present frontier very close to the important Bulgarian port of Varna.

The War itself gave to Rumania the province of Bessarabia, that is, extended its Black Sea frontier from the Chilia mouth of the Danube to the right bank of the Dniester. The only port on this strip is Cetatea-Albă (Akkerman), of little value save for local traffic. Soviet Russia, it may be noted, does not recognise the transference of Bessarabia.

The other political changes are nominal rather than real. A part of the northwest coast, with the port of Odessa, is now included in the Ukraine; most of the rest of the northern shore belongs to the Russian Socialist Federal Soviet Republic, while the remainder of what was formerly the Russian coast belongs to Georgia, all of which states are included in Soviet Russia. Ukraine includes the most productive of the grain lands of European Russia, and Odessa was the most important Black Sea

port of imperial Russia. On the Georgian coast the two ports of Batum and Poti are the main outlets of the Caspian oil-fields.

In Rumania and Russia the export trade from Black Sea ports has shown changes alike in amount and in character. Before the War Rumania was, after Russia, the most important wheat-exporting country in Europe, wheat forming on the average more than two-fifths by value of her total exports. The War period led inevitably to the total collapse of this trade. *See* DARDANELLES.

BLAKE, EDWARD (1833–1912), Canadian politician (*see* 4.35), died at Toronto March 1 1912.

BLAKELOCK, RALPH ALBERT (1847–1919), American painter (*see* 4.38), died near Elizabethtown, N.Y., in the Adirondacks, Aug. 9 1919. Owing to insanity he was kept under restraint during the last 18 years of his life. In 1913 he was made an associate of the National Academy of Design and in 1915 a full member. In 1916 the Toledo Art Museum paid $20,000 for his "Brook by Moonlight."

BLAND-SUTTON, SIR JOHN (1855–), British surgeon, was born at Enfield Highway, Middlesex, in 1855. He studied medicine and surgery at Middlesex Hospital from 1878 onwards, and from 1881–6 made systematic examinations of animals dying in the gardens of the Zoological Society, London. This work formed the substance of a series of lectures delivered at the Royal College of Surgeons 1886–91. He subsequently carried out much valuable work on hysterectomy and the diseases of women. He was president of the Medical Society of London in 1914, of the Royal Society of Medicine 1921–2, of the Royal College of Surgeons in 1923, and was also consulting surgeon to Middlesex Hospital. He was the recipient of many British honours, being knighted in 1912 and made a baronet in 1925.

His published works include *Evolution and Disease* (1890); *Ligaments, their Nature and Morphology* (1887); *Surgical Diseases of the Ovaries, etc.* (1891); *Tumours, Innocent and Malignant* (1893); *Diseases of Women* (1897); *Surgery of Pregnancy and Labour, complicated with Tumours* (1901); *Gall Stones and Diseases of the Bile Ducts* (1907); *Man and Beast in Eastern Ethiopia* (1911); *Fibroids of the Uterus* (1913); *Selected Lectures and Essays* (1920); *Orations and Addresses* (1924).

BLASCO-IBANEZ: *see* IBANEZ, VICENTE BLASCO.

BLASHFIELD, EDWIN HOWLAND (1848–), American artist (*see* 4.43), executed, among other works, mural decorations for the chancel of St. Saviour's, Philadelphia; the state Capitol at Madison, Wis.; the courthouse at Youngstown, O.; and the state Capitol of South Dakota. For these two last works he received the gold medal of the Architectural League (1911). He has published *Mural Painting in America* (1913).

BLASTING: *see* MINING.

BLIND, TRAINING AND WELFARE OF THE.—In April 1925 the total number of blind persons known to the registering authorities in Great Britain was 48,472. On the same date (April 1925) the number of employed blind in Great Britain was 10,274. Nearly 2,000 were employed in basket-making and nearly 1,000 each as piano-tuners and in the knitting industry. Brush and mat-making employed together about 1,100.

The number of cases of blindness from disease and accident is on the decrease, and more care is taken by local authorities in the prevention and treatment of infantile ophthalmia and better precautions against accident are insisted upon in textile, metal and other factories. Additional power was given by the Public Health Act, 1925, to local authorities in England and Wales to make, with the consent of the Minister of Health, such arrangements as they may think desirable for assisting in the prevention of blindness, and in particular for the treatment of persons ordinarily resident within their areas suffering from any disease of, or injury to, the eyes.

Educating the Blind.—For many years the work of the elementary schools for the blind has progressed steadily. In 1907 the English schools were transferred to the jurisdiction of the Medical Branch of the Board of Education. This was carried out from motives of administrative convenience, and the transfer, although undesirable on purely educational grounds, may have contributed something to freedom and individuality. Excellent progress was made till 1921 when, for reasons of economy, teaching staffs were reduced and the number of children in a class increased with a resultant decrease of efficiency. In 1908 the College and in 1912 the Association of Teachers of the Blind were founded, and after doing much good work independently were amalgamated in 1924. By their efforts the general level of teaching and the qualifications of teachers in schools for the blind were raised and a corporate spirit was introduced into this branch of the teaching profession.

Suggested Reforms.—In 1910 the industrial affairs of the blind world were in an interesting condition. An organisation of blind workers, mainly workshop employees, called the National League of the Blind, had begun to direct public opinion to the need for a more systematic solution of the problem than could be secured by the piecemeal action and insufficient resources of the voluntary institutions. The institutions had been in the main opposed to the idea of government assistance for the adult blind. The alternative plan, proposed by the workshop authorities, was to secure government contracts, and orders for brushes and baskets were obtained from the Post Office and the War Office. Unfortunately the work could not be executed except at a loss, so that the institutions were no better off than before. Because of the failure of this line of approach the institutions swung round completely in favour of state assistance.

The number of blind men and women employed in British workshops was only 2,300. About 200 young persons were completing their technical training annually, and for these practically no provision was being made. At the same time the wages paid were inadequate and, owing to lack of funds in most of the institutions, very little could be added thereto. As far back as the days of the Royal Commission on the Blind of 1886 the blind workers had stood united in favour of a state subsidy of wages in one form or another, but their petitions had gone unheeded. Now the matter came again to the front and, along with the demand for municipal workshops, a measure before Parliament stipulated for an adequate wage. The institutions were thus driven to produce a measure of their own. This was the state of affairs in 1910 and in December of that year the first attempt was made to bring the two competing measures, the league's bill and the institution's bill, into line. An agreed bill was at last put forward with the united support of the blind world and secured its first reading in May 1914, but it got no further, probably because of the outbreak of war.

Administrative Action.—The forward step, however, came by another route. Mr. Wardle, Labour M.P. for Stockport, initiated, in March 1914, a useful debate on the conditions of the blind. The Govt. were friendly and on May 7 set up a departmental committee "to consider the present condition of the blind in the United Kingdom and the means available for (*a*) their industrial or professional training and (*b*) their assistance, and to make recommendations." The committee's report was published in August 1917 and contained, among much that was negligible, one suggestion of far-reaching consequences. This was that a central authority should be set up "in the Ministry of Health, whenever such a Ministry should be created, and in the meantime in the Local Government Board, for the general care and supervision of the blind." This central authority was to have at its disposal funds provided by the Exchequer. It was to be responsible to Parliament for its actions and to be guided as to policy by an advisory committee.

By the establishment in the following year of this department and of a similar department in the Scottish Board of Health, a new era was begun. Since that date the advance in all branches of work for adult blind has been unprecedented. New services have been instituted and old services developed out of recognition. In Aug. 1919 regulations were issued explaining the services in respect of which grants would be paid. The following table details these services with the grants paid in England and Wales during the years 1921–2 and 1924–5.

Act of 1920.—In 1920 the Blind Persons Act, which had been in suspense during the War period, was passed. Its provisions may be summarised as follows:—

	1921–2	1924–5
	£	£
Counties' Assns.	6,844	7,292
Workshops	31,476	39,365
Home Workers	6,117	15,013
Homes and Hostels	7,412	8,650
Home Teaching	12,978	19,035
Book Production	4,912	4,683
Capital Expenditure	..	577
Tools and Miscellaneous	147	355
	69,886	94,970

Section 1 provides for a grant of pensions to blind persons on attaining the age of 50 at the same rates and on the same conditions as old-age pensions.

Section 2 places a duty on local authorities to promote the welfare of blind persons ordinarily resident in their area, and for this purpose enables them to provide and maintain or contribute toward the provision and maintenance of workshops, hostels, homes and other places for the reception of blind persons, or to do any other thing approved by the Ministry or the Scottish Board of Health for promoting the welfare of the blind. Local authorities were required to prepare and submit to the Ministry or Board a scheme for the exercise of that duty.

Section 3 applies the provisions of the War Charities Act, 1916, with certain modifications, to all agencies making public appeals for subscriptions on behalf of the blind.

The Local Authorities have gradually increased their interest in, and contributions toward, this service since the Act came into force on Sept. 10 1920. The amount of their contribution was under £15,000 in 1921–2, and the estimated figure for 1925–6 was over £127,000. Most of this subsidy has gone to the voluntary institutions and agencies to supplement and expand their work. In 1925 nearly 13,000 blind men and women in England and Wales between the ages of 50 and 70 were in receipt of an old-age pension at a cost to the community of about £320,000. The figures for Great Britain and Northern Ireland were over 16,000 pensioners at a cost of about £413,000. In Great Britain, therefore, public money, in one form or another, is spent, either directly upon, or in the interests of, blind people to the extent of over £600,000 a year. This figure is more than equalled by the amount received by institutions and agencies by way of voluntary contributions from the charitable public. During the year which ended March 31 1924, these institutions, other than the endowed pension societies, received in this way no less than £662,000.

The War and the Blind.—The war years of 1914–8 brought about a great addition to the numbers of the sightless. In all probability more than 10,000 soldiers and sailors lost their sight on active service. To this appalling total the British Commonwealth contributed nearly 2,000 and Germany 3,000. In Britain these blinded men were cared for in special institutions, St. Dunstan's in London and Newington House in Edinburgh. There they were given fresh hope and inspiration, were taught an occupation such as mat-making, boot-repairing, massage or telephony, and, for the most part, established in their own homes. In Germany, a laudable effort was made to find occupation for those blinded in the War in particular sections of factory production. Messrs. Siemens led the way in this endeavour, and about 450 were so employed at the close of 1925. (J. M. Ri.)

The United States

Activity and progress have been marked in work for the blind in the United States since 1910. The following paragraphs summarise briefly the independent actions of the various states.

The Young Blind.—Seven residential schools have been rebuilt in suburban locations, most of them adopting the cottage plan. In 1913, certain low-vision children began attending day centres opened for them in common schools, and by 1925, 15 states had collectively 205 of these sight-saving classes. There is as yet no systematic provision for the blind who are feeble-minded. Deaf-blind pupils now mostly attend schools for the deaf. While little demand exists for specially prepared teachers of the blind, a movement for them has begun. In 1917 the country adopted Braille as its uniform type, and in 1919 the Govt. increased from $10,000 to $50,000 its yearly subsidy for embossed books for the schools.

The Adult Blind.—New legislation to reduce industrial accidents has lessened the cases of blindness due to this cause. Since the World War, practically every state conducts a rehabilitation bureau which will assist blind persons not served by other agencies. Ten states have set up permanent commissions for the blind, making 19 in all. These employ the usual instrumentalities, the latest means to employment being the placing of the fit in industry alongside the seeing. Suitable occupations are the assembling of parts in factories and typing. The Federal compensation in 1925 to those (477) blinded during the World War is from $150 to $200 a month. Moreover, money was abundantly spent in efforts to re-educate these young men and to place them back in industry. Congress in 1924 authorised the Veterans Bureau to expend not exceeding $100,000 in obtaining embossed books for them, which, with the general hand-copying of stories begun during the War, adds materially to the books available for finger readers.

The Blind, by Harry Best, Ph.D. (1919), is the most notable American monograph on this subject. There was launched in 1922 the American Foundation for the Blind, with offices in New York City. Its slogan, "nation-wide service to the blind," indicates its purpose. (E. E. A.*)

BLINDNESS: *see* OPHTHALMOLOGY.

BLISS, CORNELIUS NEWTON (1833–1911), American merchant and politician (*see* 4.72), died in New York Oct. 9 1911. Although prominent in the Republican party, and for a long period the treasurer of its national committee, he refused to accept public office. His lack of sympathy with Theodore Roosevelt's growing influence led him to retire from politics.

BLISS, TASKER HOWARD (1853–), American soldier, was born at Lewisburg, Pa., Dec. 31 1853. He graduated from West Point Military Academy in 1875, and from 1885 to 1888 was professor of military science at the Naval War College. In 1897 he went to Madrid and was military attaché at the American legation. He served through the Porto Rican campaign during the Spanish-American War and from 1898 to 1902 was in charge of Cuban customs and collector for the port of Havana. In 1903 he became commandant of the Army War College. From 1903 to 1905 he was a member of the Joint Army and Navy Board and also of the general staff. From 1905 to 1909 he held various commands in the Philippines. During the latter half of 1909 he was president of the Army War College, afterwards becoming assistant chief of the staff, to which post he returned in 1915 after four years' service in command of military departments. In 1917 he was made chief of the staff and promoted to the rank of general, but he retired later in the year, having reached the age limit. He was a member of the Allied Conference (1917), of the Supreme War Council (1918) and of the International Peace Conference (1918–9).

BLISTER: *see* BURNS AND SCALDS.

BLOCKADE.—Several years before the World War began, the British Admiralty had realised that there could be no thought of stationing a squadron off the German coasts and declaring a blockade of Germany. The development of minor attack by means of mines, light torpedo craft and submarines had given naval states a means of keeping enemy forces away from their coast-lines; apart from which the German battle-fleet was sufficiently powerful to destroy or drive off any line of cruisers which attempted a blockade.

The British Admiralty was bound to make its naval dispositions accordingly. On the outbreak of war two cruiser squadrons were given the duty of watching the enemy's trade and stopping it as far as they could. The first was stationed at the western mouth of the English Channel. The second, called Cruiser Force B or the Northern Patrol Force—was not given any definite station; but was intended to watch the northern exits from the North Sea, between the north of Scotland and Norway. Neither of these cruiser squadrons was a blockading force; their duties were to arrest all enemy ships and to stop cargoes of contraband.

The cruisers at the mouth of the Channel were soon withdrawn, and their duties transferred to a boarding flotilla in the

Straits of Dover. The history of Cruiser Force B was different. During the autumn and winter of 1914, the commander-in-chief treated it as part of the Grand Fleet cruiser squadrons; and attempted to use all his light forces to intercept and inspect trade. To do this, he divided the northern part of the North Sea into patrol areas which covered the line between Buchan Ness and the Norwegian coast, and allotted a squadron to each. The loss of " Hawke " to a German submarine showed that the watching line must be withdrawn to the north and west, and the steady increase in the escort and reconnaissance work of the Grand Fleet cruiser squadrons made it necessary to give one single squadron the specialised duty of watching and inspecting the trade routes to northern Europe. The squadron of old cruisers, which had hitherto made up Cruiser Force B, was paid off, and its place was taken by a force of armed merchant cruisers called the 10th Cruiser Squadron.

The line along which these ships patrolled varied continuously but it was found that the bulk of the east and westbound European traffic ran through the rough rectangle bounded by the Faeroes, the Faeroe Bank, the Hebrides and the Shetlands, and the lines of patrol were so arranged that they ran across it. Another line of watching cruisers was maintained between the Faeroes and Iceland and, during the summer months, a small patrol was kept in the strait between Iceland and Greenland. These may be called the stabilised dispositions of the 10th Cruiser Squadron; they were subsequently altered in points of detail only. About the same time it was announced that, owing to the enemy's reckless mine-laying policy, the North Sea was henceforward to be looked upon as a military area, and that any neutral ship which passed through it did so at her own risk, unless she called at Kirkwall and received the Admiralty's instructions. These two measures gave final shape to the naval arrangements for putting all neutral commerce to northern Europe under observation.

The Central Organisation.—The British Admiralty's dispositions when the War began made provision for intercepting enemy ships and contraband; but the Govt. had realised for long that the mechanism of modern sea-borne commerce is too intricate to be controlled by naval means alone. But although the point had been grasped, little provision had been made for setting up an adequate organisation, and the central staff, known later as the Ministry of Blockade, was built up during 1915.

The Ministry of Blockade, in its final shape, consisted of various departments and branches. The chief of these and the nucleus round which the whole organisation was formed, was the Contraband Dept. of the Foreign Office, created in Aug. 1914. The Contraband Committee was formed in Oct. 1914. In Jan. 1915 were created the War Trade Intelligence and the War Trade departments and the Licensing Committee. In the same year were established the Enemy Exports Committee (March), War Trade Statistical Dept. (April), War Trade Advisory Committee (September), and the General Black List Committee (October). In 1916 were added to the Ministry the Foreign Trade Dept. of the Foreign Office (January), Finance Dept. (January), and the Restriction of Enemy Supplies Dept. (August). Finally in Jan. 1917 the Insurance Intelligence Dept. and the Blockade Committee were set up.

Contraband.—As there was no thought, when war began, of blockading Germany, or of stopping all her import and export trade, and as the British Govt. could only order the seizure and arrest of enemy ships and contraband cargoes, it was a matter of great importance to state the rule of law on which they would act in the matter of contraband. The Declaration of London was not binding on the Govt., in that it had not been ratified; it was, none the less, in substance, a summary of the rules of maritime law established by custom, and had all the weight, though possibly not the binding force, of an international convention. It so happened, however, that the rules of the Declaration of London which referred to contraband gave great advantage to neutral traders who intended to traffic in it surreptitiously.

Contraband was divided into two classes. Absolute contraband, defined in a list of military stores, could be stopped if its ostensible destination were a neutral port, and its final destination an enemy country; conditional contraband, in which were included foodstuffs and fodder, could only be arrested if destined for the armed forces or an official department of an enemy state. Free commodities, which included several articles of great importance in munition factories, could not be stopped in any circumstances. The British Govt. was not bound by these rules, and indeed, could not be expected to observe them. It was, none the less, most important that the Govt. should observe rules of warfare which were justifiable by custom.

Orders in Council.—Various orders in council were issued during the War. (1) The order of Aug. 20 1914 laid down that the rule of continuous voyage should be applied to conditional as well as to absolute contraband. It also reaffirmed the Government's intention, previously expressed in the royal proclamation of Aug. 4, to place articles on the contraband list by its own authority, without obtaining the consent of neutrals. Jurists have quarrelled with this procedure; but it is too well established in practice to be seriously contested. The order also stated that the ultimate destination of contraband might be established by any *sufficient evidence.* In all previous wars most of the evidence against a cargo had been taken from the ships' papers and the letters in the captains' possession at the time of seizure. This order empowered the naval authorities to stop all cargoes of conditional contraband which were being sent to Germany through the Netherlands, Denmark, Sweden and Norway.

By the order of Oct. 29 1914, issued in reply to American pressure, the Govt. resigned some of the rights it had claimed under the previous one. " Notwithstanding the provisions of Art. 35 of the said Declaration," ran the order, " conditional contraband shall be liable to capture on board a vessel bound to a neutral port, if the goods are consigned ' to order ' or if the ship's papers do not show who is the consignee of the goods . . . . " This obviously gave neutral shippers of contraband exceptional facilities, as it is quite easy under modern conditions of commerce to disguise the ultimate destination of a cargo without consigning the goods " to order." The order, none the less, reserved to the British Govt. the right to treat neutral countries as bases of enemy supply, if statistics showed that they were so; but this clause was never applied.

The order of March 11 1915, commonly, though not officially, styled the reprisals order and issued in answer to the German declaration of submarine war against merchantmen, was the basis of the blockade of Germany. In it the British Govt. stated that its naval forces would thenceforth stop all ships and cargoes with a German origin or destination; contraband would be condemned; non-contraband would either be requisitioned or returned to the owner. The orders in council of Oct. 29 1915 and March 30 1916 amended the order of Oct. 29 1914. The order of July 7 1916 rescinded the Declaration of London, and stated that thenceforward the British Govt. would act in accordance with the customary law of nations. A statement of the rules of law which they intended to follow in the matter of contraband was added to the order. The order of Jan. 10 1917 amended the reprisals order of March 1915.

The order of Feb. 16 1917, issued in answer to the German declaration of unrestricted submarine warfare, was complementary to the reprisals order of March 1915. It declared that a vessel, met at sea, whilst on its way to a neutral port giving access to enemy territory, without previously calling at a British port for examination, would be deemed to be carrying goods of enemy destination or origin. Goods of this character would be liable to condemnation in prize, instead of being requisitioned or returned.

A Stronger Blockade.—It can be seen from the foregoing that the blockade of Germany began with the order in council of March 1915, which was a measure to prevent goods of any kind from entering or leaving Germany. The difficulty was that, at the time, the British Govt. did not possess the means of giving full effect to its intentions. Two cordons of cruisers, one watching the Heligoland Bight from the Danish frontier to the Ems, and another patrolling the Baltic between the Great Belt and the

Russian frontier, might have stopped all Germany's seaborne supplies. The 10th Cruiser Squadron, holding a patrol line between Scotland and Iceland, obviously could not do so. It could have blockaded all the states of northern Europe together; but had no power to isolate any one of them. The duty before the Govt. was, therefore, to make this order in council effective in two ways: (1) by distinguishing between goods intended for consumption in neutral countries and goods intended for re-export to the enemy, (2) by seeing that no British or Allied goods found their way to the enemy, or released similar goods, produced in neutral countries, for re-export to Germany. These two schedules of duties had best be treated separately.

The original policy of the British Govt. had been to persuade neutral governments, contiguous to Germany, to prohibit the export of all goods which were declared contraband in London; but this proved unworkable. Neutral governments could not always be persuaded; and when traders were prosecuted for disobeying such prohibitions as existed, the penalties imposed were not deterrent. A little experience showed that the British Govt. would have to deal direct with neutral traders and neutral shipping companies and leave their governments alone. The new policy took time and it was not until the end of 1915 that it was working properly. The leading commercial and industrial magnates in the Netherlands, Denmark and Switzerland were induced to form themselves into trusts, and were made the sole consignees of all goods that the British Govt. desired to stop from going into Germany. These trusts signed agreements with the British Govt., in which they gave guarantees that no goods consigned to them would be re-exported.

Arrangements with Neutral Shippers.—The first of these guilds to be formed was the Nederlandsche Overzee Maatschappij; in Denmark, the guild was called the Industrieraadet, and in Switzerland the Société de Surveillance Suisse. No general trust of the kind could be formed in Sweden, owing to the opposition of the Swedish Govt., but in Sweden, Norway and the United States the policy of dealing direct with trading associations was pursued successfully. During 1915 American cotton was stopped from going into Germany by separate agreements with the cotton industries in the United States and Sweden, and American meat supplies were dealt with by a far-reaching agreement with the American Meat Packers' Association. Norway differed from other Scandinavian countries in that, owing to her geographical position, she was not so likely to become an intermediate dumping station for German goods. In her case the problem consisted mainly in finding some means of stopping Norwegian fish oils and in seeing that Norwegian shipping, a great carrier of foreign goods, was not used for indirect German trade. This was done by negotiations and agreements with a special body called De Norske Fabriker (Denofa).

Although this could not have been done by naval means alone, neither could it have been done without predominance at sea. The 10th Cruiser Squadron, controlling all the sea approaches to northern Europe, was the source and origin of the British Government's power of bargaining. Neutral traders knew that Great Britain could stop all the sea-borne traffic to northern Europe if she wished, and they realised that if they were to carry on their ordinary business they must come to terms with her.

Development of the Policy.—By creating these great consignee trusts in neutral countries and by dealing direct with neutral traders, the British Govt. found a method of solving the problem of cutting off enemy supplies, and it only remained to perfect the existing machinery. At the beginning of 1916 statistics and information showed that the Germans were certainly beginning to feel the effects of the economic warfare, but that supplies were still going through from neutral countries and that considerable stocks had been laid in during the first months of the War, as well as during the period when Great Britain's general policy was in the process of formation. During 1916 the gaps and defects in the system were to a large extent made good by (1) the rationing system, (2) the issuing of Letters of Assurance or "navicerts," (3) blacklisting, (4) bunker control.

The rationing system was, as its name implies, the placing of an embargo upon all neutral goods in excess of a certain figure which was arrived at by examining the statistics of the country's trade. At first sight it seems incredible that neutrals should have allowed their imports to be regulated by a foreign Power. The new system eased friction between Great Britain and neutrals very considerably for the following reason. The trade agreements signed during 1915 had dealt with some, but not all, of the important imports of northern neutrals. They could not be made to cover all the articles of the country's import list, because there were certain commodities for which the trade guilds refused to be responsible. The consequence was that cargoes of these unguaranteed goods were often held up, to see if evidence could be collected against them; and the delays and uncertainties had caused a great deal of irritation. The rationing system lacked a legal basis, but it gave neutral traders the certainty and security which they sought.

Letters of Assurance was a name given to a system of control which applied only to shipments from the United States to Scandinavia. American traders submitted to the British embassy at Washington a complete list of the goods they wished to ship, and of their quantities and applied for permission to pass these through the patrols. Thanks to an elaborate organisation, formed solely for the purpose of making the necessary investigations as rapidly as possible, a permit or a refusal was generally telegraphed within 48 hours. If further investigation was necessary the applicant was informed. This system was a development of the general policy of easing friction by allowing the neutral merchant to know where he stood. It was extremely successful; over 40,000 applications were made between March 1916 and April 1917 and 30,000 were granted.

The blacklisting system grew out of the postal and telegraph censorship. The inspection of all mails and wires which passed through the country gave the blockade authorities an immense amount of information about the organisation of German import and export trade. It disclosed the firms in America and Scandinavia which were most concerned in it, the dummy consignees which were being used to disguise the dealings, and it also gave details of a great number of particular transactions. The blacklisting system was elaborated to ensure that all the firms known to have an interest in enemy trade should be absolutely denied the use of British shipping or British insurance. In addition, all neutral shipping lines were called upon to give undertakings that they would not carry the goods of blacklisted firms on pain of being refused British bunker coal. Both a general and a statutory blacklist were kept by the blacklisting committee.

Bunker control, already mentioned as a means of enforcing blacklist regulations, was a formidable economic weapon. The principle of the system was that neutral shipping lines were only allowed to take in British bunker coal if they visited a British port for examination, and if they gave guarantees that they would not handle goods which were prohibited. The control which this gave Britain over neutral shipping companies was very great. In 1917, the 10th Cruiser Squadron was actually withdrawn, and yet all the shipping to northern Europe continued to call voluntarily at British ports of examination.

Control of Domestic Resources.—Before the War began a subcommittee of the Committee of Imperial Defence had examined the question of trading with Germany in time of war; they had decided that there were many branches of trade between Germany and Britain which might be continued with advantage to Great Britain; but that a policy of non-intercourse was, on the whole, the best. As a result a draft Trading with the Enemy Act was ready for presentation to Parliament when War was declared. It forbade all commercial and financial intercourse with enemy countries, but not with men of enemy nationality domiciled abroad. It fell to the Trading with the Enemy Committee, a body constituted by the Treasury on Aug. 4 1914, to give effect to the proclamation. Its business consisted mainly in advising the Privy Council to grant or refuse licences for export trade, and in making recommendations with regard to export prohibitions. The control of the insurance market, the sequestration of

enemy property, the liquidations of enemy businesses and enemy banks were carried out by specially appointed committees.

The United States declared war against Germany in April 1917 and soon passed measures for stopping all German trade and for making it absolutely impossible for adjacent neutrals to re-export to the Central Powers. As the 10th Cruiser Squadron was withdrawn during the year the American Govt. was not asked to assist in the naval side of the blockade, but in all else—blacklisting, export embargoes, postal and telegraphic censorship—the American Govt. acted far more drastically and severely than the British.

Effects of the Blockade.—Information received from Germany shows that, although Germany was not completely deprived of foreign supplies until the autumn of 1917, the country was, none the less, reduced to terrible distress in the winter of 1916, and that it was only the conquest of Rumania and the occupation of the Ukraine which saved a breakdown. One of the most decisive factors was the complete loss of all artificial fertilisers at a very early period of the War. The soil of Germany cannot produce its normal harvest of grain, fodder and potatoes without these fertilisers. It was thus impossible to make good the increasing shortage of sea-borne supplies by intensive cultivation, or even to prevent the harvests from falling below their average yield. All this was accentuated by the demands of the military, the loss of productive man-power and the inevitable waste of foodstuffs sent and distributed to armies in the field. The loss of oils and fats was severely felt at a comparatively early date, and had effects which nobody could have foreseen. The damage to the population was great, but that was not all. The lack of lubricants lowered the transporting capacity of the railways.

The meat imported from adjacent neutrals during 1915 and 1916 was never enough to fill the deficit created by the British agreement with the American Meat Packers Assn.; the cattle killed at home in any year could not be replaced in the next, owing to lack of fodder for raising the young kine. The suffering and demoralisation caused by this progressive lack of most of the necessaries of life was most severely felt in the industrial districts of the west and centre.

Austria felt the blockade even more than Germany. When the Armistice was signed the population of Vienna was in little better plight than the population of Paris in 1871. In the autumn of 1919 Prof. E. H. Starling, after making a dispassionate and scientific study of the conditions of life in Germany, reported officially to the British Govt. that "the nation of Germany is broken both in body and spirit." (White Paper Cmd. 280.)

The blockade of Germany proved that modern states are interdependent to a degree which nobody had conceived before the War began. An industrial country cannot be isolated from the outer world and continue to produce machinery and food supplies at the same time; an agricultural country severed from its neighbours may possibly feed itself, but it will never keep its armies supplied with arms and material. Even after the coalition of the Central Powers covered half Europe with its conquests and occupations, its lack of sea-borne supplies created wants and deficits which, in their turn, created others, and in the end the entire population of Germany, Austria, Bulgaria and Turkey broke down under the strain created by these progressive discomforts and sufferings.

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(A. C. B.)

BLOEMFONTEIN (*see* 4.74), the capital of the Orange Free State and the seat of the Court of Appeal of the Union of South Africa has a population (1921) of 36,491. The white inhabitants increased from 14,720 in 1911 to 17,711 in 1921. Owing to its central position, its excellent climate, and its railway facilities, Bloemfontein became increasingly used for conferences—political, educational and agricultural—of delegates from all the provinces of the Union. It is noted for its annual agricultural show, and has the most important live-stock market in South Africa. Since 1916 Grey University College has been a constituent college of the University of South Africa. Law Courts, in the classical style, have been built; government buildings replace those burnt down in 1908, and a State Museum has been erected. The Raadzaal of republican days became the meeting place of the provincial council; Government House was turned into a Girls' High School. The foundation stone of an Archives Building was laid in Oct. 1925, the first building in South Africa designed solely for the preservation of historical documents. Bloemfontein returns two members to the Union Parliament.

BLOK, ALEXANDER (1880–1921), Russian poet, was born in Leningrad (then St. Petersburg) in 1880. His father was professor of mathematics at Warsaw. In 1903 he married the daughter of the Russian scientist, Mendeleev. His first book of poems, *Songs to the Belle Dame* (1904), show the influence of the mystic poet and philosopher, V. Soloviev. Later his romantic style was changed to one of bitter irony and sarcasm and his works show deep disillusionment conflicting with a national idealistic inspiration. "The Scythians" is representative of this latter phase. All these alternating motives, expressing the eternal contrast between the real and the ideal form the vast scope of Blok's greatest poetry. The Bolshevik revolution inspired him to write his famous poem "The Twelve"—English translations by C. E. Bechhofer (1920), and B. Deutch and A. Yarmolinsky, New York (1920). The poem is an apologia for the revolution. He is the finest lyric poet of modern Russia, and ranks with the great masters of the past. His outstanding qualities are the great depth of feeling manifested in his poetry, the rich melody of his verse, his extremely varied rhythm, and the blending of an exquisite lyrical style with the raciness of speech of the masses together with an extremely skilful use of the vulgarisms and slang of the street. He died in Leningrad Aug. 7 1921.

Blok's principal poems, besides those already mentioned, are "The Unexpected Joy" (1907), the lyric drama, *The Fair Booth*, "The Earth under Snow," "Hours of the Night," "The Hoary Morning" and the romantic drama, *The Rose and the Cross*.

BLOK, PETRUS JOHANNES (1855–), Dutch historian, was born Jan. 10 1855 at Helder, Holland. After holding a professorship in Gröningen University, he became, in 1894, professor of Dutch history in the University of Leyden, a position which he retained until 1925. From 1894 to 1897 he was history tutor to Queen Wilhelmina. In 1904 he founded the Netherlands Historical Institute in Rome. His most important work is *Geschiedenis van het Nederlandsche Volk* (*History of the Dutch People*) (1892). Among his other historical books are *Een Hollandsche Stad in de Middeleeuwen* (*A Dutch Town in the Middle Ages*) (1882); *Willem de Eerste Prins Van Oranje* (*Prince William the first*) (1919).

BLOODLESS SURGERY.—In a sense this method is an accidental and indirect outcome of Listerism. Its originator, Lorenz of Vienna, was an early follower of Lister and suffered so severely from carbolic acid intoxication that surgery by antiseptic methods of all kinds became impossible for him. Still impressed, however, with the cardinal aim of Lister's teaching, namely, the avoidance of introduction of bacteria into a wound from without, he concluded that he would make no wound at all unless absolutely necessary. The method is employed in orthopaedics and, strictly speaking, is not bloodless for the bruising that may result is evidence of ruptured blood-vessels; a better term would be woundless or subcutaneous surgery.

Stretching Procedure.—The contrast between surgery and bloodless surgery in correction of an orthopaedic deformity is as follows:—Orthosurgery, by cutting or excising, adapts the bones to the shortened soft parts; bloodless surgery lengthens the shortened soft parts by stretching until they correspond to the length of the bones. This lengthening is effected by repeated (many hundred) small stretching procedures (the modelling correction of the Germans) and not by a single forcible procedure

(the forcible correction of the French), which introduces undesirable damage, such as fracture or injury to nerves. Modelling and forcible correction differ further in that the former gradually annihilates the natural elasticity of the shortened soft parts so that they fail to retract when the modelling tension ceases, and can be fixed, passively, in any desired position by a suitable appliance. This gradual process is unaccompanied by the pain that characterises forcible correction.

Modelling Correction.—Modelling correction is not without danger, even if cautiously performed. The soft parts, when subjected to tension and extension, are of different tolerance. Muscles and ligaments are much less liable to damage. In case of absolute resistance to stretching, the tendons are severed with a thin, sharp needle (tenotome), although in this case the character of the bloodless operation is blurred to a certain extent. Fortunately the blood-vessels, being elastic, are less sensitive to stretching. In spite of this, the circulation can be greatly impaired if excessive stretching of the vessels cause their inner walls to come in contact, thus stopping the flow of blood. Therefore the circulation must be watched closely.

Nerve Stretching.—Of all soft parts the nerves are the most sensitive to stretching. " Pins and needles " is a familiar example of the fact. Should pressure on the nerve last a comparatively short time—say some hours—paralysis may ensue, the nerve remaining anatomically uninjured. Such a paralysis persists for many months.

Reactive Swelling.—Another danger of modelling correction is reactive swelling of the soft parts after the procedure. The plaster cast, maintaining the limb in the corrected position, must therefore be very accurately upholstered and even split appropriately, in order to provide room for the swelling, which is always to be expected, or gangrene may develop in the parts enclosed within the bandage.

Nature of Deformity.—The aim of modelling procedure is correction of deformity. The question arises: What is a deformity in the orthopaedic? The answer is likely to be: Deformity means any alteration of the normal form. But this would cover the conception in part only. A knee bent to a right angle may be a very severe deformity, or no deformity according as the joint is fixed or movable. It does not matter whether the bones forming the knee-joint be normal in shape or not. As soon as there is fixation, there is deformity. A straight knee-joint represents no deformity in the common sense, yet is a severe one, if the joint is fixed in the straight position. Club-foot, knock-knee, bow-legs are obvious deformities, in which alterations of the shape of the bones concur with immobility of the parts.

Deformity and Function.—The essential character of deformity is impairment of function, with or without obvious alteration in shape of the bones of which a joint is composed. Most of the deformities are represented by fixed joints. The angle, in which a joint is fixed, is of no importance. We differentiate the deformities of the joints, not by this angle, but by firmness of the given position. Thus, a joint is " contracted " if there is still some mobility between the bones of the joint, or " ankylosed " if no mobility is left, because the bones of the joint have become united by bony tissue as a sequel to the underlying disease.

It is evident that ankylosis is beyond the reach of bloodless surgery. If an ankylosed knee is not straight, it cannot be made so by the modelling correction, but solely by the chisel. Contracted joints, however, with even the slightest trace of mobility, represent the most important objects of bloodless treatment. But even here the field of bloodless surgery is limited by the nature of the underlying disease.

Contractures.—To make evident the necessity of such further limitation, contractures must be classified according to their origin. The most important causes of contractures are tuberculous disease of the joints, rickets and similar softenings of the bones and infantile paralysis. Congenital deformities, though less frequent, are, in many cases, the cause of contractures. In addition there are contractures caused by accident (fractures of bones, luxations of joints), by rheumatic joint diseases, by luetic, cerebral affections, etc.

Tuberculous Contractures.—On the whole the army of cripples can be divided in two groups, viz., diseased cripples and healthy cripples. Among the first are those whose contractures are due to tuberculosis. The treatment of tuberculous bone and joint diseases exclusively belongs to bloodless surgery. Resections of tuberculous joints in children in the course of time often result in deformities more severe than those occurring naturally. Open-air life, plentiful food and sunshine, combined with bloodless mechanical treatment, bring about results which contrast favourably with those due to the knife.

It is not yet possible to cure tuberculosis by direct specific medication. We must reach the aim by a roundabout way, viz., by improvement in the general health of the patient, and since a rather severe operation does not improve general health, osteoplastic operations in cases of tuberculous disease of the spine in children (Pott's Disease) are contra-indicated.

Spinal Disease.—This operation of German-American origin, consists in inserting a bony peg from the tibia between the split spinous processes of the vertebrae. By bony union of the transplanted bone-peg with the spinous processes disintegration of the vertebrae should be lessened, if not prevented. This operation might be necessary if cure could not be brought about without it. Fortunately this is not the case. On the contrary, it is proved by every day experience, that even the worst cases of their kind can be cured without any operation, while the resulting deformity (gibbosity) is no worse, and the duration of the treatment is no longer than in cases which had been operated upon. It is in tuberculosis of the spine that mechanical bloodless treatment can be proud of the result it has obtained. It is essential in the treatment of tuberculous diseases of the spine as well as of other tuberculous joints to secure immobilisation, for in this way the efforts of nature in producing bony union of the diseased parts are most effectively assisted.

The Plaster Bed.—The apparently difficult problem of immobilising the spinal column has been solved in a most satisfactory way by Lorenz's plaster bed, which is a well-upholstered plaster model of the trunk. Though pain has been severe, especially during the night, the patient in his plaster bed is exempt to such a degree that he bears perambulator exercise with equanimity. Thus he is neither confined to his bed nor to his room, he can enjoy open air, sunshine, undisturbed sleep, his appetite increases and he gets well without any operation. The developing gibbosity can be lessened, and sometimes even prevented, by adjustable cushions placed underneath the prominent parts. A similar plaster bed has been employed with benefit for spinal war injuries.

Other Joint Diseases.—In the same way immobilisation is essential in the treatment of all other tuberculous diseases of the joints (hip-disease, white swelling of the knee, etc.). Immobilisation by plaster casts is superior to extension, though this latter method is also useful as a means of fixation. By far the greater number of cases of tuberculous joint diseases, develop contractures, whatsoever method of treatment they may have gone through. Should the contracture not be evident at the time when the treatment has come to an end, it will develop later on, when the patient is left to himself.

The usual contraction of the knee-joint is flexion, of the hip-joint is flexion and abduction. It might be thought that if the treatment of tuberculous diseases of the joints is the exclusive field of mechanical bloodless treatment, it should be the same with the resulting final contractures. Although Lorenz advocates bloodless surgery in the treatment of the acute stage of tuberculous joint diseases, he warns strongly against treatment of the resulting contractures by modelling correction. The healed tuberculous joint is comparable to a bone scar and should not be torn asunder, lest the tuberculous process be stirred up anew. Such contractures call for the chisel, and correction is done not in, but near, the joint (pararticular osteotomy).

Rickets.—To the diseased cripples also belong patients suffering from rickets. During the acute stage of the disease, correction of deformities belongs to bloodless procedures. In reality, also patients with lateral deviation of the spine belong to the

class of diseased cripples, because their deformity is due to a pathological softening of the bones of the spine. The treatment of scoliosis is the task of bloodless surgery. Besides measures to improve the general health of such patients, gymnastics, massage, corsets, etc., are of great importance in treatment, in which also the plaster bed plays a great part.

Healthy Cripples.—Finally reference must be made to the class of healthy cripples. Leaving on one side deformities due to accident where recourse may be had to bloodless surgery, mention must be restricted to deformities consequent on infantile paralysis, the most terrible scourge of childhood. It can well be asserted that all contractures caused by paralysis can be straightened out by the bloodless method. When the normal shape of the limbs is restored, a very simple brace is sufficient to make walking possible. It must be admitted that conditions can be improved by successful transplantation of tendons. But this operation is not absolutely necessary. Many cases do without it—for instance, cases of paralytic flexure-contraction of the knee-joint. Instead of transplanting the active flexors of the knee-joint to the paralysed extensor (quadriceps), Lorenz substitutes the lost power of this latter muscle by the weight of the body. This is done by a slight overstretching of the contracted knee, by which the line of weight is thrown in front of the axis of the knee-joint.

Arthrodesis, or artificial stiffening of joints by an operation on the cartilage and on the bone, gives poor results, except in the shoulder joint. Lorenz also strongly objects to extirpating bones in paralytic deformities of the foot. At first the result may seem to be good enough, but very often in the course of years consecutive deformities develop, which are worse than the original ones. To the healthy cripples belong further such congenital deformities as congenital wry-neck, congenital club-foot, and—most important of all, because most frequent—congenital dislocation of the hip-joint.

Advantages of Modelling Correction.—In all these cases bloodless treatment obtains better results than operative procedures. Modelling correction, assisted by preliminary tenotomy in case of absolute necessity, can overcome the severest deformities of this kind. Extirpation of bones, resection of wedge-shaped pieces of bones is superfluous in ninety-nine cases out of a hundred. Instead of resecting bones, the modelling correction restores the normal position of the deformed bones to each other and maintains this position by mechanical means. The bandaged foot, being compelled to support the weight of the body, is subject to the formative power of physiological function. By acting in their normal function the deformed bones, in the course of time, assume the normal shape. In this way the function, viz., to bear the weight of the body is forced to serve the purpose of the orthopaedic treatment. Similar benefit may often be derived from the treatment in cases of flat-foot.

Luxation of the Hip-joint.—Congenital luxation of the hip-joint, the most frequent of all congenital deformities, can be entirely cured by bloodless surgery without open operation. This achievement is one of its greatest successes. Reposition of the displaced head of the femur into the acetabulum is brought about by manoeuvres which are entirely consistent with those of modelling correction. By repeated stretching of the soft parts the head of the femur is forced into the acetabulum. This is the first, and often a very difficult part of the procedure.

Far more difficult is the second part of the treatment, *i.e.*, retention of the head of the bone in the socket, the latter being too small and too shallow to retain it within its defective borders. To accomplish this, the thigh has to be fixed in certain extreme positions, by which the head is prevented from slipping out of the socket. Owing to forced pressure of the head into the socket, the latter develops according to the size and shape of the head of the femur, while without it the socket would get smaller and smaller. Contractures and shortening of certain soft parts caused by the extreme position of the thigh help to retain the head in its normal place. It takes about a year before the socket is developed so far as to guarantee retention of the head.

The third part of the treatment consists in gradual reduction of the extreme abducted position of the thigh into the normal one. The difficulty of simultaneous treatment of bilateral hip luxation can be imagined from what has been said about unilateral luxation. Children with unilateral luxation are allowed to move about during the greater part of the treatment's duration and bear fairly well the impediment caused by the fixing bandage.

Described thus shortly the plan of treatment seems to be simple enough, but its actual achievement is by no means so simple. Experience has proved, that within certain limits of age (up to 5 or 6 years) the cure of the children can be a perfect one, while in older cases at least great improvement can be obtained. This is so much the more remarkable, as surgeons of all times regarded the deformity in question as absolutely incurable. When all mechanical experiments had failed, some surgeons opened the hip-joint with a knife, in order to deepen the shallow acetabulum with sharp spoons and to replace the luxated head of the femur into it. The results were fairly good in young children, but in older ones frequently resulted in a stiff and contracted joint. But this was not the worst, for opening the hip-joint and artificially deepening the socket proved to be an operation much more dangerous than laparotomy. Some operators had up to 10% mortality.

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BLOOD TRANSFUSION, the term used in medical literature for the process of transferring the blood from the circulation of one living animal to that of another. The first authentic record of it was not made until the middle of the 17th century. A Florentine physician, Francesco Folli, claimed to have transfused blood from one animal to another on Aug. 13 1654. Subsequently many experiments bearing on the subject were made by Dr. (later Sir Christopher) Wren, Richard Lower, Edmund King, and Thomas Cox, their experiences being recorded in the *Philosophical Transactions* published by the Royal Society about 1666. Some of these experiments were witnessed by Samuel Pepys, who referred to them in his *Diary*. In spite of this activity in England the credit for first performing a blood transfusion upon a human being must be given to Jean Denys of Montpellier. An account of his experiment done upon a boy aged 15, was published in *The Philosophical Transactions* for July 22 1667.

On this occasion, and indeed throughout the 17th century, the blood for transfusion was taken from a lamb or a calf, and, although good therapeutic results were claimed at first, the operation soon fell into disrepute and was almost entirely abandoned. Little or nothing was heard of it during the 18th century and it was not until 1818 that attention was again focused upon its possibilities. This was due to the writings of James Blundell, lecturer at St. Thomas's and Guy's Hospitals, who invented a syringe for receiving the donor's blood and for pumping it into the recipient. His first experiments were performed upon dogs and in 1824 he described the transfusion of patients with human blood. From this time onwards many different observers recorded their experiences and several methods of performing the operation were described. The coagulation of the blood outside the body was always the prime difficulty. One way of overcoming this was to remove the fibrin which forms the basis of the clot, and from 1835 onwards this defibrinated blood was used by various operators.

Transfusion did not, however, come into general use as a therapeutic measure during the 19th century, and after the year 1875 was largely neglected. This was probably due to the increased number of disasters which had attended the operation as soon as it began to come into fashion. An improvement in technique was initiated in America through advances in the surgery of the blood vessels, and this culminated in the work of Crile, who about 1907 described in detail an efficient method of performing

direct transfusion by means of an anastomosis between an artery of the donor and a vein of the recipient. Coagulation of the blood was thereby prevented and it was possible, at any rate in theory, to transfer as much blood from one person to another as might be desired, though it was difficult to ascertain, even approximately, how much blood had passed.

Meanwhile discoveries were being made which tended to eliminate the chief factor responsible for the fatal results of some of the earlier transfusions. It had long been known that the bloods of different species of animals were incompatible, that is to say, the blood of a calf introduced into the circulation of a man was inevitably and rapidly destroyed, this process being attended by more or less serious symptoms, or even by death, according to the amount of blood introduced. In 1907 it was shown by Jansky in Scandinavia that an analogous incompatibility existed in all races of man between the bloods of different individuals, so that a given recipient might safely receive the blood of certain selected donors only. Hitherto no such selection had been practised. Jansky's work was repeated by Moss in America in 1910, and human beings have since that time been classified into four definite groups, the blood of only one of these being suitable for more or less indiscriminate injection into all recipients. This group (No. 4 of Moss's classification) includes over 40% of the individuals of western peoples and its members have been called "universal donors." Further research has shown that this term must not be interpreted too literally, but it may be regarded as a close approximation to the truth. The blood of any individual can readily be assigned to its correct group for clinical purposes, and the test is now never omitted before transfusion except in cases of great urgency.

A further advance was made in 1914 when Agôte of Buenos Aires first used sodium citrate as an anti-coagulant for the donor's blood. This substance, when mixed with the blood as it issues from the donor's vein, combines with, and renders inert, the calcium which is present in the blood in small quantity and is an essential factor in the coagulation reaction. The blood then remains fluid for an indefinite time, and the small amount of citrate which it contains is usually harmless to the recipient. Direct transfusion by Crile's method was technically difficult to perform, and it was soon abandoned in favour of citrated blood. This method was introduced opportunely for use in the treatment of the wounded during the World War, 1914–8, though it was largely employed only after the entry of the American surgeons into the hospitals in France, transfusion being more widely known in their country than elsewhere. Some surgeons, however, believed, and still believe, that citrate is responsible for the reactions, usually mild in degree, which follow a certain percentage of all transfusions, however carefully the bloods of donor and of recipient may have been tested. In spite of much controversy the supposed harmful effect of citrate has not yet been proved, and this method, which has many advantages, is more often used than any other. If whole, or untreated, blood be preferred, coagulation may be retarded by receiving the blood into a glass vessel coated on the inside with paraffin; it must then be transferred to the recipient as rapidly as possible. Several forms of apparatus have also been invented depending on the use of a syringe, which is alternately filled from the donor and at once emptied into the recipient. The use of such an instrument demands that donor and recipient should be lying side by side, and this may be a disadvantage.

In 1923 a return was made by Storer to the older method of using defibrinated blood to which no foreign substance has been added, and it is possible that this may prove to be the method of choice in the future. Storer's ground for eliminating the anti-coagulant was the belief that its presence impaired the anti-bacterial properties of the donor's leucocytes, but his contention still has to be substantiated in practice, and could only be of weight in treating patients with bacterial infections.

Blood transfusion has been found to have its greatest clinical value in the treatment of acute anaemia (*see* ANAEMIA) due to loss of blood following injury, or in conditions such as bleeding from a gastric ulcer or *post-partum* haemorrhage. The picture of depletion of the patient's circulating fluid is here presented in its simplest form, and replacement of the blood which has been lost is the obvious and most satisfactory remedy. Transfusion is also of value in combating the shock following severe surgical operations or injury, which may or may not have been accompanied by much loss of blood, and in the treatment of several diseased conditions in which, for one reason or another, the patient's blood is deficient in its power of coagulation. Thus, in the hereditary disease known as haemophilia, the patient may be rendered temporarily normal by transfusion of blood, and persistent bleeding will cease. Transfusion has been used in the treatment of a very large number of patients suffering from pernicious anaemia, some having received as many as thirty injections of blood over a period of several years; but, although a temporary remission of the disease may be obtained by this means and the patient's life be prolonged, the disease cannot thereby be cured. Transfusion has a distinct value in the treatment of many conditions in which the patient has become exhausted by prolonged illness, particularly those due to chronic bacterial infection, but here again improvement rather than cure is to be expected. The limitations of transfusion as a therapeutic measure, are, therefore, fairly well defined. It is still used more widely in America than in other countries, but it is coming to be employed more frequently everywhere.

Transfusion may also be considered from the point of view of the donor. Here the chief point of interest is the amount of blood which he can afford to lose without danger. It has been found that a healthy young man can part with any amount up to a litre of blood without experiencing anything more than a transient faintness. Usually he is not called upon to give more than 500 to 750 cu. cm. for one transfusion.

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(G. L. K.)

BLUE SKY LAWS.—This name is popularly applied in the United States to those statutes enacted in many states to protect purchasers of stocks and bonds from fraud. The first Blue Sky law was passed in Kansas in 1911, requiring investment companies among other things to file with the Secretary of State a full description of their business and forbidding them to sell securities until authorised by the bank commissioner. Within two years no fewer than 18 other states had enacted similar legislation, and in 1926 some form of Blue Sky law was to be found in 45 states. Requirements vary in the different states, but in every case information must be filed with a designated official or commission and licence obtained.

In 1914 there developed considerable opposition to Blue Sky legislation. Its constitutionality was attacked on the ground that it violated the commerce clause of the Federal Constitution; that it delegated legislative and judicial power to an executive official; that it deprived citizens of liberty and property without due process of law. In Michigan, Iowa and Ohio these contentions were upheld by the lower courts; but in 1917 the U.S. Supreme Court decided that such laws were constitutional on the ground that "prevention of deception is within the competency of government."

BLUM, LEON (1872–), French politician, was born April 9 1872 in Paris, a member of an Alsatian Jewish family. In 1890 he entered the "École Normale Supérieure," taking his degree in philosophy. He also studied law, and in 1895 entered the Conseil d'État. In 1919, however, he was elected to the Chamber. Whilst still engaged in law he became prominent as a brilliant literary and dramatic critic. His first book, *Nouvelles conversations de Goethe avec Eckermann*, was published anonymously in 1902. He took part in the Dreyfus campaign (*see* 10.882) with Jaurès whom he loved and admired.

From 1905–14 he was dramatic critic on *Comoedia* and *Le Matin*. He joined the Socialist party in 1899, but it was only during the World War and after, that he became an active member. In 1919 he was returned for the Seine to the Chamber of Deputies and strenuously opposed Poincaré's policy concerning the occupation of the Ruhr. He played a leading rôle in the International Socialist Congresses of Hamburg in 1923 and Marseilles in 1925. Although opposed to the participation of Socialists in the government, he favoured a policy of "Support" to such governments as Herriot's and the Painlevé second ministry in 1925.

BLUNT, WILFRID SCAWEN (1840–1922), British writer (*see* 4.93), died at Crabbett Park, Sussex, Sept. 10 1922. He published a complete edition of his poetical works in 1914 and two volumes of *My Diaries* (1919 and 1920). His wife, LADY ANNE BLUNT, became Baroness Wentworth on the death of her niece, daughter of the 2nd Earl of Lovelace, in 1917. She died Dec. 25 1917, and the barony of Wentworth descended to her daughter, the wife of the Hon. Neville Lytton.

BOEHM VON BAWERK, EUGEN (1851–1914), Austrian economist (*see* 4.112), died Aug. 28 1914.

BOHEMIA: *see* CZECHOSLOVAKIA.

BOHR, NIELS HENRIK DAVID (1885–), Danish physicist, was born at Copenhagen, and graduated as a doctor in 1911. From 1911–2 he studied at Cambridge and Manchester under J. J. Thomson and Ernest Rutherford. In 1913 he became a lecturer at the University of Copenhagen, and from 1914–6 was reader in mathematical physics at the University of Manchester. In 1916 he was appointed professor of practical physics at the University of Copenhagen, and in 1921 head of the institute for theoretical physics, Copenhagen. In 1922 Bohr was awarded the Nobel Prize for Physics, and in 1923 received the honorary degree of doctor of science from the universities of Cambridge and Liverpool.

The most important of Bohr's researches are those concerned with the application of the Quantum Theory to the problems of the structure of atoms and molecules, the interpretation of their spectra and the interchange of energy between matter and radiation. His pioneer work in this field, on the mechanics and the spectrum of the hydrogen atom, was set forth in two papers in *The Philosophical Magazine* for 1913–4. Later developments include the extension of the theory to the structure and the optical and X-ray spectra of more complicated atoms, and the explanation of the regularities in the properties of different elements which are expressed by the periodic table. (*See* ATOM.)

BOILERS (*see* 4.141).—The principal developments and improvements in boiler design, construction and operation since 1910 may be summarised as larger units, additional application of heat-saving devices, increasing pressures, powdered coal firing and greatly improved automatic stokers, combustion control systems, deconcentrators, de-aerators and the experimental use of alloy steels in forged, cast and welded material.

Size of Units.—In 1910 the largest units in one setting were the Stirling boilers at the Delray station at Detroit, Mich., with 24,000 sq. ft. of surface. Many boilers of this general design are now in use in sizes varying from 15,000 sq. ft. to 30,000 square feet. Most of these installations are in the north-central United States. Flanagan (Proc. Iron and Steel Elec. Eng.) claims that the design is particularly advantageous where the feed water is bad. The Delauney-Belleville Co. in France has installed a number of similar boilers under the Ladd patents, while in America this type is best represented by the Ford plant, River Rouge, Michigan.

The horizontal tube type has increased in size from 7,000 sq. ft. in 1910, best represented by the 14 tubes high, 21 tubes wide, tube bank, with three 42 in. drums of the Babcock & Wilcox Co., to sizes containing 14,000 to 24,000 sq. ft. of heating surface, 24 tubes high, 54 tubes wide, with but one 60 in. cross-drum. Maximum furnace widths of 13 ft. in 1910 have been increased to 30 ft. in 1925, while the tube length—which was standard in 1910 as 18 ft.—has been increased in some instances to 24 feet. Steel-cased air-tight settings, the general use of superheaters and economisers, and greatly increased furnace volumes, the reappearance of air preheaters in stationary practice and the increasing use of water-tube sectional designs are notable developments.

European Practice.—In Europe, boilers of the Garbe type have been increasingly popular, although the Stirling, Babcock & Wilcox, Yarrow, Spearing, Steinmuller and other types have made progress. The largest sizes have been of Stirling type, although the double Babcock & Wilcox boilers at Barton, Manchester, are nearly as large.

Fuel Consumption.—Perhaps the best indicator of progress is the amount of coal burned per front foot of furnace. In 1910 this did not exceed 400 lb. per hour when good efficiency was obtained. This figure has been increased until 1,400 lb. per front foot has been burned in regular work at good efficiency with 1,700 to 1,900 lb. per hour during peak periods at reduced efficiency. The modern large boiler with 30 ft. furnace will burn 20 tons of coal per hour at better than 70% efficiency, evaporating 200 tons of water per hour from and at 212° Fahrenheit.

Steam Pressures.—Maximum steam temperatures still remain at about 750° F., although oil stills are being worked at 1,000° F. to 1,100° Fahrenheit. Steam pressures have steadily risen from 200 lb. gauge to 600 lb. for the majority of the installations completed in 1925, while one large boiler of 1,200 lb. pressure is in service at Weymouth, Mass., and several smaller ones in Germany and Sweden. The Swedish installations are of the Blomquist type, where the boiler consists of 10-in. tubes revolving in the furnace with the water held to their inside surface by centrifugal force (*see* fig. 2). Most of the German boilers are of the Schmidt type.

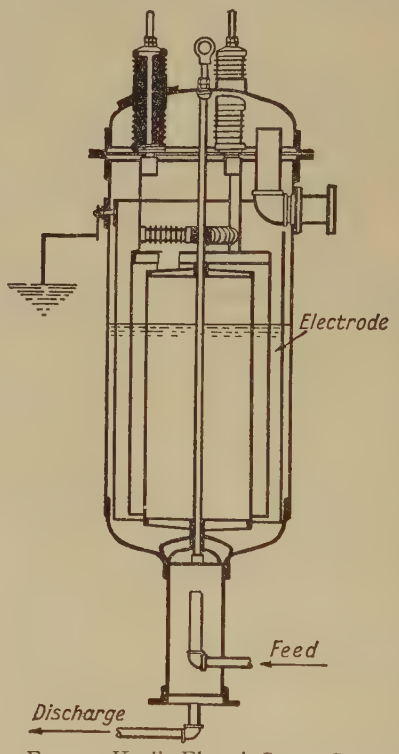

FIG. 1.—Kaelin Electric Steam Generator—three phase—single unit system.

Superheaters.—The use of superheaters has become general, and most of the newer installations are using maximum temperatures around 700° F., which was true of only a few plants in 1910. Radiant heat superheaters of a number of types are in use but have not become standard. Steel tube economisers have nearly replaced the cast-iron tube variety for high pressure work. Many designs of both tubular and plate air heaters are also in use, but this apparatus has not been in use long enough to be standardised.

Electric Boilers.—Where there is a surplus of hydroelectric power, the electric boiler, first manufactured by Sulzer Bros., has been largely used. The greatest use of this boiler is in Canada, where it has been brought to a high degree of perfection. The hydroelectric power must be very cheap or else coal or other fuel excessively dear, to make the use of these boilers economical. The internal combustion boiler, where the fuel is burned inside of the boiler in contact with the water, has been used for some years in chemical works, for gas turbines, and in torpedo service. Little real work has been done, and commercially the last two types may be neglected.

Construction.—Most of the rules for boiler construction before 1910 were drawn from the rules of such classification societies as Lloyd's, Bureau Veritas, A.B.C. or from such associations as the Manchester Steam Users' Assn. or the Swiss Boilermakers' and

Users' Association. In 1915, the American Society of Mechanical Engineers bringing together the designers, manufacturers, insurance societies and users, adopted the report of the boiler code committee. This code is now standard in the United States, having been adopted by 19 states and 15 cities. Most of the German states have similar construction laws, and the tendency toward a uniform construction law is well marked.

Tubes.—Both iron and steel boiler tubes are in use, but by far the most extensively used are the hot finished and seamless

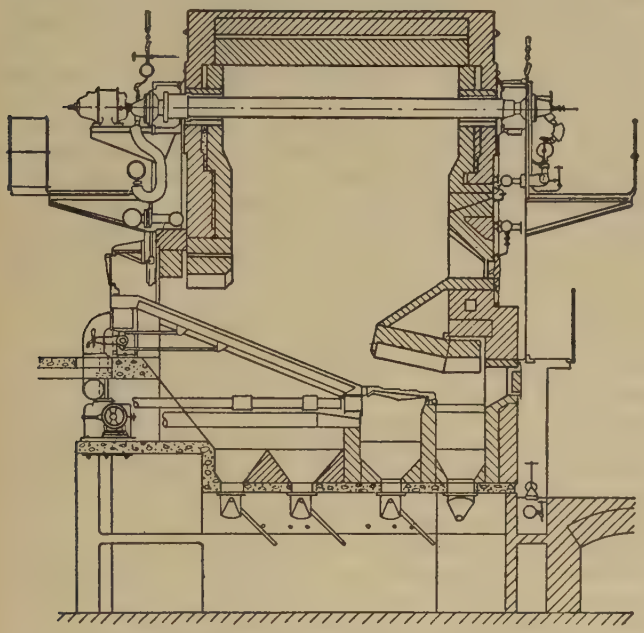

FIG. 2.—Blomquist High Pressure Boiler, 1,500 lb. per square inch.

cold-drawn steel tubes made from pierced billets. Sectional headers are made from cast steel, from welded forged steel, and swaged up from seamless drawn steel tubes. Boiler drums are made from plates riveted in the usual way, but welded shells are in use as well as seamless forged shells. Alloy steels have been introduced for all purposes and are finding a place in high-pressure work, the drum for the 1,200-lb. Weymouth boiler being a hollow forging with swaged ends 24 in. in internal diameter and 4 in. thick. Staybolt manufacture has been greatly improved, and the control of riveting pressures in order to secure perfect filling of the hole without overworking the metal has been studied with great advantage.

Operating Practice.—In general, the improvement of practice has been the securing of greatly increased capacity while maintaining a better efficiency. This was not possible with hand firing or with the short and inefficient stokers in vogue in 1910. The longer underfeed stokers put in at Conner's Creek, Detroit, in 1912, gave that station a maintained boiler efficiency over a year of 78%, which was excellent work. Efficiencies over a year of 88% for boiler, superheater and economiser are now reported from Lakeside (Milwaukee) and other stations. The forced draft chain grate stoker has been most successfully used, and is built in very large sizes, while the underfeed type has been much lengthened and improved.

Capacities.—Capacities have been greatly increased. The evaporation of 4 to 6 lb. of water per sq. ft. of surface was considered good practice in 1910, and a maintained efficiency of 78% at this rating was difficult. Evaporations of 10 to 12 lb. at the same efficiency are now possible, and some late guarantees will run as high as 17 lb. equivalent evaporation per sq. ft. of surface at an efficiency of over 90%.

These improvements are due to better stoker design, to better utilisation of radiant heat, to the use of pure feed water and to automatic combustion control. Ash grinders, properly located, allow practically all of the combustible to be burned out of the fuel and most of the sensible heat of the ash to be absorbed by the air for combustion. Soot blowers, installed in most new installations since 1910, enable tubes to be kept clean. Deaerators for eliminating oxygen and other gases from the feed water prevent corrosion and assist in keeping the surfaces clean. Much more care is taken with the feed water, and water-softening plants are in universal use. Deconcentrators, working continuously, take water from the circulation system, filter it and return clean water to the boiler. Automatic combustion control systems, where the air and coal are automatically proportioned to the load, help in securing perfect combustion and maintaining a high efficiency. Furnace design has progressed until a 30 ft. by 20 ft. setting with walls 40 ft. high is possible. Greatly improved refractories are obtainable and the air-cooled firebrick furnaces gave little trouble. Water-cooled furnace walls of the fin type, cast-steel box or refractory types, are in successful use, the water used being part of the circulatory system of the boiler.

Powdered Coal.—The most striking departure, however, is the expansion of powdered coal firing, which has extended the range of good efficiency and enabled the operator to use different qualities of coal in the same apparatus with equal efficiency. The systems lends itself to the maintenance of high combustion temperatures and high CO_2, and the losses of combustible in ash and clinker are much less than where a fire bed is used. The cost of pulverising the fuel is not large, and many of the later instal-

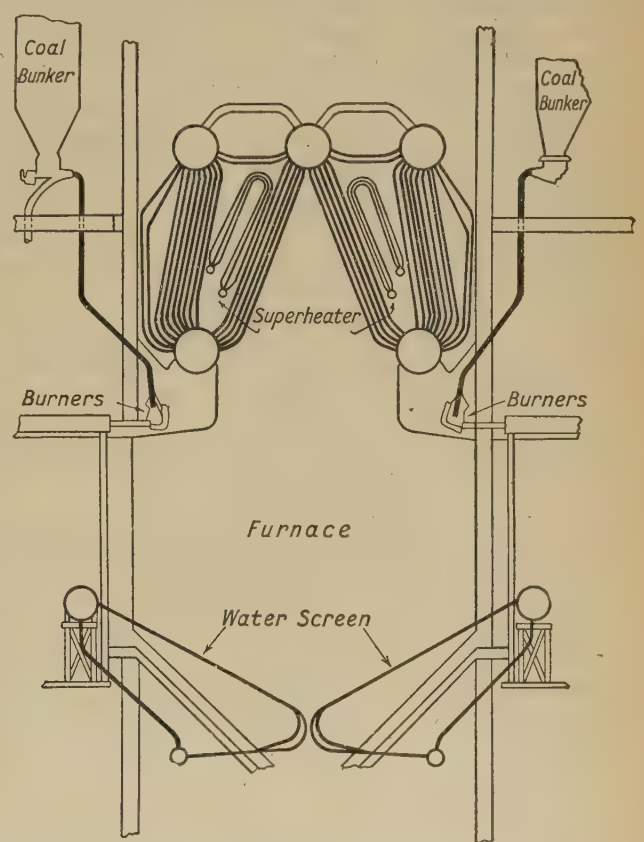

FIG. 3.—Section through Boiler House, Trenton Channel, Mich., showing great height of settings. Stirling boiler.

lations have adopted this method of firing. The system necessitates large furnace volumes, about one cu. ft. of space being required for each 1·5 lb. of coal for best efficiency. The bin and feeder system, with a central pulverising plant is most successful at present, but the many unit systems are promising and much used for small installations.

Oil Firing.—Since 1910, the mechanical atomising of oil fuel has been introduced with marked success, as much as 3,000 lb. of oil per hour being handled by a single burner. When the oil is heated to the right viscosity (that is, between 3°–4° Engler)

atomisation is nearly molecular and the results are good. The power and heat used is usually less than ·5% of the steam output of the boiler in contrast to ·75% to 1·5% consumed when steam atomisation is used. *See* F. J. Drover, *Oil and Oil-fired Boilers*, 1924. (G. A. O.)

BOITO, ARRIGO (1842–1918), Italian composer (*see* 4.155), died June 10 1918.

BOK, EDWARD WILLIAM (1863–), American editor and author, was born at Helder, Holland, Oct. 9 1863, and brought to the United States when six years old. Educated in the Brooklyn public schools, he became an office boy with the Western Union Telegraph Company. Continuing his education at a night school, he entered the employ of Henry Holt & Co., publishers, in 1882, and two years later became associated with Charles Scribner's Sons, publishers, eventually becoming advertising manager. He acted as editor of *The Brooklyn Magazine* from 1882 to 1884. In 1886 he founded *The Bok Syndicate Press*, the success of which led to the offer of the editorship of *The Ladies' Home Journal* in 1889; under his management this magazine became one of the most successful publications in America. After 30 years as editor he retired in 1919. A year later he published *The Americanization of Edward Bok*, which won the year's award of the Joseph Pulitzer Prize for the best biography, and the gold medal of the Academy of Political and Social Science. In 1923 he created the American Peace Award, providing $100,000 for the best practicable plan by which the United States might co-operate with other nations to achieve and preserve the peace of the world, one half to be paid upon the acceptance of the plan by a selected jury and the balance upon its acceptance by the Senate. The plan submitted by Dr. C. A. Livermore, of the New York Peace Society, won the award.

In addition to his autobiography Mr. Bok published, among other works: *Successward* (1895), *The Young Man in Business* (1900), *Her Brother's Letters* (anonymous, 1906), *Why I believe in Poverty* (1915), *Two Persons* (1922), *A Man from Maine* (1923), *Twice Thirty* (1925), *Dollars only* (1926), *You; A Personal Message* (1926) and *America, Give Me a Chance* (1926).

BOKHARA or **BUKHARA** (*see* 4.156), a province of the Uzbek Socialist Soviet Republic (*see* TURKESTAN).

BOLIVIA (*see* 4.166), a republic in South America and a member of the League of Nations. Estimates of the area vary, the boundary dispute with Paraguay being still unsettled. The official estimate is 708,195 square miles. No exact census of the population has been taken. In 1925 it was estimated at 2,820,119, but it is probable that, allowing for aboriginal tribes, Bolivia has about 3,200,000 inhabitants.

I. POLITICAL HISTORY

On Aug. 6 1909 President Montes was succeeded by Senor Eliodoro Villazón. From this moment the progress of Bolivia was most marked, and during the period to the end of 1925 conditions in the Republic were much more stable, both economically and politically, than ever before. General Montes assumed office for a second term on Aug. 6 1913, and remained President until 1917. The World War had a considerable influence upon the trade of Bolivia: imports decreased, while her exports, mainly minerals, increased very considerably in value. The country proclaimed its neutrality in 1914, but departed from this attitude in consequence of Germany's submarine policy. Diplomatic relations with Germany were severed on April 13 1917, the reason for this action being that a German submarine had torpedoed in neutral waters a ship with the Bolivian Minister to Berlin on board. The Republic took no direct part in the War on the side of the Allies, but all her resources in metals were at their disposal.

Montes relinquished office on Aug. 6 1917, and was succeeded by his former Minister of Finance, Señor José Gutiérrez Guerra. Shortly after this the agitation for an outlet to the Pacific reached an acute stage. The policy of President Guerra was apparently aimed at a *rapprochement* with Chile over the long-standing grievance resulting from the loss of Bolivia's coastal territories. Popular indignation against this attitude led to demonstrations: Guerra was forced to resign, and was escorted out of the country to Arica. Meanwhile the World War had ended. Bolivia was represented at the Versailles Conference, and signed the Peace Treaty of 1919. As a signatory of the treaty, she became an original member of the League of Nations.

Relations with Chile.—Following the deposition in July 1920 of President Guerra, the Provisional Govt. of Bolivia prosecuted the popular demand for a revision of the situation in regard to her lost territory. Invoking Article 19 of the Covenant of the League of Nations, the Bolivian delegates to the First Assembly of the League presented a request on Nov. 1 1920 for the modification of the Treaty of 1904, whereby hostilities with Chile, nominally maintained since the termination of the war of 1879, were formally concluded. It was contended that the treaty had been imposed on Bolivia by force; that Chile had not fulfilled certain of its clauses; and that the resulting situation constituted a constant menace to peace: while Bolivia suffered a wrong, contrary to the rights of nations, because, under the pact she had "become a country completely enclosed and deprived of access to the sea."

The Assembly of the League decided that it could not properly entertain this request for the alteration of a treaty, and that ordinarily an international compact could only be modified by the contracting parties. Bolivia then attempted to become a party to the negotiations between Chile and Peru for the settlement of the controversy over the disputed territory of Tacna-Arica. Chile declined to admit Bolivia's claim to participation in the negotiations, declaring that it had accepted the invitation of the United States to a conference at Washington to consider the unfulfilled clauses of the Treaty of Ancon, and that those clauses related only to Chile and Peru.

Saavedra's Presidency.—In view of Chile's refusal to recognise Bolivia in the Tacna-Arica negotiations, President Bautista Saavedra, who had been elected President in 1920 and had entered office on Jan. 29 1921, appealed early in 1922 to President Harding of the United States, explaining Bolivia's case and urging that she be admitted as a third party at the approaching conference. Dr. Saavedra emphasised that the negotiations affected Bolivia as a victim of the War in which she had been associated with Peru against Chile, and that the question of the disputed territory could not be adjusted unless his nation's loss of an outlet to the sea were repaired. Further he argued that Bolivia's consent to the Treaty of 1904, by which she recognised Chile's sovereignty over the Department of Atacamá, was obtained under duress. In his reply President Harding took the view that he could not ask Bolivia to be a party to the negotiations: the inclusion of Bolivia in the discussions, he stated, was a matter for the sole consideration of Chile and Peru. Thus Bolivia was excluded from the conferences at Washington, which resulted in an agreement by Chile and Peru to submit their dispute over the unfulfilled clauses of the Treaty of Ancon to the arbitration of the President of the United States.

The presidency of Dr. Saavedra was productive of a greater efficiency in administration, and in marked economic progress. Nevertheless some measure of political unrest was experienced both in 1924 and 1925. A revolutionary movement took place in July 1924 and was promptly suppressed by the Government. Ostensibly the object was to promote the secession of the province of Santa Cruz to the neighbouring republic of Brazil; but active opposition to the policy of the Saavedra Govt. was really the purpose of the disturbance. In Jan. 1925 Dr. José C. Villanueva, a physician who had been serving as Minister of Public Instruction and Agriculture, and Abdon Saavedra, a brother of the President, were nominated as Republican candidates for President and Vice-president. The Liberal party nominated Dr. Salamanca for the presidency. After a vigorous electoral campaign the Republican candidates were elected on May 2 by an overwhelming majority. The successful candidate for the presidency should have taken office on Aug. 6, but Congress refused to ratify his election on the ground that it was invalid because Dr. Villanueva had not resigned public office, as required by the Constitution, at least six months before election. Meanwhile Saavedra continued in office.

At this moment the centenary of Bolivian Independence was being celebrated by an International Exposition at La Paz, and a good deal of political excitement developed. On Sept. 1, Congress formally declared the election of May 2 null and void. President Saavedra transferred his office to Dr. Felipe Guzmán, President of the Senate, to administer the government provisionally, pending a new election. A Cabinet was appointed to deal with the political unrest resulting from the unseating of Dr. Villanueva. To some extent the army was affected, and on Sept. 18 martial law was proclaimed in three provinces. Dr. Villanueva and his partizans were accused of tampering with the army and the unseated President was instructed to leave the country. Conditions then improved. In Dec. the new election was held and Dr. Hernando Siles, a Republican, was elected. He was installed in office in Jan. 1926.

The Constitution adopted in 1880 was still in force in 1926. Sucre remained officially the capital of the Republic, but actually La Paz had become the political and commercial capital. The National Congress meets in La Paz every year; the Presidential Palace and most of the Government offices are maintained there, and Sucre is merely the seat of the Supreme Court.

(W. S. Ro.)

II. FINANCIAL AND ECONOMIC HISTORY

Finance.—The annual revenue of the Republic rose from 12,583,232 bolivianos (Bs.) in 1910 to Bs. 43,063,489 in 1924: expenditure increased in proportion, the figure for 1924 being Bs. 41,494,949. Surpluses of Bs. 816,667 and Bs. 1,368,540 were realised in 1918 and 1924 respectively, but in the 10 years 1915–24 the net deficits amounted to Bs. 39,512,416. On Jan. 1 1925 the national debt amounted to Bs. 127,834,844: it consisted of external debt, Bs. 92,970,000, internal debt, Bs. 20,647,355 and floating debt, Bs. 14,217,489. Under a contract with the Equitable Trust Co. of New York, dated May 31 1922, Bolivia arranged for a loan of $33,000,000 at 8% with a currency of 25 years, of which sum $29,000,000 had been issued in 1925, part being used to redeem a French loan for railway construction, and the balance for further railway and road building.

Production and Industry.—Mineral deposits remained the principal source of wealth in Bolivia during the period 1910–25. Throughout the World War intense activity prevailed in mining owing to the increased demand at high prices for such metals as tin, lead, copper and wolfram. In 1925 Bolivia stood second among countries in the world in the production of tin. Of her total exports in 1924, valued at Bs. 115,191,500, metals were represented by tin, Bs. 84,200,000; lead, Bs. 9,080,000; silver, Bs. 8,800,000; copper, Bs. 4,587,000; bismuth, Bs. 2,387,000; antimony, Bs. 410,000, and zinc, Bs. 86,000. The exploitation of the vast mineral wealth of the country depends largely upon the development of transport facilities and the utilisation of the immense water-power resources of the country. There has been a distinct advance in agricultural production, but methods were still primitive in 1925 and only a comparatively small area was systematically cultivated. Rubber production particularly is proving a valuable industry, exports in 1924 being valued at Bs. 2,930,000. Stock-raising was still in a backward condition in 1925, but to this branch of industry and to agriculture the Government is giving serious attention.

Trade.—Developments in mineral production resulted in a great increase in exports. The balance of trade between 1910 and 1925 was consistently in favour of Bolivia, particularly during the war years when the prices of metals rose to phenomenal heights. The course of trade is shown by the following table:—

	Imports Bs.	Exports Bs.
1910	48,802,394	75,622,146
1913	54,762,833	93,721,513
1918	34,999,886	182,612,850
1923	62,914,000	107,693,000
1924	62,570,000	115,191,500

The countries furnishing the largest amounts of imports were the United States, Chile, Great Britain and Argentina. In 1924 the main items of imports, and their values, were: manufactures, Bs. 40,057,864; foodstuffs, etc., Bs. 15,833,005; raw materials, Bs. 5,649,248; live animals, Bs. 1,028,345. Exports to the United Kingdom were valued at Bs. 81,909,611; to the United States, Bs. 25,521,144; to Argentina, Bs. 3,228,041; and to Chile, Bs. 463,119.

Communications.—As a country without a seaboard Bolivia is dependent on railways passing through the territories of her neighbours for her communication with the outer world. Traffic rights over these railways are guaranteed by treaties. There are three distinct connections with the Pacific coast. One outlet is by way of the La Paz-Guaqui Railway, thence by the Southern Railway through Peru to the port of Mollendo. Further south Bolivia can be reached from the Chilean port of Arica by a railway that runs practically straight through to La Paz, the distance between the two places being only 279 m., as against the journey of 529 m. between Mollendo and La Paz. Still further south there is the railway from Antofagasta, in Chile, which joins the main Bolivian trunk line at Uyuni. A great improvement in the communications with Bolivia was the completion in 1925 of the section of the trunk line between Atocha and Tupiza, thus giving the republic through connection, by way of La Quiaca, with Buenos Aires and the Atlantic seaboard. On the east the country can be reached via the Amazon and Madeira rivers. Most of the rubber and other tropical produce of the Beni and Colonias regions is shipped this way, with the Mamore-Madeira railway acting as a link with the river communications. In 1925 Bolivia had about 1,300 m. of railways. A further 200 m. were under construction, while projects were being considered for about 1,000 miles. In association with colonisation schemes it was proposed also to create ports along the Paraguay river—constituting part of the eastern frontier of Bolivia—so that steamers could approach the republic by way of the River Plate.

Money and Banking.—By a law of Dec. 31 1908 Bolivia virtually adopted the gold standard. The monetary unit is the silver boliviano, given a value under the above law of Bs. 12·50 to English and Peruvian pounds, both of which are legal tender. In 1920 United States gold coins were also declared legal tender, the boliviano having a par value to the dollar of $0·3893. After 1914 practically all the silver coins were exported from Bolivia, and in 1925 the currency consisted of nickel coins and paper money. On Dec. 31 1924 the stock of gold held by the three principal banks of the country amounted to Bs. 21,067,855 against a total note circulation on the same date of Bs. 34,754,848. During the war period the exchange value of the boliviano fluctuated considerably. Efforts were made by the Government to steady the exchange by means of a moratorium, the prohibition of gold exports, the suspension of banking conversion and the fixing of an official rate of exchange, but none of these expediencies sufficed to maintain the boliviano at par.

A national law of Jan. 7 1911 gave Bolivia a semi-state bank known as the Banco de la Nación Boliviano. Its original capital was Bs. 15,937,500, of which half was subscribed by the Government from proceeds of a loan raised in Paris. This bank absorbed the Banco de Bolivia y Londres, the Banco Agricola and the Banco Industrial. All national banks operating in Bolivia must subscribe 20% of their capital to the Banco de la Nación, though foreign banks may place this quota in national bonds. The paid-up capital of the Banco de la Nación on Dec. 31 1924 was Bs. 22,000,000, and the Republic then held 114,738 of the total of 176,000 shares. A German bank, the Banco Alemán Transatlántico, is the only foreign institution in Bolivia, though banking operations are also conducted through special departments of several large foreign mercantile concerns. There are two nationally constituted mortgage banks, the Crédito Hipotecario de Bolivia and the Banco Hipotecario Nacional. In Nov. 1914 a law was passed confining the right to issue paper currency to the Banco de la Nación, though permitting till Dec. 31 1924 the circulation of notes to the approximate value of Bs. 3,000,000 already issued by the Banco Nacional and the Banco Mercantil. All such notes were required to be cancelled by the end of 1929.

III. EDUCATION AND DEFENCE

Education.—After 1910 substantial progress was made in education, and the degree of illiteracy greatly reduced. It stood as high as 84% in 1900, but was reduced to about 60% in 1925. This was due not only to the big increase in the number of schools, but to the education of the army conscripts from the remote districts, who help to impart a knowledge of reading and writing to Indians who previously did not know Spanish. The amount spent on education in Bolivia rose from Bs. 1,497,643 in 1910 to Bs. 3,650,203 in 1924. Schools are maintained either by the National Govt. or by the municipalities. The number of national schools rose from 187 in 1910 to 450 in 1918, and in 1925 was well over 500. The attendance at these schools was 58,766 in 1918, and in 1925 was estimated to be over 80,000. In addition to the elementary schools, there are the high schools, or *colegios nacionales*, as well as private academies. The supply of teachers is met by training colleges established throughout the country, with a Superior Normal Institute in La Paz. A remark-

able impetus has been given of recent years to practical or vocational training. Schools of arts and crafts are now found in the principal cities, and an Institute of Applied Arts at La Paz has an enrolment of about 250 trainees. The University of La Paz furnishes instruction in law, medicine, obstetrics, pharmacy, dentistry and theology. Each Department in the Republic also has its own university, with the exception of Beni, but in these institutions only one course, that of law, is generally given. A national School of Mines exists at Oruro, and the Government also maintains a School of Agriculture and Animal Husbandry, a School of Commerce, an Institute of Bacteriology, an allied School of Agronomy and Veterinary Science, a Conservatory of Music and various model farms.

Defence.—Universal military service is theoretically the basis of Bolivia's defence system, all males between the ages of 19 and 50 being liable. Actually only a limited number of the available conscripts are taken into the army, lots being drawn to fill the annual quota for training. A law of Dec. 15 1915 provided for a permanent force of 3,577 men, and the ordinary peace strength of the army is about that number, with an immediate reserve of 15,000 men, though in 1925 there were also available for defence about 200,000 men who had undergone some training. There are four regiments of infantry, a regiment of cavalry, a regiment of field artillery, equipped with Schneider-Creusot guns, a regiment of mountain artillery and a machine gun corps of 150 men. The amount actually spent on defence during 1924 was Bs. 7,878,170.

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(L. MA.)

BOLL WEEVIL, COTTON.—The first home of the cotton boll weevil was undoubtedly in the plateau region of Mexico or Central America. Before 1892 the insect had spread throughout the larger portion of Mexico. It occurs southward to Guatemala and Costa Rica, and in the eastern half of Cuba. About 1892 it crossed the Rio Grande near Brownsville, Tex., and entered U.S. territory. It may have flown across, or it is possible that it was carried over in seed cotton. By 1894 it had spread to half a dozen counties in southern Texas. Since 1894 it has extended its range annually from 40 to 160 m., although in several instances the winter conditions have caused a decrease in the areas that are infested.

At the end of the year 1922, 87% of the American cotton belt had become infested by the weevil. This infested area produces most of the cotton crop of the United States, comprising almost all of the important cotton-producing sections. Practically the only territory remaining uninfested is the semi-arid zone along the western margin of the cotton belt. Some of this territory has been invaded in seasons of favourable weather, but the weevils have been driven back in periods of adverse weather. Whether the weevil will ever become seriously injurious in that territory is problematical, but it has shown marked ability to adapt itself to unfavourable conditions. The losses caused by the boll weevil are both direct and indirect and extend throughout practically the entire cotton belt. The Bureau of Crop Estimates of the U.S. Dept. of Agriculture reported the potential production of cotton prevented by weevils in the year 1921 as 6,277,000 bales.

The adult boll weevil is about one-fourth of an inch long, varying from one-eighth to one-third of an inch, with a breadth about one-third of its length. This measurement includes the snout, which is approximately half the length of the body. Variation in size is due to the amount of food the insect has obtained in the larva stage. Individuals from bolls (unripe pods containing lint and seed) are therefore nearly always larger than those from squares (fruit buds). The recently emerged individuals are light yellowish in colour, but this changes to a grey or nearly black shade in a few weeks' time. In the field the most conspicuous indication of the presence of the boll weevil is the flaring and falling of numbers of squares or buds. Unfavourable climatic conditions and careless cultivation, however, frequently cause great shedding of the fruit, which is often mistaken for weevil damage. If excessive shedding be noted and the squares upon being cut open show a white, curved grub that has fed upon the contents, there is little doubt that the boll weevil is the insect causing the damage.

The boll weevil passes the winter as an adult or beetle. With the advent of autumn weather the adult boll weevils in cotton fields begin to seek protection against the winter. They fly from the fields in every direction, although their movements are governed partially by the prevailing winds. They may fly into hedges, woods, cornfields, haystacks, farm buildings or other places. A number of weevils also obtain hibernating quarters without leaving the cotton fields. These may crawl into cracks in the ground, under grass, weeds or other trash, and into the burrs from which the cotton has been picked. During the winter the weevils take no food, and remain practically dormant; on warm days they may move about to a certain extent. Emergence from hibernation depends primarily upon temperature and rainfall in the spring, although some minor factors are concerned. In the southern portions of the cotton belt emergence usually begins from the first to the middle of March, but farther north it is somewhat later. Emergence from hibernation has been prolonged from the middle of March to June 28, and in more extreme cases from the middle of Feb. to about the first of July.

In the spring and throughout the fruiting season of cotton the eggs are deposited by the female weevils in cavities formed by eating into the fruit of the plant. An egg hatches under normal conditions in about 3 days, and the grub immediately begins to feed. In from 7 to 12 days the larva or grub passes into its pupal stage, corresponding to the cocoon of butterflies and moths. This stage lasts from 3 to 5 days. Then the adult issues, and in about 5 days begins to breed. Climatic conditions cause considerable variation in the duration of the stages, but on an average it requires from 2 to 3 weeks for the weevil to develop from the egg to the adult. The males feed upon the squares and bolls without moving until the food begins to deteriorate. The females refrain, throughout most of the season, from depositing eggs in squares visited by other females, but late in the autumn, when all of the fruit has become infested, several eggs may be placed in a single square or boll. As many as 15 larvae have been found in a boll. The squares are greatly preferred as food and as places for depositing eggs. As long as a large supply of squares is present the bolls are not generally damaged to any serious extent. The bolls, therefore, have a fair chance to develop as long as squares are being formed. The weevil, so far as at present known, breeds in no plants other than cotton and a wild plant related to cotton and found in the mountains of Arizona.

In spite of the many complexities involved in the problem of weevil control, efficient methods (*see* COTTON) have been developed for reducing its damage, which are of practical use to growers. These are described in *Farmers' Bulletin No. 1329*, procurable on request from the U.S. Dept. of Agriculture, Washington, D.C. (B. R. C.)

BOLSHEVISM is the name given, first to the theories and later to the practice of a section of the Russian Social Democrats. Since 1917, when the Bolsheviks came into power in Russia, the word has become currently accepted as synonymous with communism. The Russian Social Democrat party was formed under the Tsarist régime to work for the replacement of the state structure by a dictatorship of the organised proletariat according to the theories of Marx. At its second convention in London (1903) the committee of this party divided into the Bolsheviks (meaning majority) with 26 members and the Mensheviks (= minority) with 25. After 1910 the two groups no longer sat in one committee; and in 1912 the Bolsheviks, under Lenin, deposed the old central committee at the Conference of Prague, declaring " we are the party."

The Bolsheviks, as opposed to the Mensheviks, aimed at the immediate establishment of the soviet system, rejecting an intermediate form of democracy. All power was to be concentrated in the hands of one centralised bureaucracy, a professional revolutionary class which required blind obedience from the mass of the proletariat, ignoring all other classes of society completely. The Mensheviks demanded a democratic republic, in which the proletariat should co-operate with the peasants and the intelligentsia.

In the abortive revolution of 1905 revolutionary Workers' Councils first made their appearance in the factories and achieved a certain amount of success. The revolutionary activity of the Bolsheviks was maintained unremittingly up to and during the World War. Discontent was sedulously sown in the army and the factories, and the method of penetration by communist " cells " was widely adopted. The Tsarist Govt. fell in 1917; after a short interregnum of the Kerensky régime, the Bolsheviks seized the supreme power and built up a new form of government based on the soviet or council system. (*See* COMMUNISM; RUSSIA.)

BOLTON (*see* 4.180) had a population of 180,851 in 1911, and of 178,678 in 1921. In 1923 it was estimated at 182,200. The

area of the parish and municipal borough is 15,279 ac. of land, and 371 of water. Leverhulme Park, 98½ ac., the gift of the 1st Lord Leverhulme, was opened in 1919, and the White Bank estate of 27 ac., with a house which is used as a central school, was presented by the descendants of John Haslam in 1920. The churches of St. Barnabas and St. Margaret, Halliwell, were consecrated in 1913, and the parish of St. Chad was formed out of several others in 1912. A Presbyterian Church and the Claremont Baptist Institute were erected in 1910. Minerva Hall, the headquarters of the Lancashire and Cheshire Miners' Federation, was opened in 1914 in Bridgeman street.

BOMBAY, India (*see* 4.183b), population (1921) 1,175,914, has undergone considerable development recently owing to the activities of the development directorate appointed in 1920. Large schemes were put in hand, destined eventually to house 250,000 of the poorer inhabitants, and so relieve the existent overcrowding, and to add 2 sq. m. to the area of the city by reclamation of land in Back Bay and East Colaba. The cost seriously exceeded the estimates, on account of the unsuitable nature of the material dredged, and it was proposed in 1926 to complete only a part of the reclamation and to dispose of the dredging plant. South Salsette Island, between Bombay and the mainland, is being developed, industrial and residential colonies have been established outside the city, and several new arterial thoroughfares opened.

The Mahim scheme is complete, and comprises two main avenues and cross roads, with a road 60 ft. wide from Worli. The reclamation scheme between Mazagon and Sewri is also finished, and the cotton, grain and oil depôts have been moved from Colaba. Previously raw cotton was carried on carts from the goods yards to the Cotton Green at Colaba, but now the Bombay Port Trust has provided railway communication between the railway station, the docks and the depôt at Sewri, which has sheds to hold 3,000,000 bales of cotton.

In 1921 the Bank of Bombay united with those of Bengal and Madras, forming the Imperial Bank of India, with local headquarters in Bombay. A new General Post Office has been built near the Victoria station, the old one being now used for the fort area only, and in 1911, the foundation stone was laid of buildings for the Royal Institute of Science on Mayo and Esplanade Roads, containing a library, public hall, examination rooms, etc. A Pasteur Institute, where research in tropical medicine is carried on and plague vaccine prepared, has been established in old Government House, and a large Sanitary Institute was opened in Princess street in 1915.

Harbour Improvements.—In the harbour a deep water pier has been built at Trombay for discharge of bulk petrol, with a pipe connection to Sewri, and the seawall of the Alexandra dock is extended for 1,500 ft. to form the new Ballard pier, with a passenger station where passengers embark and disembark. A floating caisson for Merewether dry dock was ordered in July 1924, and the harbour defences have been remodelled and supplied with the heaviest guns. Docks are to be built on a large area of reclaimed land to the north of the present docks. Other recent activities of the Bombay Port Trust include the building of a line to connect with the Great Indian Peninsula and Bombay, Baroda and Central railways at a point 6 m. from the city, to take over traffic and convey it direct to the docks and depôts as required. Part was opened in 1915, and the main system finished in 1924. The total length with sidings is over 100 miles.

Electric Power.—The remarkable electric power works of the Tata hydroelectric scheme were opened in 1915. The monsoon rainfall on the Ghats is impounded in three lakes at Lonavla, and falls to a general station where 40,000 H.P. is generated by five turbines; more power will be available as the scheme develops. It is conveyed 42 m. to a receiving station on Bombay Island by aerial transmission cables, whence it is distributed to mills and other customers. Further hydroelectric developments are in progress near the present lakes where the Andhra river has been dammed to form a lake 12 m. long. The company, connected with the Tata Supply Company, was formed in 1916, and the supply of power began in 1922.

A memorial of the landing of the King and Queen in Dec. 1911 has been erected on the Apollo Bunder, replacing the temporary pavilion erected for the occasion. Previously the Apollo Bunder was used for embarking and disembarking passengers in fine weather with an iron shelter only. The memorial building of Indian design is of yellow basalt, and consists of three halls. The large centre one is flanked by arched entrances, and the smaller ones seat 600 people in each.

Trade Commerce.—Bombay suffered to a smaller extent than any other Indian port from the World War, though shipping was seriously affected by mines; 1920–1 was a record year, for though there were prolonged strikes in 1919 and in Jan. 1924, there was a strike in the mills which eventually affected 150,000 hands owing to the non-payment of a yearly bonus during a period of depression. There were disorders, and attempts, which were frustrated by the police, were made to burn down mills. There was much distress among the strikers, who returned to work in March, but in Sept. 1925 trouble again arose. In that month only five mills were at work.

Bombay remains the chief distributing centre in western India for imported cotton goods, and there are 82 cotton spinning and weaving mills in the city and environs. The preponderating share of trade is in Indian hands, and most of the mills have Indian managers. In 1922–3 the total imports and exports were worth £217,017,000 (exports £93,572,000; imports £123,445,000), as compared with £142,394,000 in 1912–3. (O. J. R. H.)

BOMBAY, UNIVERSITY OF.—In 1913 a start was made with the provision of lectures for post-graduate students in history, economics, philosophy, Sanskrit and Persian. In 1919, schools of sociology and economics were established for research, and buildings costing over 8 lakhs of rupees completed in 1923. The university is still mainly concerned with examinations and has affiliated to it a number of institutions in Ahmadabad, Baroda, Bombay, Dharwar, Junagarh, Karachi, Poona, Sangli and Surat. Ten lakhs of rupees have been given by Sir Cunimbhoy Ebrahim for scholarships by way of repayable advances to Mahommedan students going to other countries for higher studies.

BOMBS (*see* 4.181).—Under this head are dealt with solely the mechanical instruments which were evolved in 1915–6, as opposed to those used with an explosive propellent, which are described under the heading ARTILLERY.

When contrary to all preparations the combatants on the Western Front settled down to trench warfare in 1914, a demand arose for short-range engines which could throw bombs to a greater distance than was possible by hand. Eventually this need was met by trench mortars and trench guns, but the first inventions were merely improvements on the ancient idea of the catapult, and relied for their propulsive effort on the energy of springs.

Types of Bomb.—The first British weapon of this kind used in France was the *Leach*, nothing more nor less than a heavy catapult worked in a strong forked wooden frame, in which powerful rubbers were pulled back to tension by a winding handle. When the bomb was in position in the pouch a trigger broke the connection and the release of the rubbers propelled the bomb. The Leach catapult with new rubbers was capable of throwing a 1½ lb. grenade 200 yards. It possessed the advantage over trench mortars of silence in action, but its ranging power was unnecessarily great for grenade work, and not powerful enough for the work done eventually by the trench mortar. The catapult of the French Army, known as the *Sauterelle*, was smaller and more portable, but correspondingly less powerful than the Leach. This catapult was a magnified crossbow, acting by the reassertion of springs bent in cocking. The *West* spring gun, used by the British in 1915, was a very powerful weapon using an ingenious combination of springs, but was too cumbrous. It had 28 springs, and a variation in range was obtained by the number employed for each shot; using 24 springs it threw a 2-lb. bomb some 240 yards. It was an efficient weapon, but was soon rendered obsolete for reasons already explained, as were many other ingenious types.

A type, which differs in principle from a gun, did remain. It used an explosive more on the rocket principle. The grenade had a sleeve tail, and the thrower consisted essentially of a peg over which this sleeve fitted, the propellent charge being loaded into the sleeve. The most enduring example of this principle was the German Granatwerfer, used in large numbers up to 1918. It consisted of a thrower and base plate on which it could be trained for direction on the same principle as a gun, and could similarly be clamped for elevation against a graduated arc. When the sleeve of the grenade, with its propellent cartridge, was placed on the peg and the safety-pin of its fuse withdrawn, the trigger lanyard was pulled, the sear freed the striker rod which was impelled forward by a spring and fired the cartridge as in a rifle.

Until 1918 this weapon used only simple high-explosive bombs. In that year a second type of bomb was introduced in which a small repellent charge in the head of the bomb was fired on impact with the ground, causing it to rebound and so to burst in the air instead of burying itself. The ordinary (1915) grenades weighed about 4 lb. and had a range of some 300 yards. The bouncing bomb was heavier (5½ lb.) and ranged only to 275 yards.

In the British service this heavy class of bomb was entirely supplanted by the trench mortars, howitzers, Stokes gun, etc., and by the light bomb thrown by hand. A bombing section of one N.C.O. and 30 men was attached to each battalion, and bomb-throwing became a part of every infantryman's training. There were inventions by which a bomb could be projected from the ordinary rifle. (*See* GRENADE.) (J. M. R.*)

BONDFIELD, MARGARET (1873–), British politician, was born March 17 1873 at Chard, Somerset. Her father was a lace designer and both parents were ardent Radicals. At an early age she became an assistant in a draper's shop at Brighton, but soon she moved to London, and in 1898 became assistant secretary of the Shop Assistants' Union. At the Trade Union Congress in 1899 she was the only woman delegate. She was a member of the administrative council of the Independent Labour party from 1913–21, and an active propagandist for trade boards, the minimum wage, adult suffrage, and peace. During the War she worked in the closest association with Mary Macarthur and on the latter's death, in 1921, succeeded her as secretary of the National Federation of Women Workers. This body was incorporated the same year in the National Union of General Workers, of which organisation she was the chief woman officer. She was made chairman of the Trade Union Congress in 1923 and in Nov. of that year was elected M.P. for Northampton. In the Labour Govt. of 1923–4 she was Parliamentary Secretary to the Ministry of Labour, but she was defeated at the general election of 1924. See M. A. Hamilton, *Margaret Bondfield* (1924).

BONESETTING: *see* MANIPULATIVE SURGERY.

BONI, GIACOMO (1859–1925), Italian archaeologist, was born in Venice April 25 1859. He entered the Venice Academy of Fine Arts, where he graduated as an architect, after which he studied practical mechanics in England. On returning to Venice he became assistant in the work of restoring the Ducal Palace, and in 1888 he was appointed Inspector of Fine Arts in Rome. Ten years later he was given charge of the office for the preservation of ancient monuments in the Lazio, and it was then that he undertook the excavations in the Forum and the Palatine with which his name is chiefly associated (*see* 23.591). He also erected the Museo Forense in the church of Santa Francisca Romana. In 1914 he undertook excavations on the Palatine, to which he thenceforth dedicated all his activity. Besides being an eminent archaeologist he was a keen classical scholar. Boni was made Senator in 1923 by Sig. Mussolini. Although he published no monumental work, he was the author of a large number of essays, pamphlets and articles on archaeological and kindred subjects and also on botany. He died in Rome July 7 1925.

BONNAT, LEON JOSEPH FLORENTIN (1833–1922), French painter (*see* 4.210a), died at the Château de Monchy, Oise, Sept. 7 1922.

BONNEY, THOMAS GEORGE (1833–1923), British geologist, (*see* 4.212c), died at Cambridge, Eng., Dec. 9 1923.

BOOK: *see* PUBLISHING.

BOOKKEEPING (*see* 4.225).—In the commercial world to-day an essential part of the organisation of a modern business is a strong and efficient accounts department organised upon modern and scientific lines far in advance of the methods adopted in the past. The modern business man realises that in order to manage and control his business operations he requires far more information than was the case in the past. With the increase in the cost of living the cost of clerical staff has risen, and for this reason and with a view to reducing overhead charges, new methods have been adopted in connection with bookkeeping systems in order to reduce the amount of clerical work involved.

Modern Devices.—In the modern business, the use of loose leaf and card ledgers in place of the old bound ledger has greatly increased, and a material saving in time is effected. In order to accelerate the balancing of the account books, the sectional balancing system is widely used, and each ledger is balanced at short intervals, often monthly. By this organisation a greater control is effected and the whole of the bookkeeping work is speeded up. The balances upon the total accounts afford valuable information for statistical purposes and enable the total book debts and the total creditors of the concern to be arrived at monthly, without extracting all the balances upon the personal ledgers. The clerical work that is done upon the books is materially reduced and accelerated by the use of adding and calculating machines, and if there is sufficient work to keep the machines occupied, the cost of the machine is soon recouped in the saving of clerical salaries.

Ledger posting can now be effected by machinery (*see* OFFICE APPLIANCES). One operation posts to a ledger account, adds up and works out the balance on the particular account, makes out the monthly statement and, at the same time, records the total of all the items posted so that this total can be agreed with the totals of the book from which the ledger is being posted. In this way the ledger postings are agreed daily and the work in connection with the balancing of the books is accelerated.

In modern systems every effort is made to reduce the number of operations in recording and handling transactions. For example, in the despatch and recording of sales, five operations—the detailed advice to the packer, the case contents note, the advice note to the customer, the invoice and the entry in the sales day book—may be effected at one typing by means of the typewriter, specially prepared forms and carbon leaves. The carbon copies of the original invoices are bound into books and thus form the sales day book. By such methods a considerable saving of time is effected and the opportunities for error are reduced.

Analysis Books.—A material amount of time can be saved in many businesses by analysis books, by which the number of items to be posted can be reduced to monthly totals. In large concerns, where a considerable amount of analysis work has to be done, machines are used, by which a great volume of transactions can be recorded and analysed accurately with incredible speed. The use of such machinery is the most marked development which has taken place in recent years, and as the result of practical experience, office machinery is firmly established as a valuable part of the modern accounting organisation.

Statistical Records.—The use of statistical records is as yet in an early stage of development. In the account books of a business a mass of detail information is recorded covering every phase of all the transactions of the concern. The bookkeeping records result in the annual profit and loss account and balance sheet of the business, but the modern business man is realising that important changes and movements can take place during a year and that it is vitally necessary that such movements should be detected immediately they develop, in order that steps may be taken at once with a view to overcoming any adverse factors.

With this end in view, it is a comparatively simple matter to organise a statistical system built up from the existing records by means of which the information available for the management is greatly expanded and every change is recorded from

week to week. Many modern businesses have developed this type of organisation to a high degree of perfection, and have proved by practical experience the great value of this information in the management and control of business operations. Many concerns prepare approximate profit and loss accounts and balance sheets monthly, so that the whole position can be watched closely and in addition have detail statistical records of every important factor.

Diagrams are of great value, as in many cases a movement is revealed far more clearly by a well-drawn diagram than by a statement of figures, and a diagram often reveals factors which may be entirely overlooked upon a close study of a series of figures.

The Double Account System.—This system was first provided for in the Regulations of Railways Acts, 1868, and its use has been extended to gas, water, electric light and canal companies. It therefore applies compulsorily only to these classes of companies which are formed under special Acts of Parliament and which are required to present their accounts upon a uniform basis.

There is no difference in principle as between the ordinary method and the double account system—the difference is merely that under the latter system the balance-sheet is split into a capital account and a general balance-sheet. The capital account shows on the one hand the share and loan capital raised, and on the other the expenditure to date upon the acquisition of the fixed assets of the undertaking. The credit balance upon the capital account, which represents the working capital of the concern, is carried to the general balance-sheet, which, in addition, includes on the one side all the floating assets, such as cash, investments, stock-in-trade, book debts, etc., and on the other, trade creditors, temporary loans, reserves and the balance upon the profit and loss account.

With the ordinary company, the information contained in the capital account and general balance-sheet, as described above, is consolidated into one account—*i.e.*, the balance-sheet. The objects of the double account system are to show the share and loan capital which has been raised, the expenditure upon fixed assets and the balance of working capital which remains.

Under the regulations governing these statutory companies, their fixed assets must be maintained out of revenue. When, therefore, a fixed asset is replaced, the cost of the renewal must be charged direct to revenue account, but these companies are not bound to provide in advance for the cost of replacement, that is to say, during the life of the asset. The whole of the cost of replacement therefore falls upon the revenue account of the year during which such replacement takes place.

This system inevitably leads to very fluctuating charges to revenue account for replacements, but these fluctuations can be overcome by the creation out of revenue of replacement reserves. Such provisions, however, are not legally necessary and are therefore quite voluntary.

Under the regulations it is not clearly laid down as to what the procedure should be in cases where, owing to increased prices, the cost of replacement exceeds the original cost. For example, the cost of replacement of a fixed asset might be £30,000, whereas the original cost was £20,000. In this connection practice differs and some companies charge the actual cost of the replacement to revenue, and others the original cost. It is generally held that the sound policy is to charge the whole of the increased cost to revenue, as the earning capacity has not been increased, the extra cost being caused merely by an increase in price levels.

In the case of a fixed asset which is abandoned and is not replaced, the regulations do not provide that the cost of the discarded asset shall be written off to revenue. The working of the system in practice, as regards the replacement of fixed assets and as regards discarded assets, is open to criticism, but these are difficulties which may be overcome by the creation of reserves out of revenue. (*See* COST ACCOUNTING.)

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(F. R. M. DE P.)

BOOKKEEPING MACHINE: *see* OFFICE APPLIANCES.

BOOTH, CHARLES (1840–1916), British sociologist (*see* 4.238), died at Gracedieu Manor, Leicestershire, Nov. 23 1916.

BOOTH, WILLIAM (1829–1912), founder of the Salvation Army (*see* 4.239), died in London Aug. 20 1912. In 1909 Gen. Booth lost the sight of one eye and, three months before his death, of the other also. His last public appearance was at the Albert Hall, London, on May 9 1912. He was buried at Abney Park Cemetery, London, after lying in state at Olympia, West Kensington, London.

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BOOTH, WILLIAM BRAMWELL (1856–), general of the Salvation Army, and eldest son of General William Booth, its founder, was born at Halifax, Yorkshire, in 1856. He became an officer in the Salvation Army in 1874, and was appointed chief of the staff in 1880, a position which he held until his father's death in 1912, when he became general. Mr. Bramwell Booth organised the first social relief operations of the army, of which he had charge from the time when it began to extend its activities abroad. As general he travelled extensively on behalf of the Salvation Army in Europe, the United States, Canada, India, Australia and New Zealand. He originated a training system for officers in the organisation, and did much to develop foreign missions. Mr. Booth was prominent in the campaign against the "white slave" traffic. In 1885, as a result of his part in a social purity agitation, he was indicted with the late W. T. Stead and others on a technical charge and was subsequently acquitted. The action proved to a sceptical public that young girls could be bought and sold under the most degrading circumstances, and it was largely due to this agitation that the Criminal Law Amendment Act, 1885, was passed. He was ably assisted in his work by his wife, Florence, herself a Salvation Army officer, whom he married in 1882.

BOOTLEGGING AND SMUGGLING.—National prohibition (*q.v.*) in the United States has brought about a revival of the lost art of bootlegging and of the once rather popular profession of smuggling. The pioneers of early colonial days found it expedient to outlaw the sale of liquor to the Indians who, unaccustomed to its use, drank to excess and under its influence often became dangerous. But unscrupulous citizens, caring more for financial profit than for community welfare, engaged in the forbidden traffic and often concealed in the legs of their boots the liquor they carried for sale. This gave the name "bootlegger" to the illicit liquor trafficker. The name has now been revived and applied to the various phases of the intricate outlaw business of supplying liquor to the market in the complex modern world.

Smuggling.—Smuggling was a lucrative and more or less accepted occupation in colonial times, there being no centralised government interested in customs revenues. After the central government was formed, it established a Federal control of customs revenue and, through the Federal agencies of customs revenue and service and coast guard, it soon made smuggling unprofitable and unpopular, and the practice almost disappeared. The boundary line between the United States and Mexico has been the one exception. This frontier is for each nation the furthest removed from its seat of government and constitutes for each its least populous region. Except at a few widely separated points it consists of more or less barren deserts and mountains. These conditions are ideal for smuggling, and both nations have suffered financially from its continued practice. In May 1925 the representatives of both nations met in El Paso, Tex., and formulated a treaty that was designed to stop smuggling along the boundary line.

Introduction of Prohibition.—While the early settlers found it expedient to forbid the sale of liquor to a certain class, it was only by slow stages that society in the United States became willing to forbid the use of liquor to all its members. Laws to this end first appeared in small communities; and here always someone was ready to import liquor for profit in violation of the law. The need was thus always felt for wider and wider control, until ultimately the Constitution of the United States was amended to forbid the manufacture, transportation or sale of intoxicating beverages anywhere within the nation. In its laws making this amendment effective, Congress defined intoxicating beverages to be those containing one-half of 1% of alcohol by volume.

The Illicit Markets.—Individuals who continued to drink created a demand for intoxicating beverages in violation of the

law, and, as always, there were unscrupulous individuals willing to supply this illicit market. There was thus rapidly built up the outlaw business of obtaining supplies of liquor and of distributing them to the market—a business involving the bribery of government and other agents and the corruption of traffic in alcohol and liquors for legitimate purposes. The Govt. easily controlled all the known supplies of liquor, and ultimately concentrated them in government-controlled warehouses from which they were withdrawn for legitimate purposes by government permit. Those people still determined to drink turned at first to home manufacture. But the bootleg business developed rapidly, and liquor soon became available at such prices as made home manufacture unnecessary, as it always had been inconvenient and unsatisfactory.

Revival of Smuggling.—The first bootleg supply was liquor withdrawn from government warehouses through the use of fraudulent permits, etc. This was soon prevented by the Govt. and the bootlegger then turned to importation from abroad. Smuggling, on an increasingly large scale, sprang into existence. Ships under the protection of foreign flags, laden with contraband liquor, hovered just without the territorial waters, within easy communication of the shore, and there established an unfailing source of supply to the bootlegger.

Coast Guard Measures.—The U.S. Coast Guard, long since relieved of its duty to prevent smuggling, and for generations engaged in the happier duty of bringing relief to those in distress at sea, was ill prepared to break up this traffic. By 1924 as many as 336 rum ships were known to be engaged in bootlegging. All along the coasts, specially equipped high-power motor-boats, often armed and armoured, and innumerable fishing and other coastwise craft, were engaged in running liquor from these ships to countless inlets and landing places. Congress increased the personnel and equipment of the coast guard to meet this situation; and the Govt. made treaties with foreign powers which, for this purpose, extended the U.S. territorial waters from 3 m. to 12 miles. By June 1 1925 the coast guard was sufficiently augmented to make a serious effort to eliminate this smuggling business off the Atlantic coast between Boston and Atlantic City. The method employed was to picket each rum ship with small patrol boats which rendered contact with the shore impracticable. This resulted in reducing the rum fleet along this front to negligible proportions and in keeping at much greater distances the few ships which did appear.

Home Manufacture.—As bootlegging found increasing difficulty in importing its supplies from abroad, it turned to home manufacture and rapidly acquired facility in imitating every foreign and domestic brand that the market demanded. Labels and containers were imitated with sufficient perfection to defy detection on the part of the purchaser. The alcohol for this manufacture was obtained by the diversion of alcohol, and particularly of denatured alcohol, from its legitimate avenues in industry. This rapidly became the chief, practically the only, source of supply. The percentage of unadulterated genuine whisky found among the total of the whisky confiscated runs between 1 and 2%.

Industrial Uses.—Alcohol (*q.v.*) is one of the articles essential to industry. Its uses are so numerous in manufacture, and the quantities used legitimately by industry are so large, that its control introduces the most serious problems for the Govt. in the enforcement of the prohibition laws. To these problems the Govt. was in 1926 giving the most serious attention, with the purpose of encouraging and protecting the legitimate use of alcohol and of eliminating its illegitimate use. This involved issuing annually over 40,000 permits and supervising the operations of the permittees.

Bootleggers and Industry.—The bootleg industry in turn invaded practically every field of business and secured permits for the use of alcohol, transacting just enough legitimate business to secure the permits, while diverting to the liquor traffic the rest of the alcohol secured. To do this successfully they sold to legitimate customers at greatly reduced prices in order to get enough business to justify their existence. They thus menaced the stability of many legitimate business enterprises and almost forced them to participate in the illegitimate profits derived from the bootleg industry. The Govt. undertook to control this situation in its earlier developments by denaturing alcohol for industrial use, to make it unfit for beverage use. But the bootlegger, indifferent to considerations of public health, soon established the practice of "boiling," or redistilling—but indifferently well. A later expedient was the introduction of chemicals to counteract the denaturant, liquors containing a double dose of chemicals thus reaching the market.

Administrative Organisation.—Early in 1925, the U.S. Coast Guard, the customs service, and the prohibition activities, all more or less directly concerned with the enforcement of the prohibition laws, were concentrated under the control of one assistant secretary in the Treasury Department. The prohibition unit was reorganised and regulations and policies were revised so as to strengthen materially the hand of the Govt. and enable it more successfully to cope with the organised and demoralising liquor traffic.

Narcotics.—While the conspicuous revival of smuggling involves liquors primarily, it is only natural that the practice, once established, should have come to include other articles. Smuggling was in 1926 practically the only source of supply for the illicit trade in narcotics. Because this trade offers tremendous profits, and because narcotics are moved in such small packages, the Govt. finds it difficult to control this smuggling. All manner of expedients are resorted to by the smugglers, and their detection requires constant vigilance on the part of highly trained agents. Real progress was, however, being made and, while there were still many addicts in the United States, it was believed that their number was continually decreasing.

It is impossible to state with even approximate accuracy the amount of liquor smuggled into the United States or illicitly manufactured during the period covered by the National Prohibition law. The very fact that the business is unlawful renders it impossible to obtain reliable figures. The table that follows gives some statistical data of the operation of the Federal prohibition officers since the effective date of the 18th Amendment. The table shows only the legal transactions uncovered by prohibition officers and permits no estimate of the undiscovered unlawful transactions.

Report of Arrests, Seizures, etc., Made by Federal Prohibition Officers

	Fiscal Year ending June 30		
	1923	1924	1925
Illicit distilleries seized	12,219	10,392	12,023
Illicit stills seized	14,000	15,853	17,854
Illicit still worms seized	7,512	8,211	7,850
Illicit fermenters seized	124,401	124,720	134,810
Gal. of distilled spirits seized	457,365	1,672,743	1,102,787
Gal. of malt liquor seized	4,803,872	5,379,528	7,040,537
Gal. of wine, cider, mash and pomace seized	9,085,411	8,774,916	10,572,933
Number of boats and launches seized	134	236	182
Total appraised value of property seized	$11,478,277	$10,843,881	$11,199,664
Number of agents injured	45	28	39
Number of agents killed	11	2	7
Number of persons arrested	66,936	68,161	62,747

(L. C. A.)

BORAH, WILLIAM EDGAR (1865–), American politician, was born at Fairfield, Ill., June 29 1865. He studied at the Enfield Academy, Ill., and entered the University of Kansas with the class of 1889, but did not finish his course. He was admitted to the bar in 1889, practised at Lyons, Kan., 1890–1, and thereafter at Boise, Idaho. He was an unsuccessful candidate for the U.S. Senate in 1902, but was elected in 1906 and re-elected in 1912, 1918 and 1924. At the time of the split in the Republican party in 1912 he opposed the nomination of President Taft, but refused to follow Roosevelt, although in sympathy with his

policy. In 1913 he introduced an unsuccessful bill for raising the income tax exemption to $4,000. He had long favoured a Federal levy on incomes, but thought that with the then existing system of indirect taxation the additional burden should fall upon the well-to-do. He favoured woman suffrage and independence of the Philippines, but was opposed to the League to Enforce Peace on the ground that it tended toward internationalism. He strongly opposed many of the measures of President Wilson's Administration, and in particular the League of Nations, of which he was always an active opponent.

Always a strenuous advocate of disarmament Borah proposed a resolution in the Senate in favour of opening negotiations with Great Britain and Japan for a mutual reduction in the naval programmes of the three Powers. Though rejected at first, it was ultimately adopted by Congress as an amendment to the Naval Appropriation bill of 1921. He suggested also a world economic conference to consider disarmament, and it was in part owing to his efforts in this direction that the Washington Conference on the limitation of armaments (Nov. 1921) was held. He endeavoured unsuccessfully to persuade the Senate to recognise the Soviet Govt. of Russia. At the time of the coal strike of 1922 he favoured the operation of the mines by the Federal Government. He was opposed to the World Court, on the ground that it was an adjunct of the League of Nations. Opposed as he was to the United States joining the League of Nations, he prepared an alternative plan to "outlaw" war, which he placed before the Senate Feb. 13 1923. His sympathy with the insurgent group within the Republican party was reflected in a movement to nominate him as a candidate at the next presidential election; but at Spokane, Wash., June 23 1923, he declared that he would neither lead a third party nor be a candidate.

At the Republican National Convention held at Cleveland, O., June 12 1924, he was nominated for the office of vice-president, but refused to permit his name to go before the convention. Both on the platform and in the Senate he continued to take an active independent interest in foreign affairs as they affected the United States, freely criticising the policy of the Government. He constantly urged that pressure be brought to bear upon the Allied nations in connection with the repayment of the loans made to them by the United States. On the death of Senator Henry Cabot Lodge he became chairman of the Committee on Foreign Relations, Dec. 3 1924. In the final vote in the Senate Jan. 27 1926, he was one of the 17 who voted against the participation of the United States in the Permanent Court of International Justice. Although one of the most influential men in American public life during the period 1915–26, Borah adopted, in general, a critical rather than constructive attitude toward specific measures and his name is associated with the enactment of few important or progressive laws.

BORDEAUX (*see* 4.244) became the seat of the French Govt. when Paris was threatened by the Germans in Aug. 1914. Its population (1921) was 267,409. During the World War the town and port were exceedingly active. The factories were engaged in munition work and great quantities of stores and troops passed through the harbour, which was the chief disembarkation point for the American forces. After the War it was the seat of an American embarkation camp. In 1920 the Grand Theatre, where the National Assembly met in 1871, was burned down. An annual international fair, with a strong colonial tendency, was started in 1916, and has been held each year since, except in 1918. The wireless station at Croix d' Hins, begun during the War by the American authorities and completed afterwards, at the time the most powerful in the world, was handed over to the French Govt. in 1920.

During the War practically a new outer port was constructed at Bassens, below Bordeaux, largely by the American authorities, with docks, sheds to accommodate 40,000 tons of stores, a grain silo with a capacity of 60,000 quintals, etc. The river channel has a depth of 26 ft. to Pauillac and of 23 to 26 ft. from there to Bordeaux. A dry dock is to be built. In 1923 the establishment of an outer, or deep-water, port at Le Verdon, at the mouth of the Gironde, was sanctioned and work was started in 1924.

BORDEN, SIR FREDERICK WILLIAM (1847–1917), Canadian politician (*see* 4.245), retired from politics in 1911. Created K.C.M.G. in 1902, he died at Toronto Jan. 6 1917.

BORDEN, SIR ROBERT LAIRD (1854–), Canadian statesman (*see* 4.245), in Oct. 1911 formed a new administration to succeed that of Sir Wilfrid Laurier and on Jan. 1 1912 took office as president of the Privy Council of Canada, or Prime Minister. He was created G.C.M.G. in 1914 and during the World War spent some time in England as a member of the Imperial War Cabinet. In Oct. 1917, with a view to the better fulfilment of Canada's part in the War, Borden formed a Government comprising members of both the Liberal and Conservative parties. In this Government, which was returned to power at the election of Dec. 1917, he took office as premier and secretary for external affairs. During the War period he rendered notable service to the Allied cause, for instance in bringing about the proper utilisation by the Allies of the resources of the British Empire, such as lumber, minerals, and food; at the same time he was a strict but courteous upholder of the Canadian point of view. In 1919 he retired from the premiership and in 1922 published *Canadian Constitutional Studies*. (*See* CANADA.)

BORDET, JULES (1870–), Belgian physiologist, was born at Soignies June 13 1870. In 1892 he graduated as doctor of medicine at the University of Brussels. From 1894 to 1901 he worked at the Pasteur Institute at Paris whence he was recalled to Brussels to found a "Pasteur Institute" for the province of Brabant of which he was made director. He was also appointed professor at the University of Brussels and in 1919 received the Nobel Prize for medicine and physiology.

His early studies showed that antimicrobic sera include two active substances, one existing there before immunisation, and known as alexine; the other a specific anti-body created by vaccination. He introduced the method of diagnosing microbes by sera; and his discovery of the fixation of alexine (in the first instance for cholera) inaugurated a general method of diagnosis for infectious fevers, now universally employed for the identification of typhoid fever, plague, tuberculosis, etc. He discovered haemolytic sera in 1898; that is, the immunisation gained by every animal when inoculated by the blood of another species, against the latter, by the production of substances which destroy the red corpuscles of the same species as those which have been injected. In this manner the various species of animals can be distinguished by the chemical constitution of their specific albuminoids. He also showed that haemolytic sera act on foreign blood by a mechanism strictly comparable with that by which an antimicrobic serum acts on microbes and, further, that the reactions of all these sera are colloidal in nature.

More recently he discovered the microbe of whooping cough determining its action and the method of immunising convalescents from that disease. He devoted much time to the study of the coagulation of the blood and has thrown light on the process of the formation of coagulin showing that it includes two elements; the first, albuminoidal and peculiar to the liquid blood and the other, lipoidal in nature, originating in the cells of the blood or tissues. He further studied the formation of anaphylactic poisons and, in the sphere of microbic biology, the autolysis of microbic transmissibility. In addition to many works on various subjects, he is the author of *Traité de l'Immunité dans les maladies infectieuses*, published in 1920.

BORENIUS, TANCRED (1885–), Finnish art historian, was born July 14 1885 at Wiborg, Finland, son of Carl Borenius. He began his studies at the University of Helsingfors and went therefrom to Italy, where he laid the foundations of his profound knowledge of Italian painting. In 1914 he was appointed lecturer on the history of art, and in 1922 professor at University College, London. When Finland became independent, he acted as secretary to the Diplomatic Mission (1918), notifying the event to Great Britain, France, Belgium, etc., and the next year he was the temporary diplomatic representative of Finland in London. His works include *The Painters of Vicenza* (1909); a new edition of Crowe and Cavalcaselle, *History of Painting in North Italy* (1912); *Catalogue* of the Collections of Sir Frederick

Cook, vol. 1, "Italian Schools" (1913); *Catalogue* of Viscount Lee of Fareham's Collection (1923); *Four Early Italian Engravers* (1923); *English Primitives* (1924).

BORGLUM, GUTZON (1867–), American sculptor, was born in Idaho March 25 1867. He was educated at St. Mary's College, Kan., studied art at the school of the San Francisco Art Assn. and during 1890–3 attended the Académie Julien and the École des Beaux Arts in Paris. He then returned to America, but in 1896 went to London, and exhibited much sculpture and painting there and in Paris. In 1902 he moved his studio to New York. He was a disciple of Rodin. The huge scale of many of his conceptions can be compared only with that of antique oriental monuments. For example, he proposed a Confederate memorial on Stone Mt. near Atlanta, Ga., to be cut in relief along the face of that granite mountain as a frieze representing an army on the march, conspicuous from a great distance. The Stone Mountain Confederate Monumental Assn. was formed in order to carry out the suggestion and Borglum prepared a design. The work, however, was interrupted owing to difficulties arising between him and the association. A new design by Augustus Lukeman was adopted Aug. 27 1925 in place of that of Mr. Borglum. In 1919 he exhibited a head of Lincoln cut from a block weighing six tons. The same year he was chosen to design a monument for Warsaw, commemorating the rebirth of Poland. Among his colossal figures are the Twelve Apostles for the Cathedral of St. John the Divine, in New York, and another head of Lincoln in the rotunda of the Capitol at Washington. Other works include the Sheridan Monument in Washington; "Mares of Diomedes" and "Ruskin" in the Metropolitan Museum of Art, New York; a statue of Lincoln, Newark, N.J.; and a statue of Henry Ward Beecher at Brooklyn.

BORGLUM, SOLON HANNIBAL (1868–1922), American sculptor (*see* 4.250), brother of Gutzon Borglum (see above), completed many important statues after 1910, including "God's Command to Retreat" in 1911, representing Napoleon on horseback in a snowdrift, in bronze; "Jacob Leisler," heroic figure in bronze at New Rochelle, N.Y.; "Reverie of a Pioneer," colossal equestrian for the Court of Honour, San Francisco Exposition; "Backin' 'Em Up" (1919), four dismounted cavalrymen, with horses; "The Little Lady of the Dew," unveiled 1920 in the churchyard of St. Mark's in the Bowery, New York City; "Inspiration" and "Aspiration" (1920), two statues of Indians, in stone, both at St. Mark's in the Bowery. He was Y.M.C.A. secretary with the French Army in 1918, won the Croix de Guerre and later was engaged in work with the American Expeditionary Force in France. He died Jan. 31 1922.

BORIS III. (1894–), King of the Bulgarians, was born at Sofia Jan. 30 1894. The eldest son of Ferdinand I, who abdicated in his favour, and of Princess Marie Louise of Bourbon-Parma, who died in 1899, he received at birth the title of Prince of Tirnovo. Though born into the Roman Catholic religion, Boris III. joined the orthodox religion for political reasons in 1896. The Prince was educated at the military academy of Sofia, and in 1911 and 1912 travelled extensively with his tutors for educational purposes in Asia Minor, along the Mediterranean coast, in North Africa and the Canary Islands. His official journeys as heir-apparent included a visit to his godfather Nicolas II., at St. Petersburg (Leningrad) in 1897, visits to Brussels and Paris in 1910 and to London for the coronation of King George, 1911. He served as major in the Balkan War of 1912. During the World War, Prince Boris was attached to his father's staff, under the strict control of Ferdinand, who was well aware of his son's opposition to the Central Powers. Following the abdication of Ferdinand, Boris III., was proclaimed King of the Bulgarians, Oct. 4 1918. After his accession he lived the life of a constitutional monarch, residing at the palaces of Sofia, Vrania Euxinograde and Sitnyakovo. His education made him fluent in Bulgarian, French, Italian and German, and gave him an acquaintance with English, Albanian, Russian and Turkish. The possessor of wit, courage and individuality, he displayed great charm of manner. A great naturalist and especially fond of botany, he was also a born engineer.

BORNEO (*see* 4.256), an island in the East Indies. Its area is 289,846 sq. m. and the population is estimated at 2,500,000.

During the period 1910–25 the four political entities into which the island of Borneo is divided were free to work out their own development. The War affected them only economically. Among the natives of the far interior there were occasional disturbances, of which the Rundum rebellion in North Borneo in 1915 was the most serious, but these were suppressed by the forces at the disposal of the Governments concerned. The native tribes now live at peace; the whole island, except possibly for certain parts of Dutch Borneo, is under effective control, and apart from one or two outbreaks in the remoter districts, headhunting may be regarded as a thing of the past.

Area and Population.—The total population of the island in 1925 was estimated at about 2,500,000. The total white population was about 5,000. The Chinese were about 250,000. The following table gives the areas and population of the four political sections into which the island is divided:—

	Area (sq. m.)	Population
Dutch Borneo	212,740	1,626,001[1]
North Borneo	31,106	257,804[2]
Sarawak	42,000	600,000[3]
Brunei	4,000	25,451[2]
	289,846	2,509,256

[1] Census of 1920.
[2] Census of 1921.
[3] Estimated.

Production.—The rubber boom of 1909–10 led to large areas of land being taken up for planting, and so brought increased prosperity to the island. The boom came at a time particularly fortunate for North Borneo, which was then passing through a critical period. Brunei, and to some extent Sarawak, also benefited. Rubber companies in Borneo suffered severe depression in the years that followed the War, but the tide turned in 1925, plantations in Dutch Borneo (where tapping was not restricted) making particularly large profits (*see* RUBBER). Increased interest has been shown in coconut planting throughout the Island, but the tobacco industry, which is confined to North Borneo, experienced serious reverses. The financial assistance of the Chartered Co. enabled the three companies still operating in 1925 to survive. The stands of commercial timber in the island are almost inexhaustible and are being exploited with European capital in Dutch and North Borneo. In 1920 a modern sawmill was established in Sandakan, but owing to the political chaos in China, the nearest and most important market, the timber industry in North Borneo had not by 1925 realised expectations.

Minerals.—Dutch Borneo, the most developed part of the Island, owes its prosperity mainly to its mineral wealth. The most extensive oil-fields are at Balik Papan, but there are several others of importance, and fresh oil is continually being struck. Gold and diamonds are also worked, the richest diamond field being at Martapura, where Cape diamonds are sent for polishing and then returned to the Cape. The workings are entirely in Malay and Chinese hands. The discovery at Miri of a rich oil-field of great extent improved the fortunes of Sarawak at a time when the gold was being worked out; the annual production is over 600,000 tons, which brings the state £100,000 in royalties. Up to the end of 1925 no oil in paying quantities had been found in North Borneo, where the only mineral worked commercially was coal, mined by a British Co. at Silimpopon. Coal is mined also in Dutch Borneo and Sarawak, but the mines at Labuan have been abandoned owing to the seams running under the sea.

Trade.—The internal trade of the island is almost wholly in the hands of the Chinese. The chief imports are rice, cloth, ironware, tinned provisions, kerosene oil and matches. These are common to all the territories, but the exports vary and show the different lines on which each area is developing. In order of importance, the six chief exports of Dutch Borneo are timber, oil, coal, diamonds, gutta-percha and copra, with rubber becoming more important every year; of North Borneo, plantation rubber, timber, tobacco leaf, copra, coal and cutch; of Sarawak,

oil, sago, plantation rubber, jelutong, pepper and cutch. Sarawak has also a considerable trade in rattans and illippi nuts.

Communications.—The development of the island has been hindered by lack of good communications. At the end of 1925 there were 125 m. of railway in North Borneo and 20 m. in Sarawak. Good roads, beyond those in the south of Dutch Borneo, are few. After the War an extensive scheme for opening up North Borneo by means of roads was introduced, but the need for economy caused a revision of this policy; a metalled road of 20 m. between Jesselton and Tuaran was completed, however, and also a few miles in the neighbourhood of Sandakan. Elsewhere bridle paths take the place of roads, while rivers and native tracks remain the only highways through the forests of the far interior. Towns and Government stations are linked up by telephone and telegraph, Sandakan having an automatic telephone service, and there are wireless stations in Dutch and North Borneo and Sarawak. The ports are connected by coasting steamers. Steamship companies also maintain communication between Dutch Borneo and Surabaya and Singapore; between North Borneo and Singapore, via Labuan, the Philippine ports, Hongkong and Australia. A British Co. has replaced the German line which served the territory before the War, while another line runs from Singapore to Sarawak.

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BORSTAL SYSTEM.—In the domain of criminal law, the notable change in public attitude and opinion with regard to the treatment of juvenile crime, finds expression, as far as Great Britain is concerned, in the two Acts of Parliament of 1908, viz.: The Prevention of Crime (Borstal) Act, and the Children Act.

In the middle of the 19th century, strong protests were made against a penal system, under which young persons and even children were subject to the harsh penalties of imprisonment, and penal servitude and transportation were commonly inflicted on young and old alike. Effort was then concentrated on the attempt to substitute for such penalties a system of industrial and reformatory treatment; and in 1854 the principle was established that at least up to the age of 16 this method should, in suitable cases, be adopted. In 1894 two public inquiries into the administration of prisons and of Home Office schools arrived, almost simultaneously, at the same emphatic conclusion, viz: "that the age 16–21 was the dangerous age; that we must concentrate on that; on the incipient criminal" or, as he was officially christened, the juvenile adult. At this time, about 20,000 young criminals of this age, 16–21, were coming every year to prison. They constituted a veritable recruiting ground or nursery for the dangerous professional criminal of later years. To find a remedy for this was the purpose of what has now become known as the Borstal System.

Under the Acts above quoted, the following principles were established:—

1. The age of criminal "majority" was extended to 21, with power to raise to 23.
2. In lieu of the ordinary sentence of imprisonment, a special form of detention was devised, under special rules, of which the purpose was to develop mentally and physically and morally all inmates (not prisoners). The duration to be for not less than one year nor more than three.
3. Except in very special cases, no sentence of imprisonment could be passed on any person under 16.

The new system took its name from the village of Borstal, Kent, where the early experiments on boys between the ages of 16 and 21 were carried out in an old convict prison, prior to the passing of the Act.

The Act gives power to the Court to order detention in any case, 16–21, "where it shall appear to the court that by reason of criminal habit or tendency it is expedient that the offender shall be subject to such instruction and discipline as appears most conducive to his reformation and to the repression of crime."

Aims and Results.—The rules and regulations are based on the principle that up to a certain age, every offender may be regarded as potentially a good citizen; that his lapse into crime may be due either to physical degeneracy or bad social environment; that it is the duty of the state at least to try to effect a cure, and not to class the offender offhand and without experiment with the adult professional criminal. The Act of 1908 further provided for the establishment of an association, whose special duty would be to provide for the after-care of all persons of both sexes discharged from Borstal Institutions. This association, known as The Borstal Association, is a highly organised method of care and supervision. Without this supplementary work of patronage the Borstal System could not have attained the conspicuous success which can be claimed for it, because, of the 6,000 lads released after training in Borstal establishments since the Act came into operation, only about 35% have again come into conflict with the law. Broadly, about two out of every three Borstal lads are reclaimed.

This result is achieved by the "personality" of the superintending staff, from the Borstal commissioner himself to, in a descending scale, governor, house master, and a carefully selected instructing staff, each with a strong optimism and belief that by an appeal to what is best in each individual—his honour, corporate spirit, pride in his house, love of sport, and rivalry in games and competitions, by all these subtle weapons, wisely and steadily employed, it is possible, though not easy, to recreate young natures and dispositions not yet thoroughly depraved.

When the day of freedom comes, gained after long and patient trial and test, in the form of a conditional licence to the care of the Borstal Association, which is only granted when "there is a reasonable probability that the offender will abstain from crime," the licencee faces life again with a changed outlook. The Borstal System ranks as a work well done, justifying the ideals of its founder:—

> He determined to save the young and careless from a wasted life of crime. Through his vision and persistence a system of repression has been gradually replaced by one of leadership and training. We shall remember him as one who believed in his fellowmen. (*See* CRIMINOLOGY.)

BIBLIOGRAPHY.—The reader should consult the quarterly review published by the Borstal Institution, Rochester. From July 1923 to Oct. 1924 it appeared as *The Borstalian;* and from Jan. 1925 onwards as *The Phoenix.* (E. R.-B.)

BOSE, SIR JAGADIS CHANDRA (1858–), Indian physicist, was born Nov. 30 1858. After graduating from St. Xavier's College, Calcutta, he entered Christ's College, Cambridge, gaining high honours in 1884. In 1885 he joined the Bengal educational service as professor of physical science at the Presidency College, Calcutta. His first appearance before the British Assn. at Liverpool in 1896 was to demonstrate an apparatus for studying the properties of electric waves almost identical with the coherers subsequently used in all systems of wireless communication. He also invented an instrument for verifying the laws of refraction, reflection and polarisation of electric waves. His discovery of a parallelism in the behaviour of the receiver to the living muscle led him to a systematic study of the response of inorganic matter as well as animal tissues and plants to various kinds of stimulus. After laborious researches he proved that the life mechanism of the plant is identical with that of the animal. His crescograph is a recorder of plant growth capable of magnifying a small movement as much as ten million times. He was the first Indian to become F.R.S. (1920) for scientific, as distinct from mathematical achievement. In 1915 he became professor emeritus of the Presidency College and thereupon devoted

himself to founding the Research Institute in Calcutta which bears his name. He was knighted in 1917.

See Patrick Geddes, *The Life and Work of Sir Jagadis C. Bose* (London, 1920) and *Sir J. C. Bose: His Life and Speeches* (Madras, 1920).

BOSNIA AND HERCEGOVINA (*see* 4.279), since 1918 provinces of Yugoslavia. Its area is 20,429 sq. m., and the population (1921) 1,889,929.

Austro-Hungarian Rule.—The winter of 1908–9 marked a decisive era in the history of Bosnia and Hercegovina, whose population found itself for six months the pivot of an acute international crisis. Despite the recent grant by the Austrian Govt. of a certain measure of church autonomy, the Serbian Orthodox element remained keenly dissatisfied, and looked more and more towards Serbia; the Moslems were nervous and reserved, realising that the steady ebb of Turkish influence in Europe was bound to increase their isolation; only the Croats, forming at most a quarter of the population, looked for help to Vienna, and they too were increasingly alienated by the trend of events in Croatia. One of the main arguments employed by Aehrenthal to justify annexation of Bosnia and Hercegovina was that the Young Turkish Revolution had forced Austria-Hungary to clear up the constitutional status of the two provinces, since otherwise the malcontent elements would have been entitled to representation in the new Parliament at Constantinople, and would thus have acquired a powerful instrument for anti-Austrian agitation.

Having made use of this argument, Vienna had no course save to grant some measure of representative Government to Bosnia and Hercegovina, and as neither Austria nor Hungary would consent to its being attached to the one rather than to the other, or to its partition between them, a hybrid form of constitution was devised, by which the territory received a Diet of its own and special laws of association and assembly, but was not represented in the two central Parliments and Delegations and thus had no say in foreign affairs. The new constitution, proclaimed on Feb. 17 1910, had the capital defect of stereotyping sectarian and social differences by dividing the electorate into three " Curiae " (or electoral colleges) and by assigning in each of these a fixed number of seats to the Orthodox, Moslem and Catholic elements, that is, 32·24 and 16 respectively, out of 72. The Diet was expressly excluded from any control of the executive, which remained as before under the Governor (Landeschef), his deputy (Ziviladlatus), the administrative head of departments in Sarajevo and the Joint Ministry of Finance in Vienna as supreme instance.

These carefully hedged concessions were very badly received. The Emperor's visit to Bosnia in the summer of 1910 was intended to symbolise to the outside world the permanence of Austro-Hungarian rule. Baron Burián, as Joint Finance Minister of the Dual Monarchy and administrator of Bosnia, tried to win the Serbian element for co-operation with the Government, and openly described them as the most progressive element in the country. Burián, himself a Magyar, was influenced by the fact that the Croats of Bosnia (with whom the Moslems were allied for tactical reasons) were strongly clerical in sentiment and were in close touch with their fellow clericals in Croatia, whose programme of Yugoslav unity inside the Habsburg Monarchy involved them in acute conflict with Budapest. The situation in Croatia reacted more and more upon Bosnia, and rendered Burián's half-measures ineffectual, while strengthening the self-confidence of the Serbs. In Feb. 1912 he was succeeded by Ritter von Bilinski, a prominent Polish Conservative who enjoyed the confidence of Francis Joseph; but any hope which he may have entertained of clearing up the internal situation was frustated by Hungary's establishment of a dictatorship in Croatia (April 1912) and by the victories of Serbia in the Balkan War (Oct.–Nov.)—events which roused the whole Yugoslav population of Austria-Hungary to a state of feverish excitement.

The Bosnian group was specially active among the Yugoslav students, who began to found organs of their own in Prague, Vienna and Zagreb as well as Sarajevo. The younger generation devoted their efforts to inculcating revolutionary ideas among university and middle school youth in Bosnia and the neighbouring provinces. They were completely successful. The confidential memoranda prepared by high officials in Sarajevo and Vienna on the very eve of the War show them to have been altogether at a loss as to what policy to adopt.

The Bosnian situation was rendered all the more difficult by the increasing jealousy between the provincial Government in Sarajevo and its nominal superior the Finance Ministry in Vienna, or to translate this into personal terms, between the military Governor, Potiorek, representing the views of the general staff and of the Archduke Francis Ferdinand, and the civilian Minister Bilinski as the confidant of the Emperor. In May 1913 Potiorek, despite Bilinski's disapproval, had closed the Bosnian Diet and dissolved various Serbian societies and the headquarters of the Serb Radicals. He continually urged the adoption of still more stringent measures, and tended more and more to act without consulting Bilinski. The most notorious instance of this was the decision, reached between Potiorek and Francis Ferdinand, that the latter should attend the military manoevures to be held in Bosnia in June 1914. Bilinski was not consulted or even notified, and the entire arrangements remained in military hands. To this circumstance must be ascribed a large share of the blame for the assassination of the Archduke Francis Ferdinand and his consort, the Duchess of Hohenberg, during their short but memorable visit to Sarajevo on June 28 1914.

This outrage was the work of Bosnian revolutionary students (*see* EUROPE; SERBIA).[1] The Governor, Potiorek, so far from being blamed for his lack of precautions, remained in high favour, was placed in command of the Austro-Hungarian forces invading Serbia and was mainly responsible for their severe defeat at Rudnik in Dec. 1914. He was replaced as governor by General Sarkotitch, who upheld all measures of repression against the Serb population. After the murder the mob of Sarajevo had, with police connivance, sacked many Serbian houses and institutions, and destroyed the Serbian printing presses and newspaper offices. During the following winter a whole series of treason trials were instituted against the youth of Bosnia—65 from the gymnasia of Sarajevo and Trebinje, 22 from Banjaluka, 9 from Mostar and 38 from Tuzla—thus demonstrating the widespread nature of the movement. Most notorious of all was the Banjaluka Treason Trial (Nov. 1915–April 1916) in which 98 out of the 151 prisoners were condemned to sentences varying from 20 years to 2 months, and 16 to death (afterwards reprieved). During the spring of 1915 the official organ at Sarajevo published list after list of Bosnian-Serb families who were thus declared to have forfeited their citizenship: and many thousands of women and children were driven across the Montenegrin frontier, often with only the clothes in which they stood.

Union with Yugoslavia.—During the War all political life ceased in Bosnia and Hercegovina. Almost all the Serbian schools were closed. When Austria's Balkan front collapsed in Oct. 1918, a national committee was formed in Sarajevo, which acted in close accord with the Yugoslav National Council at Zagreb. Since the formal recognition of union with Serbia by deputation from the Council, the fate of Bosnia has been bound up with that of the new Yugoslav State. But though centralising tendencies gained the upper hand in the seven years following the War, many vital problems of local concern still survive. The very difficult Bosnian land question, which Austria-Hungary failed to solve in her 40 years' rule, was solved all too drastically and on party lines. The state promised the big Moslem landlords compensation, but did not fulfil its pledge, once more for party reasons; but though the large estates were split up, a new agricultural and urban proletariat was created. Sarajevo and other towns lost much of their prosperity, owing to the ultra-centralist tendencies of Belgrade (*see* YUGOSLAVIA).

[1] For a full discussion of these events and the question of responsibility, see *Sarajevo*, by R. W. Seton-Watson (1926).

BOSTON, United States (*see* 4.290).—The population of the area incorporated as the city of Boston was, in 1920, 748,060, an increase of 77,475, or 11·6% over that of 1910, being by far the smallest percentage of increase in the history of the city, and the smallest numerical increase since 1875. But the two figures are not precisely comparable, as the municipal area was enlarged from 43 to 48 sq.m. in 1912 by the inclusion of Hyde Park, which in 1910 had a population of 15,507. During the five years 1915–20 the increase of population was less than one per cent. The official estimate for 1925 was 781,529.

The metropolitan area, constituted by the Legislature of Massachusetts for certain purposes of common action, includes, in addition to municipal Boston, 39 adjacent cities and towns, with an area of 409½ sq.m., and had in 1920 a population of 1,658,936, and in 1910 of 1,423,429. The percentage of population in the city, as compared with that of the metropolitan area, thus decreased from 47·8% in 1910 to 45·5% in 1920.

Commerce.—Boston's coastwise trade is important, the tonnage being much larger than that of its trans-Atlantic commerce. It is second only to New York in export of meat and dairy products, and is the largest leather, wool and fish market in the world. The port's foreign commerce is shown in the following tables:—

Vessels in Foreign Trade

	Entered		Cleared	
	Number	Net Tonnage	Number	Net Tonnage
1910	1,355	2,714,382	1,136	1,828,887
1915	1,488	2,463,651	1,161	1,659,802
1920	1,089	2,021,152	850	1,293,681
1923	1,695	4,303,563	1,036	2,229,408

Imports and Exports of Boston District[1]

	Imports	Exports
1910	$129,006,184	$ 70,516,789
1915	152,653,791	107,475,677
1920	456,246,322	281,614,919
1923	307,322,274	552,158,108

[1] Since 1919 known as the Massachusetts district, including Boston and eight minor ports.

Manufactures.—The following table shows the value of products and materials and the amount paid in wages in the years 1909, 1914, 1918, and 1923:

Manufactures of Metropolitan Boston

Year	Value of Products	Value of Materials Used	Wages Paid
1909	$ 510,583,337	$284,354,062	$ 93,125,349
1914	584,115,582	323,455,579	107,139,932
1918	1,240,496,193	737,506,555	210,781,794
1923	1,232,206,787	620,031,648	245,640,825

First in importance among manufactures is outer footwear, $172,879,356. Next in importance are slaughtering, $45,261,202; machinery and foundry products, including electrical machinery, $113,150,576; printing and publishing, $88,918,414; men's and women's clothing, $61,713,941; confectionery, $44,690,008. The increase in the value of manufactured products during the years of the World War (1914–8) was rapid, but was due largely to the increase in prices. The total increase in the number of persons thus employed from 1913, before the World War, to 1919, the period of highest production under war pressure, was 44,354. Then followed a period in which a large number of employees were out of work. With the immigration of foreign workers and the relatively static industrial demand, increasing numbers of native-born persons moved away from Boston and the actual increases in population were largely in the ranks of the immigrant peoples. In 1920, 32% of the inhabitants of municipal Boston were foreign-born. Of these, in percentages 24 were Irish, 16 Russian, 16 Italian, 5 English, 3 German and 36 all other nationalities; 64% of the municipal population was wholly or in part of foreign parentage.

Railways.—During the 15 years 1910–25 the subway system was enlarged. The Boylston addition from Arlington to Kenmore street (1911–4) and the extension under the Common over the Charles river basin and underground in Cambridge to Harvard Square (1914–8) developed a system 9 m. long. New subways with the elevated system gave central clearance and ease of transfer throughout the district. In the cities and towns several interurban lines were abandoned, but the motor transport service by private initiative was greatly increased. The second transportation requirement—the need for equipment to keep in touch with outside markets—has not been met. Boston has failed to provide adequate terminal and storage facilities; and it is constricted in its railway service. There are three railway systems that look to Boston for clearance and outlet: the Boston & Maine, the Boston & Albany, and the New York, New Haven & Hartford. But the lack of facilities for transfer from one system to another makes Boston virtually three ports instead of one—competitors with each other instead of with outside ports. The cities to the north (*e.g.*, Lowell, Lawrence, etc.) often find it of advantage to ship via New York. The same is true for freight originating on each of the three systems.

Education.—The public-school system is under state guidance and patronage (*see* MASSACHUSETTS). The trend of higher education has been toward increasing opportunity for the masses. This is shown not only by the increasing number of full-time college students, but also by the rapid growth in the number taking part-time university extension courses.

Buildings, Libraries and Museums.—In 1910 the Museum of Fine Arts was demolished, and on the site was erected the Copley Plaza Hotel, built at a cost of $3,800,000 and opened in 1911. The new building of the Museum of Fine Arts, erected on Huntington avenue, was opened Nov. 15 1909, and a second section opened Feb. 3 1915. The Boston Opera House was erected on Huntington avenue in 1909. To the State House east and west wings were added during 1914–9 at a cost approximating $3,000,000. John Sargent's series of panels in the public library was practically completed in 1916, when he added a third sequence, "The Theme of the Madonna." In Feb. 1924 the public library contained 1,308,041 volumes and had the large free circulation of 2,922,861 books for 1924. The New England Conservatory of Music remained the largest in the United States, having, in 1924, 3,374 students. In 1925 the Metropolitan Theatre was completed at a cost of $8,000,000; the Keith-Albee Theatre at a cost of $3,000,000.

History and Finance.—Boston, as a metropolitan district, has retained much of the institutional structure of the old towns which have grown together and become consolidated for certain purposes by legislation. Several things happened between 1909 and 1925 which indicate a drift toward political unification. What was known as the Boston 1915 movement resulted in better business leadership, in more ample support given to the Chamber of Commerce and other trade bodies and legislation toward a unified harbour. A charter adopted in 1909 gave to the city a small council of nine members elected at large. In 1920 a first effort was made to consolidate the several independent cities and towns under a Greater Boston charter, and in 1925 the holding of primaries (primary elections) was discontinued. In many ways the whole metropolitan district has developed the habit of acting together.

Boston's *per capita* expenses continued to be the largest of any American city; but the average yearly expenditure for the five years ending in 1923 was $48,504,028, excluding payments on funded and floating debts. The city debt in 1924 was $85,502,173 (gross debt, $128,627,401); this included the debt of Suffolk county, which in 1923 was $1,435,335. The Metropolitan Water Board System has a capacity of 80,000,000,000 gallons. The city's tax valuation in 1923 was $1,714,104,300, of which only $160,146,800 represented personalty. (F. A. Cl.)

BOTANY (*see* 4.299).—In treating generally of the progress and development of a science during a stated period attention may be either centred on specific events of importance which have marked that period, or directed to those gradual changes which

occur without any startling innovation, but still influence opinion or alter practice. We shall consider the progress of botany from both aspects.

Discovery of a New Class of Plants.—It is not often that so short a time as 15 years is stamped by any discovery of the first rank. But the foundation of a new class of plants justifies such a claim. The discovery of the *Psilophytales* in the Rhynie Chert, of early Devonian age, is an event not merely notable as introducing in full detail a type of vegetation barely hinted at before, but also because the early land-plants so disclosed present material of the highest importance for comparison. The positive illumination which they bring in the region of morphology may be compared with that shed by the observations of Hofmeister in 1857. The publication of the Memoirs, in which they are fully illustrated, may be held as the most striking botanical event in these 15 years.

This series of memoirs on Old Red Sandstone plants from the Rhynie Chert Bed (Kidston and Lang, *Trans. Roy. Soc. Edin.*, 1917–21) embodies detailed descriptions of four species belonging to three distinct genera of land-plants; three of them are complete from end to end as they might be of any modern types. Though vascular plants, they are rootless, and there is no differentiation of stem and leaf. The relations of these plants to the living *Psilophytales* are clearly recognised, though it was found necessary to establish a distinct class to receive them, associated as they now are with the old Devonian fossil, *Psilophyton*. The reticence which the authors show is one of the most remarkable features of these monographs. They stand as statements of objective fact, and will always have to be taken into account when the foundations of the morphology of the sporophyte are discussed. In particular these plants present a new aspect of the problem as to the origin of the main categories of members in vascular plants.

The Algae.—Almost coincidentally with their publication there appeared a series of memoirs by Dr. Church of Oxford, the most notable of which was an elaborate essay entitled "Thalassiophyta." They deal with the origin of the larger algae, and suggest views as to their relation to a land flora through some early but direct transition from marine to terrestrial life. But no details of the actual transitory forms are supplied. In contrast with the memoirs on the Rhynie Chert these writings convey little in the nature of new fact. They are original but highly speculative, while the Rhynie Memoirs provide material for new inductions with the minimum of theoretical conclusion. Time will surely show which of the two methods is the more fruitful and scientific.

Generations in Plants.—The old controversy on the antithetic as against the homologous origin of alternation of generations in plants had lost its intensity in 1910, in face of the obvious deficiency of facts which could lead to a final conclusion. Moreover the cytological detail in the development of the zygote in *Coleochaete* did not support the suggestion that the mass of cells produced represents a rudimentary sporophyte (Allen, *Ber. d. D. Bot. Ges.*, 1905, p. 285). Further, the product of germination of the zygote of *Oedogonium* was regarded by some merely as a sporetetrad. Little aid could be derived from the life histories of the desmids and diatoms, for they show inconstant suggestions of alternation in the making, but with the same cytological cycle at the back of all. The brown algae also tell an inconstant tale; for on one side we see a cycle of balanced alternation of haploid and diploid phases, such as was demonstrated for dictyota by Lloyd-Williams: on the other is the lop-sided cycle of *Fucus*, where there is no independent haploid generation at all beyond the gametangia themselves, and the substantive plant is diploid. The period under discussion has happily shed light on this difficulty by the demonstration, through various hands, of a minute but independent gametophyte in *Laminaria*. Those who will, may see in it some elucidation of the state of *Fucus*, and hold the view that there has been a progressive elimination of the independent gametophyte along lines roughly parallel to those of angiospermic plants, the final result appearing in the simple cycle of *Fucus* itself.

Meanwhile a serious attack has been made at a more promising point by the study of the cytological history of one of the simpler brown algae. MissKnight (*Trans. Roy. Soc. Edin.*, vol. 53, 1923) has shown that the cycle of *Pylaiella* may be traced from diploid plants bearing unilocular sporangia and haploid spores, to haploid plants producing haploid gametes whose fusion results in the re-establishment of the diploid condition. But the completion of this cycle may be indefinitely postponed by a long succession of haploid and diploid individuals, while there appears to be no obligate relationship between the cytological states of the somatic nuclei and the kind of sporangium developed on a given thallus. In fact, in *Pylaiella* the cytological state cannot be viewed as determining the nature of the reproductive cells. This instability suggests that we see here a form of alternation nascent rather than complete; and it stimulates interest in a continued cytological study of other simple algae.

Cytology of the Red Seaweeds.—The complicated life histories of the Red Seaweeds have, during the period under review, been reduced to a common cytological scheme, through the investigations of Yamanouchi, Kylin, Svedelius and others. In the simpler types the reduction takes place on the first division of the egg (Scinaia), so that the egg only is diploid and the rest of the cycle haploid, reproducing vegetatively by monospores: this state is not unlike that of *Oedogonium*. But in others three distinct generations may occur in the life history, the reduction taking place in the *Tetrasporangium*. The germination of a tetraspore gives a haploid gametophyte; on syngamy the result may be a diploid carposporophyte, which is dependent upon the sexual plant and produces carpospores. These again on germination produce diploid tetrasporophytes, bearing after reduction haploid tetraspores; and these again germinate to form gametophytes that may be dioecious. Notwithstanding the variability and the apparent complication of these life histories, as first described by Bornet and Thuret, they prove to be based upon a simple cytological cycle, essentially similar to that which Strasburger demonstrated in 1894 underlying the alternation of the Archegoniatae, as first described by Hofmeister.

Cytology of the Algae.—There is in point of fact a high degree of variety in the way in which the cytological cycle fits upon the succession of formal changes in the algae. These plants may be regarded as showing an instability of "generations" that is not dominated or corrected by environment, since the conditions under which the cycle is executed are as a rule relatively uniform. It is different with the landliving archegoniatae. Here the nuclear cycle (though still open to occasional exceptions) is more definitely stabilised in relation to successive "generations," so that the sporophyte is normally, though not invariably, diploid, while the gametophyte is normally, though not invariably, haploid. It may be suggested rather than fully substantiated that this stabilisation has in descent been related to the land-habit and to that amphibious life which it imposed upon the earlier denizens of the land. This greater stability certainly accompanies the existence of the archegonium, an organ which is plainly a means of encapsulating the defenceless ovum in plants exposed to the air. Some such general view of the archegonium, first suggested by Schenck and by Lang, formed the background of many of the arguments advanced in the discussion on alternation at the Linnaean Society in 1909 (*New Phyt.*, vol. 8, p. 104).

If the archegoniate type of alternation be thus regarded as stabilised in accordance with an amphibious habit, though possibly initiated in some less stable ancestral cycle, the old controversy between antithetic and homologous alternation may be held as drawn. The field has been appreciably widened from the restricted source of comparison with green algae. The problem of the future in this relation will be not so much the origin of the gametophyte and sporophyte respectively, as that of the correspondence of the diploid and haploid states with somatic phases characterised by differences of external form. For the nuclear cycle appears to be a more constant thing than the formal phases of the soma upon which it is imposed. One feature, however, appears to be general, viz., that a diploid nuclear state habitually underlies the most complex structure

that the soma has attained. What is specially required as a foundation for a settled opinion on alternation is a wider knowledge of the nuclear cycle in the simpler forms of algae. But even when such facts come to hand, it may still be a question whether the archegoniatae are related phyletically to any known algae, or yet whether they all sprang from one common source.

Morphology and Physiology.—The relations between morphology and physiology have been changing during the years under review (1910–26). The old formal morphology, which dealt with conformation in the abstract and submitted the data to stiff objective comparison, has now given place more fully than ever before to that treatment which is best described under the title of organography. Not only is the method of Schleiden adopted, which ordained that development is the foundation of all insight into morphology, but that development is now studied from the point of view of the conditions under which it proceeds. The results are consciously and intentionally related to the impress of those conditions upon the individual life. This aspect of form is presented in a work which will probably be held as, more than any other, representative of the period, viz., the second edition of the *Organographie der Pflanzen* (1913–23), by Professor Karl von Goebel. In its 2,000 pages there is embodied a great mass of fact, methodically stated and treated comparatively. But the work suffers from a want of close co-ordination of the rich material, and from the absence of any apparent attempt to draw the isolated threads together into any general conclusion that can be held as phyletic. Moreover the material, magnificent as it actually is, is singularly deficient in two essential features, viz., in comparison of the internal structure of the adult plant, particularly of the characteristics of the vascular system, and in the comparison of related fossils with the data from living vegetation. In the absence of these aspects, so essential as they now are for any balanced comparative conclusion, the deficiency of positive phyletic results is readily intelligible. Probably such results lay entirely outside the scheme of the distinguished author. His object may have been the study of Organography in the abstract, in which case he has fully achieved his end.

Scheme of Descent.—During the period under review opinion has been gradually assuming some more definite form as to a general scheme of descent of the vegetable kingdom. It has been influenced by the new and positive data of palaeontology which have emerged (*see* PALAEOBOTANY). The data may not appear greatly to aid the construction of any "evolutionary tree." They tend rather to induce a negative opinion, that, though signs of convergence downwards may sometimes be recognised, if any connection of the several lines existed at all it must needs be sought in periods of time prior to those of which we have any exact knowledge at present. Such a view is supported by the early existence of wood of coniferous type, such as that of Hugh Miller's "cone-bearing tree," from the Old Red Sandstone of Cromarty.

Importance of Palaeontological Records.—The investigation of eospermatopteris,[1] presumably a pteridosperm from the Devonian of New York State, appears to support the view, already beginning to be entertained, that the filicales and the pteridosperms were more distinct from one another in descent than had been previously believed; perhaps that they represent separate lines of evolution from some such a type of vegetation as is seen in the Rhynie fossils. A still more separate origin must be sought for the lycopodiales, equisetales and sphenophyllales, and for the bryophyta. On the other hand the palaeontological evidence has become more and more explicit in showing the priority of Eusporangiate as against Leptosporangiate ferns. It is even doubtful whether any typical Leptosporangiatae were existent in palaeozoic time. With such a basis already secured for a phyletic scheme within the class of the filicales, it is becoming possible to lay out the several families of ferns with some degree of certainty as to their evolutionary relations, their progressive features being constantly subject to check according to their remarkably consistent palaeontological record from the carboniferous period onwards.

[1] W. Goldring, *New York State Museum Bulletin* (March 1924).

Such results for the pteridophytes depend upon a wide range of comparison, combined with a consecutive palaeontological record. This is shared in some degree by the gymnosperms, and remarkable progress has been made in their study both in the living and the fossil states, especially in America (*see* PALAEOBOTANY) and compare the writings of Coulter and Chamberlain, of Jeffrey, of Wieland and of Lawson of Sydney, Australia. But the angiosperms present a problem hitherto well-nigh insoluble, notwithstanding much intensive examination of their fossil remains. No doubt the system of Engler was an advance upon its predecessors. No one will feel confident satisfaction in its results. What is required is some great extension of the criteria of comparison by which the higher plants may be seriated, together with more ample palaeontological data according to which the results of those comparisons may be checked. Without such added means the end, viz., a naturally phyletic grouping of angiospermic plants, seems not yet to be within sight.

Tentative efforts have been made from time to time, but the success has been slight or partial. Perhaps complete success may never be attained, for on the one hand essential features of the propagative organs of Angiosperms are highly standardised: as witness the constancy of the embryo-sac and its contents; of the pollen-sac and pollen grains; and of the embryogeny. On the other hand, the vegetative system is very directly subject to modification according to circumstances. Thus the most valuable ground for their seriation is cut away from under the feet of the phyletic systematist of the angiosperms. Probably the best means of advancing this difficult branch will be to begin from the distal end, by the specific and generic study of some carefully selected families. As such results become cumulative it may become increasingly possible, with the help of palaeontological data, to probe downwards towards the earlier sources. But in practice this method is still in its infancy.

Cytology.—In cytology (*q.v.*) and its allied branch of heredity (*q.v.*), the general tendency has been toward a less implicit confidence in the exclusive importance of the chromosome. But on the other hand a beginning has been made in the critical review of older classifications of the algae and fungi on the basis of cytological characters in a broader sense. As regards the chromosomes themselves the position as stated by Bateson appears still to hold, that all the evidence points to the conclusion "that we are about to find among the chromosomes one more illustration of the paradoxical incidence of specific difference, not the fundamental phenomenon on which that difference depends" (Mendel's *Principles of Heredity*, 1909, p. 270). As regards heredity the fundamental importance of the establishment by Johannsen of the pure-line principle has become ever more evident, and it is now embodied in the practice of plant breeding stations. But this need not by any means exclude the possibility of change of features in the pure lines themselves, in which in any case rare mutations are known to occur: in particular such changes as may result from the impress of environment extended over periods of secular time.

Evolution in Plants.—The years under review have witnessed changes in opinion on evolutionary questions, but these have not yet consolidated into any general agreement respecting the methods of evolution in plants. The eager pursuit of the chromosome, stimulated as it was by the coming of Mendelism (*q.v.*) has not provided any completely satisfactory solution. It is now realised more clearly than before that Mendelian segregation is at best a distributing agency; it is not a means of producing new characters, though characters may be grouped by its means, as in Prof. Biffen's wheats. The real question is that of the origin of heritable features. In this connection there is a pronounced tendency to break loose from the old obsession of Weismannism.

It is beginning to be realised that the whole mechanism of sexuality in the two kingdoms of living things has been homoplastic in origin; for the segregation of the kingdoms (if they ever had a common origin) certainly antedated the distinction of sex, and apparently also the existence of any form of

conjugation. Accordingly it is quite immaterial to the botanist (except for purposes of interesting comparison) what views may be held by zoologists as to the way in which inherited characters may have appeared in animals. In particular, the early segregation of the gonad in animal embryology has no counterpart in the plant, and with this falls away any cogency as regards plants that Weismann's argument from that source may have possessed, against the inheritance of characters acquired during the lifetime of the parent. The readiness with which the individual plant is moulded by the conditions under which it develops would make it appear probable that the race should also be so moulded. Given the latitude of secular time for the effect to be impressed as heritable, in contrast to the brief period of experiments which appear to give a negative result, it would seem, *a priori*, probable that many characters held as adaptive may have been so inherited: in fact that the distinction between fluctuating variations and mutations is not absolute. In the case of the filicales, with their long palaeontological history, a consecutive argument may be advanced supporting this view (*see* EVOLUTION).

The "Mnemic Theory."—In his presidential address to the British Association in Dublin in 1908, Sir Francis Darwin advanced a Mnemic Theory as applicable to plants. He had found it possible to impose rhythmic movements upon certain plants experimentally, by stimuli repeated at intervals; the rhythmic reaction was continued after the stimulus was removed. This suggested to him a reception of engrams, such as played a part in the mnemic theory of Semon. His address has received less attention than it deserves. Botanists should allow themselves full freedom from the views of Weismann, which have been imposed upon them on grounds which in plants have no cogency. When this is done the way will appear open for a rational explanation of those characters which are held to be "adaptive": without it they appear unintelligible, and even fortuitous.

Development of Plant Physiology.—The opening of the present century has been marked by great extension in the opportunities for research into the physiology of plants. Not only is this seen in the better equipment of departments in universities and colleges, but also in separate establishments carrying on physiological enquiry apart from teaching. It will suffice to mention as examples of these in Britain, the John Innes Institute at Merton, the Royal Horticultural Society's Station at Wisley, the Lawes Institute at Rothamsted, now greatly extended with increased staff, plant-breeding establishments, such as those of Corstorphine and Aberystwith, and marine stations, such as Plymouth and Millport. Similar stations exist also abroad, notably in America, where they culminate in such centres as the Desert Station at Tucson, the Marine Laboratory at Woods Hole, and in the newly established and richly equipped Thompson Institute at Yonkers. Funds have become available in many lands for purchase of costly apparatus necessary for experiments under constant and controlled conditions, such as are necessary for arriving at quantitative physiological results. Since special articles appear under the headings ECOLOGY, PATHOLOGY, PHOTOSYNTHESIS and PHYSIOLOGY, it is not necessary here to pass into detail on these branches. But in case any workers less richly endowed than others should be discouraged by lack of financial support, it may be well to remember that money cannot buy mentality, while the excellence of the work in an institute is often in the inverse ratio of the facilities, as Reinke long ago remarked.

During the period, the physiological work of Sir Jagadis Chandra Bose has been brought prominently before the public eye in the newspapers. His observations were based upon the use of remarkably elaborated recording instruments, the readings of which require most accurate checking and correction. Unfortunately the statement of the results has been in terms pictorial rather than scientific, which has aroused criticism rather than acceptance both in Europe and in America.

Importance of Systematic Botany.—Increase in the facilities for physiological research may bring certain risks with it, and there is at the present time some reason for entering a caution based upon the history of a past period. Between 1860 and 1880 the condition of botanical teaching in British universities was deplorable. This was due partly to a want of initiative in the professoriate that is not likely to recur, but more to perverted ideals consequent upon the insistent demands of Empire. A similar state characterised also the American universities. There, as in Great Britain, botanists were chiefly engaged in systematic and descriptive work, and physiology in the broadest sense was in abeyance. It required a minor revolution, conducted by those who found their stimulus in foreign text-books and continental laboratories, to adjust the perverted balance. By its means a safe middle position had been attained by the end of the century. The head of any university department was then expected to cover adequately the whole field of his science: to turn out graduates well grounded in all its branches, and able to specialise in any of them. The tendency now appears to be towards a completion of the pendulum-swing to an opposite extreme to that of 1870, and to turn out specialists highly expert in certain branches only, and, in particular, physiologists who know little or nothing of morphology.

The demand of the Govt. for the supply of fungologists, plant pathologists and the like enhances this risk, and encourages rapid production of the highly specialised expert rather than the fully equipped botanist. Official sanction has lately been given to a lop-sided training in the pages of *The New Phytologist*. It has there been urged that morphology should be given a subordinate place in botanical education, and physiology a superior position. Thus within half a century we see evidence of an extreme swing of the pendulum, from 1870 when systematic botany ruled and physiology was ignored, to a present position when physiology is advanced by some at the expense of morphology. It must be borne in mind that systematic botany is but the methodised product of morphology, and morphology the record of continued physiological action. The several branches can never be detached with impunity. Preferential treatment of physiology would tend to restrict the supply of those trained systematists of whom the British Empire has constant need, but of whom the supply is already deficient. The divergence of interests here referred to is not restricted to Great Britain. It is liable to occur wherever there is a large and specialised departmental staff. High specialisation brings a risk of a loss of general view over the whole field of a science, such a view as is essential for well-balanced judgment; and it is most of all necessary in those whose duty it is to direct large organisations, such as a government garden, or more particularly the department of botany in a university. Here the training should be such as to fit students equally for the pursuit of all branches of the science, rather than to turn out finished experts ready to meet at once governmental needs in any one branch.

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BOTHA, LOUIS (1862–1919), Boer soldier and statesman (*see* 4.303). Botha's conciliatory policy in the Transvaal was one of

the prime factors in promoting a better feeling between Dutch and English throughout South Africa and so encouraging the movement towards closer union. He himself had long realised the need of such union for the peace of South Africa, and he welcomed Lord Selborne's *Memorandum* of 1907 as a basis of discussion. The delegation from the Transvaal to the Convention of 1908–9, composed as it was of Dutch and English, most of whom had been fighting one another six years before, was, of all, the most effective and harmonious. This was chiefly due to the tact and careful preparation of Botha and his lieutenant, General Smuts, who with their colleagues had worked out the policy of close union which ultimately found expression in the constitution adopted. In the lengthy deliberations of the Convention his influence, supported by his Transvaal colleagues, was outstanding; while the final difficulty about the capital, which threatened to wreck the whole proceedings, was overcome by his personal appeal to his own die-hards.

First Premier of South Africa.—Botha was one of the delegation that took over the new constitution for sanction by the Imperial Parliament in 1909, and on the proclamation of the Union in May 1910 was asked by the governor-general to form the first South African Ministry. Though he rejected the idea of a coalition ministry as impracticable at the time, he had no idea of governing solely in the interests of the Dutch; on the contrary he believed that his great object, the fusion of the two races, could be best attained by showing that his South African party, mainly, but by no means entirely, Dutch in composition, could under his guidance deal fairly with English as well as Dutch. As General Smuts said of him, he " had a vision of a great Afrikander nation . . . . one great people of the white sections of the population of South Africa." He gave signal proof of this spirit when one of his ministers, Mr. J. B. M. Hertzog, made anti-English speeches in the country, by excluding him from the Ministry (Dec. 1912); and he persuaded a great meeting of his party, in spite of strong opposition led by De Wet, to endorse his policy (1913).

The confidence of his own party and the growing appreciation by the Unionists of his conciliatory policy gave him the needful backing in dealing with two serious domestic difficulties in 1913 and 1914. The first was the question of settlement by Indian immigrants, to which there was strong opposition in South Africa. M. K. Gandhi, supported as he was by the Indian Government, proved an able advocate of the Indians' views; but finally General Smuts, acting on behalf of the Cabinet, made a compromise with which Gandhi professed himself satisfied.

The other difficulty was more serious. In July 1913 there was great unrest on the Witwatersrand followed by a strike of the white miners and threats of a native rising also; many acts of violence occurred, and, to make matters worse, the Union forces were being reorganised and so were not available. Much against his will Botha had to call on the Imperial troops to deal with a domestic difficulty, and, after a collision between them and the Johannesburg mob, he and Smuts signed an unsatisfactory agreement with the strikers. In the following Jan. a still more serious strike broke out, which became general and stopped the entire railway service. But this time the Government was prepared. The burgher force was called out, martial law was declared; and nine of the labour leaders were summarily deported without trial. The strike thereupon collapsed; and, though there was some criticism both in England and in South Africa at the high-handed methods of repression adopted, the South African Parliament endorsed the action taken by Botha and Smuts.

The Outbreak of War.—At the Imperial Conference of 1911 Botha had familiarised himself with the foreign policy and the military resources of the Empire. Accordingly when war was declared against Germany in Aug. 1914, Botha, contrary to the view of many of his Dutch supporters, at once declared that South Africa, as a part of the Empire, was at war also. He suggested that the Imperial troops might be recalled for service in Europe, and offered to assure the defence of South Africa by the Union forces alone. Further, on the invitation of the Imperial Government, he agreed to invade German South West Africa. But this was going much further than a large part of the Dutch in South Africa were prepared to follow him. While preparations were being made for the campaign, C. F. Beyers, the commandant-general of the Union forces, and S. G. Maritz, the commander on the German border, suddenly revolted and in Oct. were joined by De Wet.

Before the end of the year it is estimated that 12,000 rebels were in arms in the Transvaal and the Free State. Though all the leaders and most of the rank and file of the rebels had been his comrades in the South African War, Botha never hesitated as to his duty to suppress the rising. But he was determined to do it with as little racial feeling as possible, and employed purely Dutch commandos of his loyal followers for the purpose. Moreover, in the two short campaigns in the Transvaal and the Free State he took command himself, saying, " It is my duty and it is the only thing for me to do. Beyers and De Wet are strong men and have a strong following in the country. There is no one else I can put in their place just now, so I must go myself." Little fighting was needed to quell the revolt: on Oct. 28 he defeated Beyer's force in the Transvaal, and their leader was drowned, while trying to escape across the Vaal, on Dec. 8; early in Nov. Botha took the field against De Wet in the Free State and on Dec. 2, De Wet himself was captured; while on Feb. 3 1915 Maritz's force surrendered. After this brief civil war, described by Botha as " the saddest experience of his life," he showed a wise clemency in his punishment of the leaders and at the end of two years had released all the prisoners.

Conquest of Southwest Africa.—He then turned his attention to the conquest of German Southwest Africa, delayed by the rebellion, and again took the chief command. He divided the Union forces, this time composed of men from both white races, into four columns, the southern (Deventer's), the eastern (Berrange's), and Mackenzie's from Lüderitz Bay, all under Smut's general direction, while the fourth from Walvis Bay, the chief fighting force, was under his own immediate orders. In March 1915 the four columns started on a converging movement into the country, sweeping all the Germans before them. The chief difficulty came from the sandy and largely waterless country, which, in spite of an excellent organisation of transport and commissariat, told heavily on the troops. Most of the fighting fell to Botha's own column, which occupied Windhoek on May 12 and obtained the final surrender of the German forces on July 9 1915. After this Botha took no further share in active fighting, though with Smuts he helped to organise the South African Brigade for service overseas as well as the expeditionary force sent to German East Africa.

He was indeed much needed at home, for after the election of Oct. 1915, when his majority was seriously reduced, he had no easy task in governing the country, partly with the support of the Unionists. Some of his Dutch supporters were still discontented, and in 1916 and again in 1918 created trouble which, under anyone but Botha, might have led to another rising. His last voyage to Europe was to attend the peace negotiations of Versailles in 1919, as one of the delegates for South Africa. There he impressed all those present by his sound judgment, always used on the side of moderation, especially towards the conquered foe; for he never forgot that his own people also had been conquered and, as he said on signing at Versailles on June 28 1919, " To-day I look back in thought to May 31 1902."

He landed at Cape Town on July 24, already a very sick man, and on Aug. 28 1919 died at his beloved farm, Rusthof in the Transvaal. The secret of Botha's power over every man who came into contact with him was his absolute sincerity, due to his simple belief in the guiding hand of God, combined with a chivalry and courtesy springing from a truly loving nature. " Never kill a man if you can capture him, or he will never have a chance to be sorry," was one of his sayings, illustrated by his every action. The service of this noble man to Britain and to South Africa can hardly be exaggerated. He fought a clean fight to the end against the whole might of Britain, but having once given his word to become with his people a part of Britain, he was better than his bond, and added to the best traditions of

British statesmanship by his example, especially in doing all that in him lay to weld into one harmonious nation the Dutch and British elements in South Africa. "You in England," he said in 1911, "have given us the hand of friendship, and we have taken it and shall not let it go."

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BOTULISM: *see* FOOD POISONING.

BOULE, PIERRE MARCELIN (1861–), French scientist, was born Jan. 1 1861 at Montsalvy. Educated at Toulouse, he graduated early at the university there and in time acquired his degree of *docteur-es-sciences*. After becoming assistant professor of geology at Clermont-Ferrand, he devoted himself to the study of palaeontology. He became a member of the commissions on Historical Monuments and the Geological Map of France and was also president of the French Geological Society and of the French Archaeological Institute. Later he became director of the institute of Human Palaeontology. Among his many works are *Le plateau de Lannemezan* (1895), *Les olcans de la France centrale* (1900), *Les grottes de Grimaldi* (1906–19), and *Les hommes fossiles* (1923).

BOULOGNE, CONFERENCE OF (June 21–22 1920), a meeting of the Supreme Council of the Allies, in which Japan, Greece and Belgium participated, as well as the principal European Allied Powers. Like the conference of Hythe on May 15–17 (*see* HYTHE, CONFERENCE OF), it was preparatory to the Conference of Spa (*see* SPA, CONFERENCE OF). The question of allocating among the Allies the prospective reparation payments from Germany was taken up, and a counter proposal (the so-called "Boulogne agreement") was prepared, in view of the expected German offer of a lump sum payment, in case that offer should prove inadequate.

BOULOGNE-SUR-MER (*see* 4.323) had a population in 1921 of 55,336. The town and port were under British administration during the World War, and devoted to military uses. The first British troops disembarked here on Aug. 9 1914, and from that date it formed the main channel for reinforcements, some millions of troops passing through and being accommodated in rest camps. The labour department of the British Expeditionary Force was housed in the town and many hotels and the casino were used for Red Cross work. The army base was shifted to Saint-Nazaire for a short time during the retreat from Mons, when the possibility of abandoning the Channel ports had to be faced, but when the German attack was checked it was brought back to Boulogne. The town was heavily bombed in 1917–8, and was awarded the Croix de Guerre for the fine behaviour of its inhabitants. A war memorial was unveiled in July 1924. In 1911 a monument to the actors Coquelin was erected behind the Chamber of Commerce.

The Port Facilities.—The equipment of the port was largely added to during the British occupation, and the opening of the Loubet Basin in 1925 has increased the quay length of the port by 1,000 feet. Improvements were made in 1924 to the railway to enable expresses from Calais to pass through Boulogne at high speed, and a scheme to rebuild the maritime station and construct a tunnel to connect with the main line at Outreau was approved. Extensive harbour works were undertaken during 1924 to provide accommodation for large liners which, it is hoped, will make Boulogne a port of call. The Carnot breakwater has been lengthened by 400 metres and the entrance to the harbour widened. Two new moles, one of about 1,000 and one of 1,300 yds., are to be built. The work of replacing the old wooden jetty by a stone pier, begun before the War, was again taken in hand in 1924. The estuary of the river Liane, behind the old harbour, is to be converted into an inner harbour and dock for the important fishing industry.

BOURASSA, HENRI (1868–), French Canadian politician and journalist, was born Sept. 1 1868. After a private education he studied law and was called to the bar in 1899. He established a name as a writer on political subjects, and was for a time editor and proprietor of *L'Interprète*. Later he became a leading contributor to *Le Nationaliste* and finally editor and joint proprietor of *Le Devoir*. In 1896 he was elected to the Dominion House of Commons as a Liberal, being at that time a follower of Sir Wilfred Laurier. In 1899, however, he disagreed with Laurier regarding Canadian participation in the South African War and resigned as a protest against Laurier's policy.

On his resignation he became the accredited leader of the Nationalist party and in 1900 and 1904 was elected to the Dominion Parliament in that interest. In 1907 he resigned in order to accept nomination for the Quebec Legislature. He was a member of the Quebec Legislative Assembly from 1908 to 1912, when he resigned. During the World War Bourassa opposed, both from the pages of *Le Devoir* and from the public platform, the enforcement of conscription in Canada and the naval policy of the Liberal party. In 1925 he returned to politics and was elected as an Independent to the Dominion House of Commons.

BOURGEOIS, LÉON VICTOR AUGUSTE (1851–1925), French statesman (*see* 4.330). During the World War he was minister without portfolio in the Briand Cabinet. He was elected to the Senate in 1905 and was president of that assembly from 1920 to 1923. M. Bourgeois was the first French delegate to the Hague Conferences of 1899 and 1907. After 1907 he evinced special interest in international arbitration and was one of the first to suggest a League of Nations. For this reason he was appointed by his Govt. to represent France during the negotiations of 1919 concerning the league. When this was constituted he was, until a year before his death, the principal representative of France, both in the Council and in the Assembly and thus acquired an international reputation. In 1920 he was awarded the Nobel Peace Prize. He died Sept 29 1925.

BOURNE, FRANCIS (1861–), English cardinal, was born at Clapham, London, March 23 1861, the second son of Henry Bourne, a high official in the Post Office, and Ellen Byrne. Educated at Ushaw College and St. Edmund's College, Ware, he went later to Cardinal Manning's Seminary at Hammersmith, London, and St. Sulpice in Paris, where he received the diaconate from Cardinal Richard in 1883. After a course at Louvain, he was ordained in 1884, and worked at Blackheath, Mortlake and West Grinstead, afterwards becoming rector of St. John's Diocesan Seminary, Wonersh. In 1893 he published *Diocesan Seminaries*, the result of his controversy with Cardinal Vaughan on the question whether there should be diocesan seminaries or only one for all the dioceses. In 1895 he was made Monsignor by Leo XIII., and in 1896 he was consecrated Bishop of Epiphania and Coadjutor-Bishop of Southwark, to which See he succeeded in the following year.

On the death of Cardinal Vaughan in 1903, Mgr. Bourne was nominated to Westminster as archbishop by Pius X. The cathedral, designed by Bentley, was finished at this time and was consecrated by the new archbishop. In 1911 he was made a cardinal. In connection with the meeting of the Eucharistic Congress in London in 1908 he arranged for a procession of the Host to take place in the streets, but eventually this was cancelled as it was represented that it would lead to a breach of the peace. Cardinal Bourne attended the Eucharistic Congresses held in Metz, Cologne, Vienna and Montreal. At Montreal he came into sharp conflict with Canadian Nationalism, and was accused of British Imperialism by M. Bourassa, the leader of the French Canadians.

At the outbreak of the World War, he immediately appealed for army chaplains. As Lord Kitchener was unwilling to transport the number deemed necessary by the cardinal, he approached Mr. Asquith, who overrode the War Office and gave his consent. Thenceforward the cardinal devoted himself to the spiritual side of the War, visiting the army in France and Belgium and the navy at Scapa. In Aug. 1914 he attended the Conclave by which Benedict XV. was elected to the Papacy, and in Feb. 1922 the Conclave electing Pius XI.

Immediately after the Armistice he made an unofficial tour sanctioned by the Holy See and the British Govt. through the East, visiting Jerusalem, Constantinople, Bucharest, Sofia and

Belgrade. He was the first cardinal to enter Sancta Sophia after its capture by the Turks.

The policy of Cardinal Bourne has been to aim at steady progress by multiplying small churches so that the faithful throughout London should find Mass within half a mile, and at dividing unwieldy dioceses. On the education question he has sailed on an even keel between Liberal and Conservative governments. Modernism he reproved, but was merciful to individual Modernists. His pastorals have been models of moderation, although one alarmed capital and another offended Sinn Fein. He declined to support the idea of a Catholic university or party in England, preferring that Catholics should join the national universities and parties. In Italy he claimed for the Papacy an independence, similar to that of Belgium, based on international guarantees, not at the mercy of the Italian Parliament, and allowing Italy to enjoy the honourable position of representing all nations in the guardianship of the Papal sovereignty. (S. L.*)

BOURNEMOUTH (*see* 4.333).—The boundaries of the borough were extended to an acreage of 6,643 by the inclusion, in 1914, of part of Holdenhurst. The population in 1921 was 91,761. The East Undercliff drive was extended to Boscombe in 1914, making an unbroken promenade of 1½ m., and the promenade was later extended for another ½ m. to the east of Boscombe pier. Art galleries were added to East Cliff hall and museum, presented by Sir Merton Russell-Cotes in 1908; these were opened to the public in 1919. Boscombe pier was extended and improved and the corporation purchased property at the foot of Sea Road, Boscombe, for open air tea gardens. The large municipal college was built in 1912, a central public library in 1913, and branch libraries at Boscombe in 1910, at Westbourne in 1916, and at Southbourne in 1925.

The court-house in Stafford Road was opened in 1914, and in 1920 a large hotel, used as a hospital during the War, was bought by the corporation for a town hall and municipal offices. The parish of St. Alban was formed from three others in 1919, that of St. Andrew in 1919, and that of St. Ambrose in 1921. A church, Christ Church, was built in Westbourne in 1914; All Saints, West Southbourne in 1915; and a synagogue in Wotton Gardens in 1911. In 1924 a War Memorial was erected in the upper pleasure gardens. The broadcasting station was opened Oct. 17 1923. In 1924 a company was formed to join Bournemouth and Swanage by a road to Poole Harbour and a ferry. From 1920 to 1924 a musical festival was held by the municipal orchestra in Easter week in the winter gardens, and, in Sept. 1925, the foundation stone of a music pavilion to seat 1,700 people was laid. In 1918 Bournemouth was made a parliamentary borough returning one member.

BOWELL, SIR MACKENZIE (1823–1917), Canadian politician (*see* 4.342), died at Belleville, Ont., Dec. 11 1917.

BOWLS (*see* 4.345).—Although during the period of the World War few men played bowls, the game has continued to make progress since 1910. The game is sharply divided into four styles of play, each with its own predominant association. The flat green game, called Rink Bowls (known in Canada as lawn bowling), is ruled in England, Scotland, Wales and Ireland by national associations. The International Board controls the laws of the game and directs the international matches between these four countries and the British overseas dominions. Of late years Canadian, Australian and New Zealand teams have visited Great Britain to play the flat green game, and English teams have visited Canada, South Africa and Australasia.

The crown green game is governed by the British Crown Green Assn., the counties controlling their own championships and ruling their own particular areas. In Lancashire, the crown green game is played by professionals, who have their own board of control. In East Anglia, a mixture of flat and crown is played, being governed by the Norfolk and Suffolk Association. In Nottinghamshire there are thousands of bowlers who support their own county association and play a game that is nearer to the English Assn. flat green game than that of East Anglia. South Warwickshire is developing its flat green game.

The flat green game has, perhaps, experienced the greatest growth since 1919. The English Bowling Assn. can claim that its individual membership stands at 100,000, and it has nearly 900 clubs affiliated. For greens in London, turf is brought from the Solway Firth or the marshlands around the Ribble mouth.

BIBLIOGRAPHY.—G. T. Burrows, *Bowls* (1920), *Modern Bowls* (1920) and *The Game of Bowls* (1924); J. Hartley, *Bowls* (1924).

(G. T. B.)

BOXING (*see* 4.350).—In 1910, though France was beginning to cultivate it as a spectacular sport, the old indigenous kicking game of *La Savate* having fallen into disrepute, boxing was hardly known at all outside the English-speaking countries. In 1926 it was a cosmopolitan game, familiar to all the Western nations and actually gaining a foothold here and there in the East. During the period since 1910 it has become a real national sport, a game pursued for its own sake, in Great Britain and in America, where although the number of amateur practitioners is still insignificant, the chief professional contests are the most crowd-compelling of popular spectacles.

The adoption of boxing as a recognised form of physical training in the Services for officers and men alike, while millions of men were being called to the colours as the World War ran its course, has been the principal factor in a revival of intelligent interest, which has not only vastly increased the number of amateur boxers in Great Britain, but has also raised the status of the professional. Though it has not quite succeeded in throwing off its disreputable adherents, boxing is now generally admitted, except by a very few Puritanical moralists, to deserve the praise given to it; in a letter to Tommy Burns, for a time the world's heavyweight champion, Father Bernard Vaughan said "Boxing is an education—you learn self-control, to give and to take, to punish and be punished, smiling all the time." The average professional glove fighter is now almost always a decent citizen, and for such experts as Driscoll, Basham, Wells, Summers, Britt, Frank Moran, McFarland and Tom Gibbons, to name only a few out of many, those who knew them well had a real regard and no little respect.

Some Great Boxers.—As regards technique, however, it cannot be said that any notable advance was made during the period in question. It is true that the best amateur form reached the professional championship standard. Outstanding amateurs, such as the cricketer, J. H. W. T. Douglas, who had the best of a private trial with Burns when the latter was still champion, and John Hopley, the Cambridge University heavy-weight, would certainly have attained the highest honours, if they had made boxing their profession. Hopley's hitting power and other physical gifts for the game were equal to those possessed by any holder of the world's heavy-weight championship, with the exception of Jeffries. The Amateur Boxing Association Championships were sometimes made stepping stones to a professional career, and several of those who adopted this plan did very well indeed in the professional ranks.

But, generally speaking, the best professional boxers of the period, especially as regards the heavier divisions, were not quite as good as those of the previous generations. Jeffries, Fitzsimmons, Corbett, Sharkey and Ruhlin were a quintette of great heavy-weights, especially Jeffries, each of whom combined unusual skill with extraordinary punching power and the real fighting temperament. They were succeeded by four very formidable coloured fighters, Johnson, Langford, McVea and Jeannette, of whom the first-named was not much inferior to Peter Jackson—a "white sportsman" and the first negro heavy-weight of all time—though the Jeffries he beat at Reno, in a fight that proved a provocation to racial riots all over America, was only the husk of the former world's champion.

The contest at Havana in which Johnson lost his title to Willard was unquestionably a "frame-up," though riotous living had not taken the keen edge off the negro's amazing artistry in what the old connoisseurs of the prize ring called "milling on the retreat." It is a debatable point whether Dempsey, who knocked out Willard, when the latter was untrained and past his prime, in three rounds, is the equal of any of the great heavy-weights mentioned above. Comparisons are unsatisfactory because the

modern heavy-weight adopts a more intensive style than his predecessors, attempting to obtain a decision from the first, instead of using the preliminary rounds to test his opponent's methods and get an insight into his plan of campaign. But, whenever he was held for three or four rounds, Dempsey relapsed into mediocrity. As regards middle-weights, America has not produced a Stanley Ketchel or even a Papke in recent years, and among the smaller men who have held championships McFarland, a graceful exponent of the classic style, and Attell, have probably not been equalled, much less surpassed.

It is only in the lighter divisions that British and French boxers have reached the American standard, even in a period when, as has been suggested, championship form on the American side of the Atlantic showed a certain falling off. Wells, the most interesting and popular of the English heavy-weights, lacked the well-fortified physique and fighting temperament which are required for success, and was easily beaten by two second-rate Americans. Carpentier, for 10 years the most picturesque figure in the European ring, would not have been much more than a " pork and beaner " (*i.e.*, a fighter of preliminary bouts who just exists by his profession) if he had been born in America. During his career he fought 12 Americans and was decisively defeated by seven of them, and was lucky to get the decision over four of the others, his only clear-cut victory being over Levinsky, a rather indifferent light-heavy-weight. Gun-boat Smith, a second-rate American heavy-weight, whom he met in London in 1914, was winning when he was disqualified. In all the contests between American and European boxers in the heaviest divisions the superior skill of the former in in-fighting, when the body is the objective of the attack, has proved a decisive factor.

Among the little men, however, Great Britain and France have held their own fairly well. Ledoux, a pocket Hercules and Criqui, a glove fighter of genius handicapped by wounds received in the War, were two French boxers who were, for a time, in the world's championship class. Britain has had in Driscoll and Wilde, two real prodigies who were for years supreme at their weights. Driscoll was by general consent the perfect stylist, the boxer's boxer, in fact, whose method in its graceful effectiveness, severity and economy of exertion, will always be remembered as a classic model. Wilde, on the other hand, was an eccentric genius, who made the most of a physique which, like that of Fitzsimmons, seemed expressly invented to get the maximum hitting punch for the minimum weight. In America, the melting pot of racial types, such freaks of physique are far more common than in the European countries, where the human body is more or less standardised, and they are scientifically utilised for securing extraordinary results in various athletic feats. That is yet another reason why America produces so many men with a special aptitude for pugilism. Mentally, as well as physically, Wilde was very much of a *lusus naturae*, for he kept his Celtic temperament on ice, so to speak, and he could control his nervous system in such a way as to be indifferent to the most painful punishment.

Control of Boxing.—In Great Britain amateur boxing is admirably organised, the executive of the Amateur Boxing Association consisting of men with a personal experience of the game and having its welfare at heart. On the professional side, however, no effective organisation yet exists with the power to (1) rule out the unscrupulous promoter and the incompetent referee and (2) suspend the unfair boxer and insist that championship holders should meet an approved challenger within a reasonable limit of time. It is to be regretted that the National Sporting Club, though it has been a great influence for good, has not been able to establish itself as the final authority. The Lonsdale championship belts, each of which is worth £500, are much sought after and can only be won in the club arena. The boxer who wins one of them three times becomes its owner and is also entitled to a pension of £1 a week after reaching the age of 50. Outside promoters, however, are able to offer such large purses that the club is unable to secure control of all the British championship contests, at the various weights. However, a British Board of Control is now in being and is gradually strengthening its position, especially as regards the selection of referees, but it is unlikely to attain the authority of the Government Commission which absolutely controls professional boxing in the State of New York and can put any promoter or boxer out of the game, if such a course seems warranted.

The Financial Side.—During the period the problem of the big purse presented itself in a form that would have seemed incredible in the days of Tom Sayers and John Heenan, who fought the most famous contest ever decided on English soil for stakes limited to £200. In 1887, when Kilrain and Jem Smith fought with the bare fists in France for a sum slightly exceeding £2,000, it was generally believed that the limit had been reached. It was so until 1906, when Joe Gans and Battling Nelson were matched for the light-weight championship of the world, and announced their intention of accepting the best bid for a much-discussed contest which, owing to the former's superlative skill and the latter's extraordinary power of endurance, created as much interest as a fight between leading heavy-weights.

It was then that Tex Rickard, a successful mining prospector who was then in Alaska, looking for an opportunity of investing his gains profitably, startled American promoters of boxing shows by offering a purse of $20,000, provided the contest took place in a small mining town in Nevada. Tex Rickard believed that huge profits could be made by staging *bonâ fide* championship contests in open-air arenas constructed for the purpose, and making such arrangements that every ticket-holder would be sure of his (or her) seat, and an uninterrupted view of the boxing, while at the same time there would be no danger of a disturbance at the conclusion of a contest which had aroused the passions of the spectators. It is in the few minutes immediately following the decision that violence is to be feared; for a single combat between partisans may act as the powder in a cap, and bring about a vast explosion.

At the fights arranged at Jersey City by this capable impresario there were, as a rule, in addition to 500 police, 1,000 to 1,200 firemen, ushers, sellers of refreshments, etc., all of whom were stalwart men able, if necessary, to suppress disorder by physical force. Rickard and his chief assistant were always able to secure the co-operation of those in charge of the various means of transport, and the charting and selling of the seats were carried out in such a way as to win the confidence of the public and avoid the necessity of using ticket agencies. At his first promotion, the Gans-Nelson contest, which was a fight to a finish, lasting 42 rounds, the gate money amounted to nearly $70,000 and the promoter's net profit exceeded $10,000. In subsequent ventures, all of which seem to have shown a very substantial profit, these figures were greatly exceeded. The following list illustrates the surprising vogue of the big purse in the United States since the famous Johnson-Jeffries encounter:—

Date	Place	Combatants	Gate Receipts
July 4 1910	Reno, Nevada	Johnson-Jeffries	$270,755
March 25 1916	New York	Willard-Moran	151,524
July 4 1919	Toledo, Ohio	Dempsey-Willard	452,522
Oct. 12 1920	Jersey City	Carpentier-Levinsky	120,000
Dec. 14 1920	New York	Dempsey-Brennan	200,000
July 2 1921	Jersey City	Dempsey-Carpentier	1,626,580
Feb. 10 1922	New York	Leonard-Kansas	126,768
June 25 1922	New York	Britton-Leonard	130,265
July 27 1922	Jersey City	Leonard-Tendler	367,862
July 4 1923	Shelby, Mont.	Dempsey-Gibbons	201,485
July 12 1923	Jersey City	Firpo-Willard	390,837
July 23 1923	New York	Leonard-Tendler	452,648
July 26 1923	New York	Dundee-Criqui	134,416
Sept. 14 1923	New York	Dempsey-Firpo	1,188,822
Sept. 11 1924	Jersey City	Wells-Firpo	700,000

Rickard himself has said that he will not be content till he owns an enclosure which will seat 250,000 spectators comfortably and give them all a clear view of the boxing. He believes that such enclosures will be built in the near future, not only in the great American centres of population, but also in such cities as Buenos Aires, Berlin, Vienna and Paris. The enormous

expansion of motor traffic, moreover, will tend, at any rate in the United States, to the staging of crowd-compelling contests in places where lumber and labour are available to build a temporary arena at a reasonable cost, though world's championship fights, especially when, as in the case of Dempsey's contests with Carpentier and Firpo, an American champion, meets a foreign challenger and spectators are drawn from both sides of the Atlantic, or from both halves of the Double Continent, will have to take place in New York or some other seaboard city.

C. B. Cochran's Promotions.—In England, though the remuneration of the successful boxer has greatly increased since 1910, nothing approaching the higher American figures has yet been recorded. In the boxing boom which followed the World War, C. B. Cochran, who in 1914 had staged the Welsh-Ritchie match at Olympia and who was one of the bidders for the Carpentier-Dempsey contest, became a serious rival to the National Sporting Club. A consummate showman, he conceived the idea, and certainly realised it, of giving boxing shows which should be as well conducted as a theatrical performance. In his book of reminiscences entitled *The Secrets of a Showman* (1925) he gives the full financial details of some of these ventures. The contest between Wilde and the American bantam-weight Moore, which was won by the former after an amazing display of skill, hitting power and stamina, was perhaps the most interesting of his promotions, which were never mere money-making affairs. The purse for this contest, which took place at Olympia, amounted to £5,000 and the total receipts were £14,205 8s. 6d. Beckett *v.* M'Goorty at the same arena brought a gate of £18,680 4s. 0d. and Beckett *v.* Carpentier at the Holborn Stadium, for which the former received £3,000 and the latter £5,000, brought close on £30,000, which is probably the English record, though it must have been nearly equalled by the figures for the absurd Carpentier-Lewis encounter at Olympia.

The Cochran boxing shows, some of which were watched by the Prince of Wales, might almost be described as social functions, and they recalled the great days of the old prize ring, when men fought with the naked fists for 50 or 100 guineas a side in the presence of all the social celebrities of the day. At these well-conducted modern spectacles a small proportion, never more than 1%, were women. In France, where purses have never yet approached the English maximum, the number of women attending a contest in which a popular favourite, such as Carpentier or Criqui in their prime, is engaged, is apt to be very large. The same phenomenon has been noticed in Italy and Spain, and the Latin-American countries. It is all largely a question of national temperament, and the horror of seeing bloodshed, which is thought to be a characteristic of northern races, is not likely to prevent women, who are in the habit of attending bull fights, from watching boxing matches.

As regards ring-side crowds, some keen observers are of opinion that the huge open air assemblies now common in America will never be seen in England. English people, they say, will pack a covered arena as big as the Albert Hall, London, to see a championship fight just as, previously, they would crowd into a boxing booth. But boxing or wrestling matches staged in an open space have not proved attractive, a case in point being the failure to pay expenses of the much-advertised heavy-weight contest between Tom Gibbons, at the time Dempsey's most formidable rival, and Jack Bloomfield, then the British heavy-weight champion, which took place in the Wembley Stadium, an arena capable of accommodating more than 100,000 spectators. Our ancestors, however, were quite willing to watch pugilists fighting in a field, despite the vagaries of the climate, and posterity may recover that lost predilection.

Effect of Big Purses.—Whether it is true to say that big purses and small personalities go together in the modern prize ring is a question worth asking, not easily answered. The fact that a successful boxer, if only he be reasonably thrifty, as many are in these latter days, can amass a competence, while being the subject of hero worship and living in the full glare of publicity, has certainly persuaded young men of a better type than the translated, but not transmuted, navvies and butchers of the old days to adopt boxing as a temporary profession. It is especially so in America, where the boxer of high repute is now almost always a quite intelligent person, who makes a keen study of his craft, lives decently, and behaves as a civilised member of the community.

The many failures of English boxers, when meeting American champions in the ring, have been the result, in nine cases out of ten, of their intellectual inferiority, and the lack of moral self-discipline that goes with it as a general rule. More than once England has had heavy-weight champions who had every physical requisite for the game, yet failed to make the most and best of themselves owing to their inability to learn from bitter experience, much less from experimental work in the gymnasium, or their unwillingness to keep fit between one special preparation for a fight and the next. The old bruiser type, whose chief asset was an insensitiveness to pain, still survives in England, but he has long since been scrapped as useless in America. It is recorded of Deaf Burke, that famous pugilist of a century ago, that he was so ignorant as to be unable to tell the time, and when a friend, well aware of the fact, would ask "What's o'clock, Deaf'un?" he would pull out his fine gold watch, turn its face to the inquirer, and reply "Who would ha' thought it was that time?" Even the more intelligent English boxers still limit their ambitions to becoming publicans or bookmakers when their fighting days are over, whereas the American champion as a rule looks forward to entering upon a business career, in which he is frequently successful.

Large purses, it would seem, bring into the ring young men of brains as well as brawn, who are capable of perfecting their technique by taking thought to it and have the mental resources that enable them to endure with patience the tedious régime of training and practice year after year. But, once a championship has been achieved, they do not fight often enough to develop their gifts to the fullest extent. A world's champion finds it now so easy to make a large income by exhibition work on the music hall stage, by film acting, etc., that he will not risk the loss of his title until he is compelled to do so by the force of public opinion. The no-decision contest, which is so popular in America, enables him to keep up his form, but the practice of choosing opponents whom he is certain of beating tends to prevent any improvement in technique.

Moreover, exhibition work of any kind has a debilitating effect and may tend to an utterly unexpected defeat, as happened when Siki, a third-rate Senegambian fighter, disposed of Carpentier in a few rounds. Dempsey, who fought more than 40 contests in the year preceding the victory over Willard, which gave him the world's heavy-weight championship, is hardly the equal of the great glove fighters of the Jeffries era. He is a mechanical boxer with little variety of attack who relies for victory on hard hitting (never straight) at close quarters, and he "explodes" after the fifth or sixth round. On his actual form, after becoming champion, he cannot be put in the same class as Peter Jackson, Fitzsimmons, Corbett and Sharkey. But if he had lived up to the adage that fighting is the best preparation for a fight, as Fitzsimmons did throughout his long career, he might have improved his boxing technique in such a way as to have been ranked with the four great heavy-weights who are mentioned above. Wills, again, though easily the best negro heavy-weight of post-War days, could not have beaten Jack Johnson, whose ability was never really plumbed, Sam Langford or Sam McVea. On the whole, big purses, though they have indirectly raised the standard of boxing in general, in the manner described, have not made for a superlative degree of proficiency in the heavier divisions. We have not seen among the middle-weights, for example, a boxer equal to Stanley Ketchel or Papke since their day.

A Cosmopolitan Profession.—Professional boxing now receives recruits from many countries and races, the old idea that only men of English or Irish descent could excel at it having long since been confuted. This point may be made clear by considering the list of world's champions at the beginning of 1925, and their racial derivation.

Heavy-weight	Dempsey	A complex mixture of Polish, Irish, Scotch, and Red Indian
Light-heavy-weight	McTigue	Irish
Middle-weight	Greb	German descent
Welter-weight	Walker	Irish (Northern)
Light-weight	Leonard	Jew
Feather-weight	Dundee	Italian
Bantam-weight	Martin	Italian
Fly-weight	Villa	Filipino

The Latin physique, which does not accumulate internal fat, perhaps as a result of frugal eating and a racial preference for wines rather than malted liquors, is admirably adapted for a game that requires a high degree of stamina. No oriental boxer has, as yet, reached the highest class, though Indians, Japanese and Chinese are occasionally seen in minor contests, but there seems no reason why the Eastern races, which have produced so many fine wrestlers, should not learn to excel in the sister-art in course of time. India has sent us some very skilful amateur boxers.

A proof that boxing is rapidly becoming popular in the Latin countries is found in the way renderings, often very comical in appearance, of English technical terms have been adapted into the French, Italian and Spanish languages. Outside the British Is., however, there are few amateur boxers of merit. Even in America those who take up the game for the game's sake are vastly inferior, both in quality and quantity, to the increasing multitude of made-in-England amateurs. There is no annual competition there comparable with the English Amateur Boxing Association Championships, and there is nothing equivalent to the flourishing boxing clubs at Oxford and Cambridge in the great American universities. If the American athlete thinks he can excel in such an exacting man-to-man game, nine times in ten he adopts it as a professional vocation. And in France, though the brilliant victories of Carpentier gave rise to a temporary craze for what was significantly styled "Byronic Boxing," fencing has now regained its old position as the gentleman's art of self-defence, an indispensable accomplishment.

In the Scandinavian countries, however, and in Germany, there is a real enthusiasm for amateur boxing. Denmark produces excellent amateurs, and her representative teams have done very well in matches against teams selected by the amateur boxing association. Such amateur international matches are a new development and are certain to become more numerous and more popular as spectacles in the near future. The impetus to boxing in Germany was given by returned prisoners of war who had acquired the rudiments of the game in concentration camps. Two sailors, Breitenstraeter and Prenzel, who were captured at the beginning of the War and learned to box fairly well in the large internment camp at Douglas, Isle of Man, were the pioneers of professional boxing in Germany. They started travelling boxing booths, and whenever demonstrations of the art were given, ex-prisoners of war attended in large numbers, and local clubs were formed. The popular impression that the excellence of the British soldier as a fighting man was due to his training in boxing greatly helped the new form of athletic propaganda, and Blücher's approval of pugilism was a stock quotation in many favourable newspaper articles. Professional boxing shows have become very popular, especially in Berlin where they are rigorously controlled by a boxers' union, the *Verband Deutscher Faustkämpfer*, and a promoters' association, the *Verband der Boxkampf Unternehmer*. For a few appearances on a Berlin stage with sparring partners Dempsey received $50,000 and all the travelling expenses of himself and his camp from London. To-day amateur boxing clubs exist in every German city and town and when the problem of obtaining competent instructors is solved, there can be little doubt that skilled exponents will be produced.

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BOYLE, JOHN J. (1851–1917), American sculptor (*see* 4.354), died in New York Feb. 10 1917. He was made an associate member of the National Academy of Design in 1910, and received a silver medal at the Panama-Pacific Exposition, San Francisco, 1915.

BOYLESVE, RENÉ (1867–), pen name of René Tardiveau, French novelist, was born April 14 1867 at La Haye-Descartes (Indre-et-Loire). He began his education at the Jesuit College of Poitiers, and passed from there to Tours. He completed his studies at the faculté de lettres of Paris, the faculté de droit and the school of political science. His output as a novelist is considerable but he has paid more attention to style and to the development of an agreeable descriptive talent than to characterisation and psychology. Among his works are:—*Le parfum des Iles Borromées* (1899); *Le bel avenir* (1905); *La marchande de petits pains pour les canards* (1913); *Le bonheur à cinq sous* (1917); *Le carrosse aux deux lézards verts* (1921).

BOY SCOUTS. The Boy Scout movement, which was established in 1908 in the British Is., extends to-day to every civilised country in the world.

Ideals and Method.—The aim of the movement is the promotion of good citizenship among the rising generation. The method adopted is that of active self-expression and the desire to learn on the part of the boy, rather than his passive reception of instruction. The scope is unlimited by class, creed, colour or political distinctions. The movement is non-military, non-political, non-class and interdenominational. Honour is made the high ideal for the boys. The Scout Law, on which the movement hinges, and which is binding on every scout, was taken from the code of the knights.

Every boy, on joining the movement, makes the following promise:—

I promise on my honour to do my best—
To do my duty to God and the King
To help other people at all times
To obey the Scout Law.

Administration and Training.—The administration of the movement is decentralised, each county in Great Britain having at its head a county commissioner responsible to headquarters. Under him are district commissioners, local associations and Scout troops, The troop numbering from 20 to about 40 boys is divided into patrols of 6 or 8, each under its own boy leader. The troop is purposely kept small in numbers in order that the scoutmaster may have personal knowledge of each of his boys and so develop the individual character.

The movement is subdivided into three groups:—

1. Rovers—*i.e.*, scouts of 17 years and over.
2. Boy Scouts and Sea Scouts—from 11 to 17.
3. Wolf Cubs—juniors from 8 to 11.

The principles underlying the training are identical for each group, but the details differ to suit the different stages of development.

The training is carried out generally under four main headings:—

1. Character and intelligence.
2. Skill and handicraft.
3. Physical health and self-care.
4. The practice of service for others and for the state.

The activities and practices of scouting are framed to develop in (1), (2) and (3) the efficient individual and then to harness this individuality for the good of the community, *i.e.*, (4) citizenship. The training is carried out mainly through activities in the open air, and the attributes of frontiersmen, backwoodsmen and explorers are held up as examples for Scouts to emulate. Military training is not employed as being contrary to the ideals of peace and educationally wrong. Through an extensive system of badges for proficiency the boys are encouraged to develop their natural gifts, to become all round handy-men, and to specialise in those subjects which are likely to help them afterwards in making a career. Through the daily "good turn" they are gradually led on to the practice of service for others and so to unselfish citizenship.

Progress and Results.—From a trial experimental camp in 1907 the movement has spread with remarkable rapidity to every part of the world. In 1908 the handbook, *Scouting for Boys*, was published in fortnightly parts. By 1910 the movement in the British Empire numbered over 123,000 members and had been taken up in many foreign countries. In 1912 the aims and methods of the movement were inquired into by the Privy

Council and a royal charter of incorporation granted. Over 100,000 Scouts served in His Majesty's Forces during the World War, 10,000 of whom gave their lives. Those who were under serving age carried out public duties at home, one notable service being that of coastwatchers, in place of the coastguardsmen who were called up for service afloat. This service was maintained by Boy Scouts from the outbreak of the War until after the declaration of peace, some 23,000 boys in all taking their turn at it.

The movement, though hampered by the loss of practically every able-bodied scoutmaster, managed not only to hold its own, but to increase steadily in numbers throughout the years of war. Numbers of troops were carried on entirely by their patrol leaders and courts of honour, without the help of officers. In 1920 an international meeting or *jamboree* was held at Olympia, London, in which Scouts of 26 nations took part. As a result of this meeting an international council was formed, with a bureau in London. A second international jamboree took place in 1924 at Copenhagen, at which 33 nations were represented. The fundamental principles, the Scout Promise and Law, are in every country identical with those of the parent movement, the details of training differing slightly here and there to suit climatic and temperamental differences. The Scout movement in 1925 extended to every corner of the world, and numbered nearly 2,000,000 members. Of these, some 700,000 belonged to the United States.

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United States.—The Boy Scouts of America was incorporated in 1910 and chartered in 1916 under Act of Congress. Boy Scouts are organised in patrols, 8 boys or less to a patrol, under the direction of an older boy, 2 to 4 patrols to a troop. Each troop is under the charge of a scoutmaster, who must be an adult American citizen, and one or more assistant scoutmasters. Troops are organised in connection with schools, churches and other institutions, or under the auspices of groups of representative citizens. For each troop there is a supervising group of adults known as a troop committee. Where there are two or more troops in a community, their activities are directed and supervised by a local council. The National Council is made up of representatives from these local councils and other distinguished men from every state in the Union. This body meets annually in New York City, where the council has its administrative and executive headquarters.

The purpose of the Boy Scouts of America as stated in its constitution is "to promote through organisation, and co-operation with other agencies, the ability of boys to do things for themselves and others, to train them in scout-craft, and to teach them patriotism, courage, self-reliance and kindred virtues, using the methods which are now in common use by Boy Scouts, by placing emphasis upon the Scout oath and law for character development, citizenship training and physical fitness." The movement is non-sectarian and non-partisan. The motto of the organisation is: "Be Prepared." Membership in April 1926 was 769,717 registered scouts, 157,429 scout officials, 23,646 troops, 661 local councils.

The Boy Scouts of America publish three handbooks, for professional leaders, for scoutmasters and for boys. The *Handbook for Boys* has been immensely popular among all interested in out-of-door activities. Thirty-four editions were printed between 1911 and 1926, totalling 3,000,000 copies. Nearly 80 merit badge pamphlets are published, forming an excellent vocational library at modest cost; a manual on nautical scouting; several pamphlets on citizenship training and co-operation with churches; and some half a hundred other general and technical pamphlets. Three monthly magazines are also published. *Boys' Life*, which is for all boys everywhere, is particularly successful and steadily increasing in popularity.

Over 312,000 Boy Scouts spend a week or more in camp each summer. In 1925 there were over 3,300 camps, not including week-end and winter camps. Rigid standards of safety and health are maintained by the A.B.C. grading system, and regular inspections are made by the National Staff. Trained waterfront leaders, boats and safety devices justify the Camp Dept. in maintaining that a boy is safer in camp than on the streets. In camp each summer some 15,000 boys are taught to swim.

The National Court of Honor has made over 1,100 awards to Boy Scouts for life saving; 69 gold medals have been presented for rescues made at the extreme risk of the scout's own life. More than 1,300,000 merit badges were awarded before Jan. 1 1926. Over 194,000 were won in 1925. These are awarded for proficiency in various activities, including several practical vocations. The emphasis is on doing, rather than text-book knowledge. In 1924 the representative Boy Scouts of America troop won the world Scout Championship in competition with scout troops from 33 other nations at the International Jamboree in Copenhagen.

The National Council holds a conference annually. Regional conferences, in each of the 12 regions into which the scout field is divided, are also held annually. Biennially the scout executives of the movement hold a national conference. Professional leaders number about one to every 171 volunteer workers.

Over 50% of scout troops are organised through the churches of America, and practically every denomination has endorsed the movement and is using the programme. Committees have been organised to promote the work among boys of Catholic, Protestant and Jewish faiths.

An important feature of scout work is the training courses for the 162,000 scout leaders. These are conducted not only by local scout councils, but in connection with colleges, normal schools and theological seminaries. Nearly 300 such courses were conducted in 1925 for scoutmasters, involving a minimum of 16 hours of work. Certificates are awarded to students who complete the course. The National Headquarters are at 200 Fifth Ave., New York City. (J. E. W.)

THE GIRL SCOUT MOVEMENT

In March 1912 Mrs. Juliette Low organised in Savannah, Ga., a group of Girl Guides, similar to the organisation developed in England by Lt.-Gen. Sir Robert and Lady Baden-Powell. On June 10 1915 the organisation was incorporated and its name changed to Girl Scouts. The national headquarters are in New York City. In April 1926 the number of Girl Scouts (including officers) was about 119,000. The purpose is to instil patriotism, to arouse the spirit of helpfulness and to develop character, largely through outdoor group activity. The slogan is "Do a good turn daily." Each member promises: "On my honour, I will try to do my duty to God and my country, to help others at all times, to obey the Scout laws."

These laws require a Girl Scout to be trustworthy, loyal, helpful, friendly, courteous, kind to animals, obedient, cheerful, thrifty and clean in thought, word and deed. The age limit was fixed from 10 to 18 years; but later a separate division was formed for little girls, known as Brownies or Junior Scouts, and another division for mature girls, known as Citizen Scouts. The unit is a patrol of 8 girls, who choose from their number a leader. One or more patrols form a troop, with a captain at least 21 years old and one or more lieutenants at least 18 years old approved by the national headquarters. The official magazine is *The American Girl*, a monthly publication.

Camp Fire Girls.—Another organisation, wholly distinct, is the Camp Fire Girls, for girls over twelve, founded in 1912 to promote the ideals of the "home, health and citizenship." The training stimulates love of being out of doors and an interest in simple handicrafts like block-printing and weaving. The work of the organisation is financed by the dues earned by the girls themselves. The slogan is "Give Service." There were 158,000 members in 1926 in the United States and 2,000 in Great Britain. An allied junior organisation is the Blue Birds. The official organ is *Everygirl's Magazine*. The headquarters of the Camp Fire Girls are in New York City.

BRACQUEMOND, FÉLIX (1833–1914), French painter (*see* 4.369), died in Paris Oct. 29 1914.

BRADBURY, JOHN SWANWICK BRADBURY, 1ST BARON (1872–), British civil servant, was born at Winsford, Cheshire, Sept. 23 1872, and educated at the Manchester Grammar School and Brasenose College, Oxford. He entered the Civil Service in 1896. Beginning in the Colonial Office, he was soon transferred to the Treasury. In 1911 he was appointed a member of the National Health Insurance Commission, but in 1913 returned to the Treasury as joint permanent secretary. In that capacity it fell to his lot to sign the currency notes issued by the Govt. when gold was withdrawn from circulation on the outbreak of the World War. He was made K.C.B. in 1913, and in 1919 was appointed chief British representative on the Reparations Commission. He resigned the post at the beginning of 1925 when he was raised to the peerage as Baron Bradbury of Winsford. In July of the same year, following upon the report of the Royal Commission on Food Prices, he was chosen chairman of the Food Council that was set up.

BRADDON, MARY ELIZABETH (1837–1915), British novelist (*see* 4.369), died at Richmond, Surrey, Feb. 4 1915. Among her latest novels were *The Green Curtain* (1911) and *Miranda* (1913). Her son, William Babington Maxwell, born June 4 1866, became known as a novelist and writer.

BRADFORD (*see* 4.370) had a population of 279,767 in 1901, and of 285,979 in 1921. In 1923 it was estimated at 290,800. The Board of Control for Wool, formed in 1917, was housed in the Great Northern Hotel there. Since 1918 the city has returned four members to Parliament. In 1920 the diocese of Bradford was formed from those of Ripon and Wakefield and the parish church of St. Peter was made the cathedral. The parish of Thornbury was formed in 1912, and a church, St. Margaret, was built.

BRADLEY, FRANCIS HERBERT (1846–1924), British philosopher, was educated at University College, Oxford, subsequently becoming a fellow of Merton College. His *Ethical Studies* (1876) were mainly critical, but his *Principles of Logic* (1883) showed that Idealism had at last found an English-speaking champion. What Hegel had done in Germany, Bradley did in England, and once and for all established the supremacy of idealism over realism, in dialectical controversy. *Appearance and Reality* (1893) is said by Prof. Sorley to have exerted more influence upon English-speaking countries than any other philosophical treatise of his generation. In revising the *Principles of Logic* in 1922, Bradley found much to correct. His mind seemed to be moving to a new viewpoint. But he was too old to press his ideas to their logical consequences.

Bradley was neither a legitimate descendant from the Hobbes-Locke-Hume school of English philosophy, nor was he able, like William James, to contribute a hard technique. What he did, and what none of his contemporaries could do, was to bring to philosophy a unique intelligence, a brilliant style and a number of new criteria. There have been philosophers more profound, but none has arisen who played more gaily with the formulas of the past. In June 1924 he was, belatedly, admitted to the Order of Merit, and on Sept. 18 he died.

BRADLEY, HENRY (1845–1923), British philologist, was born at Manchester, Eng., Dec. 3 1845. He was educated at Chesterfield Grammar School, became a teacher and later a clerk in a commercial house in Sheffield. At the same time he wrote a little for the literary reviews, and this work brought him to London. There he worked for *The Athenaeum* and *The Academy*, and through F. York Powell was introduced to *The New English Dictionary*, then in preparation and this became his life-work. He succeeded Sir James Murray as senior editor on the latter's death in 1915 and remained on this undertaking until his death He worked with Skeat on certain Chaucerian studies, and published several works of his own, notably *The Making of English* (1904). His eminence as a scholar was recognised throughout the learned world, and at Oxford by the degree of D. Litt., 1914, and a fellowship at Magdalen College, 1916. He died at Oxford May 23 1923.

BRAGA, THEOPHILO (1843–1924), Portuguese writer and politician, was born at Punta Delgada, in the Azores, Feb. 24 1843. Educated at the University of Coimbra, he began writing at an early age, publishing his first volume of poems in 1859. His written works fall into three groups: poetic, historic and philosophic. The first includes some six volumes of poems, published between 1859 and 1868; in the second are four important works, including his greatest literary work, *The History of Portuguese Literature*, published in 20 volumes between 1870 and 1881. In philosophy he was a Positivist, as is shown in his six principal philosophical works.

Braga did not take up active politics till about 1909. He was elected deputy for Lisbon in Aug. of that year, and in Oct. 1910, when the new-born Portuguese Republic was faced with the difficult task of political reconstruction, this man of unquestionable attainments and irreproachable character was selected as first provisional president. He remained in office till the election of Dr. Arriaga as first constitutional president, Aug. 24 1911, and when Arriaga resigned on May 27 1915 Braga's services were again requisitioned, and he returned to the presidency for the remainder of the term. He died Jan. 24 1924.

BRAGG, SIR WILLIAM HENRY (1862–), British physicist, was born at Wigtown, Cumberland, July 2 1862, and was educated at King William's College, Isle of Man, and Trinity College, Cambridge. In 1886 he was appointed professor of mathematics and physics in the University of Adelaide, South Australia, where he carried out his earlier researches in radio-activity. In 1909 he was appointed Cavendish professor at Leeds University and in 1915 Quain professor of physics in the University of London. His researches upon various radio-active phenomena and his power of lucid exposition brought recognition from scientific bodies both at home and abroad; in 1906 he was elected a fellow of the Royal Society; in 1915 he received the Nobel Prize for physics and the Barnard Gold Medal (Columbia University), both of which distinctions he shared with his son William John Bragg (b. 1890).

The joint work of father and son went far toward elucidating the arrangements of atoms and crystals, an achievement rendered possible by their development of the X-ray spectrometer. During the World War Sir William Bragg acted in an advisory capacity to the British Admiralty especially with regard to the problem of submarine detection. He was created K.B.E. in 1920. In the same year he was elected an honorary fellow of Trinity College, Cambridge, and was president of the Physical Society of London. In 1923 he was appointed Fullerian professor of chemistry at the Royal Institution and director of Davy-Faraday Research Laboratory. In addition to many publications, chiefly upon radio-activity in *The Philosophical Magazine* and *The Proceedings of the Royal Society*, he also wrote *The World of Sound* (1920); and *Concerning the Nature of Things* (1925). (*See* CRYSTALLOGRAPHY).

BRĂILA (*see* 4.391).—One of the three Danubian ports of Rumania, Brăila has seen considerable development since 1910. The Danube below the town has been deepened and the navigation shortened by canalisation by the Danube Commission. The minimum depth of the Sulina branch is 18½ ft. with 12 to 28 ft. in the docks of Brăila, which accommodate 20 steamers and 29 laden barges. Brăila is a comparatively modern town and fully a quarter of the site of some 148 ac. is closely built over. In May 1921 an arrangement was made for Poland to use the port as Czechoslovakia uses Trieste. In Jan. 1917 the Russians evacuated Brăila, after destroying the granaries, and it was occupied by the Germans and Bulgarians. A branch office of the American Red Cross, which did valuable work in Rumania, was established there after the Armistice, and in 1919 and 1920 there was great activity in the port; large quantities of goods accumulated owing to the lack of transport. (*See* DANUBE).

BRAKE: *see* MOTOR VEHICLES.

BRANDEIS, LOUIS DEMBITZ (1856–), American jurist, was born in Louisville, Ky., Nov. 13 1856. He was educated in the public schools of his native city and at the Annen Realschule, Dresden, Germany. He graduated from the Harvard Law School

in 1877, was admitted to the bar in 1878, and practised in Boston from 1879 to 1916. He was much interested in labour legislation, acting as counsel for the people in cases concerning the power of the Govt. to fix hours of labour and a minimum wage in several states. In 1910 he was counsel for Mr. Glavis in the Ballinger-Pinchot investigation in Congress; in 1910–1 was counsel for the shippers before the Interstate Commerce Commission in the advance freight-rate case; and in 1913–4 was special counsel for the commission in the second advance freight-rate case. In Jan. 1916 he was appointed by President Wilson associate justice of the Supreme Court, being the first Jew to attain this position. He was the author of *Other People's Money* (New York, 1914) and *Business as a Profession* (Boston, 1914), besides numerous articles on public franchise, business efficiency, labour and trusts.

BRANDL, ALOIS (1855–), German scholar, was born at Innsbruck, Austria, June 21 1855. He studied at Innsbruck, Vienna, Berlin and London and in 1881 was appointed lecturer on English philology in Vienna. He was successively professor in Prague, Göttingen, Strasbourg and Berlin. He became president of the German Shakespeare Society in 1903 and chairman of the *Verein für Deutschtum im Auslande* (Association of Germans Abroad) from 1899–1903. He was also co-editor of *Quellen und Forschungen*, of *Palaestra*, of the *Shakespeare Annual* and of the *Archives for the Study of Modern Languages*. In 1903 he became a member of the Prussian and Viennese Academies of Science.

Brandl's chief works are: *B. H. Brockes* (1878); *Thomas of Erceldoune* (1881); *S. T. Coleridge und die Englische Romantik* (1886); *Geschichte der alt-englischen Literatur und die englische Volkspoesie* (1892–1908); *W. Shakspeare* (1894); *Quellen des weltlichen Dramas in England vor Shakspeare* (1898); and the valuable *Geographie der alt-englischen Dialekte* (1915).

BRANTING, KARL HJALMAR (1860–1925), Swedish statesman, was born in Stockholm Nov. 23 1860, the son of Lars Gabriel Branting, head of the Central Gymnastic Institute, Stockholm, and Emma Georgii. Branting was educated at the Beskow school and passed his student examination in 1877. Both at school and university he took a great interest in astronomy and from 1878–80 and 1882–3 he was secretary at the Observatory of Stockholm. He continued his scientific studies at Uppsala University, where he came under the radical influences which were instrumental in forming the students' union "Verdandi." This union produced several of Sweden's more noted radical politicians. About the same time he joined the labour movement to which he henceforward devoted his whole life.

In 1884 Branting associated himself with the Radical newspaper *Tiden* and shortly afterwards became editor. In 1886 he worked on the *Socialdemokraten*, a newspaper started in 1885. In 1887 he was made editor and held this post, except for some short intervals, till 1917. From that time onwards he devoted himself entirely to parliamentary and political work. As the responsible editor of the *Socialdemokraten* he was sentenced in 1888 to $3\frac{1}{2}$ months imprisonment for libel. Between 1887–90 and 1892–6, he was obliged, for economic reasons, to combine his editorship of *Socialdemokraten* with work on the Liberal newspaper *Dagens Nyheter*, and his genius for journalism and his good education very quickly placed him in the first rank of Swedish publicists.

When the Social Democratic Labour party was formed in 1889, Branting was generally considered the greatest intellectual force in the movement. Even at that time he combined a socialistic outlook with a marked capacity for practical politics. He considered it vitally important that the theoretical tendencies of the Labour movement should be in line with the socialistic ideas promulgated by Karl Marx. Above all he wished to make of the movement a power which, on the one side, would be useful to the working classes in their economic struggle, and on the other of service to political democracy. It must be acknowledged that it is chiefly due to Branting that the Swedish trade-union movement has always been of a pronounced social democratic character and as an organisation still keeps in close touch with the Social Democratic party. At the time the party was formed there was a demand, strongly supported by Liberal middle class opinion, for adult, equal and direct suffrage. The first task of the new party was to broaden the basis of this demand and to mobilise the working classes in support of it. Thus Branting soon became the most influential leader in the franchise movement. As early as 1890 he linked up the policy of the Labour party with that of the progressive middle class party and made co-operation between them possible. The result was a Liberal Socialist government in 1917, and in 1918 the constitutional reform which facilitated the spread of social democracy throughout Sweden.

Although Branting had been the most prominent figure in the Labour party in Sweden ever since its formation, it was not until 1907 that he became its leader. As early as 1897 he was a member of the second Chamber where till 1902 he was the only Social Democrat. At that time the most pressing political problem, with the exception of the franchise reform, was the question of the separation of Norway from the Swedish Crown. In face of a powerful Chauvinistic group, Branting, strongly supported by the Labour party, demanded a peaceful settlement between the two countries, and his contributions to the cause of peace when the union was dissolved in 1905, together with his valuable work in the same cause during and after the World War, qualified him for the Nobel Prize which was awarded him in 1921. During the World War he energetically supported the demand for strict neutrality on the part of Sweden, although he displayed a marked sympathy for the Western Powers, owing to his conviction that their policy, if successful, would hasten the advent of truly democratic and peaceful progress.

Within the international socialist ranks Branting had early attracted attention, and at the end of the War when it became necessary again to mobilise international social democracy, great hopes were placed on his ability to re-unite all those whom the War had placed in opposite camps. A worthy attempt had been made in this direction in 1917 at the Swedish-Dutch conference known as the Stockholm Conference. Branting who presided was the dominating personality. He was honoured with the Chairmanship of the first post-War conference of the Socialist International, held in Bern 1919, and he held a leading position in the permanent international commission which was to complete the work of reconstruction within the International.

At the same time Branting's great abilities were needed for official work connected with foreign politics. He was consequently appointed delegate to the Peace Conference in Paris in the spring of 1919 and at the negotiations concerning Aaland 1919–21. After the entry of Sweden into the League of Nations, Branting was the first representative of his country on the League Assemblies, and in 1922 was made a member of the Council. There he won the respect of all for his integrity and impartiality. His aim was to make the League a truly democratic alliance of the nations, a real instrument for peace. Although he disapproved strongly of the imperialist and militarist Germany during the War, he was a warm friend of the democratic Germany which arose from the ashes of the World War. His great desire was that the new Germany, as a member of the League of Nations, should have an opportunity of contributing towards peaceful development in the world. During the Corfu affair he was the courageous and far-seeing champion of right that he had always been.

His defence of the Council of Ambassadors on this occasion gained for him the sympathy and gratitude of the whole world. In the handling of the English-Turkish conflict over Mosul Branting's influence was no less significant. He was appointed reporter to the Council, a task he accomplished with an impartiality acknowledged by all. In the Swedish Parliament the question of constitutional reform and natural defence interested him keenly. On the latter question Branting took the view that from the military standpoint Sweden should confine herself to a "neutrality defence." The total disarmament tendencies which now and again appeared in the Social Democratic party had in him an irreconcilable opponent.

His ministerial career began in 1917, when the Liberal Socialist Ministry was formed, with the Liberal leader, Professor Nils Edén, as Premier. Branting accepted the post of Minister of Finance, but resigned after a few months on account of illness. When the Liberal-Socialist coalition broke up on account of differences over the communal rates question in the spring of 1920, Branting undertook the task of forming Sweden's first Social Democratic Ministry. The parliamentary elections in the autumn of the same year made it impossible for him to carry on the government, but after a fresh election in the autumn of 1921 the parliamentary situation was such that he was again placed at the head of a government in which he filled the posts of Prime Minister and Minister for Foreign Affairs. This government remained in power until April 1923, when it was forced to resign after a defeat over the unemployment relief question. After the elections in the autumn of 1924 Branting formed his third Ministry. But his health was failing and shortly after his condition was so serious that he was forced to resign the premiership, but remained in the Government as minister without portfolio. He died in Stockholm Feb. 24 1925.

During his long life journalism and politics had claimed so much of his time and energy, that he had no opportunity of enriching either the social or political literature of his country with any notable or comprehensive writings. In 1906 he published a work of some importance entitled *The Age of Social Democracy*. This, however, was not an original work, but an adaptation of a Danish publication of the same name. Some small pamphlets are all that bear his name. Branting was married to the authoress, Anna Branting, née Jäderin. (S. H.*)

BRASSEY, THOMAS BRASSEY, 1ST EARL (1836–1918), British politician (*see* 4.435), was created an earl in 1911, and died in London Feb. 23 1918. He was succeeded by his son, Thomas Allnutt Brassey (1863–1919), who before his father's death was known as Viscount Hythe. The second earl had been, since 1910, the editor of the *Naval Annual*, founded by his father, and like him was much interested in imperial questions. He was largely instrumental in raising a considerable sum of money for the endowment of the University of Oxford, to which he belonged. His works include *The Case for Devolution*, 1913. He died in London Nov. 12 1919 and, as he left no children, the earldom became extinct.

BRATIANU, JON (1864–), Rumanian statesman, was born at Florica, Rumania, on Aug. 20 1864, the son of Jon C. Bratianu (*see* 4.436). He was educated at the Polytechnic School in Paris and on returning to Rumania took up a position as engineer on the state railways. In 1895 he joined the Liberal party, and was elected a deputy. In the following year he was appointed Minister of Public Works in the Cabinet presided over by D. Sturza (*see* 25.1051) whom he succeeded as Prime Minister and chief of the Liberal party when the latter retired in 1909. He remained in power until Jan. 1911, when he resigned, but in 1913, after the signature of the Treaty of Bucharest, he again formed a Cabinet. At the opening of the World War Bratianu was in power and it was his Govt. that guided Rumania's destinies throughout the period. He resigned on Jan. 29 1918 following the decision of the military command to conclude an armistice with the Germans. In Dec. 1918, however, he was again called to power following upon the decision of Gen. Coanda's Govt. to denounce the separate peace signed with the Central Powers.

Bratianu was chief Rumanian delegate at the Peace Conference in Paris, but he refused to sign the Treaty of Versailles, as a protest against the division of the Banat of Temesvar between Rumania and Yugoslavia, whereas Bratianu, in accordance with the treaty of alliance concluded between Rumania and the Allies in 1916 claimed that province entirely for Rumania. In consequence he resigned and remained in opposition until Jan. 1922, when he became Prime Minister again. Bratianu followed closely the policy of consolidation inaugurated by his father, and most of the chief reforms, such as the introduction of universal suffrage, agrarian reform and the settlement of the Jewish question, were enacted during the period when he was in power. (G. Bo.)

BRATISLAVA or PRESSBURG (*see* 22.299), the chief Danubian port of Czechoslovakia, had a population in 1921 of 93,189. Before the War it was largely dependent on Vienna, but after the creation of the Czechoslovakian Republic its development was actively pushed forward. The daily capacity of the port increased from 400 tons in 1919 to 2,100 tons in March 1921. The scheme of development aims at the creation of a harbour containing large docks capable of dealing with 3,000,000 tons a year, with a free zone equipped with bonded warehouses and factories. The work made good progress in 1924 and 65,000,000 crowns were set aside for the improvements of port works. New quays and railway sidings were constructed, and the winter harbour was deepened.

Bratislava is the seat of the International Danube Commission, which, under the Treaty of Versailles, controls navigation on the river Danube. Its annual Orient Fair is of importance; the town is developing into an important distributing centre for Balkan trade. Its industries include glass grinding and the manufacture of mineral oil, explosives, leather, and edible and industrial fats. In 1919 the Slovak Komenskelo University was opened. A summer service with Prague was maintained in 1924 and 1925. (*See* DANUBE.)

BRAUN, KARL FERDINAND (1850–1918), German physicist, was born at Fulda on June 6 1850 and was educated at Marburg and Berlin. In 1877 he was appointed a professor at Marburg and after other university appointments at Strasbourg, Karlsruhe and Tübingen, became in 1895 professor of physics and director of the Physical Institute at Strasbourg. He pursued important researches concerning the electrical phenomena of cathode rays and the problems connected with the foundations of wireless telegraphy. In 1909 he received, with Marconi, the Nobel Prize for physics. He died in New York April 20 1918.

BRAUN, LILY (1865–1916), German socialist and writer, was born at Halberstadt July 2 1865. The daughter of Gen. von Kretschmann, she was brought up in an atmosphere of Prussian militarism, but was nevertheless drawn to the Socialist movement, and married a Socialistic professor, Georg von Gizycki. He died in 1895 and the following year she married Heinrich Braun, a Socialist writer and politician. In connection with her interest in Socialism she visited England and met leading members of the Fabian Society. Much of her written work deals with the place of women in politics, for example *Die Frauenfrage* (1901); *Frauenarbeit und Hauswirtschaft* (1901); and *Die Politik und die Frauen* (1904). Her outstanding work, however, is her *Memoiren einer Sozialistin*, published in two volumes, *Lehrjahre* and *Kampfjahre* (1910 and 1911). Cast in the form of a novel, this work was largely autobiographical, and gave a striking account of the growth of the German Social Democratic movement at the end of the 19th century. Among her other books are *Die Liebesbriefe einer Marquise* (1912); and *Lebensucher* (1915). She died at Zehlendorf, near Berlin, Aug. 9 1916.

BRAUNER, BOHUSLAV (1855–), Czech chemist, was born May 8 1855 at Prague. He studied chemistry at Prague and also under Bunsen at Heidelberg and Roscoe in Manchester, where, in 1881, he was elected Berkeley fellow of Owens College. In 1883 he was appointed lecturer and in 1890 professor of chemistry at the Czech University of Prague. Brauner devoted himself mainly to the field of modern inorganic chemistry, with special reference to the grouping of the elements in Mendeleyev's periodic system, and did important work on the atomic weights and chemistry of the rare elements. He became a fellow of the Bohemian Scientific Society, a member of the Czech Academy, and a corresponding member of the American Academy of Science.

The results of his extensive chemical research have been issued in numerous publications, the chief of which are as follows: *On Fluorescence* (1877); *On the Atomic Weight of Beryllium* (1878 and 1881); *Contributions to the Chemistry of the Rare Earths* (1882 and 1883); *On the Atomic Weight of Cerium* (1885); *Experimental Studies on the Periodic Law* (1889); *On the Volumetric Determination of Tellurium* (1890); *On the Constitution of Certain Metallic Chlorides* (1889); *Observations on Argon* (1895); *A Method of Preparing Argon in Large Quantities* (1895); *Revision of the Atomic Weight of Cerium* (1903).

BRAZIL (*see* 4.438), a republic of South America which covers an area of 3,291,416 square miles. The population, according to the census of Sept. 1 1920, was 30,635,605—an increase of over 13,000,000, or 77%, since 1900, which is largely attributable to immigration. The Federal District, comprising the city of Rio de Janeiro and suburbs, had 1,157,873 inhabitants; other towns of over 100,000 inhabitants were São Paulo, 579,033; Bahia (São Salvador) 283,422; Pernambuco (Recife), 238,843; Pará (Belem), 236,402; and Porto Alegre, 179,263.

I. POLITICAL HISTORY

The electoral defeat of Ruy Barbosa in the presidential election of March 1910 by Hermes da Fonseca was followed later in the year by revolutionary outbreaks in the north and at Rio de Janeiro. On the night of Nov. 22 the crews of the two new dreadnoughts "Minas Geraes" and "São Paulo" mutinied, threatened to bombard the city and demanded reforms. The revolt spread to other naval units, and when the President delayed a reply fire was opened on the city; this was followed by a grant of the mutineers' demands and a general amnesty, which brought about a general surrender of the ships. The defeat of the Marine Corps at Cobras Island in Rio harbour on Dec. 10 was the end of the revolt, which resulted in many reforms in naval administration. The presidency of Hermes da Fonseca was marked by:—

(*a*) the amicable settlement, largely through the offices of Baron Rio Branco, the Minister for Foreign Affairs, of several boundary disputes, whereby Brazil's territory was increased;
(*b*) increased budget deficits, intensified by the rapid decline in the price of coffee and rubber and by the reduction of exports and imports with a consequent falling off in customs receipts;
(*c*) the widespread rebellion of unemployed rubber collectors in Ceará under Padre Cicero;
(*d*) the culmination of a series of minor financial, industrial and commercial troubles in a grave national crisis in 1914; the Government was unable to meet the demands for money by local and foreign contractors, and in October announced a funding scheme, whereby interest on most foreign loans became payable in script for three years and the redemption of the majority of securities was postponed for 13 years.

War Period.—President Wenceslao Braz, who succeeded Hermes da Fonseca in 1914, was greatly assisted in his efforts to restore national prosperity by overseas demand, notably from the United States, for Brazilian products. By the end of 1915 the high prices received for coffee began to affect the national exchequer so favourably that, with a reduction in expenditure, a small surplus was shown in the budget. In 1916 prosperity was definitely restored, and, for the remaining years of the World War, optimism prevailed in commerce and finance, and was reflected in the comparative quiet of internal politics. In foreign relations progress was made towards a consolidation of understandings with Argentina and Chile (known as the A.B.C. Entente); a treaty was ratified by Brazil in Oct. 1916 by which these three countries undertook to submit differences to arbitration, and to avoid open hostilities until an appointed arbitral committee had given a decision. The remaining two years of Wenceslao Braz's presidency were years of increased prosperity and with that a feeling that assertion should take the place of the almost passive part Brazil had hitherto taken in international affairs.

A series of War incidents (during which popular sympathies were with France, Italy and Great Britain) intensified this feeling; and the sinking of the Brazilian S.S. "Paraná" off the coast of France by a German submarine on April 3 1917 provided an opportunity for satisfying national ambition. Three days later the United States formally declared war on Germany, and from that date Brazil did not hesitate as to her attitude. On April 10 the German Minister at Rio de Janeiro was handed his passports. During the crisis Dr. Lauro Müller, the Foreign Minister, who was of German descent, resigned, and his place was taken by Nilo Peçanha, a former president. Rupture with Germany did not involve immediate abandonment of neutrality, for, despite fairly widespread anti-German demonstrations, the passing of a bill on May 29 authorising a revocation of the declared neutrality, and the seizure of German shipping in Brazilian waters, it was not until after the sinking of another Brazilian vessel, the S.S. "Macao," that a state of war was formally declared on Oct. 26 1917.

Brazil sent physicians and aviators to France; several destroyers and other smaller vessels went on active service. The means of equipping an army for European service were lacking, however, and the important naval units required overhauling. But the will to help was shown, not only by the provision of raw materials, commodities and merchant shipping, but by the passing in Dec. 1917 of a military law by which all citizens between the ages of 21 and 30 were made subject to selective draft. The years 1917 and 1918, up to the cessation of hostilities, were notable for their prosperity and for a considerable development in local industries, largely owing to the War and the measures taken for its prosecution. German banks were placed under control in Nov. 1917, and decrees were passed for the encouragement of national industries and schemes for industrial development. Brazil was forced, for the first time in her history, to recognise the necessity of making herself independent of much of the foreign assistance upon which she had been accustomed to rely. Goods manufactured at home began to take the place of European articles, and the predominance of the United States in the import trade began to be felt. The steady economic progress of this period affected the political life of the country, in that there were no noteworthy incidents apart from activities and legislation made necessary by the War.

Post-War Period.—In 1918 there was no contest for the presidency, the only candidate being Sr. Rodrigues Alves, who had been president from 1902–6. Considerable confusion was caused in Nov. and Dec. 1918 when it was found that Alves was unable, through illness, to assume office and therefore unable to sign legislative measures or assist congress in fulfilling its duties. Alves died on Jan. 15 1919 without having assumed office; his place was taken by Dr. Epitacio da Silva Pessoa, who was elected (during his absence in Paris as chief of the Brazilian delegation to the peace conference) by a large majority over Barbosa.

The year 1919 was the record year for Brazilian foreign trade, but from May 1920 a downward tendency showed itself. In Brazil the balance of foreign trade acts as the barometer of the country's prosperity, and on prosperity depends peaceful political life. The Minister of Finance, Dr. Homero Baptista, was unable to devise measures adequate to meet the difficulties into which national finances drifted, although the Government authorised the issue of large quantities of paper money. Fluctuations in exchange, and a rapid increase in the cost of living, brought strong criticism of the Government and added to the existing tension. During this period Dr. Epitacio Pessoa introduced an ambitious scheme to provide a series of great dams for the storage of flood-waters to safeguard the states of Ceará, Parahyba and Rio Grande do Norte against the periodic droughts which have retarded their economic progress. It was recognised that such a scheme must, if successful, enrich Brazil; but the moment for its initiation was considered to be inopportune. The visit of the King and Queen of the Belgians during Sept. and Oct. 1920 helped momentarily to distract attention from the serious financial problems to be faced. Another notable event was the signing by the president, on Sept. 3 of the same year, of a decree repealing the Act of Banishment of the Imperial Brazilian family of Dec. 21 1889; the remains of Dom Pedro II. and the Empress were brought from Portugal to Brazil in Jan. 1921, accompanied by the Conde d'Eu, son-in-law of the Emperor. Diplomatic relations with Germany were formally renewed in Dec. 1920.

The financial crisis continued throughout the years 1921–2 and was the subject of much oratorical recrimination during the presidential election of 1922, when Dr. Arturo Bernardes, president of the State of Minas Geraes, was elected to succeed Dr. Epitacio Pessoa, whose administration was accused of having brought the country from prosperity to the verge of ruin. Followers of the defeated candidate Nilo Peçanha attempted to create disaffection in the army and navy, and on July 5 the garrison in a fort of Rio de Janeiro harbour was led to revolt by a son of ex-president Hermes da Fonseca. Pessoa showed

great firmness, during his last months of office, in suppressing the revolt, which, in itself, caused very little damage; but as a consequence many people feared to come to Rio de Janeiro for the exhibition that had been organised to celebrate, on Sept. 7 1922, the centenary of Brazil's independence. The centenary exhibition was notable in that special missions, representing countries interested in Brazil and amounting in all to some 300 persons, were accredited. The first South American Olympic Games were held in Rio de Janeiro in recognition of the event; the exhibition closed in Dec., having proved very successful.

The presidency of Dr. Arturo Bernardes, 1922–6, was one of the most trying in Brazilian history. It was characterised by a strong policy of attempted retrenchment and reform, which caused considerable hostility amongst the elements thereby affected. The year 1923 was, on the whole, a quiet one. A press law, introduced with a view to stamping out libel, was received with indignant protests from the newspapers. The most disquieting event was a wordy quarrel with Argentina regarding a proposed conference on armaments; the bitterness caused by this controversy, as reflected in the Press of both countries, went a long way towards dispersing the good feeling that had been growing during the preceding five years. The year closed with the suppression of a rebellion in the State of Rio Grande do Sul through the intervention of the Federal Govt., and it was realised that President Bernardes was progressing in his efforts for reform. Finance still remained the worst problem to be faced, and in his efforts to do this the President invited a mission of British financial experts to investigate and report upon the state of Brazil's finances. Early in 1924 the report of the mission was published; it recommended drastic economies and retrenchment, the development of national industry, the freeing of industrial undertakings from state control, and the necessity for the influx of foreign capital. These proposals were welcomed by the President and his Finance Minister although they did not please the public.

On July 5 1924 a serious revolutionary movement broke out in the State of São Paulo, attributed to general military discontent and hostility toward the *régime* of President Bernardes. The leader of the rebels was General Isidoro Dias Lopes, whose efforts were directed towards deposing the President. To this end the rebel forces occupied the city of São Paulo, hoping thereby to attract the main body of the Federal army and thus leave the capital unprotected. But the President retained a strong force, augmented by recruiting, in Rio de Janeiro, and sent detachments in increasing numbers to surround the rebels. From July 9–27 São Paulo was held against the Federal forces, but the withdrawal of the insurgents at the end of the month was a signal for the general collapse of the movement. In the north there was a revolt on July 26 of Federal troops at Pará; outbreaks were also reported at Manaos, Sergipe, Amazonas and Bahia, but all were quickly suppressed; the Federal districts and State of Rio de Janeiro remained quiet. On Nov. 4 the crew of the dreadnought " São Paulo " mutinied, seized the ship and proceeded to Montevideo, whence it was restored to the Brazilian Government by the Uruguayan authorities. Early in 1925 order had been so successfully restored by the Federal Govt. that President Bernardes was again able to turn his attention to the readjustment of the finances, broadly in accordance with the recommendations of the British financial mission.

The year 1925 showed a small though steady progress. The revolutionary movement of July 1924 was responsible for many isolated manifestations of unrest, and in a few places minor conflicts took place; the country had not returned to a normal state by the end of the year. Trade and commerce easily adapted themselves to the changed conditions, which had but little effect on commercial life. Political troubles have not, as a rule, greatly affected traders in Brazil, although serious trade depressions have considerably affected politics. In 1925 the annual deficit was again reduced, and it was believed that the efforts of the President to restore financial normality would, if continued, be successful. Sr. Washington Luiz was elected on March 1 1926 to succeed Dr. Arturo Bernardes in the presidency. The speech in which the president-elect declared his policy indicated that, with few modifications, he proposed to continue the reconstructive efforts that had been begun by his predecessor.

As a signatory of the Treaty of Versailles, Brazil was not only one of the original members of the League of Nations, but the first Latin-American republic to become a member, having also a non-permanent seat on the Council. In 1921 Dr. Gastão da Cunha was nominated as President of the League, and in 1923 Brazil, while showing her anxiety to be elected to permanent membership of the Council, was satisfied with Dr. Epitacio Pessoa's appointment as Judge of the Permanent Court of International Justice. By a decree of March 12 1924 a permanent representation with the League of Nations was organised, consisting of a representative equivalent in status to ambassador with a staff of secretaries. In March 1926 the Brazilian demand for permanent representation on the Council of the League, expressed by her representative at Geneva, caused a postponement of the admission of Germany to permanent membership of the Council, the view of Brazil being that if further permanent seats were to be created, she also was entitled to one, as the senior representative of Latin-America. It was found impossible to reconcile these differences and in June 1926 the representative of Brazil gave official notice of the withdrawal of his country from the League, this withdrawal to take effect on June 13 1928.

Defence.—The navy in 1920 comprised two battleships of dreadnought type, two cruisers, three light cruisers, 10 destroyers, three submarines and various auxiliary vessels. Five destroyers and three large submarines were under construction. The navy is manned by approximately 900 officers, 100 cadets and 10,000 ratings. A naval mission from the United States arrived in 1922, and under its guidance many administrative improvements were effected by 1925. There is a naval floating dock for ships up to 23,000 tons; three dry docks at Rio de Janeiro, one of which accommodates dreadnoughts; and repair docks at Pará and Ladario de Matto Grosso. Under the military law of 1923 every Brazilian between 21 and 44 years of age is liable for service, which consists of two years with the colours, seven in the first-line reserve, seven in the second line and eight in the national guard. The strength of the army in 1925 was 40,390 maximum; the first line mobilisation is estimated to yield 500,000 officers and men. A French military mission, from 1919–25 effected improvements in discipline, armaments and efficiency. There is also a gendarmerie of 26,000. Air forces were, by 1924, divided between army and navy, each possessing its own flying branches. Naval aviation was centred at a base in Rio de Janeiro harbour; a new and larger base was in course of construction at Ilha do Governador. In 1924 the navy possessed 25 aircraft for instructional purposes, and 43 for service use. Naval flying personnel consisted of a director, 35 qualified pilots and 450 other ranks. Army aircraft consisted of about 70 machines, with 14 administrative officers, 15 pilots, 11 observers and over 600 other ranks.

Education.—Elementary education is free but not compulsory. Secondary and university education are administered by the Federal and states governments; primary, by states and municipalities. By decree, a Federal University was established in Rio de Janeiro in 1915, comprising faculties of medicine and law and a Polytechnic School. The Federal Ministry of Agriculture and the states governments have under their immediate inspection and direction many agricultural colleges.

II. FINANCIAL AND ECONOMIC HISTORY

The World War gravely affected Brazil's financial position. Foreign sources for borrowing were closed, trade was interrupted in 1914–5 with a corresponding fall in customs receipts, and internal borrowing largely replaced foreign. Again, from 1919–22 there was an economic crisis (which had not ended in 1925) caused by over-importation and speculation, over-exportation on consignment and the inability of Brazilian exporters to retain markets gained during the period 1915–8; in addition, the Federal Govt. in 1920 renewed the payment of interest abroad, while little foreign capital was available. Government bonds and paper money were issued, and budget deficits became the rule; from 1914–8 the internal debt increased by over 100,000,000 milreis, and the foreign debt by £12,000,000. The total Federal indebtedness (calculated at 6d. to the milreis) on Dec. 31 1924 was nearly £300,000,000 of which about one-half was foreign. The following table shows the revenue and expenditure for each year from 1920–5:—

Year	Revenue, £	Expenditure, £	Balance, £
1920 .	41,688,000	41,243,000	+ 445,000
1921 .	22,936,000	24,869,000	− 1,933,000
1922 .	28,903,000	42,992,000	−14,089,000
1923 .	28,175,000	33,220,000	− 5,045,000
1924 .	34,106,000	36,335,000	− 2,229,000
1925[1] .	34,623,000	35,611,000	− 988,000

[1] Estimate.

Production and Industry.—The main crop is coffee, of which Brazil produces four-fifths of the world's supply. More than half of this is grown in the State of São Paulo; the remainder is mainly from the States of Minas Geraes, Rio de Janeiro and Espirito Santo. The coffee crop fluctuates greatly in the 5,000,000 ac. under cultivation, but the total steadily increased, until the years 1920–5 showed an annual average of 12,000,000 bags of 60 kilos (132 lbs.) each. The value of the coffee crop to Brazil may be estimated from its share of total exports, which increased from 50% in 1913 to about 75% in 1925. A constant effort is made to maintain a good price by encouraging consumption through propaganda abroad, and by means of "valorisation" (*see* 6.647, Coffee convention scheme of 1907), which was again resorted to in 1917. The Federal Govt. bought stocks of coffee at firm prices, to be released for sale as and when prices became remunerative; this policy was continued in modified form up to 1925. Every confidence has been officially expressed that coffee plague (ascribed to a minute beetle of the *Stephanoderes* type) could be combated, and that the measures devised to this end by the Government committee under Dr. Arthur Neiva in 1925 were efficacious.

Cotton is native to Brazil and can be grown in all parts of the republic. The best lands are in the centre and along the northeast coast to the mouth of the Amazon, whence the finest varieties are equal to the Egyptian. Annual production averages 130,000 metric tons, of which the greater part is shipped to England. In 1920–1 the question of the culture of cotton was much in evidence. In 1921 Mr. Arno Pearse, secretary of the Federation of Master Cotton Spinners, arrived with experts from England to study the problem. From this visit, and the international cotton conference held in Nov. the same year, it was made evident that Brazil's potentialities were great, but that better methods of seed-producing, planting and grading were essential. Since the presidential decree of March 27 1920 the Federal Govt. has encouraged and facilitated such enterprise.

Stock raising has made considerable progress, notably in the states of Rio Grande do Sul, Minas Geraes, Paraná, São Paulo, Rio de Janeiro, Matto Grosso and Goyaz. The World War gave a great impetus to cattle breeding and its derived industries. In 1914 only one ton of frozen meat, valued at £40, was exported; in 1917 this had increased to 66,400 tons, valued at £3,000,000; by 1923 exports of frozen and chilled beef amounted to 76,829 metric tons, valued at nearly £2,000,000, and of hides and skins 62,000 metric tons, valued at £3,626,000. A census of livestock, taken in 1920, showed some 34,000,000 oxen, 5,000,000 horses, 1,800 asses and mules, 7,000,000 sheep, 5,000,000 goats and 16,000,000 pigs: the greatest numbers were in Rio Grande do Sul and Minas Geraes. The industry has been modernised and is encouraged by the Federal Govt.; packing plants of the latest design and efficiency are in operation and the treatment of by-products has received increased attention.

After 1910 the rubber industry suffered severely from foreign competition, notably from the Far East. In 1910 Brazil exported 38,547 metric tons, valued at £25,000,000; exports then fell steadily, both in quantity and value, until in 1923 only 17,030 metric tons valued at £1,713,990 were exported; 1924–5 showed little difference, and the prospects generally were not encouraging. Sugar is produced largely in the states of Pernambuco, Rio de Janeiro and Minas Geraes. There are some 200 sugar factories in the country with an average annual production of 480,000 tons. From 1884 the export steadily declined, touching the minimum in 1912; after that date there was an increase reaching its maximum in 1921 with 252,110 metric tons, but falling in 1923 to 153,710 metric tons. The introduction of modern machinery is gradually making sugar one of the principal sources of national wealth. Tobacco is grown in Bahia, Rio Grande do Sul and other states. The Bahia product (85% of the whole Brazilian crop) is of good quality and finds a ready market abroad. Brazil is the second tobacco producing country in the world, its annual production approximating 100,000 tons. The lumber industry, with its derived products (fibre and wood-pulp for paper-making), has progressed in Paraná. Other important agricultural products are cacao, nuts, wool, caranauba wax, bran, rice, wheat, manioc flour, herba matte and beans.

Mineral Wealth.—Brazil is known to be rich in minerals, but they have been little exploited. Iron ore is abundant, especially in Minas Geraes, and contains a high percentage of hematite. Large quantities of manganese were exported to the United States during the War. Since 1919 much attention has been directed to investigating the commercial possibilities of petroleum deposits. Wolfram and tin are found at Encruzilhada. Brazil is one of the few world sources of mica. A small amount of gold is produced, the average annual value of the output approximating £650,000; copper is found in Parahyba and Bahia. Coal of rather poor quality exists in Santa Catharina and Rio Grande do Sul. Bauxite, chromite, lead, nickel, diamonds and other precious stones are also found. Natural gas has been discovered at Graminha. The Ministry of Agriculture has a geological branch, which undertakes surveys and the preparation of geological maps.

Manufacturing Industry.—Local manufactures of every description developed considerably after 1910. The difficulties of importation during the World War stimulated home manufacture, and from 1916 onwards great progress was made. São Paulo is the chief industrial centre. Cheap hydroelectric power was made available in limited quantities in Rio de Janeiro, São Paulo and Minas Geraes; the development of water-power resources is of immense importance to the home manufacturer. The textile industry is the most important; from 1921–4 it accounted for 40% of the total production of manufactured articles, and in 1925 there were altogether some 300 spinning and weaving mills in operation. The whole of the native textile output is sold in Brazil, supplying 80% of the fabrics in use. The tanning industry, with its derived manufactures of boots, shoes, leggings, slippers and sandals, supplies a large percentage of the home demand for footwear. Brazilian manufacturing industries are encouraged by heavy import duties, from which the Federal Govt. derives the greater part of its revenues; without this tariff they could not easily compete with foreign goods.

Foreign Trade.—The following tables show the value of the foreign trade of Brazil between 1911–24, and the percentage trade with certain countries in 1913–9–24:—

Years	Imports	Exports	Total
1911–5 (Annual Average)	£49,795,000	£61,538,000	£111,333,000
1916–20 (Annual Average)	68,175,600	83,653,300	151,828,900
1921	60,468,000	58,587,000	119,055,000
1922	48,641,000	68,578,000	117,219,000
1923	50,543,000	73,184,000	123,727,000
1924	68,949,000	95,103,000	164,052,000

Proportion of Total Imports and Exports by the Following Countries

Country	1924		1919		1913	
	Imports Per Cent	Exports Per Cent	Imports Per Cent	Exports Per Cent	Imports Per Cent	Exports Per Cent
United Kingdom	24·2	3·4	15	8	24·5	15
U.S.A.	23·9	42·8	50	42	15·5	32·5
Germany	12·2	6·6	...	..	17	14
France	6·7	12·1	3·5	22	10	10

Immigration and Labour Conditions.—Immigration is of vital importance to the development of so scantily peopled a country as Brazil, and it is encouraged and facilitated by various schemes of the Federal Government. The years 1910–3 showed a steady increase in the numbers of immigrants, which, however, fell from 192,000 in 1913 to an annual average of 39,728 for the period 1914–9, rising again in the post-War period to 86,967 in 1923. Immigrants are mostly from Portugal, Italy and Spain. The labour question as understood in Europe exists only to a limited extent in Brazil. Trade unions exist but are badly organised. The enormous size of the country, the lack of communications, and, outside the Federal district and São Paulo, the sparse population, render combined action difficult and completely ineffective; notwithstanding these

factors, however, strikes grew in numbers and extent. In 1923 a decree was published creating a national council of Labour to act in an advisory capacity to the Government. It began by considering hours of work, arbitration, insurance and other problems directly affecting workers, and in 1924 suggested that the 1918 Law of Accidents should be amended, in view of the prevalence of accidents (125,000 per annum) and the unsatisfactory state of employers' liability under the 1918 law.

Communications.—Brazilian railways have developed as a series of independent systems because of the wide separation of populated centres; thus Pernambuco is the focus of one system, Bahia, Rio de Janeiro, Santos, Pará and Rio Grande do Sul of others. The lack of transport facilities hinders economic progress; communication with the vast outlying district is slow and difficult, but apart from this the existing transport facilities are inadequate to deal satisfactorily with the output of the great productive zones. The extent of lines in operation on Dec. 31 1924 was officially stated as 31,310 km. (approx. 19,570 m.); there were over 2,000 km. under construction, and plans were approved for nearly 10,000 km. more. The need for railway development is recognised by the Federal Govt., but financial difficulties have greatly hindered progress. The lines in the interior running north and south are slowly being connected to afford communication independent of the sea; connection has been made from Natal to Maceió, and from Rio de Janeiro north to Victoria, and south to the Uruguayan frontier, where connection was made in 1913 with the Central Uruguayan Railway for Montevideo. Construction was not limited to the coastal region; for example in 1916 an important line was completed between Itapura and Porto Esperança, near Corumbá on the Bolivian frontier; this reduced the time from Rio to Corumbá from six or more weeks' travelling by water to six days by rail. Many other minor schemes were carried out or are being planned. The Federal Govt. operates 25% and has leased a further 25% of the lines. Many electrification schemes are planned or have been completed, notably in the State of São Paulo.

The development of telegraphic communication with the interior was largely the work of the Brazilian army. In 1924 there were 50,000 m. with more than 1,000 offices; more than half of the systems belong to the Government. Wireless telegraphy progressed after 1910 and communication is maintained from Manaos to the interior of Amazonas and the Acré district. Over 40 stations existed in 1923 and a powerful station was planned and commenced in that year to establish radio-communication with the rest of the world; on Sept. 5 1923 the Brazilian Press began to receive a news service by wireless from France. In 1924 Brazil was connected with Europe by three submarine cables, with the United States of America by two, and with the River Plate by two; connection was established with Monrovia (Liberia) in 1911. The high cost of transport and lack of adequate means of communication have caused a constant deficit in post-office administration since 1840; in 1922 there were over 4,000 post offices in the republic. Civil aviation had made little progress. The Budget law of 1925 authorised the issue of regulations governing aviation in Brazil. A company was formed in 1925 mainly with the object of mail carrying. At the end of 1922 the Brazilian mercantile marine consisted of 556 steamers with a total gross tonnage of 522,663, and 107 sailing vessels of 41,535 gross tons; half the total tonnage belonged to the Government-owned Cia. Lloyd Brazileiro, which extended its foreign service, after having acquired 15 of the 45 German ships interned during the War. The river systems are largely used for transport purposes, notably the Amazon, which is navigable up to Iquitos.

Banking.—Efforts to stabilise foreign exchange resulted in the creation during Penna's presidency (1906–10) of a conversion fund (*Caixa de Conversão*), which, though effective in its early years, was unable, partly through lack of continuity in its original policy, to stop fluctuations after the outbreak of the World War. The *Caixa* issued, from time to time, notes based upon a gold deposit, the maximum, on Feb. 12 1913, amounting to 420,924,300$000. The first set-back to its policy was the raising in 1912 of the rate of exchange to 16d. In 1914–5, trade depression, speculation, and war conditions also had an adverse effect, and the *Caixa* became indebted to the Treasury by increasing amounts annually, until on Dec. 5 1917 it was closed; by 1919 there were still 20,771,610$000 of its notes in circulation, a drop of over 60,000,000 milreis. The Budget law of 1920 suspended its functions, which were taken over in 1921 by the guaranteed *Caixa de Amortisação*. By a contract of April 24 1923 the Federal Government authorised the Bank of Brazil to become a Bank of Issue for 50 years; thus the issue of currency no longer lies with the Federal Government. Paper money in 1914 amounted to 980,000,000$000 and in 1925 to 3,000,000,000$000. Banking transactions showed a steady increase, particularly those of national banks; in 1921 they amounted to 11,302,604,000$000 and in 1924 to an estimate of 16,000,000,000$000.

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See also: *Diario Official* (1910, etc.); A. Boyle, *The Brazilian Green Book* (1918); *Reports* of the Department of Overseas Trade on the Economic and Financial Conditions in Brazil (H.M. Stationery Office, 1919, etc.); *Wileman's Brazilian Year Book;* the *Anuario Ibero Americano* (1923, etc.); Pan-American Union, *Reports of Pan-American Conferences.*

(C. Du.)

BREAD MAKING (*see* 4.465).—Since 1910 no entirely new and different methods of preparing bread have been introduced, but there has been a slow evolution of methods and machines which were introduced in earlier years. The machinery has been passing through a process of perfection and elaboration so that as near an approach as possible is being made towards an automatic system of forming the dough and shaping the loaf.

Arrangement of Plant.—In a modern bakery, the plant is arranged on three floors. In the upper is the flour store where the mixing and sieving machines pass the flour on to the automatic weigher. From there, it passes to the mixing machine where the water at a proper temperature is added. From the dough mixer the dough passes into the trough where it is to ferment. Large pieces are cut out at the end of that period and fed to the automatic divider which passes the weighed pieces of dough on to a machine called the rounder up or moulding machine which first gives shape and form to the piece of dough. The loaf then passes into the travelling trays which move slowly through a large proofing chamber which can be kept at a uniform temperature and where the dough again expands. Afterwards, the dough again passes through the moulding machine which gives it the final shaping before it passes into the oven.

Motive Power.—With the increased use of machinery more attention has been given to motive power. Electricity is largely used and the motor is part of the machine so that there is no waste of power by carrying loads unnecessarily.

Ovens.—The machine bakery demands a type of oven capable of being used more speedily than the older forms, where the oven was filled by means of the long-handled wooden spade, known as a peel, and much greater use is being made of travelling ovens. The bread to be baked is placed on rows of tins or otherwise on platforms which are carried through the oven by power at such a rate that when it reaches the further end of the oven it is completely baked.

Fuel.—For firing purposes, solid fuel is being replaced by more modern and cleaner methods of heating. In newly installed ovens, gas either from a producer furnace or from the ordinary municipal supply is used. Where heating by steam pipe is still in use, the heating is obtained from oil burners, the necessary power for the spraying of the oil being obtained from that already in use in the bakery. The use of oil fuel means a decrease in cost and labour and a great increase in cleanliness. In a large bakery where oil fuel has been introduced, the ratio of cost per sack between coke and oil firing is as 9 to 5. There is the absence of all dust which is bound to be present where solid fuel is used and a steady heat is kept up for a continuous process of baking. From every point of view, the ideal oven is one that is heated electrically. Fine ovens of this type are now available and the only requisite for their extensive use is a current supply at a reasonably small rate per unit.

Recent Changes.—The operations in a modern bakery are no longer carried on by rule of thumb and traditional methods but are based on technical knowledge. The number of revolutions of the mixer is predetermined and the speeds of the divider, rounder, proofer, moulder, travelling oven, cooler and wrapping machine are synchronised so as to eliminate waste time and motion. The humidity of the dough room is fixed. Temperatures are exactly observed and often thermostatically controlled. Some advance has been made, in America mostly, in arriving by a rapid method of indicators at the correct degree of acidity in the dough when it is ready for moulding. Fermentation in two stages, first in a thin sponge of flour, salt and water, and finally in a thicker dough made by mixing in a further quantity of flour, is being superseded by a shorter process where the first mixture of flour, water, yeast and salt is the final one. In this process the fermentative action of the yeast is usually stimulated by the use of some form of the many chemical yeast foods that are now

obtainable. These usually contain phosphates and are sold under proprietary names and are not considered legally to be adulterants. In the large bread factories in the west of Scotland, the process of preparing dough is still the sponge and dough process, with the fermenting agent a fairly acid barm called Parisian barm, the epithet being merely distinctive. The use of enriching materials such as whole and skimmed milk has improved the character of bread and its nutritive value, protein and mineral content of milk being removed in the process of milling the flour.

Delivery.—A further development in the hygiene of the bread supply has taken place within the past few years. The bread, before being delivered, is allowed to cool in ordinary bread racks, or in specially devised ones, and then passed through a machine which automatically wraps it in paper ready for delivery. The transport to the customer in a motor delivery van completes the whole process of the mechanical handling of this food product, perhaps, the most important of them all.

See J. Grant, *The Chemistry of Bread Making*, 4th ed. (1924); J. Stewart, *Bread and Bread Baking* (1924).

(J. St.*; H. E. Ba.)

BRÉAL, MICHEL JULES ALFRED (1832–1915), French philologist (*see* 4.481), died in Paris Nov. 25 1915.

BREASTED, JAMES HENRY (1865–), American orientalist and historian, was born at Rockford, Ill., Aug. 27 1865. After graduating from Northwestern College in 1888 he studied at the Chicago Theological Seminary and at Yale University. In 1894 he obtained the degree of Ph.D. from the University of Berlin, and subsequently honorary degrees from the Chicago Theological Seminary and the universities of California and Oxford. Obtaining an appointment at the University of Chicago in 1894 as an assistant in Egyptology, he became professor of Egyptology and oriental history in 1905, and in 1915 was made chairman of the department of oriental languages, becoming also, four years later, director of the Oriental Institute of the university. By commission of the royal academies of Germany in 1900 he was appointed on a mission to the museums of Europe to copy and arrange the Egyptian inscriptions in those museums for an Egyptian dictionary. He directed archaeological expeditions for the University of Chicago in Egypt in 1894–5 and 1905–7 and in Mesopotamia in 1920. In 1925 he headed an expedition organised for the excavation of Armageddon in Palestine.

He has published, among other works, *De Hymnis in Solemn sub Rege Amenophide IV. Conceptis* (1894); *A New Chapter in the Life of Thutmose III.* (1900); *Ancient Records of Egypt* (5 vol., 1906–7); *A History of Egypt* (1906, 2nd ed., 1909; also French, German and Russian editions and editions for the blind); *Egypt Through the Stereoscope* (1905); *The Battle of Kadesh* (1903); *The Temples of Lower Nubia* (1906); *A History of the Ancient Egyptians* (1908); *The Monuments of Sudanese Nubia* (1908); *Development of Religion and Thought in Ancient Egypt* (1912); *Survey of the Ancient World* (1919); and *History of Europe, Ancient and Medieval* (with J. H. Robinson, 1920).

BREGUET, LOUIS CHARLES (1880–), French engineer, a descendant of the famous watchmaker, Abraham Louis Breguet, was born Jan. 2 1880 in Paris. He received his education at the Lycées Condorcet and Carnot, and graduated in science. He was from the outset of his career a prominent member of the engineering firm that bears his family name, and eventually became head engineer of its electric service. The Maison Breguet, which came to the front in French aeronautical construction, provided him with ample ground for research; he published a quantity of reports on aerodynamics, on the energy set in force by propellers in motion and on the rise of aircraft from the ground. He studied and equipped in 1909 the first helicopter able to rise perpendicularly carrying a passenger.

BREITNER, GEORGE HENDRIK (1857–1923), Dutch painter, was born Sept. 12 1857 at Rotterdam. He began to study painting at The Hague, and was a pupil of William Maris. His early work showed the influence of Rochussen, who was the first to discover Breitner's great talent. In later years he was strongly influenced by Jacob Maris' colouring, but afterwards became an independent impressionist, occupying a prominent place in modern painting. The subjects of Breitner's pictures were chosen from the old parts of Amsterdam, from popular life in the town or from the vigorous movements of manoeuvring cavalry and artillery. He died at Amsterdam June 5 1923.

BREMEN (*see* 4.493) had a population in 1919 of 269,806; in 1921 two fresh communes and parts of two others were added to the city. Bremen is the chief port in Germany after Hamburg for international trade, and in 1925 the shipping had almost reached its pre-War level. In 1913, 3,876 vessels, totalling 2,149,000 tons, entered the port. In 1923 the number was 3,407, totalling 3,256,000 tons. Sailings to New York by the North German Lloyd line, which lost nearly nine-tenths of its tonnage during the War and under the Peace Treaty, were resumed in 1922. The total water area of the docks is 126 ac., and the waterway is kept open as far as the Hohethorshaven in winter by ice-breakers. The museum in the Bahnhofsplatz was enlarged between 1907 and 1911. The cathedral, bourse and town hall were damaged in the Spartacist disturbances of 1919, when the city was bombarded and occupied by government troops.

BRENTANO, LUDWIG JOSEPH (1844–), German economist (*see* 4.496), was one of the delegates sent over to London in Nov. 1919 to attend the economic conference convened by the "Fight the Famine" Council. At the first session of the conference, held at the Caxton Hall on Nov. 4, he urged the organisation and encouragement of German industry to enable Germany to fulfil her treaty obligations. His more recent publications include a pamphlet on the proposed League of Nations, and two short works, *Ist das System Brentano zusammengebrochen?* and *Russland, der kranke Mann* (1918).

BRESLAU (*see* 4.498) had in 1919 a population of 528,260, including the suburb of Gräbschen, which was included in 1911. An estimate in 1925 was 563,000. It is the capital of the Prussian province of Lower Silesia, the largest town in Silesia, the seventh in the republic, and the chief industrial centre of eastern Germany. In 1913 an exhibition to celebrate the centenary of the Wars of Liberation was held in a building specially built to the east of the city. A vast, circular building, called the Jahrhundert Halle and seating 10,000 people, was also erected; the dome has a span of 220 feet. Since 1918 fairs have been held three times a year in these buildings. A canal, the Breitenbachfahrt, for the use of barges from Upper Silesia, which branches off the Oder near Wilhelmshaven and joins the Alte Oder below the Gröschel Bridge, was made between 1912 and 1917. In July 1923 Communist outbreaks occurred here.

BREST-LITOVSK, BATTLES OF.—Under this heading are related the fortunes of Mackensen's third forward bound in the great offensive of the Central Powers against Russia in 1915. The period covered is from the middle of July to the middle of September. The aim of Mackensen's group of armies, directed between the Bug and Vistula rivers toward Brest-Litovsk—the same direction as that of the first Austrian offensive of the War—was to force the retirement of the Russians from the Polish salient, and, if possible, to cut their line of retreat. His attack was combined with one from the north by Gallwitz's XII. Army against the Narew line. In the upshot, though both attacks were successful, Russian resistance slowed them down sufficiently to enable the forces in the Polish salient to escape.

Mackensen's two previous attacks had carried him from the Dunajec to the San, then, after a pause, to Lemberg, which was captured on June 22, and northeast toward the Chelm (Kholm)-Lublin line. Again a short pause was necessary to reorganise his forces and prepare a fresh advance. Meanwhile the Russians had transferred three corps, Guard, II. Siberian and VI. Siberian from their northwestern armies to the III. and IV. Armies opposite Mackensen. The IV. Army (Ewarth) had, on July 8, administered a sharp check to the Austrian IV. Army, under the Archduke Joseph Ferdinand, at Krasnik.

The Armies Employed.—In the middle of July, when Mackensen resumed his advance, the position of the opposing forces was roughly as follows: The Russian IV. (Ewarth), III. (Lesh) and XIII. (Gorbatovski) Armies faced southwest, from the Pilica river near its junction with the Vistula to about Sokal

on the Bug (northeast of Lemberg), covering Dęblin (Iwangórod), Lublin, Chełm and Włodimierz Wolynski. On the right of this group, the II. Army still held the Bzura-Rawa-Ruska positions west of Warsaw; on the left, the VIII., XI. and IX. Armies stretched south along the Upper Bug to Złoczów and thence to the Rumanian border. The Russian losses had been extremely heavy; in the III. Army, for example, five corps mustered between them only 25,000 bayonets. Their morale had naturally suffered.

Mackensen's group comprised, in that order from northwest to southeast, the Austrian IV. Army, the German XI. Army, the new German Army of the Bug (Linsingen), and the Austrian I. Army (Puhallo). The first three were to carry out the main attack between the Bug and the Vistula, while the I. Army was to cover the right and advance towards Włodimierz Wolynski. Further south, the Austrian II. Army and German Southern Army were to cover the offensive against counter-attack from the east, the same task that the Austrian II. and III. Armies had failed to perform at the beginning of the War. On the extreme right, the VII. Army (Pflanzer-Baltin) was to push forward and clear the southern portion of East Galicia. West of the Vistula, Woyrsch's corps of Landwehr was to advance in conjunction with Mackensen's left and if possible cross the river below Dęblin.

The Fighting Begins.—Mackensen's attack began on July 15. From the first, progress was slow. The Austrian I. Army captured Sokal and established a bridgehead east of the Bug, and the XI. Army took Krasnystaw. The Russians withdrew a few miles, but in no part of the line was any decisive success achieved. On the 18th, for the first time in history, the Prussian Guard met the Russian Guard on the field of battle; honours appear to have been even between them. Meanwhile Woyrsch had overcome the right wing of the Russian IV. Army and reached the Vistula; he crossed on July 28, some 20 m. north of Dęblin. Mackensen attacked again on the 29th and broke through the Russian front half way between Lublin and Chełm; the former place was evacuated on July 31 and the latter on Aug. 1. It had taken Mackensen 17 days to make good the 25 m. from his starting point to these places.

Gallwitz in the north had also been unable to gain a rapid success and was advancing only slowly. But before the triple threat of the forces of Mackensen, Woyrsch, now firmly established east of the Vistula, and Gallwitz, the Russians were compelled to evacuate Warsaw and Dęblin, the former on Aug. 4, the latter on Aug. 5. The Russian left wing (IV., III., XIII. Armies) in front of Mackensen was now executing a wheel to the east, to conform with the retreat of the centre from the salient. Positions had been entrenched in anticipation of this movement. Mackensen made a last effort to break through and intercept the Russian centre between Warsaw and Brest-Litovsk. But his attacks at Lubartow between Aug. 5 and 8 only gained ground slowly. By Aug. 9 the Russian line ran from Loniza, west of Siedlce and north of Lubartow-Włodawa. It was obvious that they had escaped from the noose which it had been proposed to draw round their centre. The main portion of Mackensen's group moved northeast towards Brest-Litovsk, exercising a purely frontal pressure on the retreating Russians. The only out-flanking movement now possible in this part of the field was east of the Bug, directed against the rear of Brest-Litovsk. This was attempted by the Austrian I. Army and the Army of the Bug. The Austrian I. Army had crossed the Bug early in Aug. and had pushed its cavalry as far as Włodimierz Wolynski. It now advanced on Kowel, while the Bug Army, which had crossed the river at Włodawa, advanced through the Pinsk Marshes (Polyesie) to cut the Brest-Litovsk-Kobryń-Pinsk railway line.

The Final Stages.—The remainder of the story can be quickly told. Under increasing pressure from the Austrian IV. Army and the German XI. Army, the Russians evacuated Brest-Litovsk on Aug. 26. But they held off the Bug Army from Kobryń sufficiently long to allow of the safe withdrawal of their forces from Brest-Litovsk. The Austrian I. Army, after reaching Kowel, sent Heydebreck's cavalry corps across the Pinsk Marshes to join the Bug Army, and itself became involved in battle against the southwestern group of Russian Armies towards Luck (Lutsk) and Równe.

At the end of Aug. Mackensen's force was reduced. The Austrian IV. Army was transferred to the right group, south of the Marshes; portions of the XI. Army had already been withdrawn for the Serbian campaign, to which Mackensen himself was now called. What remained of his forces was placed under Linsingen and pursued the Russians as far as Pinsk, where a line was taken up which remained unaltered to the end of the War.

The poverty of the communications had much hampered Mackensen. In his previous drives from the Dunajec and from the San he had depended principally on the effect of his heavy artillery. The lack of roads and railways south of Lublin and Chełm made it difficult to advance his guns and to keep them supplied with ammunition. The Russians, too, had shown all their traditional stubbornness in retreat. In this part of the theatre the Pinsk Marshes made a wide enveloping movement impossible, and the direction of Mackensen's advance was inevitable. Ludendorff had foreseen the slowness of advance on this line and had persistently counselled that the main blow should be directed by Kovno and Wilno (Vilna) on Minsk. *See* also EASTERN EUROPEAN FRONT and Map; DUNAJEC-SAN; LEMBERG; NAREW.

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(A. P. W.)

BREST-LITOVSK, TREATY OF.—There were two treaties of Brest-Litovsk, the first a treaty between the Ukrainian Rada and the Central Empires, signed on Feb. 9 1918, and the second a treaty between the Soviet Govt. of Russia and the Central Empires, signed three weeks later. The Ukrainian Treaty was signed by the representatives of a Ukrainian Govt. which had no longer any footing in the Ukraine, where it had been replaced by the Soviets. It was followed by other agreements which invited the occupation of the Ukraine by the Germans. It was never annulled because, although the Germans restored the government that had signed it to power in Kiev, that government ceased to exist as soon as the Germans, having occupied the Ukraine, had no further need of it. The second of the two treaties is that generally known as the Treaty of Brest-Litovsk.

An armistice between Russia and the Central Empires was arranged in Brest-Litovsk on Dec. 5 1917.[1] Peace negotiations were to begin at once. The Russians, who hoped to secure the support of the working classes of Germany and to rouse those of other countries to demand an immediate ending of the War, wished to ensure publicity for the negotiations, and proposed that they should be held in Pskov or in any neutral capital[2] (Stockholm was suggested). The Germans, for precisely opposite reasons, wished that they should be held within the walls of what was then a German fortress. The negotiations were held in Brest-Litovsk.[3] It soon became clear that the Germans wished to conclude an oppressive peace and to secure the connivance of the Russians in covering it with a "democratic" formula. Negotiations were adjourned on Dec. 28 for 10 days, in the hope that other fighting Powers might be induced to join in them. Meanwhile, the Soviet Govt. was to consider the German proposals. When the negotiations were renewed, the Russians showed at once that they had no intention of pretending that the German proposals fulfilled the conditions they had previously announced of "a peace without annexations or contributions on a basis of the self-determination of peoples."

It is impossible to say whether the Germans would or would not have modified their demands if their task had not been suddenly made easier for them by the readiness of the Ukrainian delegates to conclude a separate treaty. The Ukraine was at this time in a state of civil war between the Ukrainian Soviets and the Ukrainian Rada, which had sent its own delegates to Brest, where, at first, they worked in contact with the delegation from the Soviet Government. On Feb. 9, the Ukrainian delegation,

[1] *Proc. of B. L. Peace Conf.*, pp. 35–6.
[2] *Proc.*, pp. 46–8.
[3] Dec. 22. *Proc.*, p. 36.

knowing that the Rada which they represented had been driven from Kiev and the rule of Soviets proclaimed there, concluded a separate peace,[1] thus cutting the Russian front (such as it was) in half and admitting, even inviting, the Germans into the Ukraine. Trotsky, who knew that the Russian trenches were already empty, then made a desperate appeal over the heads of the German delegation to the German people, and declared that Russia would not sign an abominable peace but would demobilise her army and no longer consider herself at war. He hoped that the Germans would not be able to move their troops.

Three days later the Germans denounced the armistice and on Feb. 18 began a practically unopposed advance towards Petrograd.[2] The Bolshevik leaders were almost equally divided, half of them thinking that they could best serve world revolution by being destroyed, half of them led by Lenin urging that they would do better to secure a breathing space for the revolution in Russia. After a series of debates, Lenin got a majority by one vote (given him by Trotsky, who crossed over) and a telegram was sent stating Russian willingness to sign the treaty at once. The Germans continued to advance and preparations were begun for a hopeless struggle.

Finally, the Germans offered peace on conditions much worse[3] than those originally refused. Russia lost the Baltic Provinces and had to cede Kars, Ardahan and Batum to Turkey, to demobilise even the post-revolutionary formations, and to pay a thinly disguised indemnity of 300,000,000 gold roubles. This treaty was signed on March 3 1918, was ratified by the Congress of Soviets on March 11, and accepted by the Reichstag on March 22. It was annulled by Germany in accordance with Point XV. of the Armistice, concluded on the Western Front on Nov. 11 1918, and annulled by the Soviet Govt. on Nov. 13 1918.

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BRETON, JULES ADOLPHE AIMÉ LOUIS (1827–1906), French painter (*see* 4.501), died July 5 1906.

BREZINA, OTTAKAR: *see* JEBAVY, VACLÁV.

BRIAND, ARISTIDE (1862–), French statesman (*see* 4.515). In Oct. 1906 M. Clemenceau formed his first government, and in it M. Briand remained Minister of Public Instruction and Worship. During the life of this Ministry his principal work was in connection with the Separation Law (*see* 10.891), in the application of which there were certain difficulties, due to the hostility of the Vatican. It was then that M. Briand gave proof of his essential liberalism. Though he held fast to the principle of the new legislation, he made possible the carrying on of the rites of the Catholic Church under the laws as to associations and public gatherings. On the death of M. Guyot-Dessaigne in Jan. 1908 he was appointed to the Ministry of Justice.

When the Govt. of M. Clemenceau fell in July 1909 M. Briand formed his first Cabinet, himself taking the portfolio of Interior and Worship. He announced that he would adopt a policy of national understanding and tranquillity. In Oct. 1910 there was a threat of a general strike on the railways. M. Briand mobilised all the railwaymen who were still subject to military service, dismissed those who disobeyed, and had the members of the strike committee arrested. A majority in the Chamber approved his action, but in spite of this the Govt. resigned on Nov. 2 1910 as a result of the withdrawal of M. Viviani, the Minister of Labour, who disagreed with his colleagues on the question of the right to strike.

M. Briand immediately formed a new Cabinet, of a more radical tendency than its predecessor. This alteration, which offended the moderate Republicans without conciliating the Radicals, weakened the position of the Ministry. A Colonial difficulty embarrassed them still further. The Franco-German Convention of 1909 had provided for economic collaboration between the two countries both in Morocco and French-Congo. In Dec. 1910 M. Pichon, the Minister of Foreign Affairs, and the German ambassador signed an agreement by which German capital was to be invested in a French undertaking in the Congo, the N'goko-Sangha, which was also to receive a large subsidy from the French Government. The Opposition criticised this scheme, and the Cabinet did not venture to ask Parliament to ratify, thus exposing themselves to the reproaches of the German Government. This affair, which was one of the causes or rather pretexts of the Agadir crisis of the following July, was among the principal reasons for the resignation of the Govt., although this was not stated at the time. A parliamentary incident gave M. Briand an excuse for an unobtrusive withdrawal. In Feb. 1911, when he was accused by the Radicals of failing in the strict application of the law with regard to religious houses, his majority fell to six and he resigned.

After some months out of office, he became Minister of Justice in M. Poincaré's first Cabinet on Jan. 13 1912. When M. Poincaré was elected President of the Republic in Jan. 1913 M. Briand succeeded him as Premier. The life of this Govt. was brief. Its most important work was to ask Parliament to lengthen the period of military service from two to three years as a rejoinder to the increase in German armaments. On March 18 1913, on the question of electoral reform, the Ministry was overthrown by the Senate, which defeated a proposal to introduce proportional representation that had already been passed by the Chamber.

M. Briand remained more or less in retirement until the outbreak of the World War. On Aug. 26 1914 M. Viviani felt himself obliged to broaden the base of his Govt. and offered M. Briand the portfolio of Justice. On the fall of the Viviani Cabinet, M. Briand on Oct. 29 1915 formed a government in which he himself took over the direction of foreign affairs. He made its character as a national coalition clear by including as ministers, without portfolio, the Socialist Guesde, the Catholic Conservative Cochin and the three former premiers, de Freycinet, Combes and Bourgeois. However, in the beginning of the summer of 1916, he was accused in certain political circles of a lack of vigour in the prosecution of the War. M. Clemenceau was one of his fiercest critics. In June he was forced to agree to the holding of secret sessions in both Chambers, and to the appointment of a parliamentary commission to supervise the affairs of the army.

By the end of autumn, the Rumanian disaster, and especially the situation in Greece, made him the object of further attacks. He was accused, for instance, of being the willing dupe of King Constantine. The question of the higher command was also causing much anxiety. At this time Joffre, who had been made a marshal, was replaced by Nivelle. M. Briand thought it advisable for all these reasons to reform his Cabinet. He appointed Lyautey Minister for War, and called in experts who were not in Parliament to take charge of the more technical offices. On March 14 1917 a difference of opinion between the Chamber and Lyautey brought about the latter's resignation. After a vain attempt to reform his Govt., M. Briand decided to resign.

For three years M. Briand took scarcely any part in public affairs. It must, however, be noted that in Sept. 1917 von der Lancken, the civil commissioner of Germany in Brussels, renewing an attempt which he had already made in the spring, proposed to M. Briand, through a Belgian intermediary, a meeting in Switzerland to discuss the possibility of peace. M. Briand was inclined to accept the offer, but M. Ribot, the Minister of Foreign Affairs, counselled him to avoid it as a snare.

During the years which immediately followed the War, M. Briand still remained in retirement. He showed, however, by one or two speeches in the Chamber, that he was inclined to move to the Left. In Jan. 1921, on the fall of the Leygues Ministry, he was called upon to form a government, and himself took charge of Foreign Affairs. He interested himself particularly in the application of the Treaty of Versailles, especially with regard to reparations. In the autumn he went to Washington as

[1] *Proc.*, p. 159; Temperley, pp. 227–8.
[2] *Proc.*, pp. 172–4.
[3] *Proc.*, p. 176.

the French representative at the conference on naval disarmament. From that moment he was fiercely attacked by those who accused him of having failed to safeguard the interests of his own country. This campaign reached its height when, early in 1922, the Inter-Allied Conference met at Cannes, and M. Briand discussed with Mr. Lloyd George the question of an Anglo-French defensive pact. A telegram which he received from M. Millerand, then President of the Republic, decided M. Briand to return to Paris and confront his enemies. When he arrived he realised that his position had become untenable. He announced his resignation to the Chamber on Jan. 12 1922.

In April 1925 he was offered the portfolio of Foreign Affairs in M. Painlevé's Cabinet, and he remained in the same office in the second Govt. formed by this leader in October. The Locarno Agreement in Oct. 1925 enormously increased the influence of M. Briand, who had played an important part in the negotiations. When M. Painlevé resigned on Nov. 22, M. Briand became the new head of the Government. A great parliamentarian, although he broke with the extreme Left in 1906, he retained his connection with many of the more advanced political thinkers. His genuinely liberal ideas, and his constant endeavours toward national unity, gained him the sympathy of the moderate parties. His ease and animation as a speaker, his parliamentary experience, and his well-known ability in the conduct of foreign affairs, all contributed to that great influence which made him, up to that time, Premier more often than any other politician in France. (P. B.)

BRIDGE, AUCTION (*see* 4.531).—As the game of bridge had succeeded whist among card players, so in turn, after 1908–10, did the first form of simple or straight bridge give way to auction bridge.

Even before 1908 it had been recognised that the great weakness of simple bridge was the restriction of the trump-making power to the dealer and his partner, and their inability to evade that privilege at will, a ruling which enforced the playing of too many poor hands and the forfeiture of too many good ones. Hence arose the plan of putting up every hand to auction. The dealer must open the bidding; every player had a chance to buy the declaration, naming at each bid the suit which he desired to play, and this was sold to the highest bidder, or to his partner in the event of that partner being the first to name the final suit, in which case the second partner was considered merely as the raiser, not the bidder. Bidding continued until three successive players had passed in lieu of bidding, doubling or redoubling; any player might abandon his original suit and switch on to a new suit, to his partner's suit or even to his adversary's. The bidding having closed, the partner of the buyer became dummy, and the buyer's left-hand adversary became the leader.

At first the original suit values and ranks were retained as at straight bridge, but many vital changes were made. The rubber bonus was raised from 100 to 250. The adversaries of the buyer, hereafter called the declarant, were debarred from scoring points towards game, or below the line, taking their profits invariably in the honours column or above the line at 50 a trick regardless of suit. The book for the declarant remained at six; over that he had to take as many tricks as he had bid. If he took more, he could score them all; if he took fewer, he could score nothing except for possible honours, his adversaries scoring 50 for each trick stolen from his contract.

The book for the adversaries varied with the size of the bid, being always the number of tricks that the declarant dared to lose; it was determined by deducting the bid from seven; in a 2-bid the adverse book was 5, in a 3-bid 4, and so on. In a doubled hand the adversaries scored 100 for each trick over their book; in a redoubled hand 200. But if a declarant, who had been doubled, succeeded in keeping his contract, his trick points were doubled; he received a 50-point bonus in the honours column, and an additional 50 points for every trick over contract. If he had redoubled, each of these 50's was raised to 100, and his trick points went to four times their normal value. Doubling was restricted to one double for each side.

Changes in the Game.—All these points remain in the game as played in 1926, but meanwhile the next move after 1910 was to change the suit values, as competition in bidding had proved that their discrepancy was too great, and had shown also that a good spade hand was invariably wasted. The dealer being still forced to bid, his solace on a poor hand was provided by spades at 2 a trick and a stop-loss of 100 honour points, while good spades were to be bid as "lilies" or "royals" and at 9 a trick. The suits thus ranked: Clubs 6, diamonds 7, hearts 8, royals 9 and no-trumps 10, with the merely nominal spade at 2.

All went well until certain American players seized the chance to use the low spades as codes, telling their partners the exact make-up of their hands without assuming proper responsibility or risk. It was thus that the first "false" bids appeared. A system of high spade bids came into vogue in American play ranging from 2 to 7, inclusive, and forming a code; 6 spades, for instance, meant "Partner, take your choice between hearts and no trumps; I can play either." The point value being but 12, the partner was enabled to make a comparatively low bid without serious risk. Though this became known temporarily as the American game about 1912–3, the sobriquet was really unfair to the majority of American players.

These false bids received no support in England and they were equally anathema to the majority of American players, though accepted by most of the contemporary American writers on the game. Eventually, however, the system was killed and of necessity the game was re-made. Spades at 2 vanished, and spades at 9 took the place of royals, the latter term disappearing. The dealer's refuge in the case of a poor hand having been thus removed, the forced opening bid was also abolished. Three successive passes still closed the bidding, except in the case of three opening passes, when the fourth player was still given his chance to bid. An entire hand might be thrown. It was thus that the game was played in 1926.

Variant Games.—Certain variants were experimented with during 1913–21, but without disestablishing the recognised game of auction. Nullos were an early variant, their object being to destroy the undue advantage of high cards. The nullo player had to lose tricks on a poor hand, a much harder thing than to win them on a good one. The idea had long been discussed, but had been deemed impossible, as no player could contract to lose all the tricks while carrying an exposed dummy of whose make-up he knew nothing when bidding. Miss F. Irwin evolved the plan of allowing 6 safe tricks to the bidder of 1 nullo, 5 safe to the bidder of 2 nullos and so on. She became an ardent champion of this difficult and scientific variant, collecting a large following. But it was a losing fight; the nullo game was far too difficult for most people.

Another variant appeared in America under the name of pirate auction, but it never received any official recognition, and died almost before it lived. More support was given in some London and Paris clubs to contract auction, of which the essential point is that no more tricks can be scored toward game than the declarer has contracted to make, a special system of scoring, different from that of ordinary auction, being adopted; but it failed to penetrate beyond a limited circle.

In American play the method of false bidding was meanwhile revived under the form of a false double. In this system to double any low bid is not meant as a genuine double, but operates as a code. The person who doubles a one-trick bid in any particular suit practically says, "Partner, I have a no-trumper except that I do not stop that suit. Do you?", while the person who doubles one no-trump says, "Partner, I, too, have a no-trumper. Bid 2 in your best suit, for I have general assistance."

Laws of the Game.—The American laws have always followed the English laws in substance, with one important exception. In England, the total of a bid must exceed the total of the previous bid, or must equal it and contain more tricks; in America, it is merely necessary to equal it with more tricks, or to out-bid it in number of tricks regardless of total value. Thus in 1925, in England, it was still necessary to bid 5 clubs (30) to out-bid 3 no-trumps (30) and 6 diamonds (42) to out-bid 4 spades (36); whereas in America, 4 clubs and 5 diamonds suffice. The Amer-

ican laws have also reduced the revoke penalty and abolished chicane as having no place in a bidding game; and they make a touched card in dummy a played card.

The Laws of 1926.—In the spring of 1926 the American Whist League appointed a committee to revise the laws and eliminate some of the defects of the existing system. The two most important changes are a different method of scoring honours and a new penalty for revoking. Up to 1926, honours, that is, the ten, jack, queen, king and ace, had had different values for the four suits, the basis for that value being that of the trick. Thus, for example, four club honours in one hand were worth 48 above the line, while the same holding in spades amounted to 72. The fault of this system was that a good minor suit in diamonds or clubs, was not played, while a poorer heart or spade hand was played for the sake of the score above the line. The new law gives all suits the same value for honours, making for more even bidding and, since they are scored in multiples of ten, greatly simplifying the scoring. The revoke laws had always been complicated and confusing. The law now stands that the sole penalty for the revoke, whether it be made by declarer or an adversary, is two tricks. There is no alternative point penalty as in the earlier system. These tricks are taken from those of the revoking side and count exactly as if they had been won in play. See Milton C. Work, *Auction Bridge Complete with the 1926 Rules* (1926). (F.I.)

Developments in Great Britain

The original laws of auction formulated by the Portland Club and Bath Club, London, followed closely on the laws of the old game, only such alterations being made as were necessitated by the new method of declaration. The values of the suits were the same as in bridge (spades 2, clubs 4, diamonds 6, hearts 8 and no-trumps 12). A brief experience of the game showed that the value of 12 given to the no-trumps bid restricted competition in the bidding and that the low values of spades and clubs (2 and 4 a trick respectively) practically prevented the holders of them from taking part in the bidding.

From America was introduced the royal spade or lily idea which gave to the spade suit a double value and altered also the values of the suits, thus: Spades 2, clubs 6, diamonds 7, hearts 8, royal spades 9 and no-trumps 10. The Metropolitan Club of New York and the Somerset Club of Boston were responsible for its introduction. It was afterwards taken up by the Racquet Club of Philadelphia and was finally adopted by the Whist Club of New York early in 1912. In the same year it was introduced into England where it rapidly became popular. After a comparatively short trial it was found that the double value of the spade suit had many inconveniences and, when the English laws were revised in 1914, the lower value was abandoned altogether and the spade suit was given one value only, viz., nine points per trick. In the framing of the English laws the card committee of the Portland Club had the co-operation of a representative of each of the following clubs—Baldwin, Bath, St. James', Turf and White's. The laws were finally approved and adopted by the committee of the Portland Club in May 1914. The revised method of scoring was soon adopted in America and the Whist Club of New York framed a new law doing away with the lower value of the spade suit.

Changes in the Laws.—After the publication of the English Laws in May 1914, further experience of the game led to a demand for further revisions. It was realised that, just as the laws of bridge were merely the whist code revised, so the laws of auction bridge were little more than the English laws of whist twice revised. Some more drastic revision was demanded. In Jan. 1924 the Portland Club issued a new code of laws under its own authority, not calling into consultation any representative of the five clubs which co-operated in the framing of the laws of 1914.

There were no drastic revisions. The new laws numbered 100 as against 110 in the previous code. There were many verbal alterations. The term " bid " was substituted for " declaration," it being recognised that in auction bridge only the final bidder whose bid is accepted by the table, can be said to make a declaration. The meaning of the laws was in many cases made clearer. They were re-arranged and an alphabetical index was added. The American numerical count was rejected deliberately, but American precedent was followed in making all the cards rank in order of their suit values for cutting, and in the reduction of the revoke penalty from 150 points to 100 points. The American code of 1920 reduced the revoke penalty from 100 points to 50 or from 3 tricks to 2.

An alteration of importance was making a pass rank as a bid. Heretofore a player who said no bid out of turn was subject to no penalty. Under the new law a player passing out of turn is liable to the same penalties as a player making any other bid. Illegal bids were clearly defined and a new option given about an under call. Further a player who looks at a trick which has been turned and quitted incurs a penalty of 50 points above the line for each offence. The new laws met on the whole with a good reception and were adopted by most clubs throughout the country. In Jan. 1925 the Portland Club issued an eighth edition of the laws bound up with cases and decisions which had reached them during the year. There were no less than 84 important decisions involving correct interpretations of the laws. When framing their revised code of laws of 1924 the Portland Club had before them the American Whist Club laws of 1920 which consisted of a code for the first time written for the game of auction. The American laws of 1920 have been again subjected to revision and a new code became effective in the United States in the spring of 1926.

The existence of two distinct code laws in the bridge world is unfortunate. On the European continent for example, American laws are usually followed, while the English laws are not even universally accepted in British Dominions. In Canada, while both codes are used, the American is more popular as is the case also in India. In Australia both codes are also in use, but the English is more widely played.

Apart from questions of law English theories and practice in bidding and play have been largely influenced by American principles during the 10 years 1915–25. In spite of vigorous opposition the American informatory doubling system was introduced and in 1925 the Portland Club, which was the stronghold of opposition, capitulated. The informatory double has now become part of the recognised English method of playing auction bridge, although all the variations of it practised in the United States have not yet been adopted.

Informatory Bids.—The two doubles of an informatory conventional character recognised in England are (*a*) the double of a no-trumps bid and (*b*) the double of a suit bid. The informatory double of a no-trumper applies only to a bid of " One no-trumps "—not two or more. The doubler should have considerable strength, at least four or five tricks, and probable support in either of the major suits. The partner of the doubler should take out the double into his longest suit, should no intervening bid have been made, even though the suit be only four, unless his hand is so strong that he can see substantial penalties in leaving in the no-trumps bid. If the player on the left of the doubler, however, makes a bid the doubler's partner is under no necessity to call and should not do so unless he has a very strong hand.

The informatory double of a suit bid of one or two announces strength in the other three suits, but probably none in the suit that is doubled. The doubler tells his partner that no matter which of the three other suits he bids, he will find a helpful dummy, while if he has two stops in the suit doubled he can go no-trumps, however weak the rest of his hand. The result of the procedure is frequently to make the player who has not got the no-trumper play the hand, and the advantage is that the first lead of the adverse suit comes up to instead of through him. This may make a no-trumper successful which would otherwise fail. The requirement for the double of a suit bid of one is that the doubler should have the three undoubled suits stopped and a hand containing better than average high cards.

(A. E. M. F.)

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BRIDGEMAN, WILLIAM CLIVE (1864–), British politician, was born in London Dec. 31 1864 and educated at Eton and Trinity College, Cambridge. He was elected Conservative Member for the Oswestry division of Shropshire in 1906, and became a frequent speaker in the House of Commons, especially on educational and agricultural questions. From 1911 he acted as an opposition whip. He was a junior Lord of the Treasury in the first Coalition Govt. and afterwards assistant director of the War Trade Department. Under Mr. Lloyd George he became successively Parliamentary Secretary to the Ministry of Labour (1916) and of the Board of Trade (1919) and was secretary of the Mines Dept. (1920–2). In 1923 he became an ecclesiastical commissioner. In the Conservative Ministry of Mr. Bonar Law and Mr. Baldwin he was Home Secretary. His action in ordering the deportation and internment in Ireland of Irish prisoners in England was declared illegal by the Court of Appeal, and an Indemnity bill was passed for his protection. Having become, in Nov. 1924, First Lord of the Admiralty in Mr. Baldwin's second Ministry, he revived the proposal for establishing a dockyard at Singapore. He represented the Govt. in the abortive negotiations with the miners in the summer of 1925.

BRIDGEPORT, Conn., U.S.A. (*see* 4.532).—After the outbreak of the World War this city received large orders from the Allies for firearms, ammunition and other articles, and within two years (1914–6) the population increased 40 to 50%. The congestion in dwellings, schools, streets and trolleys became serious and there were numerous strikes. Before the end of the War, housing developments to provide for 2,000 families had been undertaken by the Remington Arms Co., the U.S. Housing Corp. and a limited dividend company which was organised at the height of the demand. A city plan was prepared in 1916 and a vice commission made a thorough study in 1915–6. After the Armistice the industries readjusted themselves to normal demands. The construction of schools and houses was able to overtake the increase in population. The general death-rate fell from 15·1 per 1,000 in 1910 to 10 or 11 in 1923 and 1924; infant mortality from 110 (deaths under one year of age per 1,000 births) to 56·2. The Federal Census (1920) found the population to be 143,555, an increase of 40·7% in the decade, of whom 46,782 were foreign-born. The value of manufactured products was $65,609,000 in 1909; $208,090,000 in 1919; $108,400,255 in 1921; $148,856,051 in 1923. The average number of wage-earners in the factories in the same years was 25,775; 42,862; 25,892; 33,207.

BRIDGES (*see* 4.533).—In the general anatomy of steel bridges no sensational developments have occurred since 1910 and evolution in this respect took place along lines previously laid down. Extreme simplicity and truthfulness of outline are the leading characteristics of modern long-span bridges, and dignity is obtained by the rigorous avoidance of meaningless curves and redundant members.

Modern practice continues to favour bridges whose anatomy is so simple that the total loads carried in the main members can be determined by the simple methods of rigid body statics, and there is a growing tendency to eliminate stresses arising from deformations and temperature variations by the introduction of suitably arranged articulations. This point is illustrated by the three-hinged arch. By the introduction of a third hinge at the crown in addition to the hinges at the abutments, the computation of the thrust in the arch is brought within the scope of rigid body statics, and stresses due to temperature variations are reduced to insignificance. Although there have been no radical alterations in the anatomy of bridges, yet in the details of design and in the methods of manufacture the vast change in the economic conditions which have taken place since 1910 are clearly reflected on both sides of the Atlantic.

In the bygone days of cheap and abundant labour large bridges were built up *in situ*, plate by plate, just as a ship is built. Economy in labour was a relatively minor consideration, and it was possible and legitimate to indulge in features of design which would have to be ruled out under modern labour conditions owing to their prohibitive cost. Nowadays as much work as possible is done in the machine shops, and field work operations are cut down to a minimum. Design in consequence turns more and more on ease of erection and the transportation of massive members, and when inviting tenders for a large bridge it is customary to allow manufacturers to submit their own designs whereby they can avail themselves of their own special experience and equipment. In short, the main difference between modern bridges and those of the past may be fairly well summed up by saying that the latter were made by hand whereas the former are machine made.

Advances in metallurgy have provided structural engineers with alloy steels which possess every advantage except that of low cost. For instance, nickel steel containing 3·5% of nickel is, roughly speaking, twice as strong as ordinary structural steel. This particular alloy was used for the central suspended span of the Quebec bridge, reduction in weight in this case being an urgent necessity. With special steels, higher working stresses effect a saving in weight, but too often this economy is more than neutralised by the extra cost per ton demanded by the steel makers, and until this difficulty is overcome ordinary mild steel is likely to remain the standard material for structural purposes. This objection does not apply with equal force to high carbon steels, and for compression members in particular there is a tendency to increase the carbon content and make use of the enhanced strength thereby obtained. The use of high tensile alloy steels greatly increases the limit of span associated with any particular type of bridge, and if spans are to exceed by any considerable amount those already in existence the employment of special steels is almost inevitable.

Among the most notable steel bridges constructed since 1910 are the Quebec cantilever bridge over the St. Lawrence river and the Hell Gate arch bridge over the East river, New York City. But the Suspension Bridge continues to be a favorite with engineers. At Bear Mountain, across the Hudson, a span of 1,632 ft. has been achieved, and at Philadelphia, the Delaware is crossed by a bridge of this design, the span of which is no less than 1,686 feet. (*See* CAMDEN.)

The Quebec Bridge (see fig. 2 on plate).[1]—The Quebec bridge is constructed on the site of the one which collapsed in Aug. 1907, when in an advanced stage of construction. Forming an important link in the transcontinental railway system, it carries a double railway track across the St. Lawrence river, about six m. above Quebec. The design and construction was the work of the St. Lawrence Bridge Co., acting under the supervision of a board of control appointed by the Canadian Government. The bridge is a cantilever construction.

Its clear span of 1,800 ft. establishes a record, and the central portion, 640 ft. long, resting on the projecting ends of the cantilevers, is also the record length for a single span. The triangulation adopted for the cantilevers is a novelty known as the K triangulation, so called because the letter K appears prominently in the pattern, and the advantages claimed by its designers in the matter of ease of erection and freedom from deformation stresses have been so amply justified that its adoption for other cantilever constructions is confidently anticipated. In contrast to the Forth bridge, there is no tapering in width of the cantilever arms either vertically or horizontally. The trusses being truly vertical, erection was facilitated and the parallel arrangement of the top chords provided a convenient track along which the erection traveller could advance during construction. The bottom chords of the cantilevers are straight, and in view of the failure of the previous bridge great care was bestowed upon their design and manufacture; an elaborate set of experiments with quarter-size models being carried out to verify the validity of the calculations. These great compression members consist of four parallel I section girders braced together with a very rigid system of diaphragms and lattice bracing. The section of this lower chord reaches the value of 1,941 sq. in. as it approaches the piers and it is considered to be the largest compression member in existence.

The top chords, being tension members, are altogether different in design. They consist of a number of eye bars packed side by side in two tiers, and, since the length between panel points was

[1] *Engineering*, vol. 106 (Sept. 13 1918).

EXAMPLES OF MODERN BRIDGE CONSTRUCTION

FIG. 1. Reinforced concrete bridge over the Seine, at St. Pierre du Vauvray, France (1924). FIG. 2. Quebec Bridge over the St. Lawrence River, Canada (1917). FIG. 3. Hell Gate Arch Bridge, over the East River, New York (1917).

(Fig. 2. Courtesy of Canadian National Rys. Fig. 3. Photo by Ewing Galloway, N. Y.)

excessive for single length eye bars, these members are made in two lengths and joined together with a pin at the centre. To prevent sag occurring, the weight of the central pins is carried by a light steel truss which bridges the distance between the panel points. With the object of facilitating erection, pin joints were extensively used throughout the bridge for connecting the ends of adjoining members.

The length and weight of the central suspended span precluded the possibility of building this out as extensions of the main cantilevers, and this great girder was accordingly floated into position and hoisted up bodily by hydraulically operated slings. As the weight to be lifted was over 5,000 tons, and the lift was 150 ft., this constituted a weight-raising effort of unprecedented magnitude. The first attempt ended in failure. Owing to the fracture of an insignificant cast steel pedestal one of the corners of the girder escaped from the supporting sling and, under the torsional stresses thus produced, the suspended span collapsed and plunged into the deep waters of the St. Lawrence. No harm was done to the cantilevers. A new span was constructed, and a year later this was successfully hoisted into position, the process occupying only three days.

Hell Gate Arch (see fig. 3 on plate).[1]—This bridge (1911–7), which achieves a high degree of aesthetic perfection, carries four lines of railway track across the East river in New York City. Measured between the faces of the abutment towers it has a span of 1,017 feet.

Technically it is classified as a two-hinge spandrel-braced arch, and it is the lower chords of the arch framework which constitute the real backbone of the bridge. These members, constructed of a fairly high carbon steel, are of box section. Their width is 6½ ft. throughout, but in depth they vary from 7 ft. at the crown to 10 ft. 10 in. at the abutments, this latter dimension reaching the limit fixed by railway transport considerations. The heaviest length of bottom chord transported to the site weighed 150 tons. A novel method of butt joint was employed to connect adjoining lengths of these compression members. Close contact was made over only the middle third of the adjoining edges, and for the outer two-thirds a slight taper clearance was provided. When the member received its full working thrust this clearance practically disappeared, but this device ensures that there is no serious eccentricity of load, and that the resultant thrust in these lower chord members is approximately axial in position.

The bearing surfaces at the ends of the lower chords are perfectly plane, but in order to give the desired degree of articulation the opposing bearing surface provided at the abutments is curved to a radius of 96 feet. The bearing pressure is 120 tons per lineal inch measured along the line of contact, but, owing to the elastic deformation of the surfaces, contact actually occurs over a strip instead of along a line, and the maximum bearing pressure is thereby reduced to about 12 tons per square inch.

The arch truss was built out from the two ends as cantilevers. To balance these cantilevers during erection a ponderous system of back stays and counterweight was required, most of this being material subsequently incorporated into the structure. Powerful hydraulic rams were provided by shortening or lengthening the back stays. By slightly shortening the back stays the middle lengths of the lower chords were inserted and then with great care the hydraulic rams were eased off until the arch became self-supported. The bottom chord at the crown being comparatively flexible, the bridge at this stage was in effect three-hinged. The upper chord and the two centre diagonal members were subsequently inserted free of stress, and these members come into operation only under the influence of train loads. Thus for dead loads the bridge may be regarded as a three-hinged arch, and for live loads it possesses the additional rigidity associated with an arch of the two-hinge variety. The Hell Gate Arch was designed by Gustav Lindenthal. It is the longest span arch but a very similar arch now in process of construction across the entrance to Sydney Harbour is designed to have a clear span of 1,600 feet.

Reinforced Concrete Bridges.—The use of reinforced concrete for bridging purposes have made such rapid progress that brick and stone have been practically ousted from the list of bridge-building materials. Short-span highway bridges are almost invariably made of reinforced concrete; for moderate spans this material is a formidable rival to steel, and it is only in the case of really long spans of 500 ft. and upwards that the supremacy of metal bridges remains unchallenged.

Reinforced concrete bridges are in effect castings poured *in situ*. The construction of the timber moulds constitutes a bridge problem in itself, and for long spans the expense of this temporary work is such a high proportion of the total cost that this system of construction ceases to be an economical proposition.

[1] *Engineering*, vol. 108 (Aug. 8 and 22, Sept. 5 and 26, Oct. 17, Nov. 1 and 21 1919).

For spans up to 50 ft. or thereabouts, construction may take the form of a deck slab supported on longitudinal beams, but reinforced concrete work is seen in its most economical and artistic form when applied to the construction of arches or bowstring girders.

Unlike metal girders of the same character, no diagonal members are included in its anatomy, experience having proved that such members in concrete constructions are a source of weakness rather than strength. The vertical posts which support the decking are generally of slender build, and in this form the bowstring girder approximates in principle to an arch, the horizontal thrust on the abutments being taken by the ties which connect the opposite ends of the arch members at the level of the springings. The abutments, being free from horizontal thrust, need not be very substantial in character, and this fact, added to certain obvious advantages of clearance under the roadway, are sufficient reasons to account for the extensive adoption of the bowstring type of bridge. The longest reinforced concrete bridge in 1926 was an arch over the Seine at St. Pierre du Vauvray.[2] This bridge (see fig. 1 on plate) is a road bridge having a clear span of 432 ft. 6 inches. It was completed in 1924, and was constructed by Messrs. Limousin et Cie. to the design of M. Freyssinet. The two arch ribs supporting the roadway are hollowed reinforced concrete tubes of rectangular section. They have the uniform width of 8 ft. 2½ in., but in depth they vary from 8 ft. 2½ in. at the crown to 13 ft. 6 in. at the springings. A novel feature in their construction was the method of removing the timber frames on which the curved ribs were constructed. Each rib was discontinuous at the centre, the two halves being separated by a small gap. In this intervening space hydraulic jacks were installed and, when the time arrived, these jacks pushed the opposing halves slightly more apart, and the centering relieved thereby of its load was readily removed. This having been done, into the gap a key consisting of metal plates coated with cement was inserted, and as the hydraulic pressure was released the gap closed up on the plates and the arch became self-supporting.

Reinforced concrete arches are usually of the hingeless type, but during the process of construction it is customary to introduce temporary hinges at the springings and crown. In these regions the section of the rib is cut down until only a short and small diameter strut of heavily reinforced concrete remains, and the local flexibility consequent on this local reduction in section provides in effect the action of a hinge. When the centering is removed, the arch, by a small rise or fall of its crown, can adjust itself to any slight change in span arising from abutment movements or contraction in the concrete arch during the process of setting. After the arch has settled down into its natural position it is made hingeless by filling in with concrete the reduced sections which provided the temporary hinges.

Reinforced concrete bridges of the arch or bowstring type by their simplicity and truthfulness of outline convey a sense of fitness which never fails to please, and if sufficient attention is given to details of design bridges of these types can attain the very highest pitch of artistic perfection.

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BRIDGES, ROBERT SEYMOUR (1844–), English poet (*see* 4.532), was appointed Poet Laureate in succession to Alfred Austin in 1913. In later years he wrote little, but he published *October and Other Poems* in 1920, and *New Verse*, written during 1921 and in 1925. However, his nobly conceived anthology, *The Spirit of Man* (1916), was perhaps a more satisfactory offering to these troubled years than the official odes which his critics called for in vain. Dr. Bridges was a founder of the Society for Pure English. In 1924 he visited the United States to deliver university lectures.

BRIDGING, MILITARY.—The construction of light bridges for the passage of attacking infantry is one of the most important duties of engineers in battle. In the warfare of the future, when tanks are employed, more use will certainly be made of physical obstacles, particularly canals and rivers, to hamper or prevent the employment of tanks.

The crossing of a river will usually commence by the infantry establishing a footing on the far bank, and pack artillery following in close support. Then for the armoured cars, field artillery, transport and supply lorries, as soon as the bridgehead is pushed forward sufficiently, substantial bridges must be constructed. When the crossing is fully established heavy bridges must be got into place and these must have approaches that are firm enough to carry the heavy artillery, tractors and heavy mechanical transport.

[2] *Concrete and Constructional Engineering*, vol. 19 (May 1924).

Initial Operation.—In the face of an enemy holding the river bank and strongly defending it, the tactical operation of forming a bridgehead is by no means simple. All existing approaches will be fully commanded and will probably have been damaged by explosives; existing bridges have probably been destroyed, and in any case their position is so well known that an attack on these lines is likely to be repulsed. To effect success, therefore, the first crossings must be made well away from the known lines of approach. Moreover, surprise is an important element, so that the cover of darkness is needed for the collection of material and the actual commencement of the operation.

The engineers who have to bridge the river, or get the leading infantry across by any other means, must be equipped with the

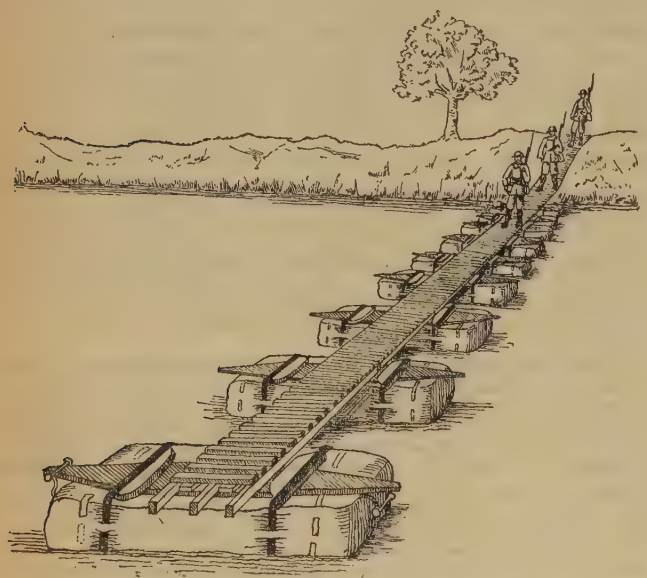

FIG. 1.—Kapok Float Assault Bridge.

lightest possible material that will stand the rough handling of carriage across broken, and often swampy, ground, some distance from the nearest point to which it can be brought by transport. The standard equipment for this purpose is the kapok assault bridge shown in fig. 1. This bridge consists of a canvas float stuffed with kapok and bearing, strapped to it, a wooden transom plate, or saddle, with a metal coupling to which is affixed the timber duckboard which forms the bridge from float to float. At each end of the float are handles so that the bridge, after its parts have been assembled at a convenient spot near the river, can be lifted bodily by two men for each float and carried forward for launching.

The operation of launching and pushing the bridge across the river can be effected in a few seconds, and as soon as it has been secured on the far bank the assaulting infantry can commence to cross. The articulation of the saddle joint allows sufficient play for the bridge to be carried and launched over rough ground whilst providing sufficient lateral rigidity to steer its head across the stream, even against cross-wind and current. The buoyancy of the floats is ample and the bridge is stable in the water.

The use of such an equipment, with which the sappers are fully conversant, immensely facilitates the operation of assault bridging, providing that sufficient material, and men skilled in its use can be provided; but other means may often have to be improvised. Such expedients take the form of petrol float bridges of similar design, but with floats made of petrol tins crated together, or of cork floats, or little ferry boats made of waterproof sheeting lashed over a timber framing, or tarpaulins stuffed with straw, or planks and hurdles made into rafts; in fact almost any floatable material may with some ingenuity be pressed into the service. For the formation of a pack bridge three of the kapok assault bridges are laid side by side, with chesses to form the roadway, or where the water is not too deep a planked trestle bridge may be suitable.

Pontoon Bridge.—For the next stage of the operation the pontoon equipment is brought up. The pontoons are large, flat-bottomed boats with a scow bow and completely decked in, having a buoyancy each of about $6\frac{1}{2}$ tons. They are built to give the maximum flotation for light weight with a skin of *consuta* two or three-ply wood on a mahogany framework and are designed so that two pontoons may be coupled stern to stern. A lifting handrail is provided along nearly the whole length of each side and additional detachable lifters are fixed by hooks and chains to bow and stern. The keelson gunwales and chines are of Oregon pine to protect the light mahogany skin from rubbing. A saddle bed of Oregon pine carries a saddle formed of two mild steel channels on which the roadbearers rest. The roadbearers are of nickel chrome steel and are fitted with steel pins which engage with slots in the saddle. The roadway is formed of planks of Oregon pine and, when laid, they are held in place by ribands which are racked down by chains with a screw attachment for binding the members together.

The equipment formed into a bridge is shewn in fig. 2 which illustrates the three forms in which the pontoon bridge may be made up: as a light bridge to carry field artillery and horsed transport, the pontoons being used singly with five steel roadbearers from saddle to saddle; as a medium bridge to carry medium artillery and lorries in which two pontoons are coupled stern to stern and seven roadbearers are used in each bay; as a heavy bridge to carry heavy artillery and track vehicles up to the 18-ton tank in weight, the piers of which are formed of four pontoons coupled in piers and carrying an extra central saddle on which 11 roadbearers are placed to carry the roadway. In either form each bay of bridge spans 21 ft.

An integral part of the pontoon equipment is the steel trestle; this is used in place of the pontoons to form a pier of the bridge

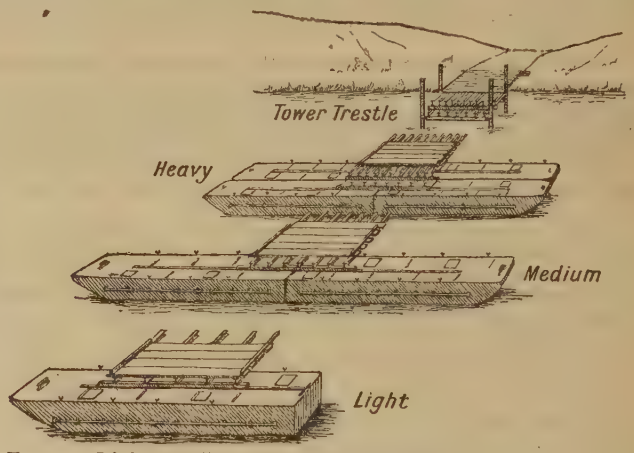

FIG. 2.—Light, medium and heavy types of Pontoon Bridge and Tower Trestle Bridge.

in shallow water, to bridge over dry gaps, or to form the tidal ramp when the floating bridge has to rise and fall with the tide. It consists of two mild steel legs with pitch pine mud shoes, a nickel chrome steel transom and two jacks for raising or lowering the transom. The legs are drilled with holes along the centre of the web into which the pins of the transom engage so that the transom and, with it, the roadway can be raised or lowered by means of the jacks as occasion requires. When used in conjunction with a heavy bridge, as shown in fig. 2, a double trestle pier is formed, but with a medium bridge a single trestle suffices to form the pier.

The pontoon equipment carried with an army is so essential to its mobility that it cannot be left long in place on one river. As soon as the crossing has been effected or whilst it is still in progress, steel girders or other form of semi-permanent bridges must be constructed on all the main crossings to take the place of the pontoon bridges which must go forward. These will be of various patterns to suit the different spans and conditions met with according to the theatre of war, but only one standard type of portable steel girder is retained for practice.

Box Girder Bridge.—This is known as the Martel box girder bridge; it is designed to enable all spans, up to about 100 ft., to be bridged in the simplest manner and also to secure that the bridge so built will be strong enough to carry either light, medium or heavy loads, or tanks. The bridge is of the deck type and the chesses lie flat on the top of the box girders. The girders are skeleton steel box girders made up in sections, each 8 ft. long. The sections are joined together by plain pin joints; no nuts or bolts are required. There are thus only two essential parts, viz., the box girders and the chesses.

Three types of bridge can be built by using two, three or four box girders under the chesses. In fact the gap is to all intents and purposes spanned by using skeleton steel roadbearers which can be made up to any desired length in 8 ft. sections. A further advantage is that any desired width of roadway can be laid. To obtain a wider bridge it is merely necessary to add more box girders and use longer chesses, or a double row of chesses. The decking is held in position by angle steel kerbs fixed down by hook bolts, and the handrail consists of posts which fit into the sockets in the centre of each 8-ft. length of kerb and piping. The handrail pipes are also used as carrying bars for carrying sections of the girders.

The bridge will usually be fitted with horn beams at each end, a construction which enables the girders to be lowered onto masonry abutments, or onto a timber bankseat so that the level of the roadway may be kept down and a ramped-up approach avoided; but where headroom under the bridge is required, or the approach level is suitable, these are not necessary.

Launching the Bridge.—Launching is usually by means of a derrick and winches. A derrick is erected on the far bank, and the bridge, having been placed on rollers, is hauled bodily across by means of tackle, a preventer winch and tackle being used from the near bank to check it. The cantilever method may in some cases be more convenient, especially when the bridge is a heavy one with three or four girders, as each girder can be used in turn as the counter-weight for the next, the last girder being rolled across on deck planks laid on those already in position and then jacked down. The third alternative, the cantilever method with launching nose attached to the horn beam, may be the quickest, and at the same time more advantageous as it can be used with lighter tackle.

The erection and launching into position of a girder bridge cannot be carried out under fire and the sequence in which the operation has been described involves a space of time which will usually place this work at a safe distance, except for intermittent long-range shelling. The construction of approach roads to a heavy bridge is often a work of greater magnitude than the construction of the bridge itself, as they must be sufficiently permanent to carry the heavy strain of mechanical transport. Thus, whilst the assault bridges are intentionally thrown well away from the main lines of traffic and the lighter forms of pontoon bridge can be used wherever a reasonable cross country approach track can be made, the heavy bridges are confined closely to the route of the main roads. This site will probably be continuously shelled until the enemy's artillery is silenced and so artillery and aerial co-operation is essential to aid the rapidity with which full communication may be established.

The engineering operations connected with a river crossing are subject to tactical requirements and it is by no means certain that a set sequence will be followed; for example, it may be essential for the tanks to go forward with, or in front of, the leading infantry. The bridging problem then is one of extreme difficulty; but it has been solved. An instance occurred in 1918 in the crossing of the Selle where, under the nose of the enemy holding the opposite bank, a crib causeway for tanks, built of railway sleepers bolted together and sunk in the bed of the river, was constructed during the nights immediately preceding the attack and kept concealed from view and from aerial photography by being completed just below water level.

Bridging in Wartime.—In uncivilised countries the chief problems for the bridge-builder are to devise the best use to which to put the scanty supply of materials available, and to adapt the local resources of the country to advantage. But, great as is the task of bridge-building for an army in undeveloped countries, greater still is the work of reconstruction during an advance in a highly developed theatre of war such as France. There the accumulation of means of attack and defence on a grand scale is made possible by the fullness of the communications, yet at the same time each of these many lines of communication is sensitive at every river crossing. Almost without exception the bridges are destroyed by the enemy on his retirement, and an army cannot safely push on its advance without its full equipment and without clear routes for its supply transport. Hence, in the final campaign of 1918 in France, the power of the British Army to advance depended on the speed with which the Royal Engineers could construct bridge crossings and roads.

During the period August–November 1918 no fewer than 539 heavy bridges were erected on this front alone, of which 326 were standard steel bridges and 213 of heavy timber or salved material. This does not include the innumerable light improvised crossings and footbridges by which the leading infantry were enabled to attack, and the pontoon and light trestle bridges for field artillery and horse transport. (*See* ENGINEERS, MILITARY.) (E. N. S.)

BRIGGS, CHARLES AUGUSTUS (1841–1913), American theologian (*see* 4.566), died in New York June 8 1913. His last published works were: *Church Unity* (1909); *The Fundamental Christian Faith* (1913); and, posthumously, *Theological Symbolics* (1914).

BRIGHTON (*see* 4.570) has developed its amenities in many directions. The population was 142,427 in 1921, and the area of the municipal borough, which includes Preston, is 2,545 acres. In 1923 part of Patcham was added.

The whole seafront of Brighton and Hove is now one long promenade, with a memorial to King Edward VII., unveiled in 1913, on the boundary between the two boroughs. A winter garden was made in 1912, and since 1921 there have been improved facilities for embarking on or disembarking from steamers. An amphitheatre to seat 1,600 was built at the head of the chief pier in 1913. New buildings for the Grammar School were opened in Dyke road in 1913, and a Municipal Day Training College in Eastern Terrace in 1911. Hollingbury Park, a large tract of downland north of the town, was acquired. The Royal Pavilion and Dome were used as a hospital during the World War and until 1920, and in 1921 the south gateway was replaced with one presented by the princes and people of India in gratitude for the hospitality shown to sick and wounded Indian officers and men.

Three new parishes have been formed: St. Matthias, Preston, in 1913; St. Alban, Preston, with a new church in Coombe road, in 1915; and St. Wilfred, with a church in Elm Grove, in 1922. Two Roman Catholic churches have been built, one in Hove in 1915, and one in Preston Park in 1911. After the War some 700 disabled ex-service men were employed in the diamond-cutting industry here, and a large factory was built in 1920, but was sold in 1924. The Brighton War Memorial, a Roman colonnade and water garden, is at the bottom of St. James street, and that of Hove is at the junction of Grand avenue and the Drive.

In 1924 the railway station and its approach were improved; the electric supply system was reorganised, and plants at Shoreham and Kemp Town extended. £100,000 was voted by the corporation for extensions to the water-supply undertakings, with £60,000 for a tidal bathing pool. In the same year it was arranged to clear the Aquarium site, and lay it out as gardens, with a theatre and restaurant, but later it was decided to retain the main part of the fish tanks.

BRISBANE, ARTHUR (1864–), American newspaper editor, was born at Buffalo, N.Y., Dec. 12 1864. After an education in the American public schools and five years spent in France and Germany, he entered the employ of the New York *Sun* in 1883 as a reporter, later becoming its London correspondent and subsequently editor of *The Evening Sun*. From 1890 to 1897 he was connected with the New York *World*, as managing editor of different editions, and from 1897 to 1921 he was editor of the New York *Evening Journal*. He purchased *The Washington*

Times of Washington, D.C., in 1917, and *The Evening Wisconsin* of Milwaukee, Wis., in 1918, selling both papers to William Randolph Hearst in 1919. After 1918 he was editor of the Chicago *Herald and Examiner*. His editorials, which for over two decades appeared in all the newspapers owned by W. R. Hearst, obtained for Mr. Brisbane a national reputation. He published *Editorials from the Hearst Newspapers* (1906) and *The Brisbane Editorial Review* (1922).

BRISBANE (*see* 4.574) had a population (1924) of 248,015. South Brisbane and suburbs were merged in 1925, giving greater Brisbane an area of 380 sq. miles. It is the capital, chief seaport and commercial centre of Queensland. A comprehensive sewage system was installed in 1924. The first part of the cathedral was consecrated in 1910, and the Queensland University established in 1911.

BRISSON, EUGÈNE HENRI (1835–1912), French statesman (*see* 4.574), was again elected president of the Chamber in Jan. 1912, and died at his official residence April 14 1912.

BRISTOL (*see* 4.579) had a population of 377,061 in 1921 and an estimated population in 1925 of 386,400. Since 1910 many public buildings have been erected or enlarged. Mr. H. H. Wills built and endowed St. Monica's Home for Incurables at an expenditure of upwards of £1,000,000, and Sir George A. Wills, Bart., a public library in the Bedminster district at a cost of £10,000. At Avonmouth the lending library was removed to more commodious premises and new rooms were opened in 1916. A branch library was opened at Knowle in 1922. A library of commerce was instituted in the central building in 1920. Separately administered children's libraries have been opened in the four quarters of the city. In 1921, the St. George branch library was reorganised and reopened as an open access library, and since this date the central and remaining branch libraries have been similarly reorganised. The premises of the Grammar School, opposite the main University buildings, have been enlarged and a new wing was opened in 1914. In 1912 a new organ was placed in the church of St. Mary Redcliffe and in 1913 the south porch was restored. The Berkeley Chapel in the cathedral has also been restored. The Royal West of England Academy was rebuilt in 1912 and the Hippodrome, a large variety theatre, was opened.

At the city's lowest point, near St. Augustine's Bridge, old buildings have been razed and premises for the Co-operative Wholesale Society erected upon the site. Additional playing-fields were provided for Clifton College at its jubilee in 1912 and a War Memorial Gateway in College Road was unveiled in 1922. The King Edward Memorial Wing of the Royal Infirmary was opened in 1912, and the Victoria Gibbs Memorial Home for Homeless Babies at Kingsdown in 1921. Colston Hall was bought by the city in 1919. Other improvements include extensions to Temple Meads station, new central police and fire stations and a central Y.M.C.A. building in Colston street. A Wesleyan Hall was opened in Old Market street in 1924. A contract for the extension of the Avonmouth Docks was placed in January 1924. A low-level road between Bristol and Avonmouth has been made, and the railway station at Hotwells abolished to make room for it.

BRITISH COLUMBIA (*see* 4.598), a province of the Dominion of Canada. Its area is 355,855 sq. miles. The population is predominantly of British stock. In 1921, out of a total population of 524,582, 221,145 were English, 104,965 Scotch and 54,298 Irish. Other racial groups were Scandinavians 19,002, French 11,246, Chinese 23,533, Japanese 15,006 and Indians 22,377. The population in 1925 was estimated at 587,000. The principal cities are Vancouver—population 117,217 in 1921—Victoria, New Westminster, Nanaimo, North Vancouver and Prince Rupert. Vancouver is the chief Canadian seaport on the Pacific coast. The opening of the Panama Canal has led to the development of grain shipments from the prairies to Europe *via* Vancouver. For the crop year 1923–4 shipments of wheat from Vancouver amounted to 53,809,505 bu. and there was a considerable trade in other commodities.

The Provincial Legislative Assembly has 48 members, with an executive council of seven. The province was represented in the Dominion Parliament in 1925 by 14 members in the House of Commons and six senators. Except in cities having charge of their own schools, to which grants are made, the school system is financed and administered by the provincial authorities. Two normal schools for the training of teachers are maintained. The British Columbia University at Point Grey, near Vancouver, is financed by the provincial government.

Production and Industry.—The area of farming land is limited to approximately 19,000,000 ac., and is distributed in widely separated valleys. Small mixed farming is predominant. Commercial fruit-growing has rapidly increased in importance. The area devoted to fruits in 1891 was estimated at 6,500 ac.; in 1924 the acreage under tree fruits was approximately 30,716, and under small fruits about 6,310. In 1924 the total value of agricultural products was $60,029,224. The amount of standing timber of merchantable size in 1925 was estimated at 360,000,000,000 and 47,500,000 cords of pulpwood, posts, etc. In 1924 there were 359 sawmills, 78 shingle mills, two pulp and paper mills and three wood-pulp mills in operation. Timber production was valued at $80,702,000 in 1924. Pulp production in the same year was 216,243 tons, and 136,281 tons of newsprint and 9,653 tons of other paper were produced.

The total value of the fisheries in 1924 amounted to $21,257,567; salmon yielded $13,027,251, halibut $5,427,542 and herring $1,392,580. Cod, clams and quahaugs, black cod, pilchards, crabs and oysters are also marketed. Fish canneries and curing establishments numbered 134 in 1924.

Since 1907 British Columbia has occupied second place among the Canadian provinces in regard to the value of mineral production. In 1925 the output was valued at the record figure of $61,491,600. Lead, coal, copper, zinc, silver and gold are the most important metal products. Manufacturing industries developed considerably during the War and post-War periods: in 1924 there were 3,345 industrial establishments in the province, employing some 75,000 hands. The tourist industry is increasing in importance, its value in 1925 being placed at $45,000,000. (*See* CANADA.)

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BRITISH EMPIRE (*see* 4.606).—The area is 12,389,874 square miles and the population 438,761,015. The British Empire or British Commonwealth of Nations, as it was styled for the first time officially, in the Irish Treaty, comprised, in 1926, the following classes of territory:—

(1) The United Kingdom of Great Britain and Ireland, consisting of England, Wales, Scotland and Northern Ireland. It possesses full sovereignty, external and internal, with the sole right to declare war and peace, but is limited in action as regards the Dominions by certain recognised conventions. Northern Ireland has a Parliament and a Government responsible to it for local matters. The Channel Is. and the Isle of Man, are in an anomalous position inasmuch as they have independent legislatures and semi-independent executives, subject to the supremacy of the United Kingdom Parliament.

(2) The self-governing Dominions, possessing membership in the League of Nations and therefore a quasi-international status, but not full sovereignty, and, though subject to the supremacy of the United Kingdom Parliament, enjoying in practice autonomy in internal affairs and membership of the Imperial Conference. These are Canada, Australia, New Zealand, South Africa and the Irish Free State.

(3) A self-governing Dominion with membership of the Imperial Conference, but without membership in the League of Nations: Newfoundland.

(4) Two self-governing colonies, with a wide but not unrestricted autonomy, and not entitled to representation at the Imperial Conference: Malta and Southern Rhodesia.

(5) Crown colonies, or colonies not possessing responsible government, that is, colonies in which the executive government

is controlled by the British Govt. through the Secretary for the Colonies. The Legislatures in these cases may be entirely independent of the executive, as in Bahamas, Bermuda and Barbados, with their nominee Upper Houses and their elective Assemblies, but normally are, either in case of emergency as in Ceylon or regularly, subject to control either because there is an official majority or because the governor alone constitutes the Legislature.

(6) Protectorates administered on colonial lines. These differ from colonies mainly in that they are not annexed to the British Crown, and their inhabitants are not British subjects. The protectorate status in such cases normally preludes annexation when administration has become more developed; it usually rests on promises of protection granted to more or less uncivilised tribes and the administration often makes wide use of the agency of chiefs in government, especially in Nigeria and Uganda.

(7) Protected states, retaining distinct personality. Some of them, as Sarawak, possess internal autonomy, while others, like Zanzibar, are administered in effect by British officers.

(8) Mandated territories, held under mandates granted with the approval of the Council of the League of Nations and subject to a certain measure of supervision.

(9) India, including British India and the Indian States. The former is administered under the governor-general; the latter possess various degrees of internal autonomy. India as a whole possesses membership of the League of Nations and representation at the Imperial Conference. (*See* INDIA.)

(10) To the Australian Commonwealth are attached, as dependencies administered on crown colony lines, Papua and Norfolk I.; to New Zealand the Cook Is. and the Ross Dependency. These Dominions and also the Union of South Africa hold mandated territories. Nauru was mandated to the British Empire, the administration to be entrusted first to the Australian Commonwealth, and then as might be agreed upon between the Commonwealth, the United Kingdom and New Zealand.

I. CONSTITUTIONAL HISTORY

Conference of 1911.—The Imperial Conference of 1911, convened in accordance with the constitution decided upon by the Colonial Conference of 1907, met under the influence of the prevailing tension in European relations, and the most important part of its deliberations centred in the question of the control of foreign policy. The Dominions by that date had secured the right to adhere to, or remain exempt from, commercial treaties concluded by the British Govt. and at their request their representatives were from time to time empowered by that Govt. to negotiate, subject to its approval, special commercial arrangements with foreign powers.

Moreover, in political matters directly affecting them, they had established the right to be consulted before the British Govt. came to any decision. In general political issues the Dominions had no say, but their acquiescence in this state of affairs had been disturbed by the controversy which had arisen regarding the Declaration of London of 1909, which was thought to diminish the power of the British Navy in time of war. Hence Sir J. Ward, on behalf of New Zealand, propounded what was virtually, though not in name, a scheme of imperial federation, contemplating the creation of a Federal government and parliament to deal with issues of foreign policy, war and peace; this scheme, however, was rejected by Canada, Australia and South Africa, and negatived by Mr. Asquith for the United Kingdom.

It was, however, agreed that in such cases as general peace conferences, agreements arrived at should be communicated before signature, to the Dominions for their observations, and that the general policy adopted by the British representatives at such conferences should, as far as practicable, be discussed with the Dominions prior to the meetings. Moreover, at a secret meeting of the Committee of Imperial Defence, the Dominion representatives were informed of the British position in regard to the grave political issues of the time, including the menace due to the friction between Germany and France. The conference also decided the terms on which the Dominions could maintain distinct naval forces, which, even in time of war, would only come under the control of the British Admiralty on transfer by the government concerned; areas were assigned for the normal operations of the Dominion fleets, and it was laid down that in any contact with foreign governments the commanders would act on any instructions given by the British Foreign Office.

The fall of Sir W. Laurier's Govt. in Canada in 1911 installed a government more inclined to intervene in world politics, and Sir Robert Borden, on a visit to London in 1912, was fully informed by the British Govt. of the state of European politics. A definite offer was made to Canada and to the other Dominions to afford them greater opportunities of taking part in foreign affairs through the appointment of resident ministers in London, who would be given full information and be able to express Dominion views, though the final responsibility must continue with the British Government. Canada alone, after some delay, accepted the suggestion for a time, while Sir R. Borden's proposal to strengthen the British Navy by a grant of $35,000,000 was defeated by the Senate.

In 1912 also a significant step was taken to assert the distinct personality of the Dominions. Hitherto at international conferences the King had been represented by one delegation only, which might contain Dominion representatives, but which acted as a whole; at the radio-telegraphic conference of that year the King was represented by distinct delegations acting under separate full powers, those granted to the Dominion representatives empowering them to act for the Dominions. This recognition for external purposes of a distinction long familiar for purposes of internal sovereignty was followed in the Conference on the Safety of Life at Sea in 1913–4.

The Empire in War.—The World War came so swiftly, on Aug. 4 1914, that it was impossible to consult the Dominions, but all the Dominion Govts. promised aid, placing under the Admiralty their naval forces, comprising the Australian fleet and the small forces of Canada and New Zealand. Similarly, the troops raised by the Dominions for oversea service were voluntarily placed under British command, though in the last year of the War a certain measure of independence was secured for the Canadian Expeditionary Force.

In the earlier period of the War the Governments were too busy to hold the Imperial Conference due under its constitution to meet in 1915; but, on the resignation of Mr. Asquith in 1916 and the advent to office of Mr. Lloyd George, the determination to secure greater efficiency in the conduct of the War and the more complete mobilising of the strength of the Empire led to the summoning of representatives of the Dominions and of India —not a member of the Conference under the constitution of 1907—for discussions with the British Government. Meetings in 1917 and 1918 took a double form; on the one hand the immediate issues affecting the War and the conditions on which peace might be made were debated at sessions of the Imperial War Cabinet, while matters of secondary importance were dealt with by the Imperial War Conference.

The Imperial War Cabinet, closely connected with the British Cabinet, was a Cabinet of quite new character, a " cabinet of governments " as Sir R. L. Borden described it. There was no Prime Minister on whom it depended; each Dominion, India and the United Kingdom were represented by independent delegates, the British Prime Minister presiding merely as *primus inter pares*. There was no joint responsibility, and the Cabinet could only pass resolutions, not take decisions. It remained for the several Cabinets to decide what effect to give to the resolutions, to which the Dominion representatives agreed only on the understanding that they must be approved by their colleagues and Parliaments. On the other hand the meetings afforded a valuable opportunity for the Dominion and Indian representatives to express their views, and thus, in some measure, to share in the supreme direction of the forces of the Empire, though final responsibility necessarily rested with the British Govt. in view of the preponderant share of the burden of the War borne by British resources. It was recognised that the new departure was essentially due to War conditions, but it was agreed, in 1917,

that the constitutional relations of the Empire should be reconsidered at a conference to be summoned after peace was achieved.

The Peace Conference.—The second meeting of the Imperial War Cabinet held in 1918 was followed shortly by the final defeat of the German forces, and the body was reconvened to consider the terms of peace, being transformed finally into the British Empire delegation to the Peace Conference of 1919. The unity which had hitherto marked the representation of the Empire was now difficult to maintain; it had been contemplated by the British Govt. that the Empire should speak at the Peace Conference through a single delegation. It was, however, felt by the Dominions that they must have the same measure of recognition as the minor powers taking part in the conference. A compromise was, accordingly, reached. Under this, in addition to the British Empire delegation on which the Dominions might be represented from time to time on the panel system, there were recognised delegations from Canada, Australia, South Africa, New Zealand and India, Newfoundland being omitted in view of her small population. The delegations were accorded the right of being heard on matters specially affecting them on the same footing as the minor belligerent Powers, but importance really attached to the influence which the Dominion representatives had in deciding, in the discussions within the British Empire delegation, what attitude should be adopted by that body, or, when matters were increasingly left to the heads of the delegations of the five Great Powers, by Mr. Lloyd George.

The Dominions insisted that the ratification of the treaty with Germany should not be carried out until approval of it had been expressed by their Parliaments, and, after demur, this demand was conceded by the British Government. In the form of the treaty the participation of the British Empire was marked by its signature, generally, by the delegates of the United Kingdom and, specifically for each Dominion and for India, by their representatives, a plan adopted from the precedent of the Radiotelegraphic Convention of 1912. This form, however, was not followed in the supplementary treaty by which the British Empire, like the United States, undertook to aid France in the case of German aggression, but that instrument, which failed to take effect through refusal of ratification by the United States, expressly provided that the obligations of the treaty would not apply to the Dominions unless undertaken by their Parliaments.

The mode of procedure in the case rested on two fundamental principles, the right of the British Govt. to conclude treaties binding the whole Empire as a matter of international law, and the duty of that Govt., in any international arrangement, to respect the autonomy of the Dominions; its importance lay in the fact that it negatived the claim made in the Canadian Parliament in 1919 and also by Gen. Smuts that signature by Dominion representatives was requisite if any treaty were to bind the Dominions in international law. This paramount power of the British Govt. stood on the same footing as its sole right to declare war or conclude peace in the name of the Crown, although the effect of a declaration of war was immediately to impose on the Dominions, without their consent, the burden of belligerent status and liability to attack.

Membership of the League of Nations.—Of paramount importance was the decision reached after hesitation, but at the request of the Dominions, to secure them an independent position in the League of Nations as created by the Treaty of Versailles. This was done by including in the list of original members the British Empire, followed immediately by the Dominions and India, ignoring the United Kingdom altogether. The effect was to confer on the Dominions and India for all purposes of the League of Nations an international status apart from the British Empire, which was to be represented at Assembly meetings by delegates appointed by the British Government. It was ruled, too, that the Dominions were eligible for election to the Council of the League to fill the places left open to election, despite the fact that the British Empire as such had a permanent place on the council. In the rather unlikely event of a Dominion obtaining election to the council, it was presumed that it would not be regarded as a distinct entity for voting purposes if any occasion should arise in which the British Empire was involved in a dispute and the matter fail to be decided by the unanimous vote of all other members of the council.

The Dominions instructed their representatives at the League Assemblies without regard to the views of the British Govt.; cases not rarely occurred of voting in different ways by British and Dominion delegations. Mandates were held direct by the Dominions from the League, and this responsibility rested on them only. Similarly, as regards the Permanent Court of International Justice, the Dominions had a distinct status, and it appeared that the Court would have jurisdiction in cases of disagreement between a Dominion and the United Kingdom, or between two Dominions. The British Govt., however, asserted in 1924 that it did not consider that the provisions of the Covenant of the League as to the registration of treaties applied to the treaty between the United Kingdom and the Irish Free State, but a contrary view was taken by the Irish Free State, apparently with the sympathy of some of the Dominions. On the other hand, it was understood that the action of the British Empire, as a member of the council, should have regard to Dominion and Indian interests, and the equity of this understanding was obvious, since the permanent membership of the council allotted to the British Empire inevitably greatly reduced the probability of the election of a Dominion to that body. A Dominion, however, is entitled to special representation on the council in the event of any matter specially affecting it, coming before that body to the same extent as that right is enjoyed by other members of the League.

The obligations of the Covenant were regarded, in one vital matter, rather differently by the United Kingdom and by the Dominions and India. As a European power the United Kingdom accepted as necessary the implications of the guarantee of the territory and independence of members contained in Article 10. Canada, however, only acquiesced in it originally under protest, and later pressed, though unsuccessfully, for the formal modification of the Article; similarly the Geneva Protocol of 1924 proved unacceptable to the Dominions and India, and except in New Zealand considerable reluctance was manifested in respect of accepting obligations under the Locarno Pact of Oct. 16 1925, which exempted the Dominions and India from obligation unless expressly accepted by their governments. On the other hand, the Dominions and India showed interest in the carrying out of the Labour clauses of the Treaty of Peace under which their distinct individuality was expressly recognised.

The demand for recognition as distinct entities conceded in the Treaty of Versailles was admitted in the negotiation and signature of the other treaties with ex-enemy Powers and the succession states in 1919, and it led, inevitably, to the claim by Canada for the right of separate diplomatic representation where that was desirable in her own interests, and primarily in the United States. The claim was conceded, subject to the willingness of the United States Govt., to permit such representation, and to the declaration that it was not the intention of either the British or the Canadian Govt. to diminish in any degree the diplomatic unity of the Empire. The assent of the United States was at first doubtful, as one of the objections there urged against the constitution of the League of Nations was that it accorded separate votes to different parts of the Empire, but ultimately the necessary approval was accorded. Difficulties in Canada delayed an appointment, and advantage of the concession, which had automatically to be extended to all the Dominions, was first taken in 1924 by the Irish Free State. The functions of the Irish minister at Washington were declared to be to deal with matters affecting solely Irish interests, but no indication was given of the mode in which this restriction would be insisted upon in practice.

The Conference of 1921.—Owing to the development of national consciousness nothing came of the movement for closer union in foreign affairs induced by the War, which had led to the resolution of 1917 in favour of holding a constitutional conference after the War. A conference met in 1921, only to declare itself satisfied that no reconstruction of imperial relations was desirable. Feeling in the Dominions indeed rendered any closer union

out of the question. Labour in Australia, which had defeated conscription during the War, was resolutely opposed to anything even suggesting loss of autonomy; French Canada, which had bitterly resisted conscription in the Dominion and rendered it largely ineffective in Quebec, was definitely hostile; Nationalist opinion in South Africa had adopted the ideal of a republic, and the great majority of the people in the Dominions were indifferent, satisfied that an organisation which had weathered the War would be adequate for the future. The value of the plan of conferences, on the other hand, was strikingly confirmed by the meeting, for it was found possible to adjust the very discrepant views of the Dominions and the United Kingdom regarding the renewal of the Japanese alliance by adopting the policy which culminated in the Washington Conference and the treaties of 1922 regarding the maintenance of the *status quo* in the Pacific, the limitation of naval armaments and the relations of the Western Powers with China. A difficulty arose regarding the representation of the Empire at the Washington Conference; the invitation was addressed by the United States Govt. to the British Govt. only, but the proposal of that Govt. for a single delegation was objected to by Gen. Smuts, and ultimately it was arranged to send distinct delegations, as in the case of the Paris Conference. The delegations, however, when at Washington, were regarded and regarded themselves as a unity, and no question of separate voting arose.

Later in 1922, however, a distinct discrepancy of feeling between the United Kingdom and Canada was manifested when Mr. Lloyd George asked the Dominions to support his Chanak policy. The Dominion view was that, as it had not been effectively consulted on the policy which led to the situation, it could not be expected blindly to pledge itself to military support. The resignation of Mr. Lloyd George and the settlement of the immediate issues removed the difficulty for the moment; but further questions were raised in March 1923, in connection with the signature of a treaty with the United States regarding the halibut fisheries. Canada successfully contended that such a treaty, as predominantly of Canadian interest, should be signed by a Canadian representative alone, contrary to the rule laid down by Lord Ripon in 1895 and Sir E. Grey in 1907, under which any such agreement should be signed also by a British representative.

Conference of 1923.—The whole matter was considered at the Imperial Conference of 1923, at which the Irish Free State was represented, as well as India and the other Dominions. It was agreed that treaties should normally be negotiated and signed, under full powers granted by the King, by representatives of the part or parts of the Empire affected, and that in negotiating any treaty it should be the duty of the government primarily concerned to secure that any other government which was affected should be invited to take part in the negotiations; in the case of international conferences the procedure adopted at the Paris conference should be followed. Ratification of treaties thus negotiated should be expressed under the same conditions—that is, on the request of the government or governments concerned.

This mode of procedure left to the British Govt. a final responsibility, for it must, in the first place, issue full powers to negotiate and sign, and secondly, it must advise ratification; the primary responsibility rested indeed with the Dominion concerned, but the British Govt. was bound to secure that nothing was done by one part of the Empire likely to be gravely detrimental to the interests of another part; doubtless in the event of a serious difference of opinion recourse would be had to discussion by an Imperial Conference. At the same time the conference recognised and approved a practice which had gradually grown up but had hitherto been deemed irregular. This was the conclusion of minor agreements, mainly of a technical or administrative character, by Dominion Govts. with foreign powers. These were not negotiated by plenipotentiaries or ratified by the King, and such agreements thus escaped any intervention by the British Government. It insisted, however, that in concluding such agreements Dominion Govts. should have due regard to the interests of other parts of the Empire.

The conference also discussed foreign policy. It approved the principle of supporting the League of Nations, and reaffirmed the doctrine laid down in 1921, that each part of the Empire should make provision for local defence; it also approved the view that the naval forces of the Empire should be equal to those of any other power, and that suitable bases should be provided, thus homologating the British Govt.'s proposals regarding Singapore. The absolute autonomy of the Dominions was, however, stressed, and no pledges of aid in the maintenance of the Navy were offered, the decision resting with the Dominion Parliaments.

An unfortunate misunderstanding, however, arose out of the conference. Apparently it was held that the discussions there of the terms of peace to be made with Turkey involved the Dominion Govts. in responsibility for the Treaty of Lausanne when finally agreed upon by the British representatives, who alone took part in the discussions. When, however, Canada was asked to approve of the ratification of the treaty she made it clear that her attitude was that, while she took no exception to ratification, responsibility for it, and for the obligations which might be imposed on the Empire under its terms, must rest with the British Govt. only. The doctrine was thus established that the Dominions would only accept active obligations when they had taken part in the negotiations and agreed to their results. A further representation from Canada resulted in the admission of the principle by the British Govt. in connection with the London Reparations Conference of 1924, though lack of time prevented the adoption there of any other than a makeshift arrangement for their special representation. The British Govt. then proposed that the question of more effective consultation on international subjects should form the subject of a special conference, but its fall from office was followed by an intimation that further experience of the working of existing arrangements was desirable, a view acquiesced in by the Dominions.

In 1925 the Prime Minister of the Australian Commonwealth arranged to station in London a liaison officer to keep him fully informed on foreign political questions and the views of the British Govt.; but neither this device nor the alternative of sending a member of the Dominion Cabinet to act as minister resident in London received general approval in the Dominions, largely because such a minister would inevitably cease to be in effective touch with Dominion feeling and would be apt to commit his government to British views, while, if he merely acted as a channel of information, his employment would hardly serve any useful purpose. Consultation, therefore, was conducted freely by telegram, both as regards the Geneva Protocol of 1924 and the Security Pact of 1925.

The attitude revealed by these consultations was one of reluctance on the part of the Dominions to take an active part in British foreign policy save in so far as it directly concerned their interests. It was admitted that the Dominions might be involved in war by British action, which they could not as matters stood effectively control, but it was recognised that it remained for each Parliament to decide whether in the event of hostilities it would afford aid, and, if so, in what manner, to the United Kingdom. The constitutional position was summed up in Article 49 of the Irish Free State constitution, which provided that, except in the case of invasion, the state could not be involved actively in war save with the assent of its own parliament, a doctrine which was also definitely approved by Canada and accepted by the other Dominions.

The Irish Treaty.—The aspect of the British Empire as an informal alliance of autonomous states, special powers as to foreign relations being vested in the United Kingdom, was emphasised by the conclusion of the treaty of 1921 between the United Kingdom and the Irish Free State. The status of a Dominion was by that measure formally granted and the instrument was styled a treaty, although concluded by the British Govt. merely with representatives of forces in armed rebellion against the Crown. As has been seen, the British Govt. held that, despite the name, the treaty was not one in the sense of international law, since it did not confer independence but merely Dominion status. The new state was admitted in 1923, with the

assent of the Empire, to membership of the League of Nations. The adoption of a special flag and the enactment of a distinct Irish citizenship marked the assertion of autonomy; projects in the same direction were announced in South Africa in 1925, to be carried into effect by agreement of the parties in 1926. Canada in 1921 defined Canadian nationals; in that case, however, the definition was motived by the necessity of distinguishing between British subjects in general and Canadian British subjects in particular in respect of eligibility for nomination by Canada for candidature for election to the Permanent Court of International Justice.

The Crown and Dominion Internal Affairs

As regards the relations of the Dominions to the United Kingdom in internal affairs no special action was recommended by the conferences of 1911–23. The retention by the Colonial Secretary of responsibility for the Dominions was objected to in 1911 by New Zealand, and Australia suggested that Dominion relations should be entrusted to the Foreign Secretary, while an alternative proposal suggested that the Prime Minister should accept the duty, delegating the detail work to a deputy minister. The suggestion was rejected on the score of the great burden already resting on the Prime Minister, but it was conceded at the conference of 1918 that Dominion Prime Ministers should have the right of direct correspondence, on matters deemed sufficiently important, with the British Prime Minister, and this arrangement was accepted as satisfactory in 1921. In 1925, on the initiative of the British Govt. a new office of Secretary of State for Dominion Affairs was created, but the retention of the post in the hands of the Colonial Secretary indicated that the change was formal rather than of importance.

Of greater consequence was the steady tendency of the Colonial Office to negative any intervention in Dominion internal affairs; thus, in 1920, the Secretary of State declined to disallow certain legislation of Queensland which was alleged by landholders, both in the state and in the United Kingdom, to be confiscatory. The governors of the Australian states were encouraged to assimilate their relations with ministers to those of the Crown with the British Government. On the other hand, the paramount character of Imperial legislation was reasserted in the Act of 1922 sanctioning the constitution of the Irish Free State. Efforts made by Canada and the Irish Free State to secure the removal of the limitation of the effect of Dominion legislation, save where expressly authorised by Imperial Acts, to the territorial limits of the Dominions, had not succeeded in securing Imperial legislation by 1925.

Appeals to the Privy Council.—The objections raised by the Irish Free State to a continuation of the power of the Judicial Committee of the Privy Council to grant leave to appeal from decisions of Irish courts under the new régime of Dominion status were overruled to the extent that it was provided that constitutional issues must be liable to appeal at the discretion of the committee while it was left to the Free State to prevent appeals in other cases if it thought fit. The question of restricting appeals from Canada to the Privy Council, though frequently debated in the Dominion, did not lead to any action, owing in part to the insistence by Quebec on the maintenance of the existing practice as a safeguard of her rights. Proposals for the merger of the House of Lords with the Judicial Committee in a single court of appeal for the whole Empire failed to arouse interest, either in England or the Dominions, but increasing effect was given to the existing legislation permitting the utilisation of the services of Dominion judges when in England as members of the committee, with the result of diminishing in some degree Dominion objections to the decision of their cases by an external authority.

Dominion Status for India.—The admission of India to Dominion status by representation in the Imperial War Cabinet in 1917 and 1918 and her inclusion as an original member of the League of Nations was based on recognition of the great services rendered by her people during the War. The anomaly of the grant of such a position in the league to a territory which did not enjoy autonomy was lessened by the formal announcement made in 1917 that the British Govt. intended to confer on India a constitution leading up to responsible government. This undertaking was carried into effect by the Act of 1919, which became fully operative in 1921 (*see* India).

The Secretary of State for India remained responsible for the actions of the central government, and through it of the provincial governments as regards reserved subjects, but his power of control and that of the central government were drastically reduced as regards transferred subjects, with regard to which it was contemplated that responsibility should rest with the Legislatures. The complexity of the new scheme, coupled with strong local movements in favour first of non-co-operation and later of demanding immediate responsible government in all provincial matters and defence, and in central matters other than foreign affairs, resulted in the very imperfect operation of the scheme of dyarchy during the period. A strong movement in favour of responsible government manifested itself in Ceylon. The solution of dyarchy as a transition stage adopted in India found no support, and no practicable scheme was brought forward for securing control by the Legislature of the executive. It was, however, decided to increase the legislative council so as to present a large elective majority and to instruct the executive to pay due regard to its wishes, though power was reserved to obviate the possibility of a complete deadlock by authorising the governor, in case of emergency, to secure legislation by the official vote only.

West Indies.—Representations from the West Indies in favour of concessions were met by the experiment of introducing an elective element into the legislative councils of Trinidad and the Leeward Is., while wider powers, subject to the reservation of authority to the governor similar to that accorded in Ceylon, were bestowed on the council of Jamaica.

Africa.—In the case of the West African colonies, which showed staunch loyalty in the struggle with Germany, provision was made for increased representation, partly elective, of the people. Much more serious problems arose as regards Kenya Colony, transformed from a protectorate by annexation in 1920. On the one hand the European settlers aimed at securing control of the executive as well as dominating the Legislature, and received in this effort the sympathy of South Africa. On the other hand, Indian settlers, who had been encouraged to settle there when South Africa was barred to them, claimed that there should be no racial discrimination, and this claim was supported by the Govt. of India. Finally, in 1923, a compromise was reached, the British Govt. asserting that its paramount duty was to the native population, and that this excluded any surrender of control of the executive or the Legislature, but meeting the views of the European settlers in some degree by refusing equal electoral rights to Indians, who were granted in lieu special community representation.

Cyprus and Malta.—Cyprus was annexed on Nov. 5 1914, immediately after War broke out with Turkey, on the ground that it was necessary to terminate the ambiguous position of the territory which had hitherto been held by an anomalous tenure from that Power. The demand for self-government in Malta, which had long rendered relations between the Maltese and the British Govt. difficult, and had encouraged aspirations in Malta for annexation to Italy, was granted in 1921, when full responsible government in domestic affairs was accorded, imperial issues being reserved to the governor acting with a nominee council.

Rhodesia.—In the case of Southern Rhodesia the obstacle to responsible government was of a different kind. The British South Africa (Chartered) Co., in whose hands the administration lay, had large landed interests as well as mining rights, while a decision of the Privy Council in 1918 laid it down that the amount of the administrative deficits of its earlier years of administration should be refunded from land revenues; moreover, the large native population had to be assured against exploitation. By a popular vote Southern Rhodesia declined to enter the Union of South Africa, though generous financial and other terms were offered by General Smuts. After financial terms had been arranged by the British Govt. with the British South Africa Co., responsible government was conceded in 1923, but subject to special provisions requisite in the interests of the native population and of the company in respect of its railway holdings. Northern Rhodesia received a constitution of the usual colonial type with a Legislature partly elective. While, however, Southern Rhodesia was annexed as preliminary to the grant of responsible government, Northern Rhodesia was left as a protectorate.

The Right of Secession.—The grant of a distinct position in the League of Nations to the Dominions inevitably raised the question of the extent of their autonomy within the Commonwealth. An observation of Mr. Bonar Law, that a Dominion might secede if it thought fit, was adopted by Gen. Hertzog and the Nationalist party in South Africa as justifying the avowed purpose of that party to seek, as an ultimate goal, the restoration of independence to the Transvaal and Orange Free State and the creation of an independent republic. This policy was laid aside as an immediate aim as part of the conditions for the coalition of the Nationalists and Labour which resulted in the defeat of Gen. Smuts's government in 1924, and on April 24 1925 Hertzog as Prime Minister, declared that, while the right of secession

existed, to exercise it " would be a flagrant mistake and a national disaster," if it were brought about in such a way as to make either section of the people feel that secession had been imposed upon it by the other.

Sir Robert Borden, on Aug. 17, while asserting that Canada was free to leave the Empire if she chose, emphasised the advantages of the British connection as assuring greater protection, giving increased prestige and influence in the world, and yet leaving the Dominion absolutely autonomous, views in accord with those repeatedly expressed by Gen. Smuts, save that the latter held that secession was not a right enjoyed by the Dominions. In the controversies in Ireland between the Govt. of the Free State and its republican adversaries the issue was discussed at length without achieving any definite result, though it was pointed out that the existing constitutions of the Dominions agreed in assuming the permanent union of the Dominions with the United Kingdom, and that no normal constitutional means existed by which that union could be dissolved.

The Mandated Territories.—A further innovation in constitutional usage was introduced by the creation of the mandatory system (*see* MANDATES), and the allocation by the principal Allied Powers to the British Govt. of mandates for Mesopotamia, renamed 'Iraq, Palestine, portions of Togoland and the Cameroons, and German East Africa; to Australia for German New Guinea; to New Zealand for Western Samoa; to the Union of South Africa for German Southwest Africa and to the British Empire for the island of Nauru. The terms of the mandates approved by the League of Nations authorised the administration of Togoland, the Cameroons, New Guinea, Western Samoa, Nauru and Southwest Africa as portions of the territory of the mandatory power, subject to the observation of certain principles in the interest of the natives and under obligation to report annually to the League, whose permanent commission on mandates was established to deal with such reports; authority was expressly given for the application to such territories of the customs and immigration laws of the mandatory state.

In the case of East Africa, as also in those of Togoland and Cameroons, further restrictions were imposed. These provided for equal treatment of nationals of members of the league; the territory was given a constitution of the usual protectorate type under the style of the Tanganyika Territory. 'Iraq, which was at first to have been administered directly by the United Kingdom, was recognised by treaties of 1922–4 as an independent kingdom, and the obligation undertaken as a mandatory power by the United Kingdom was held by the Council of the League to be satisfied by the acceptance of responsibility for the due carrying out of the treaties, which, however, were to lapse if 'Iraq should be admitted a member of the League before their expiry by lapse of time in four years. This period, however, was extended to 25 years by the treaty of Jan. 13 1926, in accordance with the recommendation of the League Council of Dec. 16 1925, for the settlement of the boundary with Turkey. In the case of Palestine the mandate was granted subject to the obligation, voluntarily assumed by the United Kingdom, of furthering the establishment of a home for the Jews; efforts to carry this out resulted in strong resistance by the Arab majority, which declined to work the constitution conferred in 1922, with the result that all executive and legislative power remained in 1925 in the hands of the representatives of the mandatory power.

Racial Problems.—The growth of Dominion autonomy and the grant of a new position to India resulted in constitutional innovation. In lieu of seeking redress for the grievances of Indian subjects through the mediation of the British Govt. the Indian Govt. entered into direct relations with the Dominions in addition to pressing the issue at the conferences of 1921 and 1923. The attitude of India was to concede, though reluctantly, the right of any Dominion to exclude Indian immigration, provided that the method adopted was not needlessly injurious to Indian sentiment, but to claim that all Indians lawfully resident should be accorded full rights of citizenship and be immune from discriminations on racial grounds. Some progress in securing the acceptance of these principles was made as regards the Dominions other than South Africa, but the Union then declined to make any concession, announcing instead the policy of applying to Indians the plan of racial segregation and promoting the return or removal to India of those who had settled or been born in South Africa. Deep feeling was aroused in India by the attitude of the Union, and the question was raised whether India could permanently remain associated with the Union in the Commonwealth if her people were denied the possibility of existence in South Africa.

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II. DEFENCE

The word " defence " has so often been taken to imply simply the defence of land frontiers against potentially hostile armies, that it is necessary to emphasise the point that in the British Commonwealth the word has a far wider meaning, embracing questions of sea, land and air forces, of central control, of political and diplomatic issues, of finance and economics. The problem of the defence of the British Commonwealth contains one outstanding factor, the need for adequate sea-power to ensure safety of communication between Great Britain as the centre and the various component parts of the Empire, and also between those parts. To that must be added an essential demand for security, against sea, land or air forces, of Great Britain as the centre of organisation and effort.

From the point of view of defence, treated comprehensively, the period from 1910 to 1925 was of outstanding importance in the history of the British Empire. Up to 1910, the people of the United Kingdom had been able to maintain a two-power standard in sea forces, thus enabling the Admiralty to guarantee the security of the territory and sea-interests of the self-governing Dominions, amongst which the Union of South Africa was included during the course of that year.

The Political Issue.—In considering the problem of defence, it is essential to bear in mind the political issue, which necessitates drawing a distinction between the " Commonwealth of self-governing nations, " in an advanced stage of national development and the British Empire proper, comprising the United Kingdom, the Colonies and Protectorates governed therefrom, and the mandated territories for the defence of which the people of Great Britain are temporarily responsible. India, an empire in itself, did not come precisely into either of these categories in 1925. The forces of the second group are controlled from Great Britain. Those of the first group are not.

Another point to be noted is that the British Is. no longer form, from the defence point of view, a homogeneous whole, owing to the grant of self-government to the Irish Free State, which controls its own defence forces. The need to take account of these points before proceeding to details is obvious. With a few exceptions, the " over-sea " nations of the Commonwealth take no part in time of peace in the defence or policing of territories beyond their own borders. This responsibility, when local resources do not suffice for the purpose, falls upon the people of England, Scotland, Wales and Northern Ireland, and, to a limited extent, upon India.

Three Events of Importance.—Before summarising, from the defence point of view, the period 1910–25, it is necessary to mention three outstanding events immediately preceding that period. These were the establishment (*a*) of the Committee of Imperial Defence by Mr. A. J. (Earl of) Balfour; (*b*) of the general staff of the army by the late Mr. H. O. Arnold-Forster; and (*c*) of the Expeditionary Force and Territorial Army by Mr. R. B. (Lord) Haldane.

Through the agency of the Committee of Imperial Defence, the principles of Empire defence put forward by the general staff of

the army had been generally accepted by the self-governing nations. These principles can be summarised as (1) security of sea communication, (2) local provision for local defence and (3) mutual support where local resources do not suffice for the purpose. It will be observed that, in these established and accepted principles, no account was taken of combined action in foreign territory in support of treaty obligations. One of these, affecting the neutrality of Belgium, had been undertaken by Great Britain before self-government had been conferred upon the Dominions, but the obligation was well known, and the Dominions rose nobly to the occasion in providing sea, land and air forces, of their own free will, to support those of Great Britain when the frontier of Belgium was crossed by the German Army in 1914.

As affecting Empire defence, the outstanding events of the years 1910–4 were the reduction of the two-power standard at sea, to a standard of 60% in capital ships above Germany; a warning issued to Canada by the British Govt. in 1912 that the possibility of sending effective sea forces to the Pacific, without courting disaster in home waters, would be diminished with the growth of foreign navies; the organisation of the regular troops in the United Kingdom as an expeditionary force of six infantry and one cavalry divisions, with line-of-communication troops; the development of the Special Reserve (late Militia) to provide drafts to replace casualties in that force; and the organisation of the Territorial Force in 14 infantry divisions for home defence, with the option of volunteering for service abroad. During the same period, the Committee of Imperial Defence, in its purely advisory capacity, was instrumental in carrying through a policy of uniformity in organisation, training, equipment and material in all the sea and land forces of the British Commonwealth. Through the activities of the same body a "war-book" was compiled, to ensure combined action by all departments of state and all parts of the Commonwealth in the event of a great war; an organisation was prepared to stabilise the rates of war insurance on shipping and cargoes; and a plan was worked out in detail for transporting the Expeditionary Force across the sea, and placing it on the left flank of the French Army as rapidly as possible, should such action ever be demanded. The value of these preliminaries was evident in 1914.

The Committee of Imperial Defence, was (and is) a purely advisory body. No provision was made for an executive body responsible for the conduct of war, excepting a large Cabinet containing 22 ministers, which proved to be too unwieldy for prompt action. After various expedients had been tried, a small "War Cabinet" was established in Dec. 1916 and remained in power until normal conditions obtained after the conclusion of the conflict. The need for some such form of central control in time of war was one of the most important of the many lessons learned about Imperial defence. Another lesson showed the tremendous potential forces, sea, land and air, economic and financial, which the British Commonwealth has at its disposal if certain conditions are satisfied; these are the inspiration of a great cause, time for development and safe sea communications. The rapid progress in aviation which resulted from the impetus of war caused a new demand for an air force of sufficient strength to make Great Britain secure.

The Post-War Years.—The post-War period was one of unrest abroad and exhaustion at home, resulting in an urgent need for recuperation. Events in North Russia, Afghanistan, Ireland, Mesopotamia, Egypt, Palestine, Turkey and elsewhere threw a considerable strain upon British forces. An undertaking to provide a contingent in German occupied territory caused additional military responsibilities, which were further increased by the acceptance of mandates, for ex-German and ex-Turkish territories. At the same time, economic and financial exhaustion led to the reduction, almost to cadres, of the immense sea, land and air forces employed by the British Empire in the World War. Meanwhile, the United States and Japan, which had suffered comparatively little loss, embarked upon new programmes of naval construction, and the British fleet was further reduced from a 1·6 to a one-power standard.

The British Army was reduced below its pre-War strength, and the Air Force to a standard below that subsequently considered as essential to the safety of the United Kingdom. In 1919 the principle was laid down by the Cabinet, that the strength of the British fighting forces should be based upon the assumption that war on a large scale would not occur within a period of 10 years. An outstanding event of the post-War period was the Washington Conference of 1921 (*q.v.*) at which an agreement was arrived at between the principal naval Powers, Great Britain, the United States, France, Italy and Japan, to limit the total and individual tonnage of capital ships and aircraft carriers, and to take certain other measures designed to bring about the limitation of sea armaments. A later event of importance was the Conference of Empire Prime Ministers held in London in 1923, at which conclusions were agreed upon that the territories and trade of the several countries of the Empire must be adequately defended, each Parliament deciding for itself what its government should do. Also that the guiding principles, affecting the general defence problem, should be (*a*) the provision of naval bases to ensure the mobility of sea forces, (*b*) equality with the naval strength of any foreign Power (the one-power standard) and (*c*) a common system of Air Force organisation.

Finally, and most important of all, came the Locarno Pact in 1925. (*See* LOCARNO.) Looked at from the point of view of British Empire defence, they can be described as greatly increasing the military commitments of Great Britain (the other self-governing nations of the Empire are not parties to them) in the event of another Franco-German War, whichever side might be the aggressor, but at the same time introducing a new spirit in international relationship, which should make such an event much less probable.

A Comparison.—Comparing the situation in 1926 with that in 1910, the most important points to be noted were the reduction in strength of the British Navy, compared with those of other nations; a reduction in the strength of the Regular Army and the abolition of its Special Reserve; the establishment of the Territorial Army on new principles, rendering it available for overseas service in grave emergencies; and the establishment of an Air Force, which was being worked up to a one-power standard. At the same time, it was necessary to take note of additional military commitments in Europe, involved by the Locarno Treaties, and in ex-Turkish and ex-German territories in Asia and Africa under mandates resulting from the Peace Treaties, and the establishment of the League of Nations. Upon the people of Great Britain fell the main burden of Empire defence which involved the safeguarding of much foreign territory, besides that of the British Empire proper.

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III. AREA AND POPULATION

The World War resulted in a considerable addition to the area of the British Empire. The greater part of the overseas possessions of Germany were conquered by British troops, and by the Treaty of Versailles were retained by the British under mandate from the League of Nations. These mandated territories together cover over 950,000 sq. m. and contain more than 9,000,000 inhabitants. In 1914, Cyprus was annexed and Egypt declared a British Protectorate, thus adding these areas to the Empire, but in 1922 the protectorate over Egypt was terminated. In 1924, an area of about 34,000 sq. m. bordering Italian Somaliland was ceded to Italy. The total area of the Empire (1926) approached 13,350,000 sq. m., containing about 450,000,000 inhabitants. This total includes the mandated territories.

The following table shows the area and population of each part of the Empire. The figures are mainly based on *The Statistical Abstract for the several British Oversea Dominions and Protectorates in each year from 1907 to 1921* (1924), which should be consulted for explanatory details. Population statistics in general are for 1921:—

Area and Population of the Various Parts of the British Empire

	Area (sq. m.)	Population
Europe		
England	50,874	35,678,530
Wales	7,466	2,206,712
Scotland	30,405	4,882,288
Ireland, Northern	5,263	1,284,000
Man, Isle of	227	60,238
Channel Islands	75	89,614
Irish Free State	26,592	3,165,000
Gibraltar	2	18,061
Malta	122	212,258
Cyprus	3,584	310,469
North America		
Canada	3,729,665	8,788,483
Newfoundland	42,734	259,259
Labrador	120,000	3,774
Central and South America		
West Indies	12,482	1,728,735
Bermuda	19	20,127
Falkland Islands	7,500	3,431
Guiana, British	89,480	297,691
Honduras, British	8,598	45,317
Africa		
South Africa, Union of	473,096	6,928,580
Swaziland	6,678	106,961
Basutoland	11,716	498,781
Bechuanaland	275,000	152,983
Rhodesia, Southern	148,575	899,187
Rhodesia, Northern	291,000	983,539
Nyasaland	39,467	1,201,983
Uganda	110,300	2,921,608
Kenya	211,060	2,529,133
Zanzibar	1,020	197,000
Somaliland	68,000	347,000
Sudan	1,014,600	4,853,000
St. Helena	47	3,666
Ascension	34	250
Nigeria	336,778	18,070,608
Gold Coast	78,650	2,110,474
Sierra Leone	30,000	1,541,311
Gambia	4,010	210,530
Mauritius	809	384,879
Seychelles	156	24,523
Asia		
India	1,805,252	318,885,980
Ceylon	25,481	4,498,605
Aden (and Perim)	80	56,500
Socotra	1,382	12,000
Straits Settlements	1,600	883,769
Malay States, Federated	27,648	1,324,890
Malay States, Unfederated	23,355	1,123,944
Brunei	4,000	25,451
Borneo, British North	31,106	257,804
Sarawak	42,000	600,000
Hong Kong	391	625,166
Weihaiwei	285	154,662
Oceania		
Australia	2,974,581	5,435,734
New Zealand	103,284	1,218,913
Papua	90,540	275,000
Fiji	7,435	157,266
Gilbert and Ellice Is.	180	29,897
Solomon Islands	14,800	150,516
Tonga Islands	390	24,935
Total	12,389,874	438,761,015

The following areas are administered under mandate from the League of Nations:—

	Mandatory Power	Area	Population
Cameroons, British	United Kingdom	31,000	632,309
'Iraq		116,511	2,849,282
Palestine		9,000	761,796
Tanganyika		373,494	4,123,493
Togo, British		13,040	187,939
South-West Africa	South Africa	322,000	227,739
New Guinea	Australia	91,000	254,000
Western Samoa	New Zealand	1,260	37,157
Nauru	British Empire	8	2,166
Total		957,313	9,075,881
Grand Total		13,347,187	447,836,896

(W. H. Wt.)

IV. FINANCE

The most important inter-Imperial financial problems are those of debt and currency. In 1900, when Mr. Joseph Chamberlain was Secretary of State for the Colonies, the Colonial Stock Act was passed, under which the British Dominions, on agreeing to certain conditions, were enabled to borrow under the Trustee Act, 1893, and their loans became trustee securities in Great Britain. The Dominions were thus placed on equal terms with the British Govt. and other high-class British borrowers and India in so far as eligibility of appeal to the general body of investors in Great Britain was concerned. Just before the World War the funded debts of the Dominions were as follows:—

	Borrowed in London	Raised Internally
	£	£
Canada	60,000,000	143,000,000
Australia (Commonwealth and States)	230,000,000	104,000,000
New Zealand	78,000,000	16,000,000
South Africa	111,000,000	14,000,000
Total	479,000,000	277,000,000

The following figures (1924 for South Africa, 1925 for the other Dominions) show how the total funded debt increased, largely on account of the World War.

	Borrowed in London	Borrowed in New York	Raised Internally
	£	£	£
Canada	62,000,000	60,000,000	380,000,000
Australia (Commonwealth and States)	481,000,000	4,000,000	537,000,000
New Zealand	118,000,000	..	104,000,000
South Africa	133,000,000	..	74,000,000
Total	794,000,000	64,000,000	1,095,000,000

After 1914, the proportion of the funded debt raised internally greatly increased in each Dominion. For Canada, practically no further loans were raised in London, and in Dec. 1925 her debt payable in New York was almost equal to that payable in London.

Currency Conditions.—Within the British Empire there is an absence of uniformity in the conditions under which the gold standard is supposed to operate. For the gold standard to be fully effective two conditions are necessary:—(*a*) that there should be no obstacle to the free flow of gold between the countries adopting the gold standard; and (*b*) that the external movement of gold should produce like results on currency and credit in the internal economy of the respective countries. Any deviation tends to throw the gold standard out of balance (*see* CURRENCY; EXCHANGE).

In England, under the Gold Standard Act, 1925, both Bank of England notes and currency notes were made convertible into gold bullion in bars of 400 oz. troy of fine gold, and the embargo on the export of gold was removed.

In Canada, although sovereigns taken at par are legal tender, and there is a branch of the Royal Mint at Ottawa, the unit of account is the dollar, and the currency almost wholly consists of Dominion notes, issued by the Govt., and notes issued by the chartered banks, both of which are legal tender. In 1925 gold could only be exported under licence (*see* CANADA).

In Australia, there are branches of the Royal Mint at Melbourne and Perth, where sovereigns are coined. These are held by the banks in their cash reserves but are not put into circulation. The currency consists of notes issued by the Commonwealth Bank, which functions both as a central and as a commercial bank. The notes are legally convertible, but, in practice, convertibility is not enforced. There is no embargo on the export of gold. The Commonwealth Bank Act, 1924, provides that: "The Board may issue Australian notes to the Bank or to other banks in Australia in exchange for money or securities lodged with the London branch of the Bank." It lies with the Commonwealth Bank, however, to determine to what extent this facility should be made available (*see* AUSTRALIA).

In New Zealand, bank-notes constitute the currency. They are issued by the two New Zealand and the four Australian banks which conduct the banking business of the Dominion. Notes can be issued against a reserve of one-third in gold and two-thirds in securities of the New Zealand, British and Australian (Commonwealth and State) governments. While the gold has to be held in New Zealand,

the securities may be held either in New Zealand or, on complying with certain conditions, in London or Australia. Although the embargo on the export of gold was removed in 1925, the notes are inconvertible (*see* NEW ZEALAND).

South Africa, as the largest producer of gold, not only in the British Empire but in the world, occupies a unique position. A branch of the Royal Mint has been established in Pretoria, and not only are sovereigns coined there but they are put into circulation. The notes of the South African Reserve Bank, which functions as a central bank, are also freely convertible into gold coin. The action of South Africa in encouraging the use of gold as a circulating medium can perhaps be appreciated from the standpoint of the largest gold producer, but it is not economical and therefore tends to make England's task of maintaining the gold standard harder.

The Egyptian System.—Although the Protectorate over Egypt was terminated in 1922, the currency system, as modified during the World War, was retained and still served the Sudan. The currency, which before the War was partly gold, consists of notes of the National Bank of Egypt. During the War the notes ceased to be convertible into gold and, for practical purposes, became convertible into sterling. By arrangement with the Egyptian Govt. British Treasury Bills are held in place of gold. The par of exchange is at the rate of £E97½ for £100 sterling, and at this rate the National Bank of Egypt, which has an office in London, is prepared to give the banks Egyptian currency in Egypt against sterling paid in by them in London; and, conversely, to receive, also at the same rate, Egyptian currency and pay out sterling in London—advice being sent by cable both ways. Thus parity of exchange with London has been absolutely maintained throughout the whole period, notwithstanding heavy movements in both the volume of currency and the trade balance (*see* EGYPT).

Empire Currency Bills.—The success which attended the Egyptian system led to proposals for the adoption of the principle throughout the Empire. On the initiative of the New Zealand Govt., a scheme for an issue of Empire Currency Bills was placed before the Imperial Economic Conference held in 1923 and submitted to a committee on inter-Imperial exchanges. The scheme provided for a composite issue of treasury bills, limited in amount, in which each of the participating countries in the Empire would have a share. The bills, which were to be given the utmost degree of negotiability and mobility throughout the Empire were to be used as a basis for currency, and as interest-bearing reserves by the banks. The scheme was rejected, partly because of the " joint and several " nature of the liability. Further, an early restoration of the gold standard, which it was thought would provide an automatic remedy, was contemplated. A supplementing and correlative scheme for an Empire gold pool has also been suggested in order to secure economies in the use of gold throughout the Empire. (J. F. DA.)

V. TRADE AND COMMERCE

After the World War there was a marked increase of interest in Empire trade in Great Britain and also in all the countries that comprise the British Empire. The evidence of trade statistics as to the increasing importance of Empire purchases to British manufactures led to a widespread adoption of the view that if Great Britain was to maintain her pre-War leadership in world economic affairs, she must adopt some method of organising the production and marketing of Empire foodstuffs and raw materials, with a view to ensuring (1) her own supplies and (2) a continuous redistribution of population throughout the Empire, made possible by an assured demand for Empire products in the British market.

If the combined effect of geographical and social conditions upon trade are considered, the countries making up the British Empire can be classified into six economic groups:—

1. The British Is., which exercises economic influence over all Empire countries in varying degrees.
2. Canada, Newfoundland, the West Indies and British Guiana. This may be called the American group because it falls directly within the economic orbit of the United States of America.
3 and 4. West and East African Colonies. The conditions governing production, commerce and transport in West, East and South Africa are so different that separate grouping is necessary.
5. India, Ceylon, Malaya and the Strait Settlements.
6. The three great southern Dominions—Australia, New Zealand and South Africa. South Africa, on account of its similarity in economic and political conditions with those of Australia and New Zealand, falls more naturally into this group than into either of the African groups.

Trade of Great Britain with the Empire.—Great Britain is the nerve centre of political, banking and business activity, and the most important part of Empire trade is the trade of Great Britain with other Empire countries. The following table shows the Empire share of British exports, pre-War and post-War:—

TABLE I.

Year	Total	To Empire	
	£	£	%
1904–13[1]	408,439,504	141,934,405	34·75
1922	719,507,410	270,201,638	37·5
1923	767,257,771	300,602,626	39·2[2]
1924	795,364,581	332,536,252	41·8[2]

[1] Annual average.

[2] It should be noted that this percentage does not take into account the territorial alteration in the British Empire as between pre-War and post-War years; especially should it be noted that without exports to the Irish Free State, these percentage figures would be 37·2% and 38·5%, respectively.

It must not be forgotten, however, that while these figures indicate the proportion of British exports taken by the Empire, they do not, as a result of the rise in the price level between pre-War and post-War years, show the actual volume of trade. Table II. gives the British export figures for 1904–13 and for 1922–3–4 reduced to the 1913 price level.

TABLE II.

Year	Total	To Empire	
	£	£	%
1904–13	408,439,504	141,934,405	34·5
1922	361,836,000	143,287,000	39·8
1923	404,404,000	158,526,000	39·2
1924	420,582,000	174,962,000	41·8

The importance of the Empire as a market for the different categories of British exports varies greatly. In 1913 the Empire share of British exports under the head of Food, Drink and Tobacco was 39% and in 1924 54·5%. Coal is the most important raw material exported from Great Britain, but the Empire took in 1924 only 8·5% of the total value of £72,000,000. Britain's exports of " articles mainly or wholly manufactured " amounted in 1924 to £618,000,000, out of a total export of £800,000,000, and the Empire share in this year was 46%, a rise of 4% on the 1913 share. It is estimated that the Empire provides a market for not less than 50% of Great Britain's completely finished manufactured exports.

The importance of Empire markets to British manufactures is clearly realised when the proportion of manufactures in the total British exports to Empire and foreign countries is contrasted. This is done in the following table for 1924.

TABLE III.

	%		%
India	95·6	Germany	57·6
Canada	82·5	U.S.A.	78·0
Australia	93·5	France	48·0
New Zealand	87·5	Italy	42·0
South Africa	91·5		

Of Great Britain's total imports for the annual average 1911–3 the Empire supplied 21% and for the annual average 1922–4 (the Irish Free State being excluded) the Empire supplied 30·7%. Table IV. gives the Empire share of the actual volume of British imports on the same basis as Table II. (*i.e.*, reducing post-War figures to the 1913 price level).

TABLE IV.

Year	Total	Empire	
	£	£	%
1913	659,168,000	135,356,000	20·5
1922	570,073,000	180,713,000	31·6
1923	641,691,000	189,940,000	29·5
1924	719,503,000	218,729,000	30·4

The development of primary production in Empire countries is clearly reflected in the British import returns. In 1913, the Empire supplied 25·8% of British imports of food, drink and tobacco

and in 1924 38·2%. Foodstuffs are the largest item of imports, valued in 1924 to £571,000,000. Britain's requirements of raw materials were met by the Empire in 1913 to the extent of 25% of the total, and in 1924 to the extent of 32·5%. The share of the Empire in British imports of wholly or partly manufactured goods is small. In 1913, it was 6·6% and in 1924 11·5%, and even this small proportion consisted in the main of semi-manufactured metals—the raw material of many British industries. These figures indicate the non-competitive or complementary nature of British trade with the Empire. The relative importance of Empire supplies of certain essential foodstuffs and raw materials is shown by the following figures:—

Imported article	Empire share of imports in 1924
Wheat and flour	53·0
Beef	9·2
Mutton	60·5
Butter	42·4
Fruit (fresh, dried and canned)	22·3
Wool	80·5
Hides and skins	46·6

Before considering the trade of the overseas groups, it is necessary to mention the new commercial position of the Irish Free State. From April 1 1923 Southern Ireland became an independent economic unit. In 1924 69·3% of her total imports, valued at £66,000,000, were of British origin and 84% of her total exports, valued at £48,000,000, went to Great Britain. In that year the Irish Free State was the fifth most important market for British goods. Direct Irish trade with parts of the Empire other than Great Britain is negligible.

Canada, Newfoundland, etc.—The American group, in which Canada takes the leadership, is in some instances less affected by the inter-Imperial aspect of trade than the other groups in the Empire. This is the inevitable result of the immense economic influence of the United States of America.

Canadian Trade: Annual Averages

	1911–3 (000's omitted)		1922–4 (year ending March 31) (000's omitted)	
	$	% of total	$	% of total
Exports				
Total exports	306,765	..	905,611	..
Exports to Great Britain	149,853	48·8	346,174	38·2
Exports to Empire[1]	168,130	55·0	407,312	45·0
Imports				
Total imports	548,778	..	814,583	..
Imports from Great Britain	121,861	22·0	137,359	16·9
Imports from Empire[1]	143,330	26·2	174,711	21·4

[1] Including Great Britain.

Though Great Britain's share of Canadian imports as between 1911–3 and 1922–4 fell from 22% to 16·9%, her share rose to 19% in 1924–5.[1] The United States is naturally Canada's chief source of supply. Canada's export trade showed a remarkable increase as between 1911–3 and 1922–4. Taking the figures for the latter period on the basis of 1913 price levels, the increase amounted to over 60%. In June 1920 a reciprocal trade arrangement was entered into with the West Indies, and in 1925 this agreement was enlarged. It seems probable that the mutual tariff advantages so arranged will lead to Canada becoming the chief source of supply of manufactures and foodstuffs to the West Indies and a valuable market for their tropical products, chiefly sugar and bananas. Although the trade between Great Britain and the West Indies is the oldest established branch of Empire trade, it is severely handicapped by the lack of adequate shipping services.

The import trade of Newfoundland is greatly affected by the United States, whose share of her imports in 1924 amounted to 31% of the total as against Canada's share of 41·6% and Great Britain's share of 22·6%. The British share of Newfoundland exports in this same year was 38·6% of the total. Newfoundland exports a limited range of products, the most important of which are dried fish, cod liver oil and paper pulp.

[1] *Preliminary Report on the Trade of Canada*, published by the authority of Canadian Minister of Trade and Commerce.

West African Group.—The West African group is composed of the following colonies and protectorates: Gambia, Sierra Leone, Gold Coast (which includes British Togoland) and Nigeria (which includes British Cameroons). The typical West African exports are palm kernels and palm oil, which, in the case of Nigeria, represent over 60% of the total value of the exports. The actual proportion of British imports and exports which arrived from and were sent to West Africa greatly increased after 1910. This fact is mainly due to the general increase of prosperity in West Africa and to the accession of certain parts of German West Africa. The total value of the trade with Great Britain amounted for the annual average of 1922–4 to £22,000,000. The inter-Imperial trade of West Africa, apart from that with Great Britain, mainly consists of trade between the several West African Colonies. Foreign trade plays a relatively small part in West African economic life.

East Africa.—Though the area of British East Africa (which includes Kenya, Uganda, Tanganyika Territory, Nyasaland and Zanzibar) is twice as large as that of West Africa, the volume of East African trade is only about two-thirds of that of West Africa. The bulk of British East African trade is with Kenya and Uganda. A significant feature of the post-War trade of East Africa was the immense increase of exports going to India. The Indian share of the exports of Kenya and Uganda in 1911–3 was 4·2%, and in 1922 had risen to 36·8%. The imports from India, on the other hand, had fallen slightly from a pre-War share of 19·5% to a post-War share of 15% of the total imports into these two colonies. Uganda is becoming of increasing importance to the Empire as a supplier of cotton. Her cotton exports have increased from 25,000,000 lb. in 1922 to 51,500,000 lb. in 1924: the value of this item of export accounted in the latter year for 56·8% of the total exports of Kenya and Uganda. In 1924 Kenya coffee represented 29% of total supplies sent to Great Britain and 80% of Empire-grown supplies. The Sudan, which is of rapidly growing importance as a source of cotton, may also be included in this group.

Indian Group.—India is the largest market in the world for British goods. Therefore the Indian group is economically the most important part of the Empire to Great Britain. The following table shows the share of Great Britain in Indian imports for the annual average 1911–3 and 1922–4:—

Indian Trade: Annual Averages

	1911–3 (year ending March 31) (000's omitted)		1922–4 (year ending March 31) (000's omitted)	
	£	% of total	£	% of total
Imports				
Total imports	107,293	..	163,164	..
Imports from Great Britain	67,883	63·5	93,496	57·5
Imports from Empire[1]	74,623	69·9	104,730	64·8
Exports				
Total exports	157,193	..	238,342	..
Exports to Great Britain	39,032	24·8	56,248	23·6
Exports to Empire[1]	62,839	40·0	90,093	37·8

[1] Including Great Britain.

The extremely close trade connection established between India and the home country is thrown into relief if Great Britain's share of the imports of another large Far East market—China—is noted. In 1924, Britain's share of Chinese imports amounted to only 12% of the total as compared with 57·5% in the case of India. The disproportion between the Empire percentage of Indian imports and exports should be noted. Indian exports to Empire countries other than Great Britain are marked by a large trade in jute goods to Australia and New Zealand, and by a more general trade with Mauritius and the Straits Settlements. Malaya has developed a great export trade in rubber and tin, and is one of the largest exporting countries per head of her population in the world.

Australian Trade: Annual Averages

	1911–3 (000's omitted)		1922–3 to 1923–4 (000's omitted)	
	£	% of total	£	% of total
Imports				
Total imports	74,958	..	136,188	..
Imports from Great Britain	37,729	50·4	66,000	48·5
Imports from Empire[1]	46,249	61·6	82,572	60·6
Exports				
Total exports	79,033	..	118,678	..
Exports to Great Britain	33,841	42·6	48,741	41·2
Exports to Empire[1]	47,898	60·5	63,269	53·5

[1] Including Great Britain.

Southern Groups.—While the majority of the Empire countries showed an increased share of British exports, the most marked instance was that of Australia, whose share rose from 6·56% in 1913 to 8·25% in the year ending Sept. 30 1925. Australia's trade with Empire countries, apart from her total trade with Great Britain, amounted to approximately one-eighth of the total. On the assumption that prices had increased by about 50% over the pre-War price level, the volume of Australian imports for the annual averages taken showed a considerable increase and the exports a slight decrease. The chief Australian exports are wool and wheat. The Australian wool exports are of the greatest importance to Empire trade, as they represented in 1924 37% of Great Britain's total imports of wool.

Of the three great southern Dominions, New Zealand, though the volume of her trade is not so great as that of either Australia or South Africa, maintains the closest touch with the trade of Great Britain and the other Empire countries.

New Zealand Trade: Annual Averages

	1911–3 (000's omitted)		1922–4 (000's omitted)	
Imports	£	% of total	£	% of total
Total imports	20,933	..	42,306	..
Imports from Great Britain	12,533	60·0	22,774	54·0
Imports from Empire[1]	17,306	82·8	33,303	78·8
Exports				
Total exports	21,261	..	47,102	..
Exports to Great Britain	16,708	79·0	38,505	81·9
Exports to Empire[1]	19,956	94·3	42,287	89·9

[1] Including Great Britain.

The figures of total trade given above indicate that, even allowing for the rise in price level, New Zealand's volume of trade within the Empire has increased since the immediate pre-War years. Official estimates give the increase in the 1923 exports to the Empire as being 33·5% above the 1913 level. A large proportion of New Zealand's inter-Empire trade consists of exchange and transit trade with Australia. New Zealand is predominant in the Empire as a supplier of butter, mutton and lamb to the British market. In 1913, her exports of butter amounted to 5% of British imports; and in 1924 amounted to 20%. In the same two years New Zealand mutton and lamb represented 46·6% and 53% respectively of British supplies from overseas.

South Africa is alone among the Dominions in showing a slight decrease in her share of British exports and imports since the War in comparison with 1911–3. On the other hand, deducting the British share of South African imports and exports, the total trade of Empire countries with South Africa increased from approximately one-fifth in 1911–3 to one-quarter in 1922–4.

South African Trade: Annual Averages

	1911–3 (000's omitted)		1922–4 (000's omitted)	
Imports	£	% of total	£	% of total
Total imports	38,129	..	55,407	..
Imports from Great Britain	21,754	57·0	28,892	52·0
Imports from Empire	25,737	67·5	35,251	63·5
Exports				
Total exports	63,190	..	73,513	..
Exports to Great Britain	57,956	92·0	54,013	71·5
Exports to Empire	58,396	92·5	61,076	83·0

In the general distribution of imports and exports there was little change. In the immediate post-War years, the United States of America and Japan made serious inroads into many Empire markets, but by 1923 British trade had largely regained the lost ground. The special importance of Empire trade to the Dominions and India is shown by the fact that in every case, except Canada, about 50% or over of the total is carried on within the Empire. New Zealand had, in 1924, an Empire trade of 84·5%, South Africa 75%, Australia 57% and India 49%. Canada's trade with the Empire amounted to 33·8% of her total. As to the actual volume of inter-Imperial trade—apart from its distribution—statistics indicate that the self-governing Dominions and India suffered from the general depression following the World War. In most cases there was an actual loss of purchasing power and, except in the case of New Zealand and Canada, exports also declined.

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(F. L. M.)

VI. COMMUNICATIONS

The first line of communication of the Empire is by sea. Until the outbreak of the World War the great majority of the ships serving Empire ports were owned by companies operating from the British Is.; but during the War and immediate post-War periods, the Dominions, notably Canada and Australia, developed mercantile marines which largely operate on Empire routes. About 400,000 gross tons of shipping engaged in overseas trade were actually owned by these Dominion Govts. in 1925, but whilst they assisted trade development they were also a cause of substantial losses. These government-owned fleets had at first an advantage in immunity from taxation, but at the Imperial Conference of 1923 it was agreed that liability to taxation should be the same as for privately owned vessels.

Liner routes steadily increased after 1910, and in 1925 there were 560 such routes from the British Isles. Not all were Empire routes, but there was at least one and frequently more than one liner route connecting Great Britain with each of the Dominions and Colonies, whilst there was a marked development in the organisation of lines working directly between the overseas Dominions. An effect of this was to give greater stability to freight rates, but also to make them less flexible. Sea carriage remained the cheapest form of transport. In 1925 it cost only 1d. to bring 1 lb. of meat from Australia to Great Britain; ¼d. per quarter for wheat from Canada or ⅜d. from Australia and $\frac{3}{20}$d. per lb. for rice from Rangoon.

Freights are, however, subject to considerable variation, due to changes in the balance of cargoes on the routes at different times and seasons. The serious drop in coal exports from Great Britain during the post-War period caused British shipping to be less remunerative, and kept up freights for the carriage of raw products to Great Britain. The Australian trade is, from a shipping standpoint, unusually well balanced. The worst balanced route is that across the Atlantic to Canada and Newfoundland, for the United Kingdom exports to Canada and Newfoundland mainly manufactured goods, occupying moderate cargo space in relation to their value, and imports grain, timber, pulp, flour and other comparatively bulky goods. A notable development, particularly after the War, was the growth of direct trade of the Dominions or Colonies with one another. The Imperial Shipping Committee, founded in 1920, materially assisted in the co-ordination and standardisation of practice within the Empire.

With the growth in the size of ships—British ships of 8,000 tons and upwards increased from 214 at the end of 1913 to 395 at the end of 1925[1]—the need for deep water ports and for dock equipment which would provide for a rapid turn round of the ship was emphasised. The outcome was a marked tendency for the traffic to pass through a limited number of ports. Though the Board of Trade publish returns for over 100 ports in Great Britain, the bulk of the traffic passes through 14 or 15 of them, while London and Liverpool together handle over 50% of the total. Taken as a whole, the Empire is well provided with ports with a depth of water of 35 ft. upwards, or with ports which can readily be deepened as soon as the necessity arises. The tendency, however, has been to develop a large number of ports, and this often compels ships to call at several to insure a full cargo. New Zealand perhaps suffers from this more than any other part of the Empire, which accounts for freights being relatively high.

[1] *Lloyds' Register* (1926).

Railways.—The railway systems of the various parts of the Empire differ very much in their adequacy. The plan of transferring the railways to a state company, or to have a railway budget independent of the national budget, was suggested. The Union of South Africa led the way, whilst Canada followed suit in 1917, when the Canadian National Railways Co. was created; and India in 1925, when the recommendations of the Acworth Commission of that year were adopted. These changes should make for a more even development of railways in the Dominions, with material advantages to trade. Lack of standardisation seriously hindered the development of railway communications in Australia, each state having chosen its own railway gauge irrespective of that of neighbouring states. In the Crown Colonies, the prospect of improving the supply of raw materials produced within the Empire depends largely upon railway development.

Air and Wireless Services.—In speeding up transport, the biggest prospect comes from the development of air transport. In 1925 its possibilities were limited, particularly by the difficulties of night flying. For communication with Great Britain, its uses were restricted to the carrying of passengers or mails for a terminal stage of the journey. A day, for instance, might be gained on the Indian mail by use of the aeroplane service to Paris and Marseilles, and a saving of 15 days made by the air service from Cairo to Baghdad for the London mails. If airship services should develop, the times necessary for mails to reach the East or Australia would be cut about two-thirds. In 1925 the only direct wireless service of an Empire character was that between the United Kingdom and Canada, which had been in existence since 1907, though a limited service with India was maintained by way of Egypt. The first suggestion for an Empire wireless scheme was made in 1911, and had it not been for the War this would probably have been put into operation. Afterwards a question arose whether the Marconi Co. or the Government should carry out the scheme in Great Britain. Eventually a decision in favour of the Post Office ownership and operation was reached, though the Marconi Co. was employed for the construction of the high power station at Hillmorton near Rugby, which was opened on Jan. 30 1926. This station is used for broadcasting the Government bulletin and other purposes, but is no longer part of the general imperial scheme, now carried out on the short-wave beam system.

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BRITISH ISLES: *see* GREAT BRITAIN; IRELAND; SCOTLAND; WALES; etc.

BRITISH LEGION.—In 1921 there existed in Great Britain four national organisations of ex-service men, namely the Comrades of the Great War, the National Association of Discharged Sailors and Soldiers, the National Federation of Discharged and Demobilised Sailors and Soldiers and the Officers' Association. These had all come into being owing to the World War and in 1921 they united, forming the British Legion, which thus became the one national organisation of ex-service men throughout the country. In 1925 the Legion was incorporated by royal charter.

The policy of the Legion is entirely non-political and non-sectarian. In the words of its charter—

> The Legion shall exist to perpetuate in the civil life of the Empire and of the world the principles for which the nation stood in the Great War; to inculcate a sense of loyalty to the crown, community, state and nation; to promote unity amongst all classes; to make right the master of might; to secure peace and good will on earth; to safeguard and transmit to posterity the principles of justice, freedom and democracy, and to consecrate and sanctify our comradeship by our devotion to mutual service and helpfulness.

Practically speaking, any person, man or woman, who is a British or naturalised British subject, who subscribes to the above principles and who has served at least seven days with H.M.F. or forces allied to the latter in the World War (except in the case of conscientious objectors) is eligible to apply for membership.

The Legion assists all its members with advice, financially in many cases, as regards to unemployment and sickness and in many other ways. It makes special appeals, the best known of which is that made on "Poppy Day." Its headquarters are at 26, Eccleston Square, London, S.W. For administrative purposes England, Ireland and Wales are divided into 13 areas in which there are 2,626 branches, and in addition to these there are 36 overseas branches. Branches are also being established overseas outside the Empire. The total membership of the Legion is over 1,750,000. (J. L. Co.)

BRNO: *see* BRÜNN.

BROADCASTING, as distinguished from wireless telegraphy and telephony, may be said to have come into being about 1920. It may be defined as the systematic diffusion by radio telephony of programmes of music and speech and other sounds for the entertainment, information and interest of all who are equipped with appropriate receiving apparatus. Further, the word "appropriate" must be understood in this connection as applying not only to technical suitability but also to qualities, such as cheapness and ease of management, which render the apparatus available for the greatest possible number of persons; and correspondingly, the rôle of broadcasting (in the executive aspect of the word) is to reach the greatest possible number of people with suitable programmes.

Development in the United States.—As it was in the United States, prosperous and relatively unstrained by the War, that broadcasting arose, the principal causes must be sought in the growing dislike of farmers and country-people for the old, self-centred isolation, and the almost universal interests of modern youth in practical science. The monotony of working hours, since machinery has replaced handicraft, has probably accentuated the need for variety and interest to fill leisure hours.

The demand first became effective in the United States, and the measures taken to cope with it were typical of the country and the time. It is a cardinal maxim of American life that individual enterprise should be subject to almost no governmental control; and, further, advertisement on the grand scale is customary and acceptable in America to an extent that is unknown in Europe. It accorded perfectly then with the American outlook, that the possibilities of wireless broadcasting should be grasped promptly and exploited daringly for "boosting" ideas or products. Consequently stations sprang up by hundreds, (mostly of very low power) to subserve all kinds of interests in serving all kinds of demands, such as police-notices, the propaganda of sects and movements, advertisement, music, education, frankly trivial entertainments, market prices, news, etc.

By Aug. 1924, 1,105 stations had been licensed in the United States, of which, only 533 were surviving in 1926, and it is certainly arguable that the movement began by overshooting the mark. The present tendency to which the indications point, is toward consolidation for better service (in point both of utility and of entertainment) and toward an economically sounder radio industry. Experience has taught—and not in the United States only—that broadcasting, unlike "listening," is both an expensive and an exclusive service, requiring for its activity (*a*) financial stability, (*b*) co-ordination of effort and resources for the equalisation of service as between town and country, (*c*) an appreciation of artistic and cultural needs and of ways of balancing these with public demands, and lastly (*d*) the elimination or minimising of mutual interference between stations, which is more and more difficult in proportion to the number attempting to operate in the narrow "wave-band" (range of wave-lengths) that the other wireless services can be induced to leave vacant for broadcasting.

Development in Europe.—The broadcasting movement, when it crossed the Atlantic, found Europe impoverished and war-weary. Yet, so prompt and general was its popularity that we must conclude that other forces, besides those which had stimulated broadcasting in America, were at work. After nearly five years in which strain and the sense of insecurity had found occasional relief in somewhat hectic pleasure-seeking, it was an opportune moment for the appearance of a form of pleasure which could be enjoyed at home, naturally and without effort, as well as cheaply.

Nor was the need one of pleasure only. The War had had a widening effect on the average man's outlook—and in this connection it is worth noticing that the two European nations whose citizens fought entirely abroad, namely the British and the German, are precisely those which have welcomed and developed broadcasting most whole-heartedly. Lastly, in the state of high

hope that followed the Armistice and the foundation of the League of Nations, the peoples, partially at any rate, shook off narrower prepossessions. In short, post-War Europe asked for something which both combined ease with pleasure, and reconciled broadened interests and outlook with domesticity, and this exactly was what wireless broadcasting offered.

From 1920 onward, amateur wireless experimenters, who were numerous even before the War, worked more and more in telephony in preference to Morse telegraphy, and in England and several other European countries (see below) broadcasting began spontaneously with transmissions of gramophone records and amateur performances. At the same time the radio industry began to foresee and prepare for a future of evidently great but unknown possibilities. Experimental work was undertaken for the improvement of microphones, and for the development of listening apparatus which could be operated with a minimum of technical knowledge. And presently arrangements began to be made (in some cases under difficulties due to the claims of vested interests) for the regular transmission of programmes.

Thus, an innovation, comparable in cultural importance to the introduction of printing, was launched tentatively upon a responsive Europe, before either the financial organisation of broadcasting services or their relations with the theatre, the musical profession, the press or the wireless industry had been properly settled, and while the conditions for good broadcasts were unexplored. Nor at that time—in advance of experience—could it be seen to what extent existing wireless services would be affected by, or would interfere with, broadcast telephony. Problems were in short largely left to the future, and the nations of Europe pushed on with the organisation of regular broadcasting services so fast that already by the end of 1924 not merely national, but international, regulation was becoming urgently necessary.

By Dec. 1925 there were over 90 broadcasting stations in Europe operating on wave lengths between 300 and 600 metres. In the hope of remedying this "overcrowding of the ether" an international union of broadcasting companies, with its seat at Geneva, was formed in April 1925, on the initiative of the British Broadcasting Co., but the functions of this body are at present limited to negotiating reciprocal concessions (technical and other) amongst members and making collective representations to the different national governments. Nevertheless, nationally at any rate, organisation and practice are now sufficiently stabilised for a general account of purposes and methods to be possible. Technical aspects are dealt with elsewhere; here we are concerned chiefly with "programme" considerations.

Programmes: Music.—As a broad classification, programme elements may be divided into music and speech. For broadcasting purposes, music, whether concerted or solo, instrumental or vocal, is best classified according to character and appeal, viz., as serious, "popular" and dance music. The proportions of each that are included in any day's or week's programmes vary according to the conceptions of the programme authorities, their resources in artists from day to day, and the demands of the public. This last is, and must remain, a source of controversy, since broadcasting is the only form of concert-giving in which the attempt is made to interest every sort of people every day. Agreed criteria are impossible, and the only sure guide is artistic feeling modified by such practical contact with the public as is possible through correspondence, the Press and discussions, but fortified by definite standards, and by a sense of the responsibility incurred—for it is in the power of the broadcasting organisation to bring the highest class of music to the very hearths of millions who have never before heard it, or, on the other hand, to debase the community's taste irretrievably.

Broadcast Speech.—Broadcast speech includes (*a*) informative and practical utility matter such as news, market prices, weather reports, time signals, agricultural bulletins and notices of various sorts (*e.g.*, appeals for charity, police notices, club or association bulletins and notifications of dangerous illness to relatives whose address is unknown); (*b*) "talks," *i.e.*, short lectures or series of lectures on all sorts of subjects, critiques of literature, drama, music and films, courses of education addressed to schools in school hours or to adults, and debates; (*c*) important public speeches, ceremonies and events taken by a microphone on the spot; (*d*) religious services, either specially arranged for broadcasting, or taken by a microphone from church or chapel; (*e*) radio drama, a form of dramatic presentation in which all effects other than vocal have to be conveyed to the ear or suggested to the imagination, and which calls, therefore, for a special technique in playwriting and acting; (*f*) humorous entertainment; (*g*) advertisement; and (*h*) political or other propaganda.

In addition there are miscellaneous special broadcasts, such as words of command for physical exercises performed by listeners at home, or messages from an explorer in the heart of a distant country. How many of these categories are admitted depends upon the constitution and policy of the broadcasting authority or concern; for example, advertisement and propaganda on controversial subjects are barred in Great Britain and certain other countries, while many stations (especially in America) are maintained solely for one or two of the named purposes.

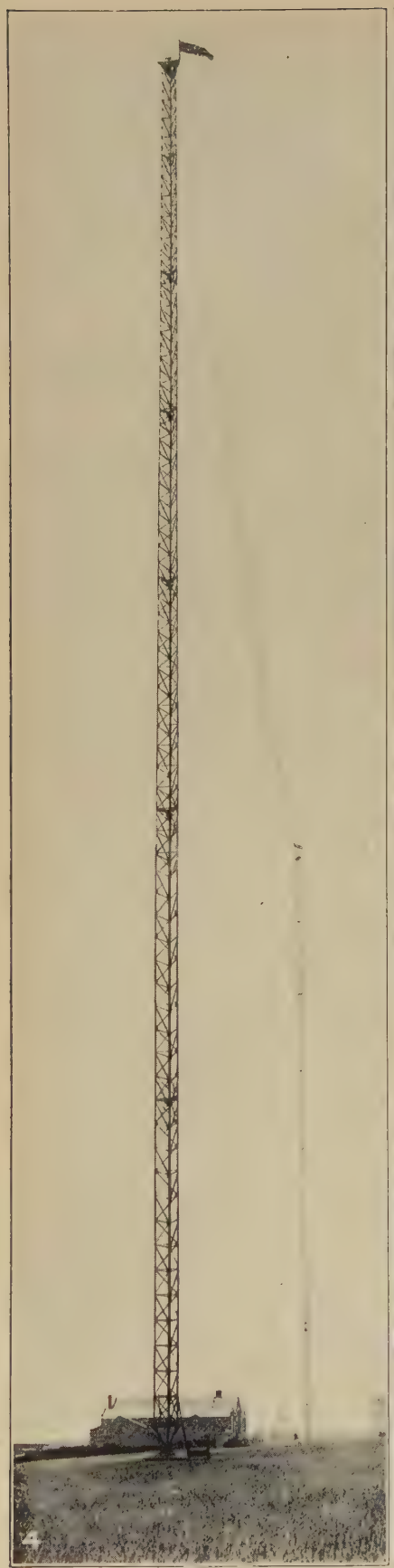
The Principles of Selection.—The mere catalogue of these activities is enough to indicate the immense social importance of broadcasting, but at the same time to display it as what it is—a means, and not an end. Its function is to render all these sorts of entertainment, all these departments of thought, all these services of information, accessible simultaneously to the maximum number of people in their own homes. But in the presence of so vast an array of material, selection must necessarily be exercised. So far, it is only under the heading (e) (*i.e.*, radio drama) that radio has created an expression-form peculiar to itself, and in all other respects programme-building is creative only in the sense that the programme-builders can create (or evoke and nurse) a mass-disposition towards certain aims and preferences. Practically, then, their power is no more—and also no less—than the power of selection. Even so, it is at present far from being an absolute power. Established interests such as the Press, the theatre and the musical industry, have in many cases safeguarded their special fields in various ways; and the technical requirements of transmission also operate to a certain extent as a check, in spite of the great improvements which have been made in the first three years of systematic practice. Nevertheless, it is gradually coming to be recognised by other interests that broadcasting has obtained a permanent hold, and, moreover, that it is really an addition to, rather than a substitute for, the older modes of intercourse.

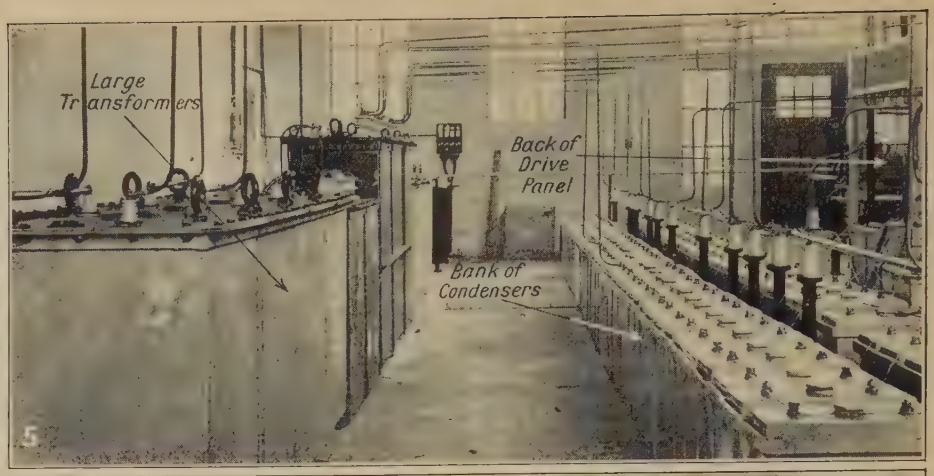
Standards and Ideals.—It is coming to be recognised also, that from the social standpoint it is not only inevitable that programme-builders should select, but vitally important that their selection should be governed by ideals and standards defined by themselves as a rule of conduct. This question, already alluded to in connection with music, affects every other aspect of a programme service also. A well-developed national broadcast system has the ear of far more people than any two or three newspapers, and this, coupled with the fact that the microphone is the most intimate and insinuating of all known vehicles of general communication, makes it perhaps more potent for good or evil than any other social influence. A broadcasting concern, therefore, must, above all, be honest, *i.e.*, if not definitely propagandist, it must be incorruptibly disinterested. Modifications of the strict rule occur and are bound to occur—for a broadcasting service is not quite a "state within the state" and cannot in practice be inflexible—but in principle the broadcasting authority must follow its view of the public interest.

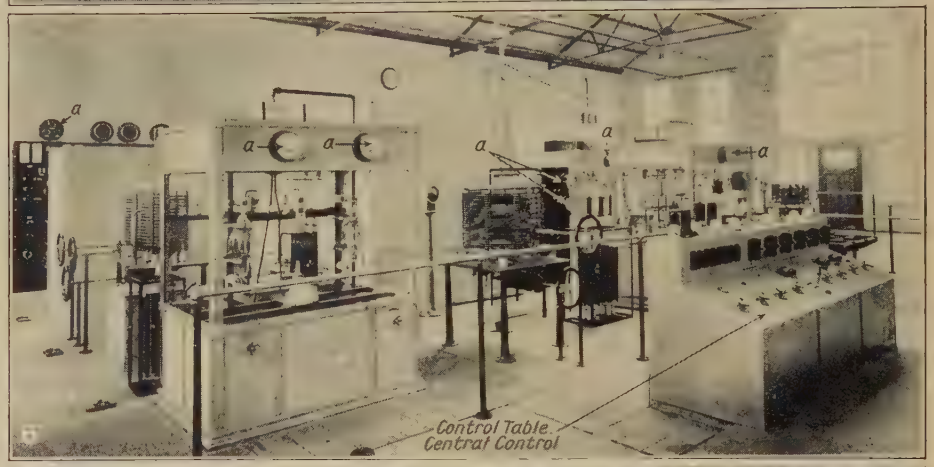
Alternative Programmes.—Nevertheless, as no one is entitled to dictate that the public shall hear only what he himself would care to hear, as the available programme material exceeds the capacity for dealing with it, and as the listener's temporary mood must be catered for, no less than his settled tastes—programme policy must seek to provide (so far as the technical and financial possibilities of each case permit) for more than one programme to be available at any given time for any given listener. The American system of unrestricted competition was expected to provide this very freedom of choice. But in practice the alter-

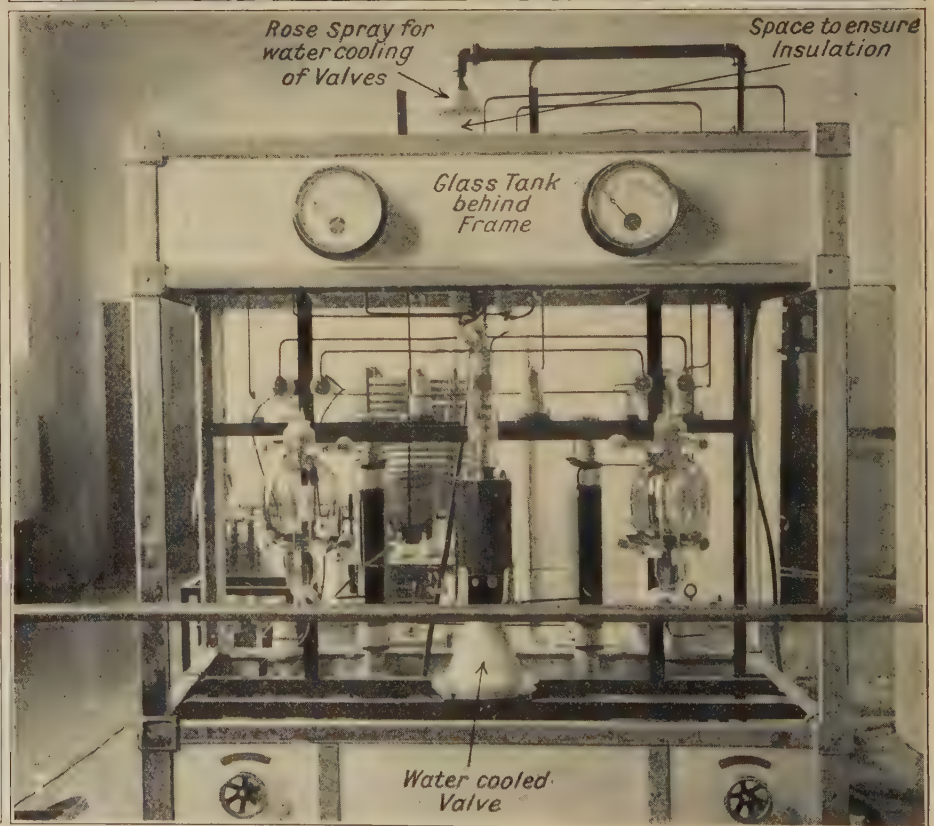
2. LO. LONDON STATION OF THE BRITISH BROADCASTING CO.

FIG. 1. Switchboard for simultaneous broadcast to 21 stations. FIG. 2. Studio, showing screen on which controlling engineer flashes instructions to artists. FIG. 3. Control room, showing engineer at work on amplifier.









5XX. (DAVENTRY) HIGH POWER STATION OF THE BRITISH BROADCASTING CO.

FIG. 4. Aerial masts, and power house. FIG. 5. View showing condensers and transformers. FIG. 6. The arrangements for one-man control of transmission; meters (*a*) all visible at control table. FIG. 7. Drive panel, showing water-cooled valve.

natives simultaneously transmitted are apt to be simultaneously received also. Experience tends to show that the number of available programmes is simply the number of really and locally separable wave-lengths; it is a function, therefore, of the selectivity of the average receiving set, the power of the stations and their position. In Europe, in the present state of knowledge and of cost of popular apparatus, an effective service of "alternative" programmes depends on (*a*) the skilful use of some "simultaneous broadcast" system (see below), and (*b*) high-power transmission, which gives great range to the individual station and therefore, over a given region, fewer stations and more separation between wave-lengths.

The Process Explained.—The actual process of broadcasting, though complicated in detail by the variety of the items broadcast and their volume (which amounts for instance to about 46,000 transmission-hours annually for the system of the British Broadcasting Co.) is simple enough in outline. Most of the performances take place in a "studio," which is carefully arranged so as to give, for the necessarily small room, an acoustical condition that is pleasing to a musical judgment as applied to the receiver. This requires a certain amount of echo elimination, by drapery and otherwise. Speakers, singers and players address themselves to the microphone, which reproduces in the form of electrical pressure the variations of air pressure that impinge in the form of sound. These variations of electrical pressure are amplified finally to "modulate" the output, in the form of ether waves, of the wireless telephony transmitter. An expert operator in a control-room, following closely the speech or music, continuously makes fine adjustments of the amount of electrical impulse modulating the transmitter to allow for changes of original sound volume, an operation necessitated by the fact that the transmitter is of fixed and limited power. The transmitting gear proper is usually separate from the "studio," and may be as much as 70 or 80 m. away, connected with the studio by a specially connected and balanced overhead telephone line.

Outside Material.—Another class of broadcast which is of growing importance is the picking-up at the place of origin of public concerts and public speeches, as well as of ceremonies, crowd noises, countryside sounds, etc. This is done by a portable microphone connected, not necessarily by wire, to the control-room; the special interest of these broadcasts to the listener is that they enable him to feel himself as a participant or member of the audience. In the case of music, large-scale performances are often, for psychological as well as acoustic reasons, more successful as "outside" than as "studio" broadcasts, but, of course, public halls, churches, theatres and opera stages, open spaces and so on, all present special acoustic problems which have to be solved according to the special circumstances.

Simultaneous Broadcast.—Of outstanding importance in the organisation of broadcasting is the simultaneous broadcast or "S.B." This involves a system of interconnected telephone lines by which a studio or other place of performance can be connected to as many transmitters as may be desirable or possible. Thus, in the case of Great Britain the London microphone may be connected to all stations of the British system for a news bulletin, and immediately afterwards all, or some, stations (London included) may be similarly connected to a microphone installed in a Manchester concert hall; or, again, the sound of the sea taken up by microphone on the shore at Plymouth may provide a background for a drama performed in London and broadcast by Plymouth, London and all other transmitters.

Needless to say, "S.B." requires the closest timing and co-ordination over the whole system, and it is carried out most completely and successfully when all the stations of a country are under one management, as in Great Britain. In the United States and Canada the method is practised wherever a distributed network of stations happens to be controlled by a large corporation. In Germany, where provincial feeling is strong, artistic resources well distributed and operation decentralised, "S.B." is usually practised only between a main station and its relay stations considered as a group. The "wireless link" (*i.e.*, the substitution of the telephone wire by a wireless telephone system) is sometimes employed where land line facilities are either unavailable or unsuitable.

Listening Problems.—Lastly, the listeners' end of the transmission system presents problems of its own. Private receiving sets are divided, conventionally rather than scientifically, into "crystal" and "valve" (vacuum tube sets). The sounds that they generate in response to the excitation of their aerials are heard either in headphones or from loud-speakers, the latter varying in power from small drawing-room instruments to large-scale installations capable of reaching crowds assembled in halls and open spaces. Listening conditions vary from room to room, and listeners rarely attempt to create for themselves the acoustic and psychological atmosphere in which to receive broadcast properly. More important still, the receiving sets themselves vary in sensitiveness, selectivity and other qualities, according to design, workmanship, nature of aerial and earth employed. Over these variables the broadcasting authority or company as such has usually little, if any, direct contact. But in actual practice the listener's tastes and means, the broadcasting service's programmes, technique and finance, all react upon one another intimately. The crucial distinction in the nature of sets, though roughly coinciding with that between "crystal" and "valve," really turns upon the distance at which a station can be heard without extraneous interferences accompanying, and more or less spoiling, reception.

There are in fact two distinct and—at present—opposite conceptions of "listening," from the listener's point of view. On the one hand, there is the desire—which may arise from technical interest, or from dissatisfaction with the local programme, or both—to listen to far-away stations. This has produced the long-distance set, which is so sensitive as to be able to pick up 1·5 kw. stations as much as 1,000 or even 2,000 m. away, but which, from the very fact of this sensitivity, is more or less open both to local and remote electrical disturbances, such as those caused by "oscillation" (re-radiation from a nearby receiving set which, when mishandled, acts as a small transmitter), by heterodyning between stations, by "atmospherics," by harmonics emitted by powerful W.T. stations, by the spark transmitters still largely used by ships and occasionally, by inductive effects, by power due to alternating-current installations.

On the other hand there are the listeners who are content with the programmes of the nearest station (which, as we have seen, do not necessarily depend on that station's own artistic resources) either because they have little or no interest in the technical side of wireless telephony, or because the local programmes are, in fact, artistically and otherwise satisfying. The interest of such listeners is concentrated upon the programme. The receiving apparatus that they need is simple, easily manageable, and owing to the nearness of the station and the consequent strength of its signals, free from extraneous interference (other than purely local troubles such as oscillation). For the listeners thus equipped variety of choice of programmes obviously depends upon the power of the stations around them and the extent to which "simultaneous" broadcasting is feasible, and, therefore, ultimately on the technical and financial organisation and unity of the broadcasting system.

For listeners equipped with long-range sets, on the other hand, interference limits both their theoretically complete freedom of choice and the artistic satisfaction that they can derive from listening. And thus, although an element of wonder will always adhere to wireless reception, public interest in the broadcast movement tends to centre itself more and more on the programmes rather than on the means of receiving them. And this in turn brings forward new problems of extending, by co-operation between national, as well as by co-ordination of local and regional, broadcasting stations, the field whence material for "alternative" programmes can be taken and locally re-broadcast.

International Aspects.—We may now glance at broadcasting in its international aspect, and more especially European broadcasting, as a possible cementing influence between nations now becoming dimly conscious of a unity that the foreground of their

history seems to deny. In 1925, when all countries of western, northern and central Europe had to a great extent absorbed broadcasting as a normal element in their national life, it became manifest that apart from incidental divergences, all broadcasting concerns, acting quite independently of one another, were putting much the same classes of fare before their respective publics, and thereby disclosing a cultural unity in Europe hitherto scarcely suspected. The barriers of political and racial geography were over-leaped. In each country, those of the public who possessed long-range listening-sets acquired (in spite of the interferences which hamper this type of reception) a double interest in remote stations, on account of their transmissions and on account of their interferences with home stations. Strange place-names—and even, through modulated telephony, distant personal voices—became familiar. The movement in favour of an international language acquired new life and importance. In fact, a whole new world of possibilities of European intercourse is being opened up.

Measures for Co-ordination.—While trans-oceanic wireless telephony remained fragmentary and impure even as late as the winter of 1925–6, the co-ordination of European broadcasting was already a clamant necessity. The work of the central office at Geneva, which has been mentioned above, on the readjustment of wave-lengths, is still tentative and dependent on goodwill. And behind this question yet others await solution, for example, problems of international copyright and rights of relay and re-broadcasting as between concerns of different nationality, limitation of *ex parte* propaganda, exchange of information as to artists and the relaying of pronouncements or proceedings of international significance. In sum, European interstate broadcasting is still in its infancy. But this at least is certain, that broadcasting—a subtle but at the same time a very vulnerable element in the new European life—depends, for its effectiveness, even within the national frontiers, upon international goodwill; and, allowing for the steady progress of technical knowledge, it is reasonably certain that this interdependence will in a not very distant future become world-wide.

Progress in Various Countries

United States.—This country was the pioneer in the field of large-scale broadcasting and it was there that the new medium received its name. The Press and commerce were prompt to recognise the possibilities of this method of getting into immediate and close touch with all classes of the population. Countless radio firms sprang up which, without delay, placed on the market both complete apparatus and the components necessary for the home assembling of sets, and soon a large number of stations of varying power (mostly small) were "on the air." Licences continued to be issued lavishly and in Dec. 1925 there were still 578 stations transmitting some kind of entertainment (apart from those specialised to transmissions of particular classes), and maintained by the proceeds of broadcast advertisement, profits on the sale of wireless gear, or in various indirect ways.

As a result of transmitters having been erected without a concerted plan, there was by 1925 a state of very considerable interference between locally overcrowded stations, while large tracts of the country were ill-served. Moreover, in many cases the quality of the programmes no longer satisfied the now experienced public, and some form of higher control and co-operation in the broadcasting movement was being demanded from both inside and outside the broadcasting system, the more urgently as the power employed increased and the possibilities of long-range work came into the foreground. Of the stations at present operating, 197 possess a power of at least 0·5 kw., and during 1925 a number of larger transmitters were erected, including a 50 kw. station at Bound Brook, N.J., and also a station for reception of European broadcasts at Belfast, Maine. Certain stations have a European reputation, for instance WJY. of Schenectady, N.Y., and KDKA., East Pittsburgh, which has experimented extensively in the very short wave-lengths.

The situation, therefore, was ripe for review when the Fourth National Radio Conference was held in Nov. 1925. At that Conference Mr. Hoover, Secretary of Commerce, announced a changed governmental policy in the words, "We can no longer deal on the basis that there is room for everybody on the radio highways," while the concerns participating in the conference declared, for their part, in favour of restrictions on advertising. Thus the limitation of stations and the adoption of a standpoint in the question of the cultural rôle of broadcasting have been established in principle. Opinions vary considerably as to the actual methods of solving the administrative and financial problems involved. A national system financed out of licence revenue and taxation on receiving sets are each widely advocated, but for the near future at any rate the indications point to a policy of amalgamation and grouping of various privately owned stations in order to cut down wasteful expenditure and to make the highest and most expensive class of programmes available over wider areas than has been the case hitherto. These developments are in fact already in progress.

Great Britain.—In Great Britain as early as 1919 experimental transmissions were conducted for a time at a station of the Marconi Co. at Chelmsford, but these were not continued, and in 1922, on the initiation of wireless amateurs, broadcasting was begun afresh from a station at Writtle, near Chelmsford. Shortly afterwards, as the result of negotiations between the Postmaster General, the leading radio firms and other interests, the British Broadcasting Co. was set up to work a single national system of stations for Great Britain and Northern Ireland. The original licence granted expired in 1924, but after a Govt. inquiry had in 1923 reviewed the experience gained up to date, it was renewed till the end of 1926. In Dec. 1925 a second governmental inquiry commenced its sittings in order to consider the situation that would arise in 1927.

Constitution of the B.B.C.—The "B.B.C." is constituted as a limited company, the shareholders being wireless manufacturers and traders. The Board of Directors is composed of representatives drawn from the industry with an independent chairman nominated by the Post Office and a managing director as executive officer. The company, as such, neither manufactures, sells, nor recommends apparatus, and its revenue is derived from a share in the proceeds of receiving licences levied by the Post Office. Although its nominal constitution is that of a commercial company, the B.B.C. is in effect a public service, since the dividends payable to those who provided the capital (which is very small in proportion to revenue) are limited to 7½% per annum, reserves are allowed only for covering depreciation and the like, and the Postmaster General has certain powers of limiting the company's revenue.

As the general description of broadcasting methods and aims already given is based very largely upon British practice, it is only necessary here to allude to a few particular features of the British system. The scheme of unified control over a nation-wide system, worked in close collaboration with the Post Office, has made possible the development of simultaneous broadcasting (see above) on a scale unknown elsewhere. The organisation is bound to work in the spirit of British constitutional practice that is, democratically and with studious avoidance of biased or tendencious transmissions. Advertisements are not accepted. The Government exercises a certain control over the character of the transmissions and the general policy of the "B.B.C." and has a right to require a part of programme time to be given to non-contentious matter (such as agricultural bulletins) supplied by public authorities, and the Board of Education and local educational authorities co-operate officially with the broadcasting service in the development of educational transmissions. Of special interest and significance is the institution of religious advisory committees; on these every Christian church that is numerically important in Great Britain is represented, and they have succeeded in reaching an agreement as to the form and substance of "studio" services that shall be acceptable to Roman Catholics and Protestants alike.

In 1925 the system of the B.B.C. comprised main stations (1·5–3 kw.) at London, Bournemouth, Cardiff, Birmingham, Manchester, Newcastle-on-Tyne, Glasgow, Aberdeen and Belfast; relay stations (0·2 kw.) at Plymouth, Swansea, Liverpool, Stoke-on-Trent, Nottingham, Sheffield, Leeds, Bradford, Hull, Edinburgh and Dundee; and a high-power (25 kw.) at Daventry. This system

provided approximately 90% of the population with one programme daily on crystal receivers, and some 35% with an alternative programme as well. Developments are in prospect which involve a general increase in power and the re-sitting of transmitters on a regional scheme, so as to provide an alternative service on a much larger scale. The number of licencees totalled in Dec. 1925 over 1,500,000, which represents an "audience" of perhaps as many as 10,000,000 people.

Irish Free State.—In the Irish Free State, broadcasting began in the winter of 1925–6 with the opening of a main station at Dublin. From this it is intended to supply other parts by means of a relay system. The Govt. controls the service.

France.—In France broadcasting began in Nov. 1922 with transmissions from the experimental station, "Radiola" of Paris, and from the military W.T. station of the Eiffel Tower. These were followed at intervals by "P.T.T." (the research station of the École Supérieure des Postes et Télégraphes in Paris), by *Petit Parisien* (a station owned by the newspaper of that name), and a few small stations in other parts of the country. In 1924–5 the Cie. Française de Radiophonie set up "Radio Paris" (the successor of "Radiola"), and provincial stations at Toulouse and Lyons, while the post-office set up "P.T.T." stations at Lyons, Toulouse, Marseille and Grenoble; others are projected at Lille, Strasbourg and Angers. The Eiffel Tower continued to broadcast, and various small stations operate in different parts of France. No broadcasting monopoly has been granted, and stations receive neither subsidies nor licence-revenues, expenses being met out of royalties on apparatus, subsidies by interested parties and public subscriptions. At present, then, there is no co-ordinated national system, but two opposed groups; on the one hand, the state with its P.T.T. stations and the Eiffel Tower, and a reserve power of promoting legislation, and on the other hand the private wireless enterprises headed by "Radio-Paris" which, in Dec. 1925, formed a union for joint action and in 1926 commanded considerable support in the Chambers and the Press.

Italy.—In Italy, the development of broadcast telephony was slow, until a decree of Oct. 1925 removed many irksome restrictions, both economic and legal, and *inter alia* enabled stations to accept advertisements. The Unione Radiofonica Italiana (an organisation constituted on commercial lines) now operates stations at Rome and Milan. A small military station at Centocelle near Rome has also broadcast occasionally. Other stations are projected. The Govt. reserves to itself control of the system for a certain period of time daily, with a view to the broadcasting of special notices.

Spain and Portugal.—Spain, arriving late in the field, endeavoured to catch up, in a few months, the progress which had been made by other European countries in two or three years. Many different organisations offered to erect stations, and in all, up to Dec. 1925, about 24 public transmitting licences, five in Madrid alone, had been conceded. There is a small receiving licence charge, but no portion of its proceeds is paid over to the broadcasters, who, for the most part, derive their revenue from royalties on apparatus manufactured by affiliated concerns, and from sums paid for broadcast advertisement. Some installations, operated by wireless clubs, are supported by voluntary contributions. Attempts are being made to consolidate these irregular services into a national system. In Portugal, broadcasting has not yet advanced beyond the state of occasional transmissions by small stations.

Belgium.—In the winter of 1925–6 Belgium possessed but one regular broadcasting station, *i.e.*, Brussels, opened in Nov. 1923, which is owned by the Société Radio-Belgique. This company does not hold a monopoly, nor does it derive revenue from licences, being, therefore, dependent upon a share in royalties on apparatus, on income from advertisements and on voluntary contributions. Other stations are projected at Antwerp and Liége.

Holland.—In Holland, as in Belgium and France, the question of finance has considerably retarded development. The first station was built at Hilversum near Utrecht, and commenced operations as early as 1919, relying upon voluntary support and some small amount of commercial subsidy. In spite of continuing financial difficulties a new plant was installed in the winter of 1924–5, and since then Hilversum has become one of the best known stations in Europe. There are also two or three small stations which broadcast only occasionally. Hitherto listeners have not been required to take out licences, nor has the Government subsidised the broadcasting concerns in other ways. A national concessionaire company supported by licence revenue is, however, being formed.

Germany.—Proposals by the Govt. and others for the establishment of broadcasting were made in the early part of 1922, but economic conditions delayed their translation into fact, and it was not until Oct. 1923 that the first regular station (Berlin-"Voxhaus") was opened. As on the one hand the Govt. could not shoulder the responsibility for possible losses, and on the other the constitution of Germany is, to a large extent, federal in character and her artistic resources well distributed, it was decided to de-centralise control without admitting free competition, and to create separate broadcasting organisations which between them covered the bulk of the population.

The concession for transmitting entertainments was granted to "Die Deutsche Stunde," that for transmitting news, lectures, etc., to "Buch und Presse." These in their turn formed programme companies (in each of which they hold a controlling interest) in the various cities selected as the sites of stations. The transmitters are the property of the Post and Telegraph administration, and are run by government engineers under government control, while the programme work is the task of the companies.

The financial arrangements between the companies and the Govt. are complicated, and here it must suffice to say that provision is made for pooling a part of the licence revenue (so that, for example, Berlin receipts are available to assist the Königsberg or the Stuttgart company) for limiting shareholders' profits as in Great Britain, and for returning surpluses to the Reichspost. In the spring of 1925, the programme companies combined for certain purposes in a central organisation known as the Reichsfunkverband. The revenue from receiving licences (paid in monthly instalments to the postman) is divided between programme companies and the Post Office.

After the opening of the Voxhaus station in Berlin, the remaining stations of the national system were built in quick succession. These are:—

Berlin (Voxhaus), Frankfort-on-Main (with relay at Cassel), Hamburg (relays, Bremen and Hanover), Münster (relays, Dortmund and Elberfeld), Munich (relay, Nüremberg), Leipzig (relay, Dresden), Stuttgart, Breslau, Königsberg. In addition, a new station at Berlin (Witzleben) was brought into operation in 1925 and the programme service from "Voxhaus" was extended to the powerful W. T. transmitter of "Königswusterhausen," northeast of Berlin, which was adapted for telephony. Other stations are under construction, or projected. Important advances in the direction of higher power were made in the latter part of 1925.

Parallel with the ordinary broadcasting system, there is a network of small governmental stations in some 70 different towns which are intended for the local re-broadcasting of government communications and addresses from the "Deutschlandsender" (Königswusterhausen). It is probable that in future this system will be used for educational purposes also. At the end of 1925, the total of licensed listeners was about 1,000,000.

Austria.—The Vienna broadcasting station (opened Oct. 1924) is owned and worked by the "Radio-Verkehrs A.G." a monopoly formed by the fusion of various trade interests. Its revenue is derived partly from a share in licence fees, and partly from royalties on the sale of apparatus. The cost of licences varies according to the income of listeners, and the purpose of the installation, but it cannot yet be said that broadcasting is within the reach of the masses. Educational and other public institutions (*e.g.*, those for the blind) are exempt from paying fees. Other stations have been or are being erected at Graz, Innsbruck and Salzburg, and a high-power station on the Rosenhügel near Vienna.

Switzerland.—In Switzerland broadcasting began with the radio clubs, but the Federal Govt. very early came to the assistance of the movement. In a land where three different languages are regularly spoken, it is difficult, if not impossible, to maintain a centralised service, and for this reason separate companies have been formed for the purpose of broadcasting entertainment in the various regions of the republic, all of which receive a generous measure of state support. The stations operating in Dec. 1925 were Zurich, Lausanne, Geneva and Berne, and a station was under construction at Basel. The charge for receiving licences varies according to the nature of the apparatus. Four-fifths of the licence revenue is paid over to the programme-transmitting companies.

Denmark.—In Denmark, after a period of irregular, and even unlicensed, broadcasting (1921–3) the Govt. permitted the broadcast transmission of concerts and entertainments by duly appointed clubs through government stations. This system was initiated in the summer of 1923, developed in 1925 into an official broadcasting service, managed by a Radio Council (Radioraadet), on which are represented the amateur wireless clubs, the Press, the Artists' and Musicians' Union, Government Departments, educational institutions and listeners' societies. The Govt. contributes the technical officials and plant. A methodical arrangement of new stations is projected, but the council at present broadcasts from a number of unequally equipped government and club stations, the greater part of the programmes being relayed from Copenhagen. The cost of receiving licences varies according to the apparatus and the uses to which it is put.

Sweden.—In Sweden, after preliminary experiments and negotiations, a sole concession was granted in Jan. 1925 to the "Svenska Aktiebolaget for Radio-tjanst," a syndicate formed by the Press and the wireless industry. During 1925 a network of 10 main and relay stations was set up by this organisation and the postal and telegraph authorities jointly, the former providing the programmes and the latter the plant and the engineer staff. Of the proceeds of listeners' licences half goes to the company. Direct advertisement is admitted, but confined to a very small portion of programme time; the privilege moreover is practically limited to organisations which share in the general liabilities of the syndicate. Owing to inequalities in the distribution of the population—and therefore of artistic resources—the greater part of the programmes are relayed from the Stockholm Station. The high power W.T. Station of Karlsborg is to be adapted for telephony and broadcasting and new relay stations are projected at various points on the coast.

Norway.—In Norway, since April 1925, control has been centred in the "Kringskastingselskapet," a company of wireless manufacturers and traders, which works in close co-operation with the postal authorities. The station at Oslo began regular transmissions in the summer of 1925, and soon acquired a wide reputation. In addition, a station at Aalesund (to be transferred to Haugesund) serves the needs of sailors and fishermen. Broadcasting is maintained by licence revenue and a share in taxes upon apparatus.

Baltic Countries.—In Latvia, Estonia and Finland, there are small broadcasting stations at Riga, Revel and Helsingfors respectively. Other stations are planned in Finland. In Lithuania, no service had yet come into operation at the end of 1925. In Poland, there was in 1925 only one low-power station, at Warsaw; but developments were under consideration by the Govt. and the radio industry jointly.

Russia.—Wireless telephony was released for the use of the general public in Sept. 1924 and from Oct. 1924 weekly concerts were sent out by the Moscow central station. Other stations came into being in Moscow and elsewhere, and in 1924–5 the problem of the broadcast service was tackled as a whole. The Govt. realising the great possibilities of broadcasting as a means of direct communication with all classes of an enormous and scattered population, promoted the establishment of wireless clubs and of technical advice offices and provided for the equipment of halls and open spaces in and around which a great number of listeners could be gathered. In the special conditions of Russian village life, communal listening is of course of prime importance, but individual receiving licences are also issued. The broadcasting company (Radio Peredacha) is a combination between certain electrical firms, the Rosta news agency and the Commissariat of Posts and Telegraphs. It receives the greater part of the licence yield and possesses the monopoly for the sale of apparatus.

At the end of 1925 stations were either in operation or in course of construction at Moscow, Leningrad and Kiev, and other transmitters are being erected, or to be erected at different centres both in European and Asiatic Russia. The existing wireless telegraphy transmitters are to be adapted to telephony and placed at the disposal of the Radio Peredacha when not required for the ordinary traffic, and it is expected that eventually 50 broadcasting transmitters will be in daily operation.

Hungary.—In Hungary a broadcasting company, formed by the amalgamation of a Budapest concern supplying concerts, etc., over the wires to telephone subscribers, with a leading newspaper, works a station at Budapest, in conjunction with the Posts and Telegraphs and with the wireless club of the Technical High School. Receiving licences are granted at a cost varying according to whether private reception or loud-speaker delivery in public is intended, and also according to geographical situation. Special licences are required by manufacturers and dealers, who are compelled to take out a certificate of technical efficiency and to guarantee that the sets sold by them do not reradiate. But concessions in the licence fees are made for receivers used exclusively for experimental work, and invalids, blind people, hospitals and educational institutions pay no fees.

Czechoslovakia.—In Czechoslovakia, a broadcasting company, formed under the name of Radio-Journal, began regular broadcasting in May 1923 from Kbely, near Prague. Somewhat later, another station was set up at Komarov, near Brno (Brünn) and at the end of 1924, Kbely was replaced by a more modern installation at Strasnice, also near Prague. A problem of peculiar political difficulty, the provision of broadcast programmes for the German-speaking population, was eventually dealt with by reopening the old Kbely transmitter in Oct. 1925 for lectures, etc., in German. As yet the country is inadequately served, so far as crystal-set users are concerned. Relay stations are projected for various centres, but future developments are conditional upon popular support or upon capital being forthcoming in anticipation of such support. In the present company the Govt. holds a 51% interest.

The Balkan States.—In Yugoslavia, Greece, Bulgaria, Rumania and Turkey, little progress has so far been made in wireless telephony. Apart from the United States, the only countries outside Europe in which broadcasting services have so far become regular and systematic are the Dominions of the British Empire. The republics of Central and South America, as stated above, contain amongst them many thousands of wireless amateurs, but broadcasting proper is still embryonic.

Canada.—Canada followed the example of the United States early, but on a much smaller scale and with a greater regard for interference difficulties that might arise. Of the 43 stations listed by the Canadian Govt., in June 1925, the most important were the 10 stations of the Canadian National Railways which form a chain across the continent. These not only broadcast entertainment and information but also enable the management of the railway to keep in touch with its widely-dispersed staff. The remainder are owned by newspapers, religious bodies, radio firms and others, operating practically independently. In many cases programme time has to be shared between adjacent stations as in the United States, and thus there is little or no "alternative" service. One station, at Winnipeg, is operated by the Govt. of Manitoba, which enjoys a certain autonomy in the management of local wireless and the disposal of licence revenue. An interesting feature in the Canadian administration is its corps of part-time inspectors for dealing with interference matters. Wave-length agreements have been negotiated with the United States.

South Africa.—In South Africa stations have been opened at Cape Town, Durban and Johannesburg. Licence fees are heavy and the juxtaposition of languages creates difficulties, but the new method of intercourse is popular in both town and country.

Australia and New Zealand.—In Australia stations owned and operated by companies and financed out of licence revenues have been established at Sydney (two stations), Melbourne (two stations), Hobart, Adelaide and Perth. At Brisbane there is a Queensland Govt. station.

In New Zealand, after a period of intermittent private broadcasting, a national system came into force, which is supported by licence revenue and maintains stations at Wellington, Auckland, Christchurch and Dunedin.

In India and Burma broadcast transmissions were, until 1926, given only from a few small local stations, but an all-India scheme was authorised at the beginning of that year.

(J. C. W. R.)

Technical and Scientific Aspects

In broadcasting the transmission is sent out from one station for the purpose of reaching a large number of receivers scattered over an area, whereas other forms of telephony generally involve two-way transmission between two terminal stations only. Moreover, the apparatus used in broadcasting not only must transmit intelligible speech but must also transmit the subtle intricacies of vocal and instrumental music with the highest degree of faithfulness and freedom from distortion.

Stated briefly, the purpose of a broadcasting system is to pick up air-pressure variations due to sound waves, transport a facsimile of them by radio means to a multitude of receiving points, and reproduce at these points sound waves as nearly as possible like the original ones. The pickup or input end and the reproducing or output ends of the system, respectively, are composed of two pieces of apparatus which in principle are essentially like the corresponding parts of the ordinary telephone instrument. At the input end is a telephone transmitter or microphone to produce electric current having variations in intensity corresponding to the variations in air pressure on the diaphragm caused by the sound waves. At the output end some form of telephone receiver is used to reproduce from such electric currents the corresponding sound waves. Since the method of transporting the electrical counterpart of the sound waves from the microphone to the telephone receiver is not by electric currents or waves on wires as in ordinary telephony, but by electromagnetic waves in free space, the mechanisms which intervene in the process are of a distinctive character.

The radio transportation or transmission is accomplished by

sending out from the transmitting station electromagnetic or radio waves which vary in intensity in the same manner as do the telephonic currents from the microphone. At receiving stations these radio waves are intercepted and their intensity variations converted back into intensity variations of a telephonic current, which actuates the telephone receiver. There are several distinct processes involved:—

1. Producing the high-frequency alternating electric current which, when introduced into a radio antenna, causes the radiation of electromagnetic waves. This current is produced by an electrical "oscillator."
2. "Modulating" this current, or causing its intensity to vary in the same manner as does the intensity of the telephone current from the microphone.
3. Radiating the electromagnetic waves by causing the modulated high-frequency current to flow in a radio antenna or aerial.
4. Intercepting some of the radiated waves energy by a receiving antenna in which modulated high-frequency currents similar to those flowing in the transmitting antenna are thereby caused to flow.
5. "Detecting" or converting the modulated high-frequency current into telephone currents having the same variations in intensity.
6. At both the transmitting and receiving stations, amplifying the currents to increase their power and to make up for losses in power suffered in transmission through the various parts of the entire system.

The mechanisms involved in items 1, 2 and 3 constitute the transmitting system, while those involved in items 4 and 5 constitute the receiving system. In the transit of the waves through space between these two terminal systems lies the field of radio transmission.

Thermionic Valve.—The most important device used in the transmitting and receiving systems is the ubiquitous vacuum tube or thermionic valve. It is employed in the most modern apparatus for performing many functions, including generation of high-frequency currents, modulation of these currents by telephonic currents, detecting or converting the high-frequency currents to reproduce telephonic currents, and amplifying both high-frequency and audio-frequency (telephonic) currents (*see* AMPLIFIERS). Discussion of the fundamental principles underlying the six processes itemised above and of the vacuum tube which plays such an important rôle in carrying them out will be found under WIRELESS TELEGRAPHY AND TELEPHONY (*q.v.*) and TELEGRAPH (*see* 26.529). This section is concerned only with those features of radio telephony which are of special importance in broadcasting.

THE TRANSMITTING SYSTEM

The transmitting system comprises the microphone (*q.v.*), which is placed at the studio or theatre, and toward which the sound waves of the voice or instrument are projected; the amplifier and control devices, which magnify the electric currents from the microphone by the desired amount; and the radio transmitting station, which sends out radio waves modulated in accordance with the amplified microphone currents.

Microphones.—Highly specialised forms of microphones (*q.v.*) are necessary in order to respond accurately to the wide range of sound frequencies and intensities of speech or music. The music, for instance, that comes from a symphony orchestra consists of tones which range from fundamental bass notes of less than 100 vibrations or cycles per second up to harmonics at 5,000 cycles or more. Thus it covers a range of frequencies of at least 5,000 cycles or, as it is expressed by the engineer, a band of frequencies at least 5,000 cycles wide. One kind of microphone in wide use consists of a tightly stretched duralumin diaphragm having two carbon microphone buttons attached to opposite sides of it at the centre. The two buttons are connected with the electrical circuit in such a way that distortion tends to be balanced out. The placing of the microphone with reference to the performers and the acoustic qualities of the surroundings are of great importance in achieving the best results. For this reason, where possible, the programme is performed in a studio room especially designed for control of placing, sound absorption and echoes.

Amplifiers.—Since the range of volume or loudness covered by the programme may be very large, the amount of amplification applied to the microphone currents before the currents go to the radio transmitter must be adjusted frequently in order that they may neither overload the transmitter, giving rise to distortion, nor fail, through weakness, to actuate the transmitter sufficiently. The amplifier adjustment, therefore, requires to be manipulated by a control operator who is provided with a radio receiver so that he can hear the programme exactly as it is heard by the radio audience. To guide his judgment further in manipulating the volume control, the operator is usually provided with an electrical device called a "volume indicator," which gives him a visual indication of the strength of the telephonic current at the output of the amplifier. The amplifier and control apparatus, and the radio transmitter, as well as the wire telephone circuits between them in case they are physically separated, must be carefully designed to transmit the telephone currents without distortion.

Transmitters.—The radio transmitters employed in broadcasting are not different in principle from those employed in other forms of radio telephony, but are designed with special attention to stability, freedom from distortion and purity of transmission. In most types the telephone currents delivered from the control apparatus are amplified and impressed upon the oscillator tubes, which generate high-frequency currents. The output of the oscillator is thus modulated to correspond with the original sound variations. In the smaller power transmitters the modulated high-frequency currents then go directly from the modulating system to the antenna, but in some larger equipments amplifiers containing powerful metallic, water-cooled vacuum tubes are interposed. The antenna systems do not differ materially from those used in modern wireless telegraph installations.

Carrier Frequencies.—The assignment of carrier frequencies to broadcasting stations is an important consideration. When there is no modulation—that is, during the silent intervals of a programme—a broadcasting station sends out waves of a single frequency as in continuous wave radio telegraphy. This frequency is known as the carrier frequency, and is expressed in kilocycles of thousands of individual waves or vibrations per second. When modulation takes place by speech or music there are also transmitted two "side-bands" or sets of waves which occupy two bands of frequencies, one on either side of the carrier, each about 5,000 cycles wide, making the total transmission cover a band some 10 kilocycles in width with the carrier frequency in the middle. The frequency range available for broadcasting is limited, being, for instance, in the United States and Canada, from 550 kilocycles to 1,500 kilocycles. Thus there are only 95 non-overlapping 10-kilocycle bands or channels. Two stations in the same service area cannot occupy the same band or even closely adjacent bands without causing interference, so it is necessary to assign station frequencies in accordance with some form of geographical zoning system, and the total number of stations which can operate simultaneously is definitely limited. In popular usage the wave-length in metres is commonly used as a measure of the carrier frequency of a station, and in classified lists of stations both the carrier frequencies and wave-lengths are often given. The numerical relation between the two is the same as for any propagated wave motion, either one being equal to the velocity of propagation divided by the other.

THE RECEIVING SYSTEM

The functions of the receiving system are (*a*) to collect the radio wave energy in its antenna, in the form of high-frequency currents, (*b*) to select to the exclusion of other channels the currents lying in the band of frequencies occupied by the station to which it is desired to listen and, then, (*c*) to amplify these currents and (*d*) to convert them into audio-frequency (telephonic) currents which are in turn amplified and delivered to the telephone receivers or a loud speaker.

Forms of Antennae.—Two kinds of antennae are in common use, the one an elevated wire similar to a transmitting antenna,

and the other a loop antenna consisting of a coil of a few turns of wire wound on a frame or other support. The former is electrically more efficient, but the loop being relatively small is often more convenient. The selecting of stations is done by means of tuning circuits having electrical inductances or coils and electrical capacities or condensers. These are adjustable, so that the circuits may be tuned to respond most strongly to currents in the band of frequencies sent out by the station it is desired to receive. Making these adjustments is known as "tuning in."

Receiving Sets.—In the arrangement and form of the tuning circuits and the vacuum tube amplifiers, receiving sets have a wide variety of differences in detail, but broadly they fall into three main classifications: (1) regenerative sets, (2) high-frequency amplifier type sets, (3) intermediate-frequency amplifier (superheterodyne) type sets. In addition to these types there is a class of much simpler and less sensitive receiving sets known as "crystal sets," which contain no vacuum tubes. A crystal set consists merely of an antenna, the tuning circuits and a "crystal detector" which serves to convert the modulated high frequency currents into audio-frequency (telephonic) circuits. A crystal detector is a device which utilises the electrical rectifying properties of certain crystalline minerals. The lead ore *galena* is one mineral thus commonly employed.

Regenerative Sets.—In regenerative sets a controllable coupling of some kind is provided between the output and input circuits of the amplifying or detecting tube or tubes, so that some of the amplified signal voltage may be fed back into the tubes again and again and be reamplified many times. This gives more effective use of a small number of tubes. Such sets when the "feed back" coupling is wrongly manipulated will generate continuous high-frequency oscillations which cause waves to be sent out from the antenna as at a transmitting station. These waves may be a troublesome source of interference to other receivers, and for this reason a decline in the use of regenerative sets is being forced by public opinion.

High-frequency Amplifiers.—In the second type (high-frequency amplifier) the high-frequency currents are amplified by a multi-tube amplifier before being impressed on the detector tube, which converts them to audio-frequency currents. If no precautions are taken to avoid coupling between the output and input of the amplifier this type may also be regenerative. Various expedients are employed in the design and construction of high-frequency amplifier types to guard against regeneration and to make them stable and non-oscillating.

Intermediate-frequency Type.—In this type the modulated high-frequency currents from the antenna are combined in a converter tube with continuous high-frequency currents generated by an oscillator tube circuit. From their interaction in the converter tube there results a modulated intermediate frequency, usually of the order of 50 kilocycles. The intermediate-frequency currents are amplified and passed to a detector tube, which reproduces audio-frequency currents from them. This type of set is stable and easily adjusted. It is, however, usually more complicated and expensive than the other types.

Amplifiers.—All types of receiving sets except the simplest contain or must be used with audio-frequency amplifiers, which, coming after the detector tube, amplify the audio-frequency currents to a sufficient intensity so that they will operate the telephone receivers or loud speakers which reproduce the sound vibrations. In order not to distort the high-frequency or audio-frequency currents it is necessary that the various circuits in the receiving set pass these currents with equal efficiencies for the different frequencies in the band, and that the various tubes, particularly the detector and audio-frequency amplifier tubes, be of sufficient size to transmit the currents without becoming overloaded.

The portions of the receiving system in which distortion is hardest to avoid are the audio-frequency amplifier and loud speaker. The best amplifiers are designed to amplify uniformly all frequencies ranging from 100 cycles, or even less, to 5,000 cycles or more, since all these frequencies are important in accurate reproduction of speech and music. In the same way the transfer efficiency from electric energy to sound energy by the loud speaker should be substantially constant over this range. The load-carrying capacity of the amplifier and loud speaker must be adequate to provide the desired volume or distortion due to overloading will result.

Loud Speakers.—Loud speakers are roughly divided into two classes: the horn types and the hornless types. In the horn type the diaphragm is attached by its edges to the small end of a horn which forms a sort of megaphone to concentrate the sound. In one of the most common hornless types the diaphragm is a shallow cone, 1 ft. to 3 ft. in diameter, made of paper or cardboard. The cone types have become very popular because they reproduce the lower frequencies or bass notes which give rich fullness and naturalness to music better than do the ordinary horn types. For the higher frequencies the two types are not so widely different. Horns if made sufficiently long are also capable of reproducing the low notes. Such long horns may be looped or coiled to avoid unwieldiness. It is not certain whether the horn or hornless type will ultimately be developed to the greatest perfection.

Forms of Sets.—In physical form receiving sets range all the way from an assemblage of the various elements or parts as separate units wired up by the user, to the most pretentious sets in which the entire system, including loud speaker and power supply sources, is housed in an elaborate cabinet designed to be a beautiful piece of furniture. The most ordinary arrangement, however, consists of the receiving set proper (enclosing the tuning and high-frequency circuits and very often also the audio-frequency amplifier), the batteries or other power supply sources for the vacuum tubes in the receiving set, and the telephone receivers or loud speaker. This combination is flexible, and the various parts of it may be purchased separately to suit the owner's preference.

Power Supply.—From the user's standpoint one of the annoying problems is that of power supply. The power supply for filament current is usually a storage or dry battery called the "A" battery. Storage battery units have been developed which are simple and convenient for use in the home. They contain within one box both the battery and a means of charging it from electric lighting circuits. Small dry batteries made up in block form and called "B" batteries are commonly used to supply the small current at 50 to 150 volts required by the vacuum tube plate circuits. There are also used to a considerable extent so-called "B battery eliminators." These are devices in which alternating current from a lighting circuit is rectified and filtered to supply plate circuit current. In some receiving systems using vacuum tubes that require only a small filament current, this also is obtained by rectification from lighting circuits and the entire set is operated from an electric-light socket, thus doing away entirely with batteries.

Problems of Radio Transmission

When the radio waves are thrown out or radiated from the antenna at the transmitting station they tend to spread out in all directions somewhat as do the waves in a pool of water when a stone is dropped into it. As they travel outward in ever-increasing circles their initial energy is spread over a larger and larger circumference, so that the intensity of the waves must correspondingly decrease. If the energy merely spread out in this way, none of it being lost, the wave intensity would change inversely as the distance increased. But due to the absorption in the atmosphere and in the ground of a part of the wave energy, which is thus dissipated as heat, the falling-off of wave intensity with distance is more rapid. The amounts of absorption caused by various kinds of terrain differ widely, being smallest for transmission over the ocean or bodies of salt water, and increasingly greater for fresh water and dry land. Since a broadcasting station is usually not surrounded on all sides by a uniform terrain, the efficiency of wave-travel in different directions is not the same. As a result the received wave intensity may not be the same at all points equidistant from the transmitting station.

Mountains and steel frame building areas of large cities cause particularly heavy absorption, which may amount to almost complete suppression of the waves, so that on the far side of such obstructions there is sometimes an area of very low wave intensity called a "dead spot." At such places, or near places where the terrain changes abruptly, as at a coast line, the waves may be deflected somewhat from their course and be thrown across the path of another part of the waves which has not been deflected. This gives rise to wave interference patterns of the same nature as those produced at the edges of shadows by diffraction of light. Since radio waves are millions of times longer than light waves the patterns are relatively gigantic, and one such pattern may cover an area of 100 sq. m. or more. Within the area the wave intensities at points separated from each other by only a fraction of a mile may show wide differences.

Interference.—If the wave intensity were the only factor in radio reception it would theoretically be possible to receive from a station at any distance, since, as the waves became weaker, the sensitiveness of the receiving system could be increased by using more amplifiers. However, the atmosphere is nearly always filled with vagrant radio waves which enter the receiving set, producing noises called "interference," which submerge the weak radio signals it is desired to receive. These vagrant waves come from a multitude of sources. The most potent come from the atmosphere itself, which, in a manner not yet fully understood but commonly thought to be due at least in part to thunderstorms, produces waves which cause in the receiver crackling sounds known as "atmospherics," or, less properly but more popularly, as "statics." The various sorts of electrical systems which are a part of every modern community where broadcasting exists are capable of throwing off radio waves when the currents flowing in them change abruptly. These may give rise to clicking, buzzing and chattering noises.

The vagrant waves are present at all frequencies and therefore cannot be tuned out by the selectivity of the receiving set. For this reason satisfactory, noise-free reception from a station can be obtained only in areas where its signal wave intensity is much greater than the intensity of the vagrant waves. The intensity and amount of the "atmospherics" change with the time of day and season of the year, being greater at night and much greater in the summer time. Superimposed on these regular changes are large fortuitous variations. The amount of absorption of radio waves at broadcasting frequencies is influenced markedly by sunlight, being less at night. On account of these two variables, which are not closely related to each other in detail, satisfactory reception from distant broadcasting stations is largely a matter of chance. In densely populated areas, where there also is interference from powerful nearby broadcasting stations and perhaps from a multitude of regenerative receivers, reception from distant stations becomes well-nigh impossible.

Fading.—Another impediment to radio reception at distances of more than 100 or 200 m. is an annoying waxing and waning of the signal intensity, called "fading." The causes of this phenomenon are not fully known, but the evidence so far adduced has led to a theory that at distant points waves from the transmitter arrive by two or more routes at least, one of which is by way of the upper reaches of the earth's atmosphere. At times these waves coming by different routes oppose and nullify each other, while at other times they add together and assist each other. In going through these two states in progressive alternation they produce fading. The fading may be selective as to frequency, so that the different frequencies within the band transmitted by a station are differently affected and there is distortion of the received speech or music.

Interconnection of Broadcasting Stations.—The method of achieving widespread distribution of a broadcast programme which has been applied most successfully is that of interconnecting a number of stations by telephone wires so that they all simultaneously broadcast the same programme. These broadcasting stations, located at strategic points scattered over the area to be served, permit most listeners to receive the programme just as satisfactorily as they receive local programmes.

The audio-frequency currents from the microphone which picks up the programme, after passing through the control operator's amplifier, are delivered to a system of telephone lines which in many respects resembles an electric power distributing network. Trunk wires go out from the programme centre to various parts of the country, and from these, at appropriate points, connecting wires branch off to the broadcasting stations. Telephone repeaters are placed in the circuits at suitable points to amplify the currents so that they may reach the broadcasting stations without material loss in volume. As has already been pointed out, distortion of the telephone currents must be very small or the faithfulness of reproduction at receiving points will be spoiled. On this account the very best kinds of telephone circuits and associated apparatus are employed.

This form of large scale broadcasting has reached its greatest development in the United States and England. In the United States as many as 29 stations have thus been tied together to broadcast a common programme of national importance. On such an occasion many thousands of miles of land wires are involved, and stations on the Pacific and Atlantic coasts 3,000 m. apart broadcast the same programme in unison. In England as well as in the United States chains of stations less widely scattered are in everyday use.

BIBLIOGRAPHY.—Technical development in radio broadcasting has been so rapid and so recent that up-to-date information must be sought in current issues of technical periodicals. Articles on receiving systems are usually confined to one type or to the products of one manufacturer. For fundamental information see references under WIRELESS TELEGRAPHY AND TELEPHONY. For transmitting systems and transmission the following articles are suggested: Edward L. Nelson, "Transmitting Equipment for Radio Telephone Broadcasting," *Proceedings of the Institute of Radio Engineers*, vol. 12, p. 553 (1924); Julius Weinberger, "Broadcasting Transmitting Stations of the Radio Corporation of America," *Proceedings of the Institute of Radio Engineers*, vol. 12, p. 745. Ralph Brown, Deloss K. Martin, and Ralph K. Potter, "Some Studies in Radio Transmission;" *Proceedings of the Institute of Radio Engineers* (Feb. 1926).

(R. Bo.)

BROCK, SIR THOMAS (1847–1922), British sculptor (*see* 4.623c), produced amongst other works after 1910: busts of King Edward VII. (1911), Lord Lister (1913, for the Royal College of Surgeons, London) and Edwin Abbey, R.A. (1917, for the British School in Rome); statues of Capt. Cook (1914, in the Mall, London) and of Lord Sydenham (1915, in Bombay). In 1911 he was created K.C.B. He died in London Aug. 22 1922.

BROCKDORFF-RANTZAU, ULRICH, COUNT VON (1869–), German diplomatist, was born in Schleswig May 29 1869. After some years in the army he transferred to the diplomatic service. From 1909 to 1912 he was consul-general at Budapest, and from 1912 to 1918 German minister at Copenhagen. On Dec. 20 1918 he was appointed Secretary of State for Foreign Affairs, in which capacity he led the German delegation at the Peace Conference at Versailles in April 1919. Unwilling to advise the German Govt. to accept the terms of the Treaty of Versailles, he resigned on June 20. In 1922 he was appointed German ambassador in Moscow.

BRONCHITIS: *see* RESPIRATORY SYSTEM, DISEASES OF THE.

BROOKE, RUPERT (1887–1915), British poet, second son of W. P. Brooke, a master at Rugby School, was born at Rugby Aug. 3 1887 and educated there. He entered King's College, Cambridge, in 1906, where he took the classical tripos (1909) and achieved considerable personal distinction among his contemporaries, notably by his foundation of the Marlowe Dramatic Society. He returned to Rugby for a short time as acting housemaster in 1909. In 1911 he travelled in Germany and Italy, publishing his first *Poems* in that year. After election to a fellowship at King's College in 1913, he set out on wide travels in the United States, Canada, Hawaii, Fiji and New Zealand, and had hardly returned to England when war broke out. In Sept. 1914 Brooke received a commission in the Royal Naval Division and took part in the Antwerp operations in October. In the Hood Battalion of the Div., he sailed for Gallipoli early in 1915, but died suddenly of blood poisoning at Scyros April 23 1915, where he was buried. His posthumous book of poems,

1914 and Other Poems, appeared in 1915; the war sonnets therein made his name familiar to thousands beyond the smaller circles of readers who had already appreciated his talent. His other published works were a study of *John Webster* (1916) and *Letters from America* (1916).

See *Collected Poems of Rupert Brooke, with a Memoir* (1918).

BROOKE, STOPFORD AUGUSTUS (1832–1916), British divine and man of letters (*see* 4.645), died at Ewhurst, Surrey, March 18 1916.

See L. P. Jacks, *Life and Letters of Stopford Brooke* (1917).

BROQUEVILLE, CHARLES MARIE PIERRE ALBERT, COMTE DE (1860–), Belgian politician, was born at Moll, Belgium, Dec. 4 1860. From 1892 to 1919 he was Catholic deputy for Turnhout, Limbourg. From 1910–2 he was Minister of Railways, Posts and Telegraphs and he became Prime Minister of the Govt. formed on June 18 1911. After the elections of 1912 he formed a new Cabinet, in which he acted as Minister of War until Aug. 1917. He introduced an army bill, making general service personal and obligatory, which became law in 1913. In 1914 de Broqueville was responsible for the mobilisation of the army, which enabled Belgium to resist the German onslaught. While at Havre, after the battle of the Yser, he undertook the reorganisation of the Belgian Army and established munition factories.

In consequence of the peace proposals emanating from Prince Sixte de Bourbon and the emissaries of von der Lancken, the German civil representative in Brussels, de Broqueville handed in his resignation as head of the Cabinet. In 1917 he became Foreign Minister, afterwards acting as Minister of Reconstruction until May 1918. He became a Minister of State on May 31 1918 and was Minister of the Interior in M. Delacroix's Cabinet from Nov. of that year until Nov. 1919, when he resigned from the Chamber of Representatives and was elected Senator for the province of Namur.

BROWN, FRANCIS (1849–1916), American Semitic scholar (*see* 4.658), died in New York Oct. 15 1916. He had been president of Union Theological Seminary, New York, since 1908. In 1911 he was tried for heresy before the Presbyterian General Board on the ground that he had published statements "contrary to cherished Presbyterian and evangelical doctrines," but was exonerated.

BROWN, JOHN GEORGE (1831–1913), American painter (*see* 4.661), died in New York City Feb. 8 1913.

BROWNE, EDWARD GRANVILLE (1862–1926), British orientalist, was born at Uley, near Dursley, Gloucestershire, Feb. 7 1862. Educated at Trinity College, Glenalmond, and then at Eton and Pembroke College, Cambridge, he studied medicine and oriental languages. In 1887 he was elected a fellow of his college in the same year qualifying M.B. at St. Bartholomew's Hospital, London, but he never practised as a doctor. In 1887–8 he travelled in Persia, becoming afterwards lecturer in Persian at Cambridge. In 1902 he was appointed Adams professor of Arabic at Cambridge, a post he held until his death. In 1906 he married Alice Caroline Blackburn Daniell, who died in 1925. Browne's published works include *A Traveller's Narrative* (1891); *Literary History of Persia until the time of Firdawsi* (1902), continuations of which were published in 1906, 1920 and 1924; *The Persian Revolution, 1905–9* (1910); a translation of *Chahâr Maqâla*, with notes (1921); and *Arabian Medicine* (1921). He died in Cambridge Jan. 5 1926.

BROWNING, JOHN M. (1854–), American inventor, was born at Ogden, Utah, of Mormon parentage. From childhood he displayed a remarkable talent for invention. In 1879 he secured his first patent for a breech-loading, single-shot rifle, which patent he sold to the Remington Company. He designed many types of sporting firearms such as the Remington autoloading shotguns and rifles; the Winchester repeating shotguns, single-shot and repeating rifles; the Stevens rifles; and the Colt automatic pistols. In 1890 a machine gun of his design, but known as the Colt, was adopted by the U.S. Army. He always avoided publicity. In one establishment only was his name used, the Fabrique Nationale at Liège, Belgium. Browning was made a Chevalier of the Order of Leopold by King Albert, on the occasion of the completion of the millionth Browning automatic pistol at Liège. He later developed two types of machine-guns, which were adopted by the United States in 1918 for use in the World War. One of these guns on test fired 39,000 rounds before breakage developed. In lieu of royalties, which would have amounted to some $10,000,000, he accepted from the U.S. Govt. a lump sum of $1,500,000.

BROWNING, OSCAR (1837–1923), British writer (*see* 4.670), published *Memories of Sixty Years at Eton, Cambridge and Elsewhere* in 1910, and *Memories of Later Years* in 1923. He died in Rome Oct. 6 1923.

BRUCE, STANLEY MELBOURNE (1884–), Australian politician, was born in Victoria of a wealthy mercantile family. Educated first at Melbourne Grammar School, in 1902 he went to Trinity Hall, Cambridge. He rowed in the university boat-race in 1904, and after graduating was called to the bar by the Middle Temple in 1907, but shortly afterwards he inherited a partnership in the Melbourne firm of merchants, Paterson, Laing and Bruce. He was again in England when the World War began, received a commission in the Royal Fusiliers, took part in the landing at Suvla Bay and was seriously wounded in the first day's fighting. Later he served with such distinction in France that he was awarded the Military Cross and the Croix de Guerre, and was promoted to the rank of captain; and in 1917, having been wounded again, he was invalided back to Australia. He resumed his commercial work in Melbourne, and in the same year, on the elevation of Sir William Ervine to the Chief Justiceship of Victoria, successfully contested the vacant constituency of Flinders and was returned to the Commonwealth Parliament.

Partly owing to his own ability and partly owing to circumstances, Mr. Bruce's political progress was extraordinarily rapid. In 1921 he chanced to be in Europe when some one was required, at short notice, to represent Australia at the second Assembly of the League of Nations. He was appointed, and his report to the Commonwealth Parliament increased his reputation as a clear thinker and logical, if uninspired, speaker. Soon afterwards, when Sir Joseph Cook became High Commissioner in London, Mr. Bruce succeeded him, after only four years' experience of politics, as Treasurer in the Cabinet led by Mr. W. M. Hughes. In this office, which is second only to that of the Prime Minister, Mr. Bruce's knowledge of commerce and law proved extremely useful and he soon built up a reputation as an essentially sane and level-headed man of affairs rather than an orator or picturesque leader of men. These qualities appealed to a country burdened by heavy war debts and many problems arising out of the War. Mr. Bruce profited, too, by the growing dislike of the National party formed by Mr. Hughes during the War. In Feb. 1923 the tottering Hughes Ministry fell, and Mr. Bruce, as the leader of the Liberal wing of the National party, succeeded in forming an alliance with the leader of the Country party, Dr. Earle Page, who took office as Treasurer.

Mr. Bruce's leadership was not, perhaps, distinguished by the brilliance and personal magnetism that were such conspicuous attributes of Mr. Hughes, but he showed judgment and restraint in his relations with Labour, marked administrative ability and a sound grasp of Australia's problems and sentiment; and if, by the end of 1925, his term of office had not been marked by any outstanding achievement he had at least made no bad blunders. In Imperial affairs he might be described in Bagehot's phrase as an apostle of animated moderation, standing for as warm and close a relationship with Great Britain as is consistent with Australia's interests as a completely self-governing Dominion. Under his leadership the Federal Parliament maintained the customs preference to British goods and agreed to a great migration scheme—though the fruits of this latter project were, owing to the difficulties of the states, rather disappointing; and at every opportunity, notably the Imperial Conference in 1923, he showed himself to be a vigorous leader of Australian thought and sentiment and a staunch believer in the future of a British Commonwealth of Nations with Great Britain as its head. Like Mr.

Hughes, however, he strongly distrusted any plan for Imperial Federation, under which any one Dominion would necessarily have only small representation, and was content to insist upon the national status granted to Australia at the Peace Conference (1919) together with the right to be consulted by the British Cabinet in any matters affecting Australia's welfare.

(G. C. D.)

BRUCH, MAX (1838–1920), German musical composer (*see* 4.677), died in Berlin Oct. 2 1920.

BRUGES (*see* 4.678) had in 1923 a population of 52,861. The improvement of transport between the town and Zeebrugge, which was beginning to make itself felt before the World War, promises to restore something of Bruges' former prosperity. New docks have been built communicating with the sea by a canal 23 ft. deep.

During the World War, Bruges remained some 20 m. behind the German front at Dixmude and was at first of little military importance, but with the growth of submarine warfare and the abandonment of Ostend as a naval base it became a centre for assembling the parts of submarines. By the spring of 1918 the various docks and concrete shelters could accommodate 35 destroyers and about 30 submarines. Captain Fryatt, of the "Brussels," was shot with 11 Belgians and one Frenchman in the cavalry barracks in the Rue Longue on July 27 1916. A tablet to their memory has been placed on the wall, now called "Mur des Fusillés," and in the same enclosure is a separate memorial to Fryatt. Little material damage was done to the town, except to the canal docks where enormous numbers of bombs were dropped, but property was taken to the value of 20,000,000 francs and an elaborate rest house, baths, etc., for the use of German officers were built at the expense of the townspeople. The town was in German occupation for four years, though the Allies were within sight of it after the capture of the Passchendaele ridge in Nov. 1917. The Belgians re-entered it unopposed in Oct. 1918.

BRÜNN or **BRNO** (*see* 4.684) is now in Czechoslovakia, the seat of the Supreme Court, and the centre of the woollen industry of the country. The population in 1921 was 221,758, so that it has more than doubled since 1900, when the figure was 108,944. The Masarykova (Czech) University was opened in 1918.

BRUNNER, HEINRICH (1840–1915), German historian (*see* 4.685), published in 1909 *Geschichte der englischen Rechtsquellen im Grundriss*. In 1913 he issued a 6th ed. of *Grundzüge der deutschen Rechtsgeschichte*. He died at Bad Kissingen Aug. 11 1915.

BRUNO, PAUL (1874–), German architect and painter, was born Jan. 19 1874 at Seifhennerstorf in Saxony. He received his artistic training at the Kunsgewerbe Schule (School of Applied Arts) at Dresden, and at the Academy at Munich. He first made a name as an artist by his drawings for *Simplizissimus*. Later his designs for the Munchner Werkstätts (Fine arts industry) attracted attention. In 1900 he received the Grand Prix in Paris; in 1902 the highest distinction at Turin; in 1904, the Grand Prix at St. Louis; and in 1906 the highest distinction at Dresden. In 1907, he was appointed Director of Instruction at the State Museum of Applied Arts in Berlin. He was also elected a member of the Academy of Arts in Berlin and the Deutsche Werkbund. He wrote a pamphlet on *The Education of Artists at State Schools* (1919), which has become a classic.

BRUSA, Turkey (*see* 4.691c), had a population, at the census of 1924, of 102,217. But for the comparative proximity to the sea this ancient and beautiful city would probably have become the capital of the new Turkish Republic. During the Greco-Turkish conflict (1919–22) Brusa and neighbourhood was the scene of severe fighting. In April 1920 the sultan's force under Anzavur Bey, when advancing on Brusa, was defeated by the Nationalists, who in their turn were defeated and driven out of the city in Aug. by the northern army of the advancing Greeks. When the final rout of their main forces took place, in 1922, the Greeks offered a stubborn resistance at Brusa, and did not finally withdraw until Sept. 12. Before this retirement a commission of Allied officers arrived to prevent any wanton damage being done to the architectural masterpieces in the city.

BRUSILOV, ALEXEI ALEXEIEVICH (1853–1926), Russian soldier, was born Aug. 19 1853, of an old family. He began his military career as a cavalry officer in the Caucasus and in the Russo-Turkish War of 1877–8 he distinguished himself by his courage and resource. In 1900 he was appointed director of the Officers' Cavalry School at St. Petersburg (Leningrad). After commanding the Second Guard Cavalry Division, he was in 1909 placed in command of an army corps, and later became assistant to Gen. Skalon, commander-in-chief of the Warsaw military district. On the outbreak of the World War Brusilov took command of the VIII. Army, which participated in the invasion of Galicia from the east. By Sept. 1915, after varying fortunes, his army had secured possession of Rovno, and was in temporary occupation of Lutsk. In April 1916 Brusilov succeeded Ivanov as commander of the Russian armies (VII., VIII., IX., XI.) south of the Pripet Marshes. A great offensive was launched during the summer of 1916 which brought much-needed relief to the Italian armies by compelling the withdrawal of considerable enemy forces to face the crisis of Lutsk, but, owing to the lack of artillery munitions, this relief was bought at the price of very heavy Russian losses.

After the Lvov Coalition Cabinet was formed in May 1917, Brusilov was given supreme command of the Russian armies, which, however, he did not long retain. During the fighting in Moscow in Nov., he was wounded by a chance bullet, though not himself actively engaged. He early realised that the Communists were in fact creating anew the Russian Army and took no part in conspiracies against them. The Polish War brought from him an appeal to Russian officers to join in the national defence. He put his own knowledge and experience at the service of the Red Army. Always a keen sportsman, he was latterly at the head of the state horse-breeding establishments and was always to be seen at the races. He died in Moscow March 17 1926.

BRUSSELS (*see* 4.692).—The population of the city and suburbs in 1923 was 787,060. The suburbs comprise 12 communes: Anderlecht, Etterbeek, Forest, Ixelles, Jette, Koekelberg, Molenbeek St. Jean, St. Gilles, St. Josse-ten-Noode, Schaerbeek, Uccle and Woluwe St. Lambert. A law of April 2 1921 decreed the annexation to Brussels proper of the communes of Laeken, Haeren, and Neder Overheembeek, as well as part of Molenbeek and a small part of Schaerbeek, in order to facilitate the construction of the new outer port which the authorities wished to bring entirely within the area of the city proper. As a result, the area of the city proper has more than tripled; it covers over 12½ sq. m., instead of just about four, and includes an additional population of about 54,000.

During 1910–21 Brussels underwent considerable transformation. In 1910 the old harbour basins were filled in; the Isabelle quarter of the city, situated between the Rue Royale and Place Royale, as well as the Putterie quarter near the university, were demolished. Numerous banks were established in the upper town—in the Rue Royale and Place Royale. In the Schaerbeek area new arterial roads were made and the Parc Josaphat was endowed with a fine sports ground. The palace of the Count of Flanders became the Banque de Bruxelles, and in Nov. 1918 the city acquired the palace of the Duke of Aremberg and gave it again its old name of Palais d'Egmont. The Royal Palace has been considerably enlarged and a public park was opened at Mollenbeek in 1922. Various memorials have been erected since 1918. On the National Rifle Range at Schaerbeek is one in memory of 35 civilians shot by the Germans. The British monument nearly opposite the Palais de Justice, erected to commemorate the brotherhood of the two nations during the War, was unveiled in 1923; it is a replica of the Belgian monument on the Victoria Embankment, London. In Place St. Jean is a monument to a Belgian, shot at the same time as Edith Cavell, whose cell in St. Gilles prison has been made into a museum of relics relating to her. A replica of the Peter Pan statue in Kensington Gardens was unveiled in the gardens of the Palais d'Egmont in 1924.

The foundation stone of new buildings for the university was

laid in Nov. 1924 by Prince Leopold. A large sum was provided towards these by the American Relief Commission from the balance of funds provided for the relief of the Belgian population during the German occupation. In 1920 a commercial fair, managed by the municipality and held in the Cinquantenaire Park and Halls, was inaugurated; in 1925, 27 nations were represented, and the area of the fair was more than doubled. An international exhibition to celebrate the centenary of Belgian independence was arranged for 1930. The terminus of the London-Brussels air service, previously at Evere, is now in the suburb of Haeren. An aerial service, Antwerp-Brussels-Basle, was started in March 1924.

The harbour works, planned in 1896, were completed in 1908. They included the widening of the canal and the construction of three large basins, the largest of which, the Vergote basin, has 20,000 metres of quayage. These basins being found inadequate, an outer port in the plain between Laeken and Vilrode was opened in 1922, with a canal 12½ m. long, connecting Brussels with the Rupel and thence with the Schelde. The canal can be used by vessels drawing 19 ft. and access to the Rupel is gained by means of locks.

The German occupation of the capital during the World War extended from Aug. 1914 to Nov. 1918. General Sixt von Armin's troops entered on Aug. 20, and on Sept. 2 Field-Marshal von der Goltz was appointed Governor-General of Belgium. He was succeeded by Gen. von Bissing in 1915. Numerous social relief movements were instituted in spite of German intervention; among them the Comité National de Secours had its headquarters at Brussels, and with the aid of Mr. Hoover's American committee organised the feeding of the Belgian population. On the suppression of Allied newspapers, a journal, *La Libre Belgique*, was secretly printed in Brussels and widely circulated. Among the many infamous executions, that of Philippe Baucq and of Edith Cavell stand out. A revolt of German soldiers against their officers broke out on Nov. 10 1918 and a violent conflict occurred in the Place Roger opposite the Gare du Nord. The Belgian Army reoccupied Brussels on Nov. 18 1918 and the King and Queen re-entered the city in state on Nov. 22. (O. J. R. H.)

BRUSSELS, UNIVERSITY OF (*see* 27.768).—Since its foundation in 1834 this university has known no more difficult days than those of the German occupation, when its activities were suspended. It is true that, in common with other universities, it has suffered from the economic consequences of the peace but it has displayed, with other Belgian institutions, a power of recuperation indicating a vitality of remarkable strength. The faculty organisation comprises philosophy and letters, jurisprudence (with a section of maritime law), science and medicine (with special sections for anatomy and physiology and applied science). The university includes a school of political and social science, a school of commerce and an educational section. The library of the university is expanding and, by the institution of chairs in special subjects, such as Flemish history and literature, colonial jurisprudence and international law, the intimacy of theoretical discipline and practical economic and political conditions is admirably maintained.

BRYAN, WILLIAM JENNINGS (1860–1925), American politician (*see* 4.697), announced that he was not a candidate for the Democratic presidential nomination in 1912, but he attended the Democratic convention, and it was largely owing to his personal influence that the nomination went to Woodrow Wilson, instead of to Champ Clark. In 1913 he was appointed by President Wilson Secretary of State, and from the start devoted much attention to the negotiation of peace treaties with foreign countries. He declared that America should wage no war while he was Secretary. Soon after entering office he went to California and urged, unsuccessfully, that the state Legislature and the governor should delay action on the proposed Webb anti-alien land ownership bill, so displeasing to the Japanese Government. In 1914 he supported the repeal of the Panama Canal tolls bill, which excluded American coastwise shipping from the payment of fees.

After the outbreak of the World War he was deeply interested in attempts to restore peace. His attitude towards foreign war loans was clearly expressed in an announcement from the Dept. of State (Aug. 15 1914). "There is no reason why loans should not be made to the governments of neutral nations, but in the judgment of this Govt. loans by American bankers to any foreign nation which is at war is inconsistent with the true spirit of neutrality." When, however, in Dec. of the same year, Senator Hitchcock introduced a bill to lay an embargo on the shipment of arms, the Secretary informed the British ambassador that it had not been introduced "at the suggestion of the Administration"; and later, in 1915, in a letter "to the German Americans" he declared that it would have been in violation of the laws of neutrality to change international rules during war by forbidding the exportation of arms.

After the sinking of the "Lusitania" in 1915, he signed the first strong note of protest to Germany. Upon the receipt of the German reply, and while the second note was being prepared, Dr. Dumba, the ambassador of Austria-Hungary, called at the Dept. of State and asked Secretary Bryan why the United States dealt more harshly with Germany than with Great Britain. The Secretary replied that Great Britain had only interfered with the commerce of the United States while Germany had drowned its citizens. This plain statement was ignorantly or wantonly misinterpreted by some German official, and the report was widely spread that Mr. Bryan had said that the note was for "home consumption," and not to be taken too seriously. There was, however, absolutely no truth in this report, even Dr. Dumba denying it in a dispatch to his government. When the President wrote his second "Lusitania" note, Secretary Bryan resigned, June 8 1915, saying in his letter of resignation: "You have prepared for transmission to the German Govt. a note in which I cannot join without violating what I deem to be an obligation to my country."

During his term of office he had negotiated 30 treaties with foreign nations, requiring the submission of disputes to impartial inquiry and a delay of a full year for arbitration before going to war. Such a treaty had not been concluded with Germany, but was under consideration when interrupted by the World War. As Secretary he was often criticised because of numerous paid engagements on the lecture platform, undertaken, he said, to supplement his inadequate salary; but it was never shown that he was less attentive to the demands of his office than any predecessor. He continued, after his resignation, to work in the interests of peace; opposed the Anglo-French War Loan; attacked the Navy League and the National Security League; and tried to resist the growing demand for preparedness in America. In 1916 he was defeated in Nebraska as candidate for delegate-at-large to the Democratic National Convention. He went, however, as a reporter and gave full support for the renomination and later the re-election of President Wilson.

From the announcement by Germany of the resumption of submarine warfare to the actual declaration of war, he favoured any measure that would keep America neutral, no matter how largely it involved the surrender of American rights on the sea. But when War was declared he asked to be enrolled as a private, though then 57 years of age; urged loyal support of the President's war measures; and in his own paper, *The Commoner*, strongly condemned obstruction of the selective draft as well as abuse of liberty of speech. He supported the League of Nations, but thought that the Monroe Doctrine should be specifically recognised. He desired a constitutional amendment changing the two-thirds vote required in the Senate for making a treaty, so that the country could get out of war as easily as it got in. In 1920 he was present at both the Republican and the Democratic National Conventions, attending the former as a reporter for his newspaper and the latter as a delegate-at-large from Nebraska, and worked in vain for a dry plank in their platforms.

The same year he was tendered the presidential nomination of the Prohibition party, but declined. He was disappointed with the nomination of James M. Cox as Democratic candidate,

but declared that he would not leave the party. He took no part, however, in the campaign, it being the first time in 40 years that his voice was not heard on the platform. In 1921 he became a resident of Miami, Florida. He attended the Democratic National Convention of 1924 in New York as a delegate from Florida, but his influence in the party councils had perceptibly waned and he took very little part in the ensuing campaign. As a politician his work was completed. For the most important "progressive" measures adopted by the United States in recent years, the popular election of senators, an income tax, the requirements of publication of ownership and circulation by newspapers, the creation of a Dept. of Labour, national prohibition and woman suffrage, Bryan laboured earnestly, and their adoption was due in part at least to his popular, persistent appeal.

His last public appearance was in 1925 at the trial of J. T. Scopes, a school teacher of Dayton, Tenn., who was arrested on a charge of violating the state law prohibiting the teaching in public schools of any theories that deny the divine creation of man as taught in the Bible. Scopes was a biologist and had been teaching evolution. Bryan, a firm believer in the literal interpretation of the Bible, went to Dayton to assist the prosecution. Widespread popular interest was manifested in the case, which in the hands of Bryan and Clarence Darrow, chief defence counsel, assumed the form of a contest between fundamentalism and modernism. The outcome was that on July 21, after a hearing extending over three weeks, Scopes was found guilty and fined $100, though Bryan was prevented, through the tactics of Darrow, from delivering the elaborate speech which he had prepared in refutation of Darwin and his theories. On the conclusion of the trial he was taken ill, and died at Dayton, Tenn., July 26 1925.

BRYANT, SOPHIA (1850–1922), English educationalist, daughter of Rev. William A. Willock, was born in Dublin Feb. 15 1850. Her family removed to England in 1868 and Sophia won a scholarship at Bedford College, London. At the age of 19 she married Dr. William Hickes Bryant who, however, died within a year. Having passed the general examination for women in London University, she was from 1875 to 1895 form mistress at the North London Collegiate School for Girls. In 1881 she graduated B.Sc. with honours in mathematics and moral science and was the first woman admitted D.Sc. (1884). She excelled as a mathematical teacher with original methods, but became known also as a writer and lecturer on general educational subjects. From 1895 to 1918 she was headmistress of the North London Collegiate School, and served on many important educational committees. In 1904 the hon. degree of Litt.D. was conferred on her at Dublin University. She met her death in a mountaineering accident near Chamonix in 1922. She was last seen alive on Aug. 15 and her body was recovered on Aug. 28. Mrs. Bryant published many educational works and several books on early Irish history.

BRYCE, JAMES BRYCE, 1ST VISCOUNT (1838–1922), British politician and man of letters (*see* 4.699), remained in the United States as British ambassador till 1913, a period of six years. The appointment, criticised at the time as withdrawing from the regular diplomatic corps one of its most coveted posts, proved a great success. The United States had been in the habit of sending, as minister or ambassador to the Court of St. James, one of its leading citizens—a statesman, a man of letters, or a lawyer—whose name and reputation were already well-known in Great Britain. For the first time Great Britain responded in kind. Mr. Bryce whose eminence as a man of letters had recently been recognised by the grant of the Order of Merit, and who was already favourably regarded in America as the author of a classical work on the American Commonwealth, made himself thoroughly at home in the country; and after the fashion of American ambassadors in England, he took with eagerness and success the rôle of public orator on matters outside party politics, so far as his diplomatic duties permitted.

These duties he performed to the satisfaction of his own Govt. and of the Govt. to which he was accredited. The difficulty between the United States and Newfoundland about fisheries was referred to the Hague Tribunal for final settlement. Most of the questions with which he had to deal concerned the relations between the United States and Canada, and in this connection he paid several visits to Canada to confer with the governor-general and his ministers. He was criticised, both in England and in Canada, for forwarding in 1911, in the course of his duties as ambassador, an arrangement for mutual tariff concessions between the two North American states; but the general election, which put Sir R. Borden in power as Prime Minister of Canada in place of Sir W. Laurier, brought the negotiations to an end. At the close of his embassy he told the Canadians that probably three-fourths of the business of the British embassy in Washington was Canadian, and of the 11 or 12 treaties he had signed 9 had been treaties relating to the affairs of Canada. "By those 9 treaties," he said, "we have, I hope, dealt with all the questions that are likely to arise between the United States and Canada."

For his services he was created a viscount in 1913, and in 1914 his old university, Oxford, gave him an honorary degree (Litt. D.). Along with other English scholars, who had ties of close association with German learning and German savants, he was extremely reluctant in the last days of July 1914 to contemplate the possibility of war with Germany; but the violation of Belgian neutrality and the outrages committed in Belgium by German troops brought him speedily into line with national feeling. He was appointed chairman of a committee to consider the evidence of such outrages not only in Belgium but in France; and his report convinced the most incredulous that the charges were based on fact. He welcomed warmly the entrance of the Americans into the War in 1917. He also presided, as an eminent constitutional lawyer, over a committee set up in that year to consider the reconstruction of the House of Lords, and spent much labour on a task which all parties were disposed to shirk. During these latter years he was largely engaged on the composition of a valuable book, published in two substantial volumes in 1921, on *Modern Democracies*, a comparative study of a certain number of popular governments in their actual working. For this monumental work he had been gathering material for several years before the War. Besides visiting Switzerland and other parts of Europe, he availed himself of his experiences in the United States and in Canada, and journeyed to Spanish America, Australia and New Zealand. While yet another book, *International Relations*, a series of lectures delivered in America, was in the press, Lord Bryce died, on Jan. 22 1922, after a long, full and distinguished career. He married, in 1880, Elizabeth Marion, daughter of Thomas Ashton, of Hyde, and sister of the 1st Lord Ashton of Hyde. (G. E. B.)

BRYUSOV, VALERY YAKOVLOVICH (1873–1924), Russian poet, was born in Moscow Dec. 13 1873. His early verses are decadent in style, and although they brought him a certain notoriety, were not taken seriously. At one time he was the acknowledged head of the Russian "decadent" school of poetry. The influence of Balmont is seen in his earlier work, and of Verhaeren in his poems of the town and in his revolt against social evils, e.g., *The Stonemason*. His later poems, however, are more scholarly and rhetorical in subject and style. He also wrote prose, his most interesting work being the historical novel, *The Flaming Angel* (1909), and was a great student of Pushkin. After the Oct. revolution in 1917 he joined the Communist party. He died in Moscow Oct. 9 1924. His poetical works include: *Tertia Vigilia* (1901); *Urbi et Orbi* (1903); *Stephanos* (1905).

BUBONIC PLAGUE: *see* PLAGUE.

BUCCLEUCH, WILLIAM HENRY WALTER MONTAGU-DOUGLAS-SCOTT, 6TH DUKE OF (1831–1914), British politician (*see* 4.712), died at Montagu House, Whitehall, London, Nov. 5 1914. His wife, Louisa, a daughter of the 1st Duke of Abercorn, had died at Dalkeith March 17 1912. He was succeeded by his son, John Charles Montagu-Douglas-Scott (b. 1864), who, as Earl of Dalkeith, was Unionist M. P. for Roxburghshire, 1895–1906.

BUCHAN, JOHN (1875–), British author, was born in Perth, Scotland, Aug. 26 1875. Educated at Glasgow University and Brasenose College, Oxford, he had a distinguished

career at Oxford, where he won the Newdigate Prize for a poem on The Pilgrim Fathers and was president of the Union Society. Called to the bar by the Middle Temple in 1901, in the same year he became private secretary to Lord Milner, then High Commissioner for South Africa. In 1903 he returned to England, and soon became a member of the publishing firm of Thomas Nelson and Sons, Edinburgh. During the World War he served on the British Headquarters Staff, and in 1917 was appointed Director of Information under the Prime Minister. After the return of peace he was appointed deputy chairman of Reuter's News Agency. As a novelist Buchan is probably best known for his tales of adventure, such as *John Burnet of Barns* (1898); *Prester John* (1910); *The Thirty-Nine Steps* (1915); *Mr. Standfast* (1919); *Midwinter* (1923); and *John Macnab* (1925). He wrote also a number of historical books, particularly after the World War, including a popular *History of the Great War*. In 1907 he married Susan Charlotte, daughter of the late Hon. Norman Grosvenor.

BUCHAREST, Rumania (*see* 4.717), had a population of 308,987 in 1917, estimated at 400,000 in 1919. The city has seen considerable industrial development since 1910. After the World War conditions were bad in every way, but the American Red Cross, which had its headquarters and warehouses in Bucharest, did much to encourage reconstruction. The first steps towards putting in force the Ostend agreement, which provides for the settlement of the city's external obligations, were taken in Sept. 1925. An American company and the municipality came to an agreement for the erection of a hydroelectric power station on the Arges river to supply power for the industries of the city and neighbourhood.

Events during the War.—The fortress was evacuated as a result of an unsuccessful battle in the foreground at the end of Nov. 1916. The arsenal was blown up on Dec. 4, and the Germans under Mackensen entered without opposition on Dec. 6. The Rumanian capital was removed to Jassy until after the Armistice. During the German occupation there was much destruction and thieving, but the city was thoroughly cleansed.

BUCHNER, EDUARD (1860–1917), German chemist, was born at Munich May 20 1860. He became a professor at the University of Berlin in 1898 and subsequently accepted similar appointments at Breslau (1909) and Würzburg (1911). He devoted himself to researches in connection with fermentation and enzyme action. In 1903 he was able to confirm Traube's theory by demonstrating that the active cause of alcoholic fermentation is due to the action of different enzymes contained in yeast and not to the yeast cell itself. Concerning the physiological nature and meaning of fermentation he showed that a ferment (zymase) can be extracted from yeast cells which causes sugar to break up into carbon dioxide and alcohol. Buchner, who gained the Nobel Prize for chemistry in 1907, was killed in the World War on Aug. 24 1917.

BUCKLE, GEORGE EARLE (1854–), British man of letters, was born at Twerton, near Bath, June 10 1854, the eldest son of Rev. George Buckle, Canon of Wells. He was educated at Winchester and New College, Oxford, being a scholar of both colleges, and graduated first class both in *literae humaniores* (1876) and in modern history (1877). He won the Newdigate Prize in 1875. From 1877 to 1885 he was a fellow of All Souls College. In 1880 he joined the editorial staff of *The Times*, London; four years later, while still under 30, he succeeded Thomas Chenery as its editor. This position he occupied for more than 28 years, retiring in Aug. 1912. When Mr. Monypenny, the biographer originally entrusted with the official *Life of Disraeli*, died in 1912, leaving his task unfinished, Mr. Buckle took over the work of completing it; under his authorship vol. 3, 4, 5 and 6 were published between 1914 and 1920. Mr. Buckle also edited *The Letters of Queen Victoria*, second series (1862–78), 2 vol., published in 1926.

BUCKMASTER, STANLEY OWEN, 1ST BARON (1861–), English lawyer, was born Jan. 9 1861 and educated at Christ Church, Oxford. He was called to the bar, and after a short time began to practice in the chancery courts. An advocate of considerable skill, in 1902 he became a K.C. In 1906 he successfully contested Cambridge in the Liberal interest, and revealed unusual oratorical powers, which he also showed in the House of Commons. Defeated at the general election of 1910, he re-entered the House in 1911 as member for Keighley, and, in 1913, was appointed solicitor-general, being knighted in the same year. In May 1915 Sir Stanley Buckmaster was appointed Lord Chancellor and was raised to the peerage in the following month. Here he was energetic, receptive of new ideas and powerful in debate; while, as a judge, he was sound without being brilliant. In 1916 he went out of office with Mr. Asquith; but he continued to sit in a judicial capacity in the Lords. He became prominent also as a strong advocate of divorce law reform, taking the civil rather than the ecclesiastical view of marriage. In 1926 he accepted the chairmanship of an important commercial undertaking.

BUCKNER, SIMON BOLIVAR (1823–1914), American soldier and political leader (*see* 4.732), died in Munfordville, Ky., Jan. 8 1914. He was the last surviving major-general of the Confederacy and the then oldest living graduate of West Point Military Academy.

BUDAPEST (*see* 4.734), capital of Hungary, remains the political, commercial and intellectual centre of the country, but its development came to a standstill during the World War. In 1910 the civil population was 863,735, showing an increase of 20·5% on the previous decade. In 1920 it was 928,996. The city suffered severely during the Bolshevik ascendancy after 1918, and from looting by the Rumanian troops who occupied it from Aug. to Nov. 1919 in disregard of the decisions of the other Allied Powers. The cessation of building during and after the War, together with the influx into the capital of thousands of refugees and unemployed officials from the territories detached from Hungary by the Treaty of Trianon, created a terrible housing shortage. A faculty of political economy was founded at the university in 1919, and the Geological and Meteorological Institutes were also established after the War. The new rampart below the Matthias Church, on the heights of Buda, with a bronze statue of St. Stephen, commands a magnificent view of the river and of the city. At the northern extremity is the new building of the National Archives.

Work on the reconstruction of the docks was started in 1922, and in the following year capital was obtained from a French syndicate to enable it to be carried forward on a larger scale. The city lives chiefly by its milling industry, which has a capacity greater than that of any other European city, but owing to the high import duties on grain coming into Hungary and the unwillingness of the former customers of Hungary to accept their cereal imports in the form of flour, the industry was seriously depressed. In Feb. 1925 it was still only working up to 25% of its capacity.

Owing to the policy of high protection adopted by the Hungarian Govt. to counter the commercial hostility of the other succession states a number of new industries have arisen in and around Budapest, notably in the textile and chemical trades. The machine industry, which worked at full power during the War, employed 50,000 workers in 1923, but the numbers have since declined. Budapest was, though in a less degree than Vienna, a great financial centre for southeast Europe, and the cessation of financial business brought ruin to many great houses. The position began to improve after the financial reconstruction of 1924. In Jan. 1925 an International Committee of Enquiry met at Basle, by agreement with the Budapest authorities, to examine the financial position of the city in the interests of the bondholders. It was agreed that £140,000 raised by taxes on tramway tickets and electric-light supply should be paid in 1924, and £168,000 in 1925.

BUDDHISM (1) (*see* 4.742).—The rivalry between Hinduism, Buddhism and Jainism quickened each religion to fresh efforts, in order to retain its own people, to win others, and to secure for itself a dominating position in India. This triangular struggle is one of the most important and significant facts in the religious

[1] The figures in parantheses in the article BUDDHISM refer to the bibliography at the end.

history of India for over a thousand years; but it does not take a prominent place in the earliest records.

What the Buddha preached was a system of teaching and discipline whereby, he affirmed, men could win *release* from transmigration, karma, and all the bonds of this world; and he had two groups of disciples, viz., monks and nuns. He also made friends with the laity wherever he went; gave them excellent advice with regard to their daily lives and their political troubles; and from them he received very large help in various ways; but he formed no new lay religion for them. They adored the Buddha, and listened gladly to his teaching but they remained in Hinduism (2).

His death and the stupas in which his relics were enshrined probably led to the beginnings of actual worship within Buddhism. What is clear is that, as the years passed, the monks drew the laity nearer to themselves; and there gradually grew up a sketchy system which bound the layman and his family to the local monastery and provided them with a simple form of worship and a few rules for their lives as Buddhists. Perhaps the largest element in the new organisation was the provision of Chaityas, or halls of worship, adorned with small stupas and other symbols of Buddhist faith, in which monks and laymen worshipped together.

Asoka, Maurya emperor of the 3rd century B.C., ruling three-fourths of India and a huge slice of territory to the west of the Indus, became a Buddhist early in his reign, and strengthened the religion of his choice not only by great buildings and monuments erected for it, and by large administrative arrangements he made to help it, but also by his royal example and the propaganda of his edicts, set up all over his dominions. He is the greatest of Buddhist laymen.

The belief that the Buddha, "the Enlightened One," was the crown of humanity, coupled with the doctrine of transmigration, necessarily created the belief that he had gradually risen to perfect knowledge and supreme character in a long series of lives previous to the culminating life. Since, during those previous lives, "bodhi," *i.e.*, enlightenment, was believed to have already been the basis of his nature, his followers spoke of him as *The Bodhisattva* down through the ages to the moment of his full enlightenment under the Bodhi tree.

Innumerable tales of the Buddha during his lives of preparation appeared; and in each his sympathy with men and animals, his unbounded liberality and his readiness to serve and to suffer were painted in glowing colours. All this appears in the Jātakas and later in the Avadānas.

Since truth never changes, Buddhists argued that there must have been other Buddhas in previous ages, who taught precisely the same truth which Gautama taught; and, necessarily, in future ages, other Buddhas would emerge with the same message. Thus Gautama is only the latest of a series of Buddhas, which stretches far back into the past and will stretch far into the future; and there must be Bodhisattvas in existence now, who in later ages will appear as Buddhas.

Unity in belief and teaching was not fully maintained. There were numerous variations within the Church; yet all Buddhists continued to worship together in the Chaityas. These divisions were, however, so deep as to be called sectarian differences; and they became more prominent as the years passed. In the teaching of some of these sects we meet the beginnings of systematic philosophy among Buddhists. The most important of the groups are the Vibhajyavadins of Ceylon and the Sarvastivadins, the Sautrantikas, and the Mahasanghikas of India (3).

Each sect had its own literature. Of those which have survived, at least in part, the literature of the Vibhajyavadins of Ceylon is in a literary dialect called *Pali*, while the other literatures are in Sanskrit or what is known as *Mixed Sanskrit*, *i.e.*, Sanskrit with an infusion of vernacular words and phrases, varying in the several sects. The common memorised tradition of the life and teaching of the Buddha and the early history of the movement assumed a more or less divergent form in each sect. The Pali canon alone has survived in completeness; of the others only portions, large or small, have come down to our days (4).

Round about the Christian era Buddhists began to use images in their worship; and during the first century A.D., in the province of Gandhara, both west and east of the Indus, where there were still many Greeks, images of the Buddha of great dignity and beauty were created by Greeks or men trained in Greek ideas and methods (5). Thus the simple cult of the Chaityas was transformed into temple-and-image worship.

Then, towards the end of the first century A.D., all these movements culminated in the creation of a new Buddhism called "The Mahayana," *i.e.*, the Great Vehicle. Clearly, there was already within the Church a large and growing party who were convinced that the old discipline was not enough, that the ancient religion of India, founded on the great and impregnable rock of the Hindu laity, was far too strong for Buddhist monasticism.

Therefore, the Buddhas and the Bodhisattvas (6) became the Buddhist pantheon, and lofty temples of noble architecture were built for their worship. A rich liturgy of great beauty was formed to accompany a new ritual as gorgeous, as attractive, as emotional as anything that Hinduism could show. Priests and acolytes, incense and music, banners and processions completed the spectacle. The Buddhist temple thus became a dangerous rival to the Hindu temple.

The new system appealed powerfully to the laity. Three noteworthy features are to be noticed:—

a. They were taught to cultivate rich devotional feeling, *bhakti*, for the Buddhas and the Bodhisattvas.

b. They were told that the monastic life was no longer necessary for the attainment of the highest spiritual ends. Married men and women were urged to enter on the new discipline by taking the vow to toil towards Buddhahood, in imitation of the great Bodhisattva. Asceticism was unnecessary; the family and society were the best training ground for the spiritual life. Love, sympathy, service were far more powerful than austerities. The taking of the vow at once transformed the devotee into a *Bodhisattva*.

c. A new philosophy was taught, which each *Bodhisattva* was urged to study, viz., *Sunyata*, the philosophy of the emptiness of all things.

A very large, varied, and attractive literature was also created which did much to strengthen the new Buddhism. One of the earliest and most influential of these books is the *Saddharma Pundarika*, "The Lotus of the True Religion," which is the Buddhist *Gita*. The Mahayana thus gave Buddhism a great uplift.

While the Neo-Buddhists spoke of their own system as the *Mahayana* or Great Vehicle, they depreciated the old monastic discipline as the *Hinayana*, or humble vehicle. But, although the Buddhist community thus became organised in two distinct churches, each with its own characteristic worship, teaching and discipline, there was no absolute separation. Multitudes of the laity did not definitely join either side; and, in the universities, the two parties worked side by side in kindly harmony.

At a later date, possibly about 500 A.D., another type of theology and practice appeared in Buddhism, viz., Tantrism, *the adoration of goddesses*, accompanied by much magic and superstition and a good deal of eroticism. This is the culmination of the Hinduising of Buddhism. A large literature accompanied this movement also.

In spite of the new vigour released in the Mahayana, Hinduism proved victor in the age-long fight. By the 7th century A.D., it could be seen that the struggle was practically over.

But meantime Buddhism, partly in the Hinayana form, but chiefly as the Mahayana, had spread to most parts of Asia. To the west of India Buddhist propaganda failed altogether, but southwards, eastwards, and northwards vast numbers of people passed into the Church. In Ceylon, Burma, Siam, and Cambodia, it is the Hinayana form that is professed; in Korea, China, and Japan both are held, the Mahayana predominating; while the Buddhism of Nepal, Tibet, and Mongolia is the Mahayana with a considerable infusion of Tantrism (7).

A large selection from Hinayana, Mahayana, and Tantrik literature was translated into Chinese and was at later dates printed

and published under the care of the Government. This canon contains 1,662 distinct works (8). In Tibetan a canon was formed of Mahayana and Tantrik works, consisting of 1,083 distinct books. It is called the *Ka-gyur*. A supplementary group of books is called the *Tan-gyur*. This mass of Tibetan translations was, at a later date, translated into Mongolian (9).

When a knowledge of Buddhism was first brought to Europe, it was received in Britain, Germany, America, and elsewhere with great enthusiasm; and societies were formed in a number of centres for the practice of the religion. In Britain and some other lands the movement has weakened, but in Germany and elsewhere there are still many Neo-Buddhists.

In Buddhist lands in Asia, Christian missions and western education led, at the outset, to a certain amount of scepticism and criticism of Buddhism; but in recent years Buddhists have developed fresh scholarship (10), and numerous societies for the exposition and defence of the religion have been formed. The movement is specially noticeable in Ceylon and Burma, in China and Japan.

Buddhist scholarship in Europe reached a climax during the last decade. The publication of the Pali canon has been completed; and a large number of the books of that collection have been translated into European tongues. Great progress has also been made with the publication of Mahayana and Tantrik texts and translations, while several great works by European scholars at last enable the student to understand clearly the historic movement of Buddhist thought and the real significance of the philosophies of the Mahayana.

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The whole history of Buddhism is now known in outline; large masses of its literature are available in MSS., and a considerable percentage have been published. Many works have been translated into European languages, and a large historical and expository literature has appeared in Europe and America. The whole of this literature, as it existed in 1912–3, is discussed and catalogued in Winternitz, *Geschichte der Indischen Litteratur*, 2., 1., 1913. A sketch of the whole, published seven years later, may be found in Farquhar, *An Outline of the Religious Literature of India* (1920). (J. N. F.)

BUDENNY, SIMEON MIKHAIL EVICH (1876–), Russian soldier, was born in southern Russia, the son of a farmer of the Cossack country. He entered the Russian Army in 1903 and rose to be a non-commissioned officer. In 1917, after the Revolution, he was elected president of the divisional soviet of the Caucasian troops. He did not join the Communist party until 1919, but soon after the beginning of the civil war found himself in conflict with the Whites and, with only a few friends and relations, began to wage guerilla warfare against the Cossacks in the district. His forces increased and early in 1918 he joined the Red army. With the nucleus of his own men he organised the Red cavalry, and after a rapid series of promotions became commander of the first cavalry army. In this capacity he took an active part in the operations against Wrangel and in the Polish War (1920). He eventually became chief of the Red cavalry and was a member of the military revolutionary council of the Soviet Union.

BUDGET, NATIONAL (*see* 4.750).—The most important condition to be attached to a budget is that it shall be a comprehensive statement of revenue and expenditure during the financial year, preferably in comparison with corresponding data for the preceding year. If important items are omitted, it is obviously impossible to obtain a complete review and a clear grasp of the financial position as a whole. A glance at a summary table should reveal whether there is a genuinely balanced budget or a deficit to be provided for. The practice of special accounts is only too often an expedient to conceal a deficit. In the years 1919–24 France, Switzerland and several other countries, charged various extraordinary items of expenditure to accounts outside the general budget, and protracted calculations were needed to arrive at a consolidated statement in either case. In the two countries mentioned the budgets for 1925–6 have contained tables showing total expenditure, and their Governments have not only expressly condemned the former methods but have undertaken to indicate in future budgets the total estimate of expenditure for the financial year.

I. GENERAL CONSIDERATIONS

The condition that the budget should include all items of revenue involves a plea for so-called gross budgeting, *i.e.*, that the special receipts collected by a service, such as court or hospital fees, and not merely the expenditure after reduction by reason of those receipts, should be accounted for. The converse system of net budgeting does not reveal the total expenditure on account of the several services. Most countries have adopted in principle the system of gross budgeting, but there are frequent illogical exceptions. The British method of stating both gross and net expenditure has the advantage of showing the total expenditure as well as the appropriations to be made from general revenue funds obtained principally from taxation. The budget figures reviewed in the budget speech by the Chancellor of the Exchequer and habitually quoted in Great Britain are the net figures with the exception of those of the Post Office, for which gross receipts and working expenses are shown.

Public Undertakings.—Special problems arise with regard to public undertakings of a quasi-commercial character (such as railways, naval dockyards, etc.) and to funds constituted for special purposes (*e.g.*, for granting loans at a reduced rate of interest to farmers or to shipping companies, etc.). It is generally thought desirable to separate the accounts of public undertakings from the general budget. The general budget becomes less clear if railway receipts and so on are permitted to swell the figures, and on the other hand these undertakings should be free to adopt a form of accounting on strictly commercial lines which are more complicated than the usual form of state accounting. It has sometimes been proposed that all public services should adopt the principles of commercial or cost-accounting. It would, of course, be ideal to know the exact cost of each administrative and combatant unit, but the system of commercial accounting when applied to all branches of the administration has proved to be complicated and expensive, and, moreover, to necessitate a great number of more or less arbitrary estimates (*e.g.*, rental value of state owned barracks). After the War cost accounting was introduced in many branches of the British Army, but in accordance with a decision taken in July 1925, the govt. announced that, subject to the approval of the Public Accounts Committee, it was proposed to discontinue the cost-accounting method in all save operative establishments (*i.e.*, laundries, electrical departments, bakeries, etc.). The practical method would seem to be that of applying cost-accounting to all quasi-commercial undertakings and to other services which delegate wide discretionary powers to the official in charge or are administered by bodies not directly subject to permanent Treasury control. If, however, certain accounts are kept separately from the ordinary budget accounts should there not be a link between the former and the latter? Generally there is such a link. The net proceeds resulting from the operations of the undertakings or the appropriations required to meet their deficits, as the case may be, are included in the general budget accounts (Austria, Czechoslovakia, Denmark, Sweden and the United States); but in certain countries (Switzerland and the Union of South Africa) the state railways have independent budgets.

To the latter system the objection may be raised that a deficit is less conspicuous in a special budget than when included

in the general budget to be covered at the expense of the taxpayer. To indicate the impossibility of generalising in this field, it may be mentioned that public undertakings of the Netherlands are treated in three different ways:—

(*a*) The state railways are run by two companies, in which the state owns shares.

(*b*) The post, telegraph and telephone services and some other undertakings are worked as independent concerns, net figures of surplus or deficit being carried to the general budget.

(*c*) The state mines are treated as ordinary government departments, the gross receipts and working expenses being included in the general budget.

The question of commercial accounting for public undertakings is often connected with a modern tendency to grant them the status of autonomous concerns, so that their management is more or less independent of the general political administration. It is thought that such a system facilitates the introduction of strictly commercial methods of calculation and reduces undue political interference, but the fact should not be overlooked that it also reduces the possibilities of Parliamentary and Treasury control. No doubt the growth of state activities of a socialistic character creates new constitutional and budgetary problems, and in many countries these problems have been studied by select public committees, among the reports of which that of a Swedish committee on railway management, published in 1924, is perhaps particularly noteworthy.

When funds are constituted for special purposes, these funds are often kept quite independently of the general budget. A road fund, a land settlement fund, may be drawn upon as long as there is any unexpended balance available. It is only natural that the system of distinct funds should prevail in new countries in process of rapid development, like Australia and New Zealand. But the practice leads to obscurity and thus involves dangers. The same objection may be raised, to a certain extent, to funds constituted for social insurances; in what way these funds may be linked to the general budget is, however, at present a very knotty problem.

Classification.—It seems almost self-evident that revenue and expenditure should be classified according to logical principles so as to permit of rational analysis and discussion of the problems which arise. In practice all kinds of difficulties present themselves. The fact that budgets are legal documents having a certain binding character introduces many mystifying complications. If, for instance, a distinction must be made between appropriations which are permanent and those which must be voted annually, between appropriations which may be exceeded by the Govt. and those which may not, or between sources of revenue subject to differing constitutional procedure, such a distinction, if shown in the budget, may completely upset a rational system of accounting for purely informative purposes. The Govt. of the United States, therefore, separates the budget from the Acts of revenue and appropriations and publishes the estimates and the statutes in different documents. In the British budget a very curious development has taken place, viz.: that details of estimates, presented for information only, have acquired by custom a binding force (*see* R. G. Hawtrey, *The Exchequer and the Control of Expenditure*, p. 59, 1921).

In many countries (Czechoslovakia, Germany, Rumania, etc.) the revenue side of the budget is grouped according to the various branches of administration responsible for the collection of receipts so that tax-revenue, for instance, is shown in the Ministry of Finance, together with various administrative receipts; surpluses from government undertakings in the Ministry of Communications. In other countries (Denmark, United Kingdom, Finland, Italy, Sweden, United States of America and the British Dominions) revenue is classified according to its nature (tax and non-tax revenue, income tax, customs and excise duties, etc.). The latter system shows more clearly and undoubtedly more quickly the facts of primary interest, and is more easily understood.

The expenditure side, on the other hand, is almost necessarily grouped according to organisation units, although this method is often combined with a secondary classification according to objects of expenditure (*e.g.*, an appropriation is given for a certain purpose in a lump sum which is not distributed among the various departments concerned). In most countries the character of the expenditure (whether ordinary, extraordinary, capital outlay or current expenses) is permitted to influence the classification. If the classification is not determined by one basic principle, the result is only too often obscurity and confusion.

In the British budget the historical division of expenditure items into Consolidated Fund Services and Supply Services is hardly logical, but the defect is of small practical importance since almost the whole of the Consolidated Fund expenditure consists of the Debt Service, the Road Fund and the Local Taxation Account. The Supply Services are grouped under administration units and the system is often praised for its clearness. But in England sums may be issued under special Acts for capital improvements (*e.g.*, the extension of the telephone system or the erection of public offices). These issues form the nearest equivalent to a capital account or an extraordinary budget in the British financial system.

In the Swedish budget a primary distinction is made between current expenditure and capital outlay (the latter term employed in a very restricted sense) so that it is clearly shown how much is expended for current requirements and how much investments which will yield a return in the future. In the United States budget current expenditure and constructions are shown as sub-headings of the primary divisions according to organisation units. In the British Dominions great prominence is generally given to the distinction between current and capital expenditure.

Extraordinary Expenditure.—On the European continent budgets are often divided into ordinary and extraordinary, but these terms are unfortunately used in widely different senses. In Germany the extraordinary budget originally included only capital expenditure, which term, however, was employed to comprise military and naval constructions also. Since the War reparation payments have been accounted for as extraordinary expenditure; moreover, in the ordinary budget there is a special distinction between permanent and non-recurrent expenditure. In Czechoslovakia the extraordinary budget comprises exceptional expenditure, but not capital outlay, while in France and Belgium the extraordinary budgets include both capital expenditure and other more or less non-recurrent expenditure. It is maintained that the whole conception is dangerous, as it may mislead the public into believing that extraordinary expenditure may properly be covered by proceeds of loans instead of by the yield of taxation. In the budgets of Austria and Hungary the League of Nations has insisted upon obtaining a clear statement of capital expenditure for strictly productive purposes, and has disregarded the distinction between ordinary and extraordinary expenditure. It is extremely difficult to strike a proper line of division between permanent and non-recurrent items. Even appropriation to alleviate hardships caused by earthquake may become a fairly regular item in the budget, as, for instance, is the case in Italy.

Subsidiary Tables.—If a budget is drawn up on fairly simple lines it may be necessary, and is greatly to be advised, to provide full explanation and recalculation in subsidiary tables, which, for instance, might show the amounts expended for certain purposes (say education) by different administrative branches (ordinary schools in the Ministry of Education, agricultural schools in the Ministry of Agriculture, technical schools in the Ministry of Trade, etc.). These tables might also attempt to evaluate, in the case of each department, what provision is made for it in other notes (*e.g.*, postal services, stationery, local rates). It is really a question rather of supplying information than of classifying expenditure in the budget. Whatever method is adopted, it is of much importance that there should be continuity of practice, successive changes greatly prejudicing comparisons from one year to another and—even worse—causing the real position of the country's finances to be misunderstood. In some European countries scarcely a year passes without some change in the system.

The Cash and Accruals System.—In some countries the yearly accounts comprise the amounts actually expended and the revenue actually collected in the course of a given year (England, Sweden). In other countries, which have adopted the system of accruals, the accounts comprise the amounts which had been legally incurred, so that claims against and revenue acquired by the Treasury are shown irrespective of the time of the actual payments or collection of revenue. The main advantage of the second method, which corresponds to private accounting practice, is that it takes into account unpaid bills, which a reckless Government may leave behind it, and it is thought to facilitate

detailed parliamentary control. On the other hand, accounts on an accrual basis do not show the amount to be collected and to be spent in a given period of time, which is an important consideration for the banking community. It is not surprising to find that England has adopted the cash system. This system can only work well, however, if the English rule is firmly established: that the normal course of business shall determine the date of payment without any manipulation. Under the cash system the monthly statements of revenue and expenditure may more easily be compared with the yearly budgets. An important feature in the budget system of a country is the publication of closed accounts with the least possible delay after the financial year ends, as these accounts form, after all, the only sure basis for judging of the soundness of the budget estimates. The closed accounts often include a valuable review of the capital wealth of the state, total liabilities, etc.

II. POST-WAR CONDITIONS IN VARIOUS COUNTRIES

Great Britain.—In Great Britain the most important change in the budget system since the War is represented by the attempts to introduce so-called cost accounting, which were not entirely successful (*see* above). In the House of Commons, Mr. Asquith on several occasions criticised the inclusion of proceeds of the sale of War stocks as current revenue in the budget; he urged that these proceeds should have been separated from the budget-accounts and devoted exclusively to debt redemption. During the period 1920–5, however, more than £700,000,000 of public debt have been so repaid.

In Sweden the proceeds of sale of stocks held by certain war commissions were handed over direct to the Public Debt Commissioners for debt redemption.

United States.—In the United States a very noteworthy reform of the budget system was introduced by means of the Budget and Accounting Act of 1921. Before that year there had been no attempt to consider the problem of government financing as a whole. The Secretary of the Treasury when submitting estimates to Congress had acted as a mere compiling authority; he had no power to modify the proposals transmitted to him by the heads of the administrative departments. The President, although legally entitled to secure co-ordination of the estimates, had no service at his disposal through which he could effectively exercise his authority. There was no budgetary message, no balance sheet, no collection of summary, analytical or comparative tables. In Congress there was also division of responsibility. Revenue and expenditure were considered by different committees; provisions for expenditure were made by passing 13 general appropriation Acts emanating from no less than 9 different committees. All this was radically changed in 1921. The President was charged with the preparation of the budget estimates to be transmitted to Congress. The budget must include analytical statements and comparative tables, data relating to public debts, etc. If a deficit is foreseen, the President has to make recommendations for new taxes, loans or other action, and he may likewise make proposals as to the utilisation of a budget surplus.

To assist the President in his task a Bureau of the Budget has been established in the Treasury Dept., under a director responsible to the President. No department may submit an estimate or a request for appropriations directly to Congress, if not specifically requested to do so by a competent committee of Congress. The procedure in Congress was reformed by the appointment of a strong committee on appropriations in the House of Representatives. The results obtained during the first four years' working of the new system were highly satisfactory, and were most conspicuously evidenced by the considerable savings in expenditure, which have led to reduction in taxation. There are very few administrations for which budgetary data are available in so clear and concise a form as that of the Federal Administration of the United States.

France.—In France the numerous special expenditure accounts existing after the War were gradually discontinued during 1922–4 and in 1925 a comprehensive budget was prepared, but the problems connected with the reconstruction of the devastated districts, the army of occupation and the reparation recoveries from Germany still cause some confusion in the budget system. Closed accounts have not been published for any post-War financial year, but monthly figures of actual revenue and expenditure are published by the Ministry of Finance.

Germany.—In Germany the budget estimates were submitted to the Reichstag by the prescribed date in both 1925 and 1926, but the votes were delayed, the budget for the financial year March 30 1924–April 1 1925 being finally voted on Aug. 9 1925. In several instances payments were made on the basis of authorisations not incorporated in the budget. Monthly figures of revenue and expenditure, however, are published with great promptitude.

Italy.—In Italy where public accounting ranks almost as a special science, monthly returns of revenue and expenditure are published regularly and closed accounts were available for post-War years without delay. The accounting system was simplified to a certain extent, the central powers of the Treasury having been strengthened and established on lines similar to those of the British Treasury.

Miscellaneous.—By means of the reconstruction schemes it has drawn up and put into operation and the control it has exercised in Austria (*q.v.*) and Hungary (*q.v.*) the League of Nations has had a definite influence on the budget systems of those countries. The reforms which have been introduced in Austria and Hungary have been studied by different countries in Europe, and their importance as an example to be followed already begins to become evident.

The diversity of system obtaining in different countries makes it very difficult to establish international comparisons. The question of international financial statistics was discussed by the International Statistical Institute at The Hague before the War. In connection with the Brussels Financial Conference of 1920, a memorandum of financial data was prepared, and the Secretariat of the League of Nations has issued two further volumes on public finance. These memoranda are not intended primarily to give directly comparable data—but to furnish sufficient information concerning the budget systems to enable the reader to understand the figures presented. An attempt has been made to prepare summary tables of total expenditure and revenue, to show the budget surpluses or deficits of the several countries and to give statements of foreign and domestic debts. The League has also published in the Armaments Yearbooks statistics of defence expenditure in different countries, which furnish material indicating the development and tendency of defence expenditure in each individual country.

The Dawes Report contains a digression on the subject of comparing tax burdens, but does not go very much farther than reviewing the difficulties. Obviously no complete picture can be drawn without taking into consideration local budgets, which raises a new set of problems, as local, even more than state, finance is concerned with public undertakings of a quasi-commercial character (gasworks, public baths, etc.). The urgent financial problems awaiting solution in almost every country have stimulated inquiry in this field of research by government bureaux, private associations and individual students of finance and economics.

See also the sections on finance under the headings GREAT BRITAIN, GERMANY; UNITED STATES, etc.

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BUENOS AIRES (*see* 4.752) continued to rank in 1925 as the largest city in South America and the fourth largest in the Americas, being exceeded in population only by New York, Chicago and Philadelphia. An official estimate of April 30 1925 placed the population at 1,850,718, an increase of 274,904 since the national census of 1914.

The celebration of the country's centenary in 1910 in Buenos Aires attracted many visitors, not only from Argentina but also from abroad. In 1913 new diagonal avenues were begun, the plan being to change the rectangular pattern, previously followed, by cutting diagonal avenues through the city on the model of Washington and Paris. Work on the two chief thoroughfares, radiating

from the corners of the central Plaza de Mayo, though interrupted by the World War, was far advanced in 1925, and did much to relieve the traffic congestion in the centre of the city. The project involves also the widening of alternate streets from the river and the demolition of many of the older parts. The parkway lying between the city proper and the Rio de la Plata was greatly improved during the period 1910–25; much land was reclaimed from the river, and a post-office and custom house were erected on this parkway, adding greatly to its beauty.

The city has been further beautified by the centenary gifts of various nations to Argentina; these include the handsome clock tower erected by the British colony at a cost of £50,000 opposite the new railway station opened in 1916, the largest in South America; the statue of George Washington erected in Palermo Park by the U.S. colony; and statues from the Spanish, French, Syrian and other foreign communities. The Congress building was finished in 1912, the park in front of it, the Plaza del Congreso, having been opened for the centenary celebrations in 1910.

Buenos Aires, transacting approximately 80% of the entire foreign trade of the republic, is the busiest port in Latin America. As the industrial and banking centre of the country, it has benefited by the protective tariff, through the aid of which a large number of factories have sprung up in and near the city. Branches of U.S. and European factories also have been established there, manufacturing chiefly textiles, hosiery, and small iron and steel articles. A branch of the National City Bank of New York was established in Buenos Aires in 1914, an example since followed by several other U.S. banks, including the First National Bank of Boston which, in 1924, opened there the largest office building in Latin America. Other improvements during the period 1910–25 were the erection of a number of modern hotels and apartment buildings and of a greatly improved immigration station, through which pass about 90% of the republic's immigrants; the opening of some 80 new parks and plazas; the construction of a new subway; and the expansion of the University of Buenos Aires. (C. L. C.)

BUFFALO (*see* 4.754).—The population in 1920 was 506,775, an increase of 83,060 or 19·6% for the decade. The state estimate in 1925 was 538,016. The population of the metropolitan district in 1920 was 602,847, and the area of the city is 42·89 sq. miles.

Administration.—Since Jan. 1 1916 the city has been under commission government. The citizens choose by direct non-partisan nomination and election a mayor and four councilmen. These constitute the sole municipal legislature and are also the chief executive heads. The mayor, *ex officio*, heads the departments of Fire, Police, and Health, which comprise the Department of Public Safety. The four other departments are Finance and Accounts, Public Works, Parks and Public Buildings, and Public Affairs, each in charge of a councilman. The principal subordinate officials are nominated by the mayor and appointed by the Council. The mayor has a vote in the Council, but no veto power. Ordinances and appropriations, outside ordinary city expenses, may be referred to vote of the people on petition of 5% of qualified citizens. The city completed in 1915 a new pumping station and tunnel 6,500 ft. long, by which water is brought from Lake Erie. The capacity of the plant is 150,000,000 gal. each 24 hours. A filtration plant at a cost of $4,000,000 was completed in 1926. The schools are under a Board of Education appointed by the mayor and council, but subject mainly to state laws.

University Developments.—The University of Buffalo acquired a new site of 106 ac. in the northern part of the city to which 44 ac. were added in 1919 and in 1920 an endowment fund of $5,200,000 was raised by popular subscription. Other important gifts have been received and rapid expansion has begun. Samuel P. Capen became chancellor in 1922. A unique gift provides for the conferring by the university annually of a civic medal to the citizen of Buffalo who is adjudged to have done the most distinguished service to the community and the world. The first medal was given in 1924 to Bishop Charles H. Brent, delegate of the United States to the international opium conference. Canisius College (Jesuit) raised, by popular subscription, an endowment fund of $1,000,000 in 1920, and was again greatly enlarged in 1924–5. D'Youville College for women (Roman Catholic) was opened in 1908.

The new City Hospital in Buffalo and the J. N. Adam Memorial Hospital for tuberculous patients at Perrysburg, N. Y., are maintained by the city. Important new buildings are the Statler Hotel, Liberty Bank, and the Walbridge, Genesee, Marine Trust, Athletic Club, General Electric, and New York Telephone buildings.

Commercial Importance.—Located at the foot of Lake Erie, Buffalo's waterborne commerce makes her the second greatest inland port in the United States and one of the ten greatest in the world. There are 37·4 m. of water frontage. The New York State Barge Canal gives water transport to the seaboard for barges up to 2,000 tons capacity. Eleven main railway lines also make the city an exceptional centre of land transport. The greatest growth in recent years has been in manufactures, particularly flour, iron and steel, and rubber products. Its proximity to Niagara Falls enables the city to depend largely on electric power obtained therefrom.

War Record.—Buffalo furnished over 10,000 volunteers and selected service men to the U.S. Army in the World War. The greater number of these served in the 77th and 78th divisions and had an active part in the Argonne and other battles. In addition, the 74th Infantry, N.G.S.N.Y., became the 108th Infantry in the U.S. service; the Third Field Artillery, N.G.S.N.Y., became the 106th Field Artillery; Troop I., N.G.S.N.Y., became the 102nd Trench Mortar Battery, and Base Hospital No. 23 was recruited in Buffalo. The 108th Regiment, forming a part of the 27th Div., participated in the breaking of the Hindenburg line, Sept. 29—Oct. 1 1918 (*see* VICTORY, ADVANCE TO). The 106th Field Artillery and the 102nd Trench Mortar Battery were in the battle of the Meuse-Argonne. Nearly 4,000 Buffalo men served in the Navy and about 1,000 in the U.S. Marine Corps. (M. M. W.)

BUFFALO: *see* BISON.

BUKOVINA, a province of Rumania, formerly included in the Austrian Empire. Its area is 4,030 sq. m.; population, 819,230.

According to the official census of the Austrian authorities made in 1910, taking the language spoken as the criterion of nationality, the total population of Bukovina numbered 794,930 inhabitants consisting of 273,250 Rumanians, 305,000 Ruthenians, 168,850 Germans (of whom 102,920 were of the Jewish faith), the rest being composed of Poles, Hungarians and Czechs. Rumanian statistics for 1923 give the population of Bukovina as 819,230, divided as follows:—Rumanians 365,000, Ruthenians 251,000, Jews 128,000, Germans 47,000, Poles 16,000, the rest being composed of Hungarians, Czechs and Slovaks.

The preponderance of Ruthenians over the other nationalities explains the policy of " Ruthenisation " adopted by the Austrian Govt., against which the Rumanian element rose to defend their nationality in 1848. In 1910 universal suffrage with secret polling was introduced into Bukovina, and by this means the Ruthenians were assured of a large number of representatives both in the Bukovinian Diet and in the Parliament in Vienna, where the Rumanians with their five Deputies formed the smallest national group in the Chamber.

Political History.—Upon the collapse of the Austro-Hungarian Empire in Oct. 1918, the last governor, Count Etzdorf, before leaving Bukovina, placed the administration of the province in the hands of the Ruthenians. For the space of four days the utmost anarchy reigned. Then, to put an end to the danger of revolution and Bolshevism that threatened the province, the representatives of the Rumanian population held a meeting on Oct. 27 at Cernauti, and proclaimed a Constitutional Assembly, which voted the union of Bukovina within her historical boundaries with the Kingdom of Rumania. In consequence, the Assembly applied to the Rumanian Govt. at Jassy for the help of Rumanian troops, which made their entry into Cernauti on Nov. 11 1918.

Administration.—For administrative purposes Bukovina is divided into five Districts, each district being placed under a

prefect appointed by the central administration at Bucharest. The official language of the administration, of the law-courts and of instruction is Rumanian. Schools for minorities, with teachers paid by the Rumanian state, are established in those centres in which the majority of the population is non-Rumanian. In these schools the language of the respective minority is used, the only obligation being that Rumanian should also be taught.

Production.—The abundance of raw materials and especially the extraordinary wealth of the province in forests (which cover 470,000 hectares of the total area of 1,040,290 hectares), and water-power place Bukovina in an exceptionally favourable position from the point of view of industrial development. In addition to the already existing brewing and milling industries, a number of new industries have been established since 1918. There are five factories for the manufacture of furniture, parquet flooring and modern joinery. The large production of potatoes has given a strong impetus to the distilling industry, and owing to the neighbourhood of Bessarabia a leather and a wool industry have sprung up. Since 1921 eleven knitting- and weaving-mills have been created, while the bacon and ham industry is in a very flourishing state.

Communications.—Being placed on the international railway line which links central Europe with Bucharest and Constantsa, Cernauti is the principal transit centre between Rumania and Poland, Czechoslovakia, Austria and Germany, and the export centre for the chief products of Bukovina (timber, horned cattle, pigs, spirit, eggs, etc.). Moreover, owing to the re-opening of the old ways of communication between northern and southeastern Europe, which before the annexation of Bukovina to Austria in 1774, passed through Cernauti to the Black Sea, the province has—in spite of repeated invasions and devastations during the War—been able to recover economically with remarkable rapidity. (G. Bo.)

BULAWAYO (*see* 4.771).—This town of Southern Rhodesia had a population (1921) of 6,831 compared with 3,840 in 1904. It retains its position as the chief commercial and railway centre of Southern Rhodesia. The public and business buildings are, for the most part, handsome and substantial. The museum, opened in 1910, has a large collection of objects taken from Zimbabwe and other ancient sites. There are good public primary and high schools. The Rhodes estate, five miles from the town, is now a government experimental farm (115,000 acres). Bulawayo is the best place from which to visit the Matopo Hills. Here, at a spot some 30 m. from Bulawayo, the body of Sir Starr Jameson, brought from England, was, in 1920, buried near the grave of Cecil Rhodes.

BULGARIA or BLGARIYA (*see* 4.772), a country of south-eastern Europe. The area is 39,814 sq. m. and the estimated population (1920) 4,846,971. For the changes in boundaries *see* NEUILLY, TREATY OF, and below.

I. POLITICAL HISTORY

The condition of Macedonia and Thrace, which had always been a source of anxiety for Bulgaria, became even worse under the Young Turks. Serb propaganda here had greatly increased since the return of the Karageorgević dynasty in 1903 and the definite triumph of the Radical party. Rival bands of Serbs, Greeks, Bulgars, Wallachs, Albanians and Turks carried on their respective propaganda in Macedonia by force of arms, and the life of the peasants became unbearable. Menace of war with Turkey, and, latterly, with Greece and Serbia, entailed a military expenditure on Bulgaria, which in 1909 was proportionately higher than that of any European state. Bulgaria had, moreover, to support thousands of destitute refugees who had escaped from Turkish territory in fear of a general massacre.

The Balkan Alliance.—In March 1911 the Malinov Cabinet fell, and Gueshov, head of the Nationalist party, became Presi-

dent of the Council. Balkan statesmen at last began to realise that only joint action could put an end to Macedonian troubles. In 1910–11, negotiations were opened at Athens between Bulgaria and Greece. The first steps took the form of private conversations between J. D. Bourchier, principal correspondent in the Balkans of *The Times*, London, and Veniselos. Eventually, Veniselos entrusted Bourchier with the transmission to King Ferdinand of a definite proposal, which was known only to King George, Veniselos and Bourchier. On May 29 1912 a secret treaty of defensive alliance between Bulgaria and Greece was signed in Salonika.

Negotiations with Serbia proved difficult. The Bulgars desired autonomy for Macedonia; the Serbs held out for a division of Macedonia into an uncontested Bulgarian and an uncontested Serbian zone, with a third zone, on which the Russian Tsar was to arbitrate. By the treaty finally signed in Sofia by Gueshov and the Serb Premier Milanović on March 13 and supplemented by the secret military conventions of Varna, May 12 and July 12, Serbia recognised "the right of Bulgaria to the territory east of the Rhodope mountains and the river Struma;" while Bulgaria recognised "a similar right of Serbia to the territory north and west of the Šar mountains;" if autonomy for the rest of Macedonia proved impossible, an agreed line from Goleš Mountain to Okhrida was to be accepted, subject to the Tsar's approval. Hartwig, the Russian Minister at Belgrade, had kept his government informed throughout. Early action was necessary in view of the approaching end of the Italo-Turkish War and the unrest in Macedonia. The Great Powers endeavoured to prevent war by the tardy offer of a guarantee for the autonomy of Macedonia. The Balkan Allies mobilised on Sept. 30. On Oct. 8, Montenegro, with which country no formal agreement had been made, declared war on Turkey. On Oct. 13 the Balkan Allies sent an ultimatum to the Porte; on Oct. 17 Turkey declared war on Serbia and Bulgaria; on Oct. 18 Greece declared war on Turkey.

First Balkan War, 1912–3.—The war with Turkey was popular, for the Bulgars, though they are usually deemed self-centred and materialistic, had felt the sorrows of their kinsfolk in Macedonia as their own, and were prepared for any sacrifice to set them free. The success of the campaign, though it showed once more the admirable qualities of the Bulgarian soldier, was less complete and brilliant than at first appeared. Although, after five weeks' fighting, the position seemed everywhere favourable to the Allies, the Bulgarian troops had suffered greatly from deficiencies in both medical and supply services, and casualties had been very heavy. On Dec. 3 an armistice was signed between Turkey, Bulgaria and Serbia. A conference met in London to decide terms of peace, but the delegates were uncompromising, and negotiations broke down over the possession of Adrianople. On Feb. 3 1913 hostilities reopened. Again the Allies were everywhere successful, and after the surrender of Adrianople to the Bulgars and Serbs (March 26), the Turks sought the mediation of the Powers, and a second armistice was concluded between Bulgaria and Turkey on April 16. On May 30 1913 the delegates to the second London Conference were induced to sign a treaty, the terms of which had been drafted by the Powers. Turkey surrendered to the Allies all her possessions in Europe up to a line drawn from Enos on the Aegean to Midia on the Black Sea. Albania was granted independence. (*See* BALKAN WARS.)

Rupture of the Balkan Alliance.—Apart from the national antagonism and mutual distrust which made an alliance between the Balkan States almost a miracle, difficulties arose as to the interpretation of the treaty. The Serbs claimed that, after the unforeseen success of the campaigns and the modification by the Powers of the arrangements on the Adriatic coast, a revision of the treaty was necessary, while the Bulgars held out for the letter of the territorial agreement. The secret annexes (March 13 1912) stated that "all territorial gains acquired by combined action . . . shall constitute the common property (*condominium*) of the two Allies" until final settlement. The Serbs and Greeks, as a result of their victories, held much territory in Macedonia that had originally been assigned to Bulgaria, and they seemed to be preparing for a permanent occupation. Early in 1913 Bulgaria began to suspect that her Allies were combining against her, and the military party, with King Ferdinand at their head, prepared for action. Bulgarian troops were transferred from Thrace to the Macedonian frontier during June; the Serbs made corresponding preparations on their side.

On June 1 Gueshov and Pasitch met in the hope of averting war; on the same day a treaty between Serbia and Greece was signed at Salonika. Gueshov, finding no support from King Ferdinand in his efforts for peace, resigned; he was succeeded by Danev. Russia urged restraint, but Austria-Hungary appeared to encourage active measures. On June 29 the Bulgarian IV. Army, acting on orders signed by Gen. Savov, made a treacherous attack on their Serbian and Greek Allies. It must, however, be remembered that the attack was not unexpected, and that it probably only just forestalled a declaration of war by Serbia and Greece. Gueshov states in his memoirs that the reports of the Ministerial Council contain no minute ordering the attack. A judicial inquiry into the case was opened in Sofia, but never concluded. Savov asserted that Ferdinand as commander-in-chief gave the order to attack.

The Second Balkan War brought calamity on both Bulgaria and Macedonia. By the Treaty of Bucharest (Aug. 10 1913) Rumania acquired the rich lands of the Southern Dobruja, which had belonged to Bulgaria since 1878; Serbia and Greece divided Macedonia between them; Bulgaria was accorded the mountainous region of the Pirin and Dospat down to the Aegean, with the two indifferent ports of Dedeagatch and Port Lagos.

Radoslavov Government, 1913–4.—The Radoslavov Cabinet, which took office on July 5 1913, declared for a policy of close friendship with Austria-Hungary. Several of the new ministers, including Radoslavov himself, had been prosecuted for corrupt practices during their previous tenure of office, and the King found them conveniently subservient. The December elections of 1913 gave the Opposition a majority of 14 in the Sobranje. An appeal for a loan to meet obligations and for constructive work met with an unfavourable response in France, England and Russia successively. The German Disconto Gesellschaft eventually (June 1914) provided a loan of 500,000,000 fr., the syndicate obtaining control of the state coal-mines, of the projected railway to Port Lagos and of that port. These terms were strongly criticised, for it was clear that Bulgaria was thereby handing over some of her chief economic assets to Germany.

Period of Neutrality, Aug. 1914–Oct. 15 1915.—At the outbreak of the World War, the great majority of the Bulgars wished to preserve neutrality; but the pro-German sympathies of the King, the German loan, the establishment of friendly relations with Turkey, resentment against Russia for her non-intervention in Aug. 1913, together with the deep humiliation created by the Treaty of Bucharest, had already drawn Bulgaria into the orbit of the Central Powers. Negotiations for a treaty had been in progress throughout 1914 and were approaching completion in Aug. (*see* EUROPE). Macedonia, the dominant factor of Bulgarian policy throughout her existence, was divided between Serbia and Greece, and it was unlikely that the Allies of Serbia would deprive her of her fruits of victory, in order to obtain the co-operation of Bulgaria. The King, who feared the victory of the Entente might mean the loss of his throne, believed, moreover, that Germany was invincible.

During the summer of 1915, the Entente made a series of guarded proposals to Bulgaria, but the propaganda and promises of the Central Powers were for obvious reasons more skilful and effective. Neither Greece nor Serbia would cede any portion of territory as the price of Bulgaria's support. On Sept. 6 a military convention and treaty between Bulgaria and the Central Powers was signed at Pless (Pszczyna) and on the same day Turkey made the concessions demanded by Bulgaria. On Sept. 10 Radoslavov stated publicly that Bulgaria "was coming in on the side of the victors"; two days later the Opposition issued a widely-signed protest against the step. On Sept. 15 the Entente promised part of Macedonia unconditionally, if Bulgaria would declare war on Turkey. On Sept. 17 at 11 P.M., the King received

the Opposition leaders in audience. Malinov, Tsanov and Stambolisky, the Agrarian leader, demanded the convocation of the Sobranje, and protested vehemently against the King's policy. Stambolisky was, in consequence, condemned to imprisonment for life for lèse-majesté. On Sept. 22 the terms of the Turco-Bulgarian agreement were published, and mobilisation was decreed. On Oct. 12 Bulgaria declared war on Serbia; on Oct. 15 Great Britain declared war on Bulgaria, while France and Italy declared war on her on Oct. 16 and Oct. 17 respectively.

The World War, 1915–8.—Mobilisation was carried out unwillingly, but when once war had begun, the Opposition became silent, for all realised that the fate of their country was at stake. The great Bulgarian successes in Serbia made the war more popular. On Aug. 27 1916 Rumania declared war on Austria-Hungary, and, in spite of Opposition efforts for neutrality, on Sept. 1 Bulgaria declared war on Rumania. Resentment against Rumania ran high, but when the troops had retaken the Dobruja, they considered their work was done. The harvest was poor, and people were indignant because much produce was sent to Germany. German officials took control of the railways, but did not otherwise interfere with internal administration.

In 1917 the Opposition urged in the Sobranje that Bulgaria, having gained her objective, Macedonia and the Dobruja, should retire from the War. Secret negotiations in this direction were carried on in Switzerland. In Oct. the Kaiser visited Sofia. In Jan. 1918 Germany ceased to pay the subsidy of 50,000,000 fr., which she had paid yearly since Bulgaria entered the War, and after March she sent no more munitions or equipment. Shortage of food, the soldiers' dislike of trench warfare and, above all, the hopes raised by President Wilson's Fourteen Points, combined to create a yet stronger desire for a separate peace. On May 7, by the Treaty of Bucharest, Rumania ceded the Dobruja to the Central Powers, Bulgaria regaining what she had lost in 1913, with immediate occupation of the southern half. On June 18 the Radoslavov Cabinet fell and Malinov took office. When the Bulgarian line was broken and the country was invaded (Sept. 19–27), Malinov asked for an armistice (Sept. 25) which was signed unconditionally on Sept. 29. Stambolisky was released on Sept. 25 and was sent by the King to the front, in the hope that he would calm the troops, who were on the verge of mutiny. Stambolisky was, however, carried away by the situation; he proclaimed a Republic and advanced with the troops on Sofia. The loyal troops, assisted by the Germans, after some fighting, succeeded in restoring order. On Oct. 3 King Ferdinand abdicated and left Bulgaria; he nominated his son Boris as his successor. Radoslavov also fled the country. On Nov. 20 Malinov resigned and a Coalition Cabinet was formed by Todorov.

The Treaty of Neuilly.—By the Treaty of Neuilly, which was signed on Nov. 27 1919 by Stambolisky on behalf of his country, Bulgaria lost the southern Dobruja to Rumania; on the west, she ceded Caribrod and Strumica to Yugoslavia; while on the south she gave up to Greece the territory in Macedonia, which she had won in the Balkan Wars, including all access to the Aegean. Her southern frontier reaches the Black Sea at Sveti Stefan. Apart from the financial conditions of the treaty, the cession of territory, the population of which was essentially Bulgarian—not least, perhaps, the cession of Caribrod; an act which, it was alleged, brought Sofia within range of Serbian guns—was very bitter for the Bulgars. They suffered a further blow, when at the Conference of San Remo (April 1920), at which Bulgaria was not represented, all Western Thrace, with the exception of a small cession west of Adrianople to Turkey, was assigned to Greece (*see* NEUILLY, TREATY OF).

The Agrarian Government, 1920–3.—A reaction set in against all who had been responsible for bringing Bulgaria into the War, and Stambolisky became the hero of the moment. The Agrarian party had been weakened, morally as well as numerically, by the secession of Draghiev and his followers, and it was only after the elections of March 28 1920 that the Agrarians secured a definite majority. Stambolisky became Premier of an Agrarian Cabinet. He announced that he was against any policy of adventure and that he intended to fulfil, as far as possible, all treaty obligations and to live in peace with his Balkan neighbours. Relations with Yugoslavia and Greece remained, however, in a state of tension. The Bulgarian population under alien rule complained of injustice and ill-treatment; thousands escaped into Bulgaria as destitute refugees, while armed bands were formed to protect those who remained in Macedonia and to carry out reprisals. The Bulgarian Govt., in reply to protests, asserted that they could not prevent the passages of bands across the frontier, because they could not recruit even the limited force allowed by treaty, owing to the peasants' dislike of long-service conditions. Bulgaria was admitted to the League of Nations on Dec. 16 1920, and at each subsequent meeting of the council her representatives brought forward the grievances of the Bulgarian minorities in Thrace and Macedonia, where Bulgarian churches and schools had been suppressed and every effort made to stamp out the Bulgarian tongue and sense of nationality.

Stambolisky did not attack the King's position, but he at once declared war on the bourgeoisie, asserting that the exploitation of the peasant by the town politician was at last to be avenged. He himself denied that he was a communist, but in his campaign against the bourgeoisie his methods and ideals closely resembled those of the Russian Bolsheviks, with whom he later opened up direct communication. He also allied himself secretly with the communists in his own country, varying this attitude with violent denunciation and persecution. One of his schemes was for the organisation of the peasants of the world in a "Green International." His programme comprised measures for the exclusion of all lawyers from the Sobranje and civil posts; for the expropriation of Crown and Church lands and of properties over a certain size[1] in favour of landless men (*see* LAND TENURE; STAMBOLISKY); for the confiscation of houses at a merely nominal price; for changes in orthography; for a year's obligatory service for the state by all members of the community and for the prosecution on various charges of almost all ex-ministers and their supporters. Not all these measures were passed and others were repealed or modified, but the agrarian law has not been rescinded and obligatory labour in another form still continues. In 1921 the Opposition Parties, with the exception of the communists, formed a bloc against the Agrarians. In Aug. 1922 some leading members of the bloc were violently assaulted by supporters of the government. A plebiscite declared in favour of prosecuting ex-ministers for high treason, and in Sept. 1922 Danev, Malinov, Todorov, Majarov, Liabchev and others were thrown into prison.

At the Lausanne Conference (Dec. 1922 to Feb. 1923) the Bulgarian delegates pressed for the fulfilment of Clause 48 of the Treaty of Neuilly. The Allies offered an *enclave* 8 m. west of Dedeagach, railway access to which would be controlled by an international commission. This offer was declined, because a port, the construction of which would be costly, "detached from Bulgaria and only accessible across Greek territory by a foreign railway," would be of no value to Bulgaria.

At the Second Conference of Lausanne (treaty signed July 24 1923), Bulgaria declined an offer from Greece of a 99 years' lease of a coastal area on the Aegean. Owing to the cession of Karagach (Qara Agach) to Turkey, Bulgarians would have had to cross two frontiers to reach their port. Up to Dec. 1925 the promise of an Aegean port (Clause 48) had not been fulfilled.

Bulgaria complied with treaty conditions as regards destruction of arms, evacuation of territory, reparations of coal and live stock, upkeep of foreign commissions, etc., but she was unable to pay any instalment of her reparation debt. Her trade was at a standstill; prices were high. After long negotiations, the sum total due from Bulgaria was reduced from £90,000,000 to £22,000,000, payable over 60 years.

At the elections in April 1923 the Agrarians secured 212 out of 245 seats in the Sobranje, but these elections were undoubtedly controlled. Stambolisky had been much abroad, and there had

[1] Thirty hectares for peasant proprietors, 10 for married, 4 for single urban proprietors who do not themselves cultivate the soil.

been dissension in his Cabinet. The vindictive prosecutions, ruinous fines and other arbitrary measures imposed by Govt. had antagonised moderate opinion in the country, and there was indignation at certain malversations of public money, while Nationalist and Macedonian widely believed that Stambolisky had sold their interests in the Agreement of Nish with Yugoslavia (March 1923). During the night of June 8–9, the Govt. was overthrown by a *coup d'état* organised by a group of intellectuals and bourgeoisie, supported by army officers. Most of the Agrarian ministers were taken quietly to prison; Stambolisky, who was in his native village of Slavovitsa, was deserted by his followers and was killed—it is said while attempting to escape. His "Orange Guards," which had struck terror in Sofia, were disbanded. The country as a whole remained calm. Unscrupulous as he was, Stambolisky had shown on occasions the courage, shrewdness and tenacity of his race; his character was not fitted to stand the test of power, and his reputation suffered yet more by revelations which followed his violent death.

The Tsankov Government, 1923.—M. Tsankov, formerly professor of political economy at Sofia University, became president of the Council, and Col. Kalfov Foreign Minister. Few of the Cabinet had had any previous connection with politics. The position of the Govt. was strengthened by the subsequent fusion of all political parties, except Liberals and Communists, into a single group, the "Democratic Entente." There was, however much unrest in the country, fostered by adherents of Stambolisky and Communists who were in close touch with the Bolsheviks. The Russian Red Cross, which had, it was asserted, organised murders and planned a revolution, was expelled from the country. In Sept. the discovery of a plot led to the arrest of some 1,000 Communists; several local disturbances, in which some 5,000 persons, it is said, were killed, were repressed by the troops with great severity. These outbreaks were followed by drastic measures against any persons suspected of communism, many of whom remained in prison for months without being brought to trial.

Relations with Greece became increasingly difficult in 1923. As a punishment for an attempted rising in the Maritsa Valley, the Greeks interned some 10,000 Bulgars in the Aegean Is. and in unhealthy places in Thessaly for over a year. More than 2,000 of the prisoners perished. In July 1924 feeling was further embittered by events near Tarlis in Greek Macedonia. According to the report of the mixed Commission of Inquiry appointed by the Council of the League of Nations, some bomb-throwing—apparently without intent to kill—at Tarlis on July 26 was attributed by the Greeks to Bulgarian *comitadjis*. On July 27 the Greeks arrested some 70 Bulgars, 27 of whom were sent off tied together, escorted by a civil guard under one Doxakis. The guard opened fire on the prisoners, killing half of them, an act which the commission described as an unjustifiable massacre. The commission commented on the terror caused among the Bulgarian peasants who were then trying to emigrate *en masse*. On Sept. 29 1924, after prolonged negotiations, a protocol was signed at Geneva, under the auspices of the League of Nations, by Greece and Bulgaria, which seemed to guarantee at last the execution of the provisions for the Protection of Minorities contained in the treaties and the Covenant. This protocol was, however, soon afterwards repudiated by Greece at the instance of the Yugoslav Government.

The acute divisions within the ranks of the associations working on behalf of the Macedonians led in 1924 to many deeds of violence. The powerful Internal Organisation, whose leader was Todor Aleksandrov, a man of marked ability and influence, looked on autonomy as the only solution for Macedonian troubles; his opponents worked for some scheme of federation. On Aug. 31 1924 Todor Aleksandrov was treacherously murdered. This murder was followed by a series of mutual reprisals. It must be remembered that a large fraction of the present population of Bulgaria is of Macedonian origin, and that the Macedonians exercise a definite influence on Bulgarian politics. The Macedonians in Bulgaria are well organised, both for philanthropic and political purposes, and they are in close touch with their compatriots abroad, especially with the considerable colony in the United States. Many of them are men of marked ability, and there has generally been at least one Macedonian minister in the Bulgarian Cabinet. The majority of the exiles cannot reconcile themselves to the partition of Macedonia, and until conditions become more equitable for the Bulgarian minorities in Macedonia, there must necessarily be a sense of injustice and resentment in Bulgaria which must strengthen the hands of the extremists. The Agraro-Communist agitation continued throughout 1924. Bands of brigands in the pay of political conspirators made life unsafe; there were attempts to wreck trains, and some 200 persons, chiefly government officials, were assassinated; among them was Prof. N. Milev, who had recently been appointed Minister at Washington.

On April 14 1925 an attempt was made at Orkhanie on the life of King Boris. The King who, in spite of the seclusion of his life, had won the respect and affection of his people, escaped unhurt. On April 16 a bomb exploded in the Cathedral of Sveta Nedelia in Sofia during the funeral of Gen. Gheorghiev who had been murdered the previous day. One hundred and twenty-three people, including many notabilities, were killed and 323 injured. The Govt. acted promptly; martial law was proclaimed and a large number of persons, many of whom were subsequently proved innocent, were arrested. Five persons, including the sacristan of the cathedral, who were found guilty of planning and executing the outrage, were publicly hanged. House to house visitations throughout the country led to the imprisonment of some 5,000 persons. These measures were carried out with the methods of severity customary in the Balkans, but the situation appeared grave enough to justify strong measures. The Govt. obtained permission from the Conference of Ambassadors for a temporary increase of the armed forces by 10,000 men in the hope of maintaining order. The outrage was not, however, followed by any general rising; in the view of the Govt. the crime was not the work of local agitators but of Agrarians who had fled the country, aided by funds supplied through Vienna from Russia. The trials of the accused continued during the year; many were acquitted, others were sentenced to varying terms of imprisonment, banishment, fines, loss of civil rights and, in some cases, to death.

Changes in Education.—The Bulgars have always set a high value on education, and statistics show a steady increase in the number of those who can read and write; in 1920 about half the population were counted as literates. The period of compulsory education was raised by the Agrarian Govt. from 4 to 7 years in the lower and higher primary schools. Above these schools are the gymnasiums or lycées, classical, semi-classical and modern, with a five-year course. There are two universities, both in Sofia. Many Bulgars complete their education abroad. The type of education provided in the past has led to the overstocking of the clerical professions and to the neglect of technical occupations. The Agrarian Govt. aimed at giving a more practical bent to instruction and at equalising opportunities for all classes. It is generally recognised that—when funds permit—the establishment of schools for vocational training would tend to diminish the number of unemployed and discontented persons, who have been unfitted by their education for life as it is in Bulgaria.

The Refugee Problem.—The ground was favorable for Bolshevik propaganda. After the remarkable material progress of the first decades of Bulgarian independence had come a period of catastrophe and humiliation. The people had been repeatedly deceived by their rulers, they had been disappointed of their national hopes and disillusioned generally. Since 1918, there had been an influx of some 260,000 refugees, chiefly from Macedonia and Thrace, some of whom had migrated to escape persecution, while others had been dispossessed of their homes to make room for Greeks coming from Asia Minor. When this influx took place, the refugees from the Balkan Wars had hardly yet been absorbed. The presence of these unfortunate people, the great majority of them destitute and home-sick and all needing houses, land and work, constituted a most painful prob-

lem, and a heavy financial burden for the state. Salaries generally had been drastically reduced; thousands of discharged officers, N.C.O.s and officials had to live on insufficient pensions. A spirit of discontent and insubordination became apparent, especially in the younger generation. In Bulgaria, however, where 90% of the population are agriculturalists, most of these being small holders, the people would have little to gain by a general upheaval.

On Oct. 19 occurred a fresh frontier incident with Greece, in the course of which Greek troops occupied 70 square miles of Bulgarian territory near Petritch. The League of Nations settled the matter, on appeal from Bulgaria (for details, see *League of Nations, Work of the First Six Years*). On Jan. 2 1926 the Tsankov Govt. resigned, and a Cabinet was formed by Liabchev, one of the leaders of the Democratic party, as president of the Council. Gen. Volkov, the chief organiser of the *coup d'état* of 1923, remained as War Minister. The Tsankov Govt., though it had steered Bulgaria through a difficult period, was necessarily identified with measures of repression, and it had long been felt that a more democratic government would be better able to carry on the work of reconciliation and pacification which the country needed. The first work of the new Cabinet was the promulgation of an amnesty on a broad basis for political offenders; the preparation of which had been the last task of their predecessors. The amnesty was promulgated Feb. 4 1926 and affected 6,325 persons.

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(E. F. B. G.)

II. ECONOMIC AND FINANCIAL HISTORY

From 1879, the year of Bulgaria's liberation, up to 1911, the economic and financial development of that country proceeded steadily. Undisturbed by wars or internal troubles, with the exception of the short Serbo-Bulgarian War in 1885, the nation was able to devote itself entirely to its own welfare, with the result that very great progress was made. But this progress did not continue after 1911, for the Balkan War (1912–3) caused an interruption, and the World War had extremely serious economic and financial consequences.

Area and Population.—In 1911, the total area of the country amounted to 96,345 sq. km. with a population of 4,337,513 and a density of 45 per sq. kilometer. Later on, however, its territory was increased to 114,424 sq. km., with 4,978,600 inhabitants, as a result of the Treaty of Bucharest in 1913 and the Convention with Turkey in 1915. The Treaty of Neuilly reduced the area to 103,146 sq. km., with a population of 4,846,971 (1920).

The chief towns of Bulgaria in order of importance and population are:—

	Pop.		Pop.
Sofia	154,025	Shumen	25,314
Plovdiv (Philippopolis)	63,415	Stara-Zagora	23,753
Varna	50,810	Burgas	21,170
Russé (Ruschuk)	41,652	Yambol	19,875
Sliven (Slivno)	28,590	Kaskovo	19,418
Pleven (Plevna)	27,446	Pazardjik	19,362

These figures are taken from the 1920 census returns, but the population of the above-mentioned towns, especially of the first four, have increased considerably since then, chiefly through the big influx of refugees from Macedonia and Thrace.

Foreign Trade.—The consequences of the Balkan War, although heavy from a political point of view, were of practically no permanent economic or financial importance, except for a drop in the value of the lev that had very little effect on the normal course of the country's foreign trade in 1914. The entry of Bulgaria into the World War in 1915, however, completely changed the situation. Although the trade balances for 1915, 1916 and 1917 were favourable, much importance cannot be attached to that fact, as the country, both economically and financially, was almost at a complete standstill; the small amount of trade that was done was carried on exclusively with the Central Powers. But for the first time in Bulgarian history, Bulgarian tobacco began to be exported in considerable quantities.

After the Armistice in 1918, and the Treaty of Neuilly in 1919, the position became steadily worse. The trade balances for 1918, 1919 and 1920, were adverse. An enormous need was felt in the country for manufactured and semi-manufactured goods from abroad, all stocks being exhausted as far back as 1917, with the result that imports increased, greatly exceeding the relatively small and diminished exports. The decrease in the latter was due chiefly to two reasons. The first was that, as a result of the Neuilly Peace Treaty, Bulgaria had to concede to Rumania her richest wheat-growing province, the Dobruja, temporarily recovered in 1916. This entailed a loss of 7,695 sq. km. of extremely fertile land, cultivated on comparatively modern lines, and producing 11% of the total grain crop. The second reason was the general disorganisation brought about throughout the country by the War.

In 1911, 1912, 1913 and 1914, the export of grain was 973,844 tons, 691,001 tons, 370,110 tons and 613,339 tons, respectively, whereas in 1919, 1920 and 1921, exports only amounted to 490 tons (when the country was on the verge of famine), 142,937 tons, and 198,362 tons, respectively. At the same time, tobacco went up to the head of the Bulgarian export list, a place it still occupies. During 1924, 32,000 tons of Bulgarian tobacco valued at 2,000,000,000 leva, equivalent to 48% of the total exports of that year, were exported. For the same year grain exports amounted to 278,000 tons with a value of 1,500,000,000 leva. At the same time as the falling-off in the exportation of cereals, the country began to be recognised as one of the biggest producers of oriental tobacco.

In 1922 and the following years, the position improved. As a result of various measures taken with a view to stabilising the lev, and also of good crops, especially that of tobacco in 1923, the trade balance began to recover. On a total turnover of 11,500,000,000 leva for the period 1918–21, a deficit of 1,800,000,000 leva was registered, whereas on a turnover of 27,900,000,000 leva for the period 1922–4, the deficit only amounted to 1,900,000,000 leva. With the latter figures, the trade balance returned to its pre-War dimensions, with an upward tendency. Imports for the period 1911–25 consisted mainly of manufactured and semi-manufactured goods, while exports were agricultural products and raw materials. Textiles hold the first place in imports, followed by metals, machinery, lumber, leather and hides, vegetable and mineral oils, coffee, etc.

Up to 1915, exports were headed by cereals. From 1918 onwards, however, the latter were displaced by tobacco and now occupy second place, with eggs, skins and hides, cocoons, live animals and rose oil following them. Great Britain held until 1924 the first place in the provision of textiles for the Bulgarian market, but conceded the place in that year to Italy. Bulgaria's biggest supplier of metals, machinery and hardware was, and still is, Germany, followed by Belgium and Great Britain. Imports of lumber are practically monopolised by Rumania, while Germany heads skin and leather imports, with France coming second. The latter country is also Bulgaria's greatest supplier of vegetable oils, with Greece and Great Britain occupying second and third places. Mineral oils are imported exclusively from Rumania. Coffee, tea and other colonial goods are imported from various countries, among which Great Britain takes the first place.

Until 1915, the largest importers of Bulgarian grain and flour were Belgium and Turkey respectively, but from 1921, the year in which Bulgaria really recommenced exporting after the War, her best client for these articles has been France, followed by Turkey, Greece, Austria and Belgium. From 1917, in which year the country began exporting tobacco on a large scale, up to the end of the War, Austria and Germany were the sole purchasers. For 1921 and following years, Bulgaria's best customers were, in order of importance, Germany, Italy, Czechoslovakia, Austria, Holland, Hungary,

Poland and the United States. Eggs are exported in very large quantities to Germany and Switzerland, while Italy is the sole purchaser of Bulgarian cocoons. Attar of roses is chiefly exported to France, the United States and Germany.

On the total imports for the period under consideration, Germany holds the first place against Italy and Great Britain, her most dangerous rivals. The latter country has been losing ground to Germany during the last few years in the metal and machinery departments, and to Italy for textiles. Germany also comes first on the total exports list, chiefly because she is the biggest purchaser of Bulgaria's staple article, tobacco. Italy as an importer of cocoons, tobacco and hides, is second. Great Britain now takes only insignificant quantities of Bulgarian produce.

Agriculture.—As in the past, agriculture still constitutes the chief occupation of Bulgaria's population. In 1912, the area of cultivated land amounted to 3,385,101 hectares, of which 2,564,588 were sown with cereals. The output of the latter amounted to 2,672,038 tons. After a considerable falling-off during the first few years after the War, during 1923–4 the area cultivated rose to 2,288,125 hectares. The production for the same year, in spite of a bad wheat crop, is estimated at about 1,950,000 tons. The most important fact to be noted during and after the World War is the great progress made in the culture of plants used for industrial purposes, the chief of which are tobacco, sugar beet and sunflower. The sugar beet and sunflower seed satisfy internal needs and produce a surplus for export.

Wheat is the most important cereal grown, covering about one-fourth of the land under cultivation, followed in order of importance, by maize, haricot beans, barley, rye and oats. Vegetable-growing has developed considerably during the period under observation and certain quantities of seeds are exported. Although vine-growing has decreased in area, in no other culture has so great progress been made from a scientific point of view. Many diseases have been stamped out, and old vineyards ravaged by phylloxera have been replaced, with great cost and sacrifice, by new vines grown on the American system. Orchards have increased, especially in southwestern Bulgaria, and it is worth noting that the entire apple crop for 1925 in the Kyustendil district was bought by Germany. In short, it may be said that, although agriculture in Bulgaria is not yet modernised, great efforts are being made in that direction, which is proved by the large imports of agricultural machinery and implements.

Industry.—Bulgaria has made some progress in industry. According to statistics for 1921, flour-milling is the most important industry, with an annual production valued at 654,713,965 leva: the mills are scattered over various parts of the country, and produce a surplus of flour, which is exported mainly to Turkey and Greece. The second industry in importance is sugar-refining: there are five refineries, having an annual output valued at 205,214,121 leva. The textile industry is third, with a yearly production estimated at a value of 243,122,395 leva: as in the past, woollen goods are the principal articles manufactured, and the industry still remains centred in the Gabrovo and Sliven districts. Other industries are pottery, metal-working, lumbering and cigarette-making. The great obstacle in the development of Bulgaria is lack of capital.

Mining.—Since 1915 all importation of coal has ceased, for Bulgarian collieries are meeting the local demand and are even producing for export. The largest coal-mines are the government mines in the Pernik, and the privately-owned mines in the Maritsa valley: the latter, however, have only recently been worked on a large scale. In 1911, the state mines' output amounted to 251,605 tons, in comparison with 17,000 tons from the private mines. In 1918 the figures were 632,488 tons and 40,393 tons, and in 1924, 1,085,935 tons and 128,905 tons respectively. Although a large number of concessions have been granted by the state for copper, lead, iron, zinc and silver mining, very few of them have been worked up; only copper is remuneratively extracted on a comparatively big scale, four mines working in 1924. The mining industry in Bulgaria is still in a very backward state through lack of capital and railway communications.

Finance.—From 1913 to 1923, Bulgarian finance was in a very unsettled state. Owing to expenditure caused by the Balkan War, the budget for 1914 showed a deficit of 18,000,000 gold leva, with receipts standing at 224,000,000 gold leva, and expenditure amounting to 242,000,000 gold leva. After the World War, things became still more disorganised as a result of the uncertain position of the country, the fluctuations of the lev, the heavy reparations amounting to 2,250,000,000 gold francs,[1] various other indemnities, and an entire lack of credit from abroad. In addition to the foregoing, in accordance with the Treaty of Neuilly, the Bulgarian Army had to be organised on the voluntary basis, which cost the state a minimum sum of 20,000,000 gold leva annually. All these factors had a very distressing effect on the financial position of the country, with the result that, although the ordinary yearly budgets showed a surplus, that surplus was always too small to cope with the requirements of the extraordinary budgets, which always closed with a deficit. During the period 1923 to 1925, very serious attempts were made with a view to balancing the budget, among which the most noteworthy are the successful efforts to stabilise the lev, the drastic cutting-down of government expenditure, and finally the Reparations Agreement of March 21 1923 by which payments for account of reparations were to be made on a moderate scale for some years.

[1]Reduced by agreement in 1923 to 550,000,000 gold francs, of which, however, only one-fourth was to be paid in the ten years following the agreement.

The lev depreciated very heavily in value from 1913 to 1923. After the Balkan War in 1913, it was quoted at the rate of 32 leva for £1., a drop of seven leva from 1912, when it stood at 25 leva = £1. Owing to the reasons stated above in connection with the budget, the lev decreased disastrously in value, reaching the rate of 807 for £1. in 1922. This state of uncertainty, and the sudden fluctuations, also lasted through 1923, until, in Dec. of that year, foreign exchange business was restricted by law to the National Bank of Bulgaria. Thanks to this measure, together with increased exports and moderate reparations payments, the rate of the lev has been fairly successfully maintained during 1925 at about 650 leva to the pound sterling.

Banking and Currency.—The National Bank of Bulgaria is the State Bank of Issue, and has the sole right of issuing bank-notes. One of its functions is the conduct of the Treasury service of the state. During the War period, the bank had to render services to the state far beyond the limits of its resources, with the result that it was obliged to issue great quantities of bank-notes. Inflation reached its highest point in 1922, when the direct and indirect liabilities of the state exceeded the sum of 4½ milliard leva, and the bank-note circulation amounted to nearly four milliards. On June 30 1922, however, a law was passed fixing the limits of the latter, and of the Treasury debt to the National Bank. Under this law the total sum advanced to the state was not to exceed 4·7 milliard leva, while the total amount of bank-notes in circulation was not to be greater than 5½ milliards. The latter, at the end of 1925, was under four milliards, with a gold reserve of 40,000,000 gold leva. At the end of the War, this gold reserve amounted to 70,000,000 gold leva, but owing to the bad crop in 1919, Bulgaria was obliged to purchase flour from America, paying 30,000,000 leva in gold before it was delivered. This is the only instance on record of a European country dealing under such conditions with America after the World War.

Conclusion.—Bulgaria has been through a very severe economic and financial crisis, and serious and successful efforts are being made to extricate the country from its difficult position. Remarkable results, such as the stabilising of the lev, had already been registered in 1925. (V. B. C.)

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BULGARIAN LITERATURE (*see* 4.785).—Since the liberation of Bulgaria (1878) Bulgarian Literature has been under the twofold influence of the modern literature of France and Russia. The three principal inspirations of contemporary Bulgarian writers are mysticism, realism and philosophy, and the general impression left by their works is sadness. A nation of peasants, depending almost entirely for their existence on the forces of nature cannot fail to endow her with supernatural powers and this tendency has created innumerable Bulgarian legends. As to realism the simple and patriarchal life of the Bulgarians offers a wide field for such studies. National trials encourage philosophical speculation. Sadness is an attribute of the Slav.

Two Poets.—The greatest poet of the modern school is Pentscho Slaveikoff (1866–1912). He died at Como, Italy, just after his name had been submitted for the Nobel Prize. German as well as Russian influence is apparent in his work. His style is bold and beautiful; his poems, philosophical, pessimistic and deep, are always dedicated to lost joys, vain enthusiasms and hopeless causes. He was an exponent of new ideas and tendencies, but the individual note is always clear and strong. In his *Island of the Fortunate* (1910), he develops the idea that a strong personality can shake off the fetters of convention and so reach the "superstate." His most remarkable work is *The Song of Blood* (1913), an epic poem in nine cantos. K. Yavoroff (1877–1914) is almost his equal, but the influence of the French symbolists and of Henri de Régnier are apparent. He is fired with pity for the oppressed and has thus gained great popularity. He also

glorifies both social idealism and individualism. His arguments are passionate and convincing, his method is synthetic, his style full of harmony and beauty. He is the author of lyric poems and two dramatic plays: *On the Slopes of the Vitoche* (1911) and *When Lightning Strikes* (1912).

But, with a few exceptions, the works of the writers of this period show a strong Russian influence and indicate a tendency toward extreme realism. Petco Thodoroff (1879–1916) has written some excellent dramas (*Zidari*, 1899; *Samodiva*, 1910), national legends and folk songs. His style is original and vigorous, and reflects a hopeful and strong personality. Eline Peline, (b.1878), the pen name of Dimitri Ivanoff, in his village songs and poems, describes nature with the eyes and experience of a born peasant. Nicolas Raynoff (b.1889) is one of the most interesting contemporary Bulgarian authors, and draws his inspiration from Bulgarian history, the Gospels and mythology alike. He is quite unaffected by foreign influence, and writes with all the art of a great painter. His historical dramas are very remarkable, the best known being *Once Upon a Time* (1923).

Ivan Vazoff.—The real foundations of modern Bulgarian literature were, however, laid by the great national poet and novelist, Ivan Vazoff who died in 1921. Of his disciples Stoyan Michaelovsky (b.1850) is by far the most important. His works *Eastern Legends* (1904), a play, *When the Gods Laugh* (1921) and satirical essays reveal his logical mind, great powers of analysis and the influence of the French classics. The other disciples of Vazoff are Constantin Velitchkoff (b.1856), dramatist and literary critic; M. Gheorgieff, an author of popular tales; V. Vlaikoff; Tzerkovsky; and A. Strachimiroff. Cyril Christoff (b.1875) is the leader of a more individual and modern school. He is a lyric poet, his chief works being *Hymns to the Dawn* (1911) and *Songs of Victory* (1916).

The new Bulgarian school includes Geo Mileff, lyric poet, editor of two literary reviews, author of *Ballads* (1920) and excellent translations in verse of French and Belgian poets including Verhaeren; Gheorghi Raitcheff, novelist, a disciple of Dostoyevsky; Tchavdar Moutafoff, novelist and art critic, author of *Puppet Shows* (1921); Gheorghi Stamatoff; Yordan Yovkoff, and Nicolas Yaneff, 1888–1921.

The lyric poets, Dimitri Schichmanoff, critic and novelist (b.1888), Emanuel Dimitroff (b.1887) and Lioudmil Stoyanoff (b.1888) are working for a national literature. Todor Trayanoff is the leader of Symbolism in Bulgaria, and author of *Bulgarian Songs* (1922) and the *Hymn of Hymns* (1922), but his verses lack the vigour of Dimtcho Debelianoff's *Offertory* (1919). This gifted young poet died in 1921. Nicolas Lilieff (b.1885), author of *Flowers for him and Songs for her* (1919), is one of his most promising disciples. Tzanko Bakaloff (b.1866), a popular writer, is the author of village songs and poems. Alexander Stambolisky (1879–1923) the agrarian Prime Minister published several books of social interest, namely *Authority, Anarchy and Democracy* (1910), *What a Politician ought to be* (1915), *The Psychology of Prisons* (1916). Other writers of merit are Michael Kremen; Wladimir Moussakoff, who died in 1916, the author of clever studies of the War; K. Konstantinoff; Petar Ghenoff; and Nicolas Rakitin.

The best known Bulgarian historian and political writer is Simeon Radeff, author of *The Founders of Contemporary Bulgaria* and *The History of Macedonia.* Dimitri Stancioff, Bulgarian minister in London till 1924, has written many important diplomatic studies and political essays.

Literary Women.—Several gifted women have contributed inspired poems to the modern literature of Bulgaria. Among them are Anna Karima (b.1871); Dora Gabe-Peneva, author of *Yesterday* (1920); Mara Beltcheva, poet and philosopher; and Elisabeth Beltcheva, whose lyric verses are full of beauty. Nadejda Stancioff (b.1895), formerly in the Bulgarian diplomatic service, has written historical and political essays and short stories. Since the War the best periodical is the *Zlatorog* which often achieves considerable literary merit.

The literature of to-day in Bulgaria is full of promise, but in order to develop a strong national character authors will have to avoid the cross-currents of foreign influence. The craving for instruction shown by the Bulgarian people is a great and valuable asset as regards the expansion of literature; but it may suffer from lack of discernment and the tendency toward imitation. By cultivating their natural gifts, and dedicating them to the service of their country alone, without attempting to invade foreign ground, Bulgarian writers may yet hope to furnish an original and sound contribution to international literature.

(N. Mu.*)

BULLARD, ROBERT LEE (1861–), American soldier, was born at Youngsboro, Ala., Jan. 15 1861. He graduated from West Point Military Academy in 1885 and was appointed first lieutenant in 1892. He served in various capacities in the Spanish-American War, and in the Philippines from 1902 to 1904. He was made lieutenant-colonel in 1906. In 1907 he was special investigator for the U.S. Provisional Govt. in Cuba, and the following year was superintendent of public instruction there. In 1911 he was promoted colonel, and in 1917 brigadier-general. He commanded the 2nd Brigade of the 1st Div. of the American Expeditionary Force in France in 1917, and was made major-general, National Army. From the middle of Dec. 1917 to the middle of July 1918 he commanded the 1st Div.; and from Oct. 1918 to the following July the II. Army. In Nov. 1918 he was appointed major-general in the regular army.

BULLET: *see* AMMUNITION.

BÜLOW, BERNHARD HEINRICH KARL MARTIN, PRINCE VON (1849–), German statesman (*see* 4.793), after his resignation of the German chancellorship in 1909 lived principally in retirement at his villa in Rome. On the outbreak of the World War he was once more employed in the service of his country. Italy, which had declared her neutrality at the outbreak of the War, had already intimated (July 5 1914) that she considered the action of Austria-Hungary against Serbia to be aggressive and provocative. Prince Bülow was entrusted with the temporary charge of the German embassy in Rome in Dec. 1914. He was active in the negotiations between Italy and Austria concerning the Trentino and Trieste; his chief aim being the preservation of Italian neutrality and to this end he used every means in his power. He was, however, unable to prevent the entry of Italy into the War on the side of the Western Powers, although he was instrumental in concluding certain economic agreements between Italy and Germany which deferred Italy's declaration of war on the latter country until Aug. 1916. On May 24 1915 he left Rome. During the War he lived in Berlin, but after the peace he returned to Rome and continued to reside there for part of every year. In a ministerial crisis of 1921 his name was mentioned as a possible chancellor, but he was entirely unacceptable to the vast majority of the German people and of the Reichstag.

BÜLOW, KARL VON (1846–1921), German soldier, was born in Berlin March 24 1846. Commissioned to the 2nd Guards regiment in 1864, he served in the campaign of 1866 and the Franco-Prussian War of 1870. After a distinguished career, he was placed in charge of the II. Army on the outbreak of the World War, and was at the head of the invasion of Belgium. During the subsequent advance into France, Von Kluck's I. Army was also placed under his direction, a faulty arrangement soon abandoned but not replaced by effective control from German headquarters. From this time the two armies were repeatedly taking divergent action, a confusion which ended in the retreat from the Marne. The responsibility for this strategical disaster was the subject of acute controversy, and public opinion in Germany was induced to fix the blame on Von Bülow. But the view of the Supreme Army Command was shown by their placing Von Kluck on the retired list and promoting Von Bülow to field marshal in Jan. 1915, and post-War knowledge has confirmed this verdict. In June 1916 he was, at his own request, placed on the retired list. He died in Berlin Aug. 31 1921.

BUNIN, IVAN ALEXEYEVICH (1870–), Russian poet and novelist, was born Oct. 10 1870 of noble family in Voronesh. His first poems were published in 1889. His poems were awarded

the Pushkin Prize, the highest academic distinction in Russia, and the same distinction was awarded to his translation of Longfellow's "Hiawatha." His other masterly translations from English poets include those of Byron's "Manfred" and "Cain," and of Tennyson's "Lady Godiva." In 1909 he was elected a member of the Russian Academy.

Bunin's poetry stands outside all modernist tendencies and has very distinctive qualities and high merits of its own. It is mainly descriptive—not lyric—impassive, of classic simplicity and harmony, of jewelled perfection, minute observation and vivid perception of colour. He derives his inspiration from many sources. A fine nature poet, he also gives realistic descriptions of human life and his pictures of the East display his keen sense of colour. He ranks highest, however, as a prose writer. The best known among his novels, tales and short stories are *The Village, A Gentleman from San Francisco, Suchodol, An Evening in the Spring.* The first two have been translated into English as also *Dreams of Chang and other Stories.* The principal theme of all his novels and tales is the decay of the old Russian gentry which he views in the melancholy poetic colours of an autumn sunset in the country, and the life and psychology of the peasantry and its relation to the town. Far from idealising the peasants he describes them under a very gloomy aspect. There is much affinity in his novels with Turgeniev and Chekhov—but he might be best described as the Russian Flaubert. He is a great master of classic prose. The complicated structure of his style has been likened to a tree with innumerable branches; and shows a great love of detail in his realistic rendering of life.

BURBANK, LUTHER (1849–1926), American naturalist and experimental botanist, born at Lancaster, Mass., March 7 1849. After attending the public schools and Lancaster Academy, he worked for two years in a factory at Worcester, Massachusetts. At the age of 21 under the stimulus of Darwin's *Animals and Plants under Domestication,* he bought a 17-ac. tract of land at Lunenburg, Mass., and began experiments for the improvement of economic and ornamental plants. Among his earliest achievements was the evolution of the Burbank potato (1872), which became one of the leading varieties in many parts of the world. Attracted by its horticultural potentialities, he moved to California in 1875 and established a nursery and experimental farm at Santa Rosa. Here he conducted many experiments on plants and trees, and produced many new varieties, including various forms of the edible thornless cactus; plumcots, derived from a cross of plum and apricot; improved forms of prunes and plums, peaches, and grapes; the Burbank, Abundance, Giant and other cherries; the Burbank and other new roses; gigantic forms of amaryllis; the shasta daisy, and Giant and Fragrance callas. At times he had over 6,000 experiments in hand and grew over 1,000,000 plants yearly for testing. He was a special lecturer on evolution at the Leland Stanford Jr. University and published *Luther Burbank, His Methods and Discoveries,* 12 vol. (1914–5); and *How Plants are Trained to Work for Man,* 8 vol. (1921). He died at Santa Rosa, Cal., April 11 1926.

Bibliography.—H. de Vries, *Comments on the Experiments of Nilson and Burbank* (1907); D. S. Jordan, *The Scientific Aspects of Luther Burbank's Work* (1909); H. S. Williams, *Luther Burbank, His Life and Work* (1915).

BURBIDGE, SIR RICHARD (1847–1917), British merchant, was born in Wiltshire March 2 1847. At the age of 13 he was apprenticed to a provision merchant in Oxford street, London, and at 19 started in business on his own. Fourteen years later he became general superintendent of the Army and Navy Auxiliary Stores. In 1882 he was appointed general manager of Whiteley's, Westbourne Grove, and in 1891 entered the service of Harrods, Brompton Road, of which he was afterwards managing director. Under him the stores became one of the largest in London. He anonymously presented about £30,000 to the fund for acquiring the Crystal Palace for the public in 1913. During the World War he was a member of the advisory committee of the Ministry of Munitions. He was created a baronet in 1916, and died in London May 31 1917.

See Mrs. A. C. Stuart Menzies, *Modern Men of Mark* (1920).

BURGENLAND, a province of the Austrian Republic, composed of districts ceded to her by Hungary. Area, 1,586 sq. m.; population (1923), 286,299, about one-third of whom are Magyars and Croats. Capital, Eisenstadt. The Burgenland forms a long, very narrow strip, bounded E. by Hungary, W. by Lower Austria and Styria, and touching Czechoslovakia N., Yugoslavia south.

Immediately after the War this small district became an international problem. The statesmen of Czechoslovakia and Yugoslavia desired to make of it a "Slav corridor" connecting their countries; while Austria claimed it on ethnographical, Hungary on historical grounds. The Peace Conference decided (July 20 1919) to allot the whole strip, including its local centre Ödenburg (Sopron) to Austria without a plebiscite. A commission headed by an Italian, a French and a British general entered Sopron Aug. 6 1921; the Hungarians were to withdraw on Aug. 29.

Meanwhile, however, the Hungarians had been carrying on a violent propaganda, based on Austria's financial collapse and socialist tendencies. Hungary's ex-Premier, Friedrich, and others, organised and armed bands on the estates of the Magyar landowners; and these attacked the Austrian gendarmerie when it entered the country on Aug. 29, repelling it and the troops sent to support it. The Hungarian Govt. declared itself powerless over these irregulars. The generals, whose sympathies were confused, recognised the brigands as a local police force, and referred the matter to the Conference of Ambassadors.

The Question of Sopron.—The difficulties centred around the town of Sopron, which was mainly Magyar in population, but all communications centred here and the country districts depended on it. The Italian Govt. offered its mediation; a conference of the Italian, Austrian and Hungarian Foreign Ministry agreed by the Protocol of Venice (Oct. 13) that a plebiscite should be held in Sopron and the eight surrounding communes. The generals were to conduct the plebiscite eight days after they were satisfied that the country was pacified. The Conference of Ambassadors ratified this agreement Oct. 27 1921.

On Oct. 20 the ex-King Charles landed in the district by aeroplane; the local brigands formed themselves into a legitimist army, and only with difficulty was Charles induced to withdraw. The Little Entente renewed its claim for a corridor, and protested against the Venice arrangement. Allied troops reached the plebiscite area on Dec. 8, Austria having already occupied the other districts. The Hungarian troops only left Sopron Dec. 12, and the plebiscite was held Dec. 14 and 19, giving a majority for Hungary in Sopron. Austria protested that the voters had been terrorised and the lists manipulated, and appealed against the verdict, but the Conference of Ambassadors recognised the decision (Dec. 23) and persuaded Austria to do likewise (Feb. 29 1922). Sopron and district were handed back to Hungary Jan. 1 1922. The result of the decision was to leave the Burgenland without a proper centre. Communications between Austria and Southern Burgenland were very bad, and these rich fruit-growing districts suffered economically in consequence, although the completion of the Friedberg-Pinkafeld railway, in Oct. 1925, will doubtless bring an improvement. *See* Austria. (C. A. M.)

BURIAN VON RAJECZ, STEPHEN, Count (1851–1922), Austro-Hungarian statesman, was born at Stampfen, near Pressburg (Bratislava), Jan. 16 1851 of a Hungarian noble family and early in life entered the consular service. From 1882–6 he was consul-general at Moscow and he lived for many years at Sofia as envoy extraordinary. From 1903–12 he was Finance Minister and as such administered the provinces of Bosnia and Hercegovina. In June 1913 he was appointed Hungarian minister to the court of Vienna, and on Jan. 13 1915 he succeeded Count Berchtold at the Foreign Office. The monarchy was at this time in the midst of negotiations with Italy. Burian, however, was unable to prevent the secession of that country into the ranks of the Entente, but he did great service to Austria-Hungary in arranging the alliances with Bulgaria and Turkey. With regard to Poland he advocated the creation of an independent state

co-equal with Austria-Hungary. In general, he maintained that in military, political and economic matters Austria-Hungary must be treated as an equal partner with Germany, her ally.

On the question of peace, too, there was a sharp antithesis between the views of Burian and those of German statesmen. He proposed, as early as Nov. 1915, that Germany should make a public declaration of her willingness to guarantee the national independence of Belgium, and during 1916 repeatedly urged that the way should be paved for negotiation with the enemy on the basis of the renouncing of conquests in the west. The peace note of Dec. 12 1916, which put an end to this quarrel, was the last important official act of Burian as Foreign Minister. A few days later he laid down his office, but was recalled after the resignation of his successor, Count Czernin, on April 15 1918. Burian now worked energetically for peace. On Sept. 14 1918 he addressed to all the belligerent nations an invitation to end the War by diplomatic negotiations. The invitation had no success; he therefore resigned, and from this time onwards ceased to take an active part in politics. He died at Vienna Oct. 20 1922.

See S. Burian von Rajecz, *Drei Jahre aus der Zeit meiner Amtsführung im Kriege*, 1923, Eng. trans., *Austria in Dissolution*, 1925.

BURMA (*see* 4.838), a province of British India, has an area of 238,738 sq. m. and a population of 13,212,000 (1921). When the pacification of Upper Burma, after the annexation of King Thebaw's territory, had been completed, the country settled down under regular administration.

I. POLITICAL HISTORY

Consolidation of the Border.—The years 1910 to 1925 fall into four periods: 1910–4, 1914–8, 1918–22 and 1922 onwards. The history of the first period, under Sir Harvey Adamson as lieutenant-governor, was one of internal development hampered by straitened finances; but action was taken to avoid Chinese encroachment upon the "no man's land" between Burma, China and Tibet by the occupation of Hpimaw, and the constitution of the Putao district to enable the Hkamti Long Shan states north of Myitkyina and the northeast border tracts to come under supervision and control. The area covered was about 10,000 sq. m., and posts of military police were established at suitable points to preserve order in these borderlands.

Tribal Unrest.—With the second period, rumours of the World War began to cause unrest in tribal areas, and there was a rising of Kachins at the end of 1914, which was, however, soon suppressed by the military police aided by some regular troops. The ringleaders were captured and sentenced to death. During 1915 Sir Harcourt Butler became lieutenant-governor; he was succeeded by Sir Reginald Craddock in 1917. The principal disturbing events of 1915 were the successive efforts of revolutionary Sikhs to enter Burma from Siam and incite mutiny among the military police as part of a larger scheme of the Sikhs on the Pacific coast of America to start a general rising in India. These efforts entirely failed. In 1917 the Chin Hills on the west and northwest became the scene of a local rebellion among the Haka Chins in sympathy with similar revolts among the tribes under the Govt. of Assam.

This rebellion had its origin in local excitements caused by recruitment for labour corps from tribes on both sides of the Burma-Assam border. The Haka rebellion was followed by a further rising among the Kukis on the Manipur border. In both cases the military police of the two provinces co-operated. The operations against the Kukis in 1919 were controlled by the general officer commanding the Burma Division, and the Somra tract on the northwest of the Upper Chindwin district was taken under administration. Once these risings had been suppressed the hills settled down peacefully, the rebels were pardoned and the Chins now supply excellent material for the army. Since these risings there were two incursions from over the Chinese border in 1921 and 1922, heralded beforehand as serious invasions with Mandalay as the objective, but in reality pitiful raids by the dupes of Burmese pretenders across the Chinese frontier. With these exceptions a profound peace reigned in all these wild areas.

War Contributions.—The efforts made by Burma during the World War are deserving of mention. The people subscribed Rs. 29 lakhs to a special war gift and contributed most generously to Red Cross and other funds, including £60,000 for the "our day" fund. They put up about £2,000,000 in the 1917 War Loan, and £337,000 in the War Loan of 1918. Before the War a single Burmese company of sappers and miners had been the sole contribution to the Indian Army, but, under the spur of the Empire's demand for men, 2,500 were raised for labour corps in France, and sufficient recruits to man four battalions of Burmese Infantry, as well as three or four mechanical transport companies for service in Mesopotamia. Service in the army in peace time is, however, very unpopular among Burmans, and in the four battalions of the 20th Burma Rifles there are now only two companies of Burmans remaining and one company of Shans. Kachins supply $5\frac{1}{2}$ companies, Chins $3\frac{3}{4}$, and Karens two and three-fourths. The British garrison in Burma has since the War been reduced to two British regiments.

Politics.—Before 1918 there were no politics in Burma. With the people, at large, pleasure came first, business second and politics nowhere. The Morley-Minto reforms had scarcely modified conditions at all, and by the end of 1917 the Legislative Council consisted of only 19 members, of whom 2 only were elected members representing the chamber of commerce and the traders' association. There were only 2 Burmans proper, with a Shan chief, a Karen, a Chinaman, a Parsee and an Indian Mahommedan, the rest being Europeans, mostly officials. In 1920 the numbers were raised by nomination to 30, the maximum provided by the Morley-Minto reforms. The period 1918–22 represents a development of politics in Burma so rapid as to be without parallel. Recruiting campaigns during the War had stimulated the idea of nationality, and when Mr. Montagu and Lord Chelmsford made their famous inquiry the doubtful position of Burma under an India progressing to self-government leapt into such prominence that the small group of Burmese lawyers and journalists in Rangoon were carried off their feet. Rangoon contained its group of Indian agitators, with whom the young Burmese party, hitherto so aloof, began to coquet, while the Indians in their turn were rejoiced to find congenial soil in which to sow their own doctrines. Each side was glad of the help of the other, while each was ready to throw over the other if the occasion offered. The exclusion of Burma from the Montagu-Chelmsford scheme was regarded by Burmans as an insult to their national pride. They had accepted without demur British control, but they had no idea of submitting to Indian rule.

The task of devising a constitution specially suited to Burma as a politically backward country devolved on the lieutenant-governor (Sir Reginald Craddock), but while he was devising a scheme, and promulgating it for criticism, the new political party made such strides that a scheme which would have exceeded all expectations in 1917 was rejected as inadequate by the now ardent Burmese politicians. Two deputations of Burmans visited London in 1919 and 1920 to demand that Burma should have the same constitution as the Indian provinces; but when, after long consideration by Rangoon, Simla, Whitehall and a parliamentary committee, it was decided to accede to their request, the second deputation returned only to find themselves completely thrown over by a political party asserting that nothing but complete Home Rule would satisfy Burma's dignity.

During this period of agitation the new university and the government schools were boycotted, and temporarily lost a large number of their pupils; and a general boycott on the lines of Gandhi's non-co-operation, but professing to be quite original, was proclaimed by the national party. These movements were met by enforcement of the ordinary law against sedition and by the passing of the Anti-Boycott Act to combat organised intimidation which the ordinary law was unable to deal with effectively. The Defence of India Act was used in a few cases to check the Indian-inspired agitation to boycott the Prince of Wales, and, when the people were thus relieved of the intimidation of the boycott, the Prince received a magnificent welcome in Burma.

The principal features of politics in Burma are the participation of the religious orders, viz., the Yellow Robe, the emancipa-

tion of the women and the ease with which political organisations are extended to rural areas. Burma has now been given a much wider franchise than India, and women qualified by property tests have been accorded the vote. At the first elections in 1922 the proportion of the electorate exercising their vote was exceedingly small—about one-sixth. The Legislative Council now contains 103 members, about four-fifths elected. The reformed government has been carried on without any serious crises and in the new councils elected in 1925 the extreme Swarajists were discomfited. Sir Harcourt Butler returned to Burma as its first governor in 1923.

II. ECONOMIC AND FINANCIAL HISTORY

Population.—In spite of straitened finances and the set-back of the War Burma has continued to progress rapidly under orderly government. The population, which was 10,490,000 in 1901, had risen to 12,115,000 in 1911 and by 1921 had increased further to 13,212,000. But for heavy plague mortality during the last decade and the effect of the great influenza scourge of 1918–9, which claimed over 200,000 victims, the increase would have been greater. The population of Rangoon has mounted rapidly to 341,000 and Mandalay, which has steadily lost population as a dethroned capital and has been stricken by frequent epidemics, has now begun to recover, and shows a rise of 10,000 to a total of 149,000. These two cities account for more than half of the population of the 24 towns of 10,000 and over in Burma, but the rural population still amounts to 90% of the total, and so vast are the forests and hills that over the whole area the density of population is still only 57 per square mile. By religion 85% are Buddhists; Hindus and Mahommedans together number 7½%; Animists 5%; and Christians only 2%. By race the Burmans proper amount to 72%, Karens number 1,250,000, and Indians 900,000. Europeans and Anglo-Indians total 25,000, Shans nearly 500,000, and Chinese 150,000. The rest of the population consists of the numerous tribes on the frontier, of whom 9,500,000 are engaged in agriculture, and 2,500,000 in industry and commerce. Public services, railways and professions employ 750,000.

Commercial Products.—Rice, timber and oil are the chief commercial products of Burma. Since 1910 the occupied area has grown from 17,000,000 to 19,500,000 ac., and the cropped area from 13,500,000 to 15,500,000 acres. The area under rice has risen from 10,000,000 to 11,500,000 ac., and the normal yield of paddy is 7,000,000 tons, of which 3,000,000 are available for export. The normal yield of ground-nuts is 120,000 tons. Sesamum covers a large area, but is not much exported. Cotton is of importance only in the dry zone. There are numerous rubber plantations, of which the most important are in Mergui. The Shan States produce potatoes and oranges. Fisheries are more important than in any Indian province. The burden of interest paid by the cultivator has been somewhat relieved by the growth of co-operative credit, from 172 societies with 5,363 members in 1910, to 5,563 societies with a membership of 157,000 in 1924. Petroleum is the most important of the mineral products, the output from seven districts totalling 280,000,000 gal. in 1922, of which the principal oil-fields, Yenangyaung and Singu, supplied about 90%.

The Burma Corp. Bawdwin silver-lead mine in the Northern Shan states has developed very greatly. Some 250,000 tons of silver-lead ore were extracted in 1923, yielding 45,000 tons of refined lead and nearly 5,000,000 oz. of silver. Zinc concentrates are now being exported in quantity. The Mogok stone area administered by the Burma Ruby Mines Co. has continued to give fluctuating outputs of rubies, sapphires and spinels. One beautiful ruby, cut in London to 11·22 carats, was sold for £4,000. Jade and amber continue to be produced from the jadeite area north of Myitkyina. The tin mines in Tenasserim have developed, and produced 2,400 tons in 1923; while the Mawchi mines in Karenni have recently been reopened. Wolfram produced in the same area enjoyed a remarkable boom in the War, but has dwindled into insignificance since. Coal exists in Mergui, on the Chindwin, and in the southern Shan states, and prospecting continues vigorously. The gold dredging in Myitkyina has been abandoned.

Forests, etc.—One of the greatest assets of the province consists in its forests of which 28,000 sq. m. are now reserved forest and 94,000 sq. m. unclassified forest. The teak extracted in 1923 amounted to 500,000 tons, and 200,000 tons were exported, mostly to India. Many other valuable woods exist, and specimens were exhibited at Wembley, but the process of exploiting them has been slow. The extraction of bamboo pulp for paper manufacture is still in a nascent condition, but there is immense scope for this industry if it can be made a commercial success.

Commerce.—The imports and exports forming the external trade of Burma, taking the average for periods of five years, 1909–14, 1914–9 and 1919–24, are as shown in the table in the next column The development of the port of Rangoon has been rapid. In 1911 the port revenues were Rs.36 lakhs. In 1924 they had risen to Rs.77 lakhs. The tonnage of shipping using the port was 3,500,000.

		Values in lakhs of rupees	
		Imports	Exports
1909–14	Foreign	1,310	2,312
	Indian	1,095	1,411
1914–19	Foreign	1,076	1,931
	Indian	1,209	1,907
1919–24	Foreign	2,053	3,127
	Indian	1,829	3,009

Provincial Finances.—The provincial finances, partly by normal expansion and partly by more favourable adjustments with the Govt. of India, have risen from under five crores of rupees in 1910–1 to over nine crores in 1923–4. The province also enjoyed a windfall of over nine crores from the control of rice in 1918–9, which has enabled it to pay off its debts to the central government and to spend large sums on railways, irrigation works and roads.

Communications.—An eastward extension of the railway into the southern Shan states to Heho, and new branches in the Yamethin, Magwe, Sagaing and Shwebo districts, and a line from Moulmein to Ye in the Tenasserim peninsula, are the chief railway developments. Water communications in the delta have been improved by the Twante canal connecting the Rangoon river with the China Bakir. Large sums have also been spent on roads, but construction is very costly, as in many areas road metal has to be brought from long distances.

General Progress.—Among other indications of progress, besides the constitutional reforms, many important administrative developments have signalised the post-War period. A High Court has been established at Rangoon; the Federation of the Shan states has been effected as a separate entity from the rest of Burma; District Councils elected for the administration of rural areas have been brought into being; a Development Trust has been created in Rangoon; and the Rangoon municipality has been elevated into a corporation with largely increased powers. Burma has always been famous for its elementary education, imparted at monastic schools; but secular education, imparted by public schools, has greatly developed. There are now 6,289 schools with 345,000 pupils of whom 121,000 are girls. Since the establishment of the Rangoon University in 1920 further progress has been attained in higher and technical education by the establishment of an agricultural college and of university courses in forestry, medicine and engineering, while the numbers attending the two arts colleges in Rangoon have very largely increased. There are now also 284 hospitals in Burma, attended by 2,000,000 patients. The Burmans are also devoting more attention to commerce and industry, hitherto almost entirely in the hands of Europeans, Indians and Chinese. The province affords enormous possibilities of further development.

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BURNAND, SIR FRANCIS COWLEY (1836–1917), British humorist (*see* 4.848), died at Ramsgate April 21 1917.

BURNETT, FRANCES ELIZA HODGSON (1849–1924), American writer (*see* 4.853), published in 1911 *The Little Princess*, a play for children and grown-up children, in Three Acts. Her subsequent writings include *My Robin* (1912), *T. Tembarom* (1913), *A Lady of Quality* (1913), *The Lost Prince* (1915), *The One I Know the Best of All* (1915), *The Little Hunchback, Zia* (1916), *The Way to the House of Santa Claus* (1916), *The White People* (1917) and *The Head of the House of Coombe* (1922). She died Oct. 29 1924 at Plandome, Long Island.

BURNHAM, DANIEL HUDSON (1846–1912), American architect, was born at Henderson, N.Y., Sept. 4 1846. He was educated at Chicago and at Waltham, Mass. He worked as an architect in Chicago, and in 1871 formed a partnership with John W. Root. They were entrusted with the planning of the Chicago World's Fair (1893). On the death of Root this work fell wholly upon Burnham. In 1894 he was elected president of the American Institute of Architects. His success with the Chicago World's Fair buildings soon led to his being called upon to design other large structures, including "The Rookery" and "Railway Exchange" in Chicago; the "Flatiron building" and new Wanamaker's store in New York; the Pennsylvania Railway station in Pittsburgh; Filene's store in Boston; the Union station in Washington and Selfridge's stores, London. He also was asked to propose plans for improving several cities, including Cleveland, San Francisco, Chicago and Baltimore. In 1905 he was asked by the U.S. Govt. to design plans for cities in the Philippines, including Manila. He was made chairman of the national committee appointed for beautifying Washington, D.C. He died in Heidelberg, Germany, June 1 1912.

BURNHAM, EDWARD LEVY LAWSON, 1ST BARON (1833–1916), English newspaper proprietor, was born in London Dec. 28 1833 and educated at University College School. His father, Joseph Moses Levy (d. 1888), acquired *The Daily Telegraph and Courier* in 1855, a few months after it had been founded by Col. Sleigh, and, aided by his son, soon changed the current of its fortunes, raising it to a leading position among the London dailies, of which it was the pioneer penny paper. Edward Levy (he took the added name of Lawson under his uncle Lionel Lawson's will in 1875) acted as editor of *The Daily Telegraph* till his father's death and then became its managing proprietor and sole controller till 1903, when he was made a baron and passed over these duties to his son. He had received a baronetcy in 1892.

For many years Edward Lawson was one of the outstanding figures in English journalism. No one in Great Britain did more than he to brighten and humanise the daily newspaper and transform it from a plain, severe chronicle of the day's events—only mitigated by the occasional ferocity of its political judgments—into a readable and entertaining presentation of the world's news. The abolition of the last of the paper duties in 1861, in which Edward Lawson himself bore an active part, called into being a host of fresh newspaper readers among the middle classes, which welcomed the popular features of the new journalism. Edward Lawson's conception of a popular daily paper was that it should be a faithful mirror of the times and make a strong appeal to the sentiment and the emotion of its readers. Under his direction *The Daily Telegraph* raised many large funds for various national, patriotic and charitable objects, dispatched missions of exploration and discovery to Central Africa and elsewhere, and started many novel features, such as popular correspondences on live topics of the day, which have since become the established commonplace of journalism. For many years *The Daily Telegraph* warmly supported the Liberal party, but it strongly dissented from Mr. Gladstone's anti-Turkish policy and the final severance came on his Irish policy of Home Rule. Edward Lawson was not by nature a strong political partisan; what interested him most was the social advancement of the people, and the development of the British Empire, to both of which causes he gave strong support, whatever the political complexion of the government of the day.

He was more than once president of the Institute of Journalists and the Newspaper Press Fund, and in 1909 presided over the first Imperial Press Conference in London. On his 80th birthday his long and eminent services to journalism were fitly recognised by the presentation of a laudatory address, signed by the leading journalists of the British Empire, the United States and many foreign countries. A man of keen business discernment, sure intuition, rapid decision, generous sympathies, unfailing kindness of heart and catholicity of interest, Lord Burnham enjoyed the honour of King Edward's friendship. He married Henriette Georgiana (d. 1897), daughter of the actor-manager, Benjamin Webster (*see* 28.459), and died Jan. 9 1916. (J. B. F.)

BURNHAM, HARRY LAWSON WEBSTER LAWSON, 1ST VISCOUNT (1862–), eldest son of the 1st Baron Burnham, was born in London Dec. 18 1862 and educated at Eton and Balliol College, Oxford. Entering political life when young, he represented, as a Liberal, West St. Pancras from 1885 to 1892, East Gloucestershire from 1893 to 1895, and the Mile End division of the Tower Hamlets from 1905 to 1906, and again, but this time as a Unionist, from 1910 to 1916, when he succeeded to his father's title. He also served on the London County Council from 1889 to 1892 and from 1897 to 1904 and was Mayor of Stepney in 1908 and 1909.

In 1903, when his father retired from the active duties of the managing proprietorship of *The Daily Telegraph*, the Hon. Harry Lawson, as he then was, became the sole director of the conduct and policy of that newspaper. These duties, however, did not prevent him from devoting a large share of his time to public work, and few busy men of the period have responded more generously to the claims of public service. Lord Burnham was a member of the committee which drafted the Reform Act of 1918, and of Lord Bryce's committee on the problem of the reform of the powers and constitution of the second chamber. He has been a member of innumerable committees, commissions, conciliation boards and the like and has been chairman of many. He was chairman of the officers' resettlement committee and of the promotion committee of the War Office, and was a member of Lord Tennyson's Empire settlement committee and Lord Justice Shearman's seditious literature committee. For three years he was chairman of the executive committee of the King's Fund for Disabled Ex-Service Men and a leading member of the Overseas settlement committee of the Colonial Office. In 1921 he was unanimously elected President of the International Labour Conference of the League of Nations at Geneva and was re-elected to the same post in the following year. Another conspicuous public service rendered by Lord Burnham was in connection with the salaries of teachers. He presided over the standing joint committees and made an award on the proposed new scales of payment. The Burnham scales, as they are universally called, received the support of the teachers, the local authorities and the Ministry of Education, and when they came up for revision in 1924 Lord Burnham was again asked to undertake the task.

During these years of parliamentary and public activity, he gave the closest attention to the direction of *The Daily Telegraph* and was prominent in the various organisations of the newspaper Press. He succeeded his father as president of the Newspaper Press Fund and the Newsvendors' Benevolent Institution. In 1910 he was president of the Institute of Journalists, chairman of the Newspaper Proprietors' Assn. from its foundation, during the War he was chairman of the Press Conference, to which the Govt. consigned the responsible duty of the regulation of news. Lord Burnham succeeded his father as president of the Empire Press Union and presided over the National Press Conferences in Canada in 1920 and in Australia in 1925. In 1917 Lord Burnham was made a Companion of Honour and in 1919 a viscount. He married in 1884, Olive, daughter of Sir Henry de Bathe, Bart., and he has one daughter. The heir to the barony is his brother, Col. the Hon. William Arnold Webster Lawson (b. 1864). (J. B. F.)

BURNS, JOHN (1858–), British politician (*see* 4.855), held the office of President of the Local Government Board for more than eight years, during which he underwent comparatively little hostile criticism save from his old friends of the Labour party. He was zealous in forwarding substantial measures of social reform, but did not take a prominent part in the great party disputes over the budget of 1909 and the Parliament bill. His activity and success in the administration of his department were recognised—much against his own wish—by the raising of the president's salary in 1910 from £2,000 to £5,000 a year; but his policy was thought to be too conservative even by some members of the Conservative party, and early in 1914 he was promoted to the presidency of the Board of Trade. He left the Govt. in the following Aug., as he disagreed with the Cabinet's decision to join in the World War. He resigned without making

any public statement of his reasons, and took no further active part in Parliament. At the general election of 1918 he desired to stand again for Battersea in the Labour interest. As, however, he refused to join the Labour party, he was unable to get local support. He therefore withdrew his candidature and continued in private life.

BURNS AND SCALDS (*see* 4.860).—Burns are caused by dry heat of 140° F. and over, and scalds by moist heat of over 120° F. Their severity is dependent on the degree of temperature, the duration of the exposure and the size of the burnt area, the gravity being proportionate to the extent rather than the depth of the injury.

Burns vary in degree from a slight scorching of the skin to complete charring of the affected parts, extending down to the muscles, and even the bones. The most superficial burns are characterised by redness, swelling and tenderness, and on healing either leave no trace or a slight pigmentation. In more severe burns blisters follow, associated with considerable inflammation and pain, or the tissue becomes devitalised, forming a dark, leathery patch, known as the eschar. This at first is adherent to the underlying tissue, but in a few days suppuration occurs beneath it, followed by sloughing, and a raw surface, covered with a purulent discharge, is left, which, on healing, results in a reddish scar. In burns of greater severity the suppuration may be so great as to lead to absorption, associated with symptoms of septic poisoning. In severe burns healing takes place slowly, with the formation of an uneven, unsightly scar, which, owing to contraction, may be followed by deformity and disfigurement.

The constitutional effects of burns vary with the situation and the extent of surface involved. They may be primary, consisting of pain, shock, collapse, or death; or secondary, consisting of toxic symptoms due to absorption of poisons from the dead tissue, or of inflammation of the underlying internal organs.

When burns are fatal, death usually supervenes during the period of shock, within 36 hours of the burn. It may occur later from toxaemia, septicaemia or even from sheer exhaustion from the pain and weakening discharges. The outlook in burns, except in those of slight degree, is invariably grave, especially when they occur on the chest and abdomen, and, should an area larger than a third of the cutaneous surface be burnt, a fatal issue is almost inevitable within a few days.

Treatment.—The treatment is both general and local. The general treatment in severe burns consists in dealing promptly with shock before attempting to treat the burn itself. Stimulants should be avoided, and every effort made to soothe the patient, a useful aid being immersion in a hot bath. After the stage of shock has passed, the secondary effects, such as toxaemia and septicaemia, must be dealt with on general medical principles. The local treatment should aim at preventing sepsis, avoiding frequent dressings, favouring the removal of the eschar, and of obtaining a pliant scar and avoiding deformity. Greasy applications, such as carron or carbolic oil, have been largely replaced by moist dressings with soothing astringent lotions, containing bicarbonate of soda, lead, aluminium acetate, etc.

Blisters should be opened with proper antiseptic precautions, and a moist dressing applied. This dressing should be left untouched as long as possible, and only when the lesion becomes septic should it be soaked off and renewed. When the eschar has separated and an ulcerated surface is left, the best method of healing it is that known as the "open" method, in which healing is allowed to take place under a natural scab, produced by powdering the moist surface with an aseptic powder, such as sterilised magnesium carbonate or stearate of zinc. Where the granulating surface of a burn is large and deep, it may be necessary to graft to ensure healing. To avoid deformities, it is essential that the affected parts should be put in proper position during healing.

Scars from burns may be reduced to some extent by radium and X-rays, provided the treatment is commenced within a few months of the injury.

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BURROUGHS, JOHN (1837–1921), American naturalist and writer (*see* 4.863), continued to write frequent essays on out-of-door life, some of which were assembled in the following volumes: *Time and Change* (1912), *The Summit of the Years* (1913), *The Breath of Life* (1915), *Under the Apple Trees* (1916) and *Field and Study* (1919). In 1910 the degree of Litt.D. was conferred on him by Yale University and in the following year he received that of L.H.D. from Colgate University. He died March 29 1921 while returning from California to his country home in New York State.

BURROWS, RONALD MONTAGU (1867–1920), British scholar and archaeologist, was born at Rugby Aug. 16 1867 and educated at Charterhouse and Christ Church, Oxford. While assistant to Prof. Gilbert Murray in the Greek department at Glasgow University, 1891–7, he started his excavations at Pylos and Sphacteria (1895–6), which had the important result of vindicating Thucydides as an accurate historian. From 1898 to 1908 he was Prof. of Greek at University College, Cardiff, and from 1908 to 1913 at Manchester University. In 1905 and 1907 he excavated tombs at Mycalessus (Rhitsona) in Boeotia, thereby systematising for the first time the study of Boeotian archaeology, and in 1907 published *The Discoveries in Crete*. He also published many archaeological papers in the classical journals. From 1913 until his death in London on May 14 1920 he was principal of King's College, London, being the first layman to hold that post. From 1913 onwards he was the leading British Philhellene, having "discovered" Veniselos in 1912, and being invited by Veniselos during the World War (1916) to be the semi-official diplomatic representative in London of the Greek Provisional Government. In 1915 the British Cabinet adopted his plan for bringing Greece into the War by the offer of Cyprus. Confidant and adviser of Veniselos, he wrote and lectured extensively on Near Eastern political problems. At King's College, he founded the many chairs concerned with European history and literature, and the School of Slavonic Studies. See George Glasgow, *Ronald Burrows: A Memoir*, with foreword by E. K. Veniselos (1924). (G. Gl.)

BUSINESS ORGANISATION: *see* OFFICE MANAGEMENT; SCIENTIFIC MANAGEMENT.

BUSONI, FERRUCCIO (1866–1924), Italian pianist and composer, was born at Empoli, near Florence, April 1 1866. After studying in Vienna and at Graz, he became a member of the Accademia Filarmonica of Bologna. In 1888 he was appointed professor at Helsingfors and in 1890 became professor at the Moscow Conservatoire, when he won the Rubinstein prize. After giving recitals and piano lessons in U.S.A. his concerts in different countries brought him world-wide fame as a virtuoso. In 1913 he became director of the Liceo Musicale at Bologna and in 1920 of the Meisterklasse for composition in Berlin, where he died July 27 1924. As a pianist Busoni possessed a superb mastery over the keyboard, probably unequalled since the time of Liszt, together with a great sense of beauty. His compositions include an opera *Brautwahl* (1913), chamber music, orchestral works, piano solos and songs. His brilliant and scholarly arrangements, notably of Bach's "well-tempered clavichord" have been invaluable to pianists; while his talent as a writer is shown in his essays, which include *Entwurf einer Neuen Ästhetik der Tonkunst* (1916).

See H. Leichtentritt, *F. Busoni* (1916) and G. Seldon-Goth, *F. Busoni* (1922).

BUTCHER, SAMUEL HENRY (1850–1910), British scholar, was born in Dublin April 16 1850, being the eldest son of Samuel Butcher, Bishop of Meath. Educated at Marlborough and Trinity College, Cambridge, he graduated as senior classic in 1873 and was awarded a chancellor's medal. After a year as assistant master at Eton he returned to Trinity College as fellow and lecturer in classics. In 1876 he married Rose, daughter of Archbishop Trench of Dublin, and was elected tutor and married fellow at University College, Oxford. In 1882 he succeeded Blackie as professor of Greek at Edinburgh University. In 1904,

two years after his wife's death, he resigned and took up residence in London. In 1906 he was elected Unionist member for Cambridge University. Butcher sat on several Royal Commissions on education and was president in turn of the English Classical Assn., the Irish Classical Assn. and the British Academy. In 1908 he was made a trustee of the British Museum. His written works include *Some Aspects of the Greek Genius* (1891); *Aristotle's Theory of Poetry and Fine Art* (1895); *Greek Idealism in the Common Things of Life* (1901); and *Harvard Lectures on Greek Subjects* (1904). In 1887 he published, in collaboration with Andrew Lang, a prose translation of the *Odyssey*. He died in London Dec. 29 1910.

BUTLER, HENRY MONTAGU (1833–1918), British educationalist (*see* 4.882). In 1914 he published *Some Leisure Hours of a Long Life*. He died at Cambridge Jan. 14 1918.

See Edward Graham, *The Harrow Life of H. M. Butler* (1920).

BUTLER, NICHOLAS MURRAY (1862–), American educationalist (*see* 4.885), was elected a member of the American Academy of Arts and Letters in 1911. In 1912 he was chairman of the New York State Republican Convention and also a delegate to the Republican National Convention. Vice-President Sherman was renominated, but died shortly before the general election, and the Republican electoral votes were cast for Dr. Butler for Vice-President. He was, however, overwhelmingly defeated on the ticket with President Taft, Wilson receiving an electoral vote of 435 (40 states), Roosevelt 88 (6 states) and Taft 8 (2 states). On the outbreak of the World War in 1914 he supported the peace policy of Wilson's administration as responding, he declared, "to the best wishes and hopes of the whole people." He disapproved of the organisation of the American Legion. In 1916, however, he urged America's entrance into the War. The same year he was again a delegate to the Republican National Convention. He favoured woman suffrage and was an advocate of the short ballot. At the Republican National Convention in 1920 he received 69 votes for the presidential nomination on the first ballot, the number gradually falling to two on the tenth and last ballot.

As an educationalist Butler was a bold critic of many contemporary tendencies in American education. He upheld the old theory of mental discipline, and in the face of the widespread vocational movement in schools and colleges remained a steadfast and eloquent defender of liberal education. Under his guidance Columbia University became a cosmopolitan institution, its total registration in 1926, including University Extension and Summer Session, Barnard Teachers' College and the College of Pharmacy, being 33,647. He was chairman of the National Committee of the United States for the restoration of the University of Louvain, destroyed by the Germans in 1914. In 1920 he resigned the editorship of *The Educational Review*, becoming instead advisory editor. In 1923 he became a member of l'Institut de France, taking the place of the late Lord Bryce, and in 1924 was chancellor of the American Academy of Arts and Letters. He was the author of *Why Should We Change Our Form of Government?* (1912); *Progress in Politics* (1913, a pamphlet); *The Meaning of Education* (1915, an enlargement of one published in 1898); *A World in Ferment* (1917, interpretations of the War for a new world); *Is America Worth Saving?* (1920); *Scholarship and Service* (1921); *Building the American Nation* (1923).

BUTLER, SIR WILLIAM FRANCIS (1838–1910), British soldier (*see* 4.888), died in Tipperary June 7 1910.

BUYSSE, CYRIEL (1859–), Flemish writer, published his first book in 1893. In his portrayal of the lives and people of eastern Flanders he is a follower of the French naturalists, and Maurice Maeterlinck was able to declare him the equal of Maupassant. He has the gift of making his characters living men and women; certainly there is no writer of fiction who shows us with more realism every aspect of the Flemish people. He is an excellent story-teller, not without humour, and with his virile art and sober, yet vivid, style he knows well how to accentuate the essential characteristics of men and things never losing sight of their natural environment. He has written over 40 novels and short stories, three of which have been translated into French.

BYELUY, ANDREI (1880–), pen name of Boris Bugaiev, Russian writer, was born in Moscow Oct. 7 1880, the son of a well-known mathematician. When he graduated in 1904 from the Moscow University, he had already published poetry of a symbolic type. His books of poetry and rhythmic prose: *Gold in Blue* (1904), *Ashes* (1909), *The Urn* (1909), four symphonies: *The Northern* (1903), *The Second-Dramatic* (1902), *The Third-Return* (1905), *The Fourth Cup of Snowstorms* (1908), are symbolic phantasies, in essence spiritual, yet expressed in realistic images. His prose is best represented in three novels: *The Silver Dove* (1910), a psychological study of Russian religious sects, reminiscent of Gogol, *Petersburg* (1916), a gloomy, fantastic tale about Russian pre-revolutionary realities, *Kotik Letaiev* (1922), an imaginative autobiography—the problems of life and the mind, seen through the soul of a child. In his books, *Symbolism* (1910), *Poetry of Words* (1923) and others he founded a suggestive theory of phonetic values of words. His mystic tendencies turned to anthroposophy, and from 1912–6 he was an ardent disciple of the famous Dr. Rudolph Steiner at Dornach, Switzerland. Later, he went to live in Moscow and one of the most remarkable of his later books is *The Reminiscences of A. Blok*. His outstanding gift is that of word creation, and as a master of an ultra-modern style in poetry and prose he greatly influenced the younger generation of Russian poets and novelists.

BYNG, JULIAN HEDWORTH GEORGE BYNG, 1ST BARON (1862–), British general, was born Sept. 11 1862, son of the 2nd Earl of Strafford, and joined the 10th Hussars in India in 1883. He passed through the Staff College, and was a major when the South African War broke out; there he raised and commanded the South African Light Horse, and later a column, gaining promotion to brevet colonel. In 1912 he was sent to Egypt to take command of the army of occupation.

In Oct. 1914 he took the 3rd Cavalry Div. to France, and he succeeded to the command of the Cavalry Corps in June 1915. But two months later he was despatched to the Dardanelles to take charge of the IX. Army Corps there and he became responsible for the Suvla area, from which he withdrew his troops most skilfully in the following December. Called back to the Western Front, in May 1916, he took over the Canadian Army Corps, a tenure distinguished by the capture of Vimy Ridge on April 9 1917. In June 1917 he succeeded to the leadership of the III. Army, which he retained till the close of the War. On Nov. 20 he carried out the now famous tank surprise attack on the Cambrai front. In Oct. 1919 he was raised to the peerage as Baron Byng of Vimy and Stoke-le-Thorpe, and received a grant of £30,000. In June 1921 he was appointed Governor-General of Canada, retaining the position until 1926.

BYRD, RICHARD EVELYN (1889–), American naval officer and explorer, was born in Winchester, Va., Oct. 24 1888. He was educated at the Shenandoah Valley Academy, Winchester, and at the age of 12 made a trip round the world unaccompanied. He attended the Virginia Military Institute from 1904 to 1907 and the University of Virginia in the session 1907–8. Entering the U.S. Naval Academy May 25 1908, he graduated in Jan. 1912. After four years' sea service he was placed on the retired list with the rank of senior lieutenant, March 15 1916, through an incapacity resulting from an incident of service. This retirement was in reality nominal since he continued in active service, taking up the study of aviation. During the World War he held the temporary rank of lieut.-commander in command of the U.S. naval forces operating in Canadian waters, and built up the naval aviation stations at North Sidney and Halifax, Nova Scotia, the latter of which he was in charge. He was appointed lieutenant Sept. 2 1918, and was promoted lieut.-commander on the retired list by special Act of Congress in 1922. In 1924 when Amundsen requested help from the U.S. Navy in his projected flight across the North Pole, Byrd volunteered but, being married, was not accepted. In 1925 he went to Greenland with the D. B. Macmillan Expedition under the auspices of the National Geographic Society. Acting as flight commander he supervised 6,000 m. of arctic flight and himself flew 3,000 miles. The experience thus gained convinced him that a flight to the

Pole was feasible if undertaken in the month of May, and on his return he immediately commenced making preparations with that end in view. The machine he selected was a Fokker monoplane equipped with three Wright air-cooled motors—a commercial type—which had already flown more than 17,000 m. in the United States and Cuba. Leaving New York City in April 1926 Spitsbergen was reached without mishap and Byrd made his attempt May 9. Accompanied only by his pilot, Floyd Bennett, he started from Spitsbergen at 12:50 in the morning of May 9 1926, having two objectives, viz., a flight to the Pole 680 m. distant and back and alternatively a flight to Peary Land. Taking off from King's Bay, Amsterdam I., he flew in a straight line to the Pole, which he reached and circled around several times, incidentally verifying the observations of Adm. Peary in 1909. Returning his course was to Verlegen Hook, New Friesland, thence west to his starting point, Amsterdam I., which he reached at 4:20 in the afternoon. His flying time was $15\frac{1}{2}$ hours and the total mileage covered was 1,600.

BYWATER, INGRAM (1840–1914), British scholar (*see* 4.906), died in London Dec. 17 1914. He left a bequest to provide for the study of Byzantine Greek at Oxford.

See W. W. Jackson, *Memoir of Ingram Bywater* (1919).

CABELL, JAMES BRANCH (1879–), American author, was born at Richmond, Va., April 14 1879. He was instructor in French and Greek at William and Mary College 1896–7, graduating with the degree of B.A. in 1898. He then engaged in newspaper work at Richmond and was on the staff of the *New York Herald* 1899–1901. He also contributed short stories to magazines and interested himself in genealogical research. His first novel, *The Eagle's Shadow*, was published in 1904. His work has a distinct individuality, presenting a central conception of human life fitted to an imaginary medieval country, Poictesme, in which the principal actions take place, its inhabitants being ancestors of the other characters appearing in his novels. His method, more or less consistently followed, is the depiction of a decisive event in the lives of two persons, then a similar untying of knots in the life of a child of that couple, and, subsequently, in one of the grandchildren's life history. Following the publication of *Jurgen* (1919) the New York Society for the Suppression of Vice brought action to have the book suppressed on the ground of obscenity. When the case came to trial, however, in Oct. 1922, the publisher, as defendant, was acquitted and the work released for circulation. Among his best known works are *The Line of Love* (1905); *Gallantry* (1907); *Chivalry* (1909); *Domnei*, originally published as *The Soul of Milicent* (1913); *The Cream of the Jest* (1917); *Beyond Life* (1919); *Figures of Earth* (1921); *The High Place* (1923); *Straws and Prayer-Books* (1924); *The Silver Stallion* (1926).

CABLE, GEORGE WASHINGTON (1844–1925), American author (*see* 4.920), died at St. Petersburg, Fla., Jan. 31 1925. Among his later publications were *Posson Jone' and Père Raphael* (1909), *Gideon's Band* (1914), *The Amateur Garden* (1914), *The Flower of the Chapdelaines* (1918) and *Lovers of Louisiana* (1918).

CABLE: *see* TELEGRAPHY, SUBMARINE.

CADBURY, GEORGE (1839–1922), British manufacturer and philanthropist, was born Sept. 19 1839 at Edgbaston, Birmingham, of Quaker parents, and was brought up a member of the Society of Friends. In 1861, when he succeeded to his father's business, it gave employment to 12 workers only, but under the management of himself and his brother Richard (1835–99) it developed rapidly, and in 1879 he founded for the employees the garden village of Bournville, which served as a model for other social ventures of this kind. He became chief proprietor of *The Daily News* (London) in 1901, and his family acquired an interest in *The Star* (London) in 1909. He died Oct. 24 1922. See A. G. Gardiner, *Life of George Cadbury* (1923).

CADORNA, LUIGI, COUNT (1850–), Italian general, was born at Pallanza, Lake Maggiore, Sept. 4 1850. His father was Count Raffaele Cadorna, a distinguished soldier of the wars of the Risorgimento and the Crimea. Luigi Cadorna entered the army in 1866, and served in the infantry, in the artillery and on the staff, becoming colonel in 1892. In 1905 he became lieutenant-general, and a year later was chosen as an army commander in the event of war. In the manoeuvres of 1911 he opposed Caneva, who as victor was given the command in Tripoli.

In 1914, however, on the death of Gen. Pollio, chief of the general staff, Cadorna was appointed to succeed him (July 10). He found the army in a deplorable condition, with regard to personnel and material; moreover, within three weeks, the outbreak of the World War forced the problems of army reform to the front. One of Cadorna's first acts as chief of staff was to adopt the Deport field-gun, and this prompt decision was of the greatest value to Italy. Though handicapped by lack of money and by Italy's low industrial capacity, in the interval between Aug. 1914 and the entry of Italy into the War Cadorna fashioned a weapon with which it was possible to strike, and to strike hard.

For 29 months, handicapped always by lack of means, Cadorna directed the operations against Austria-Hungary with insight, vigour and determination. Facile critics have found fault with his plan of campaign, but the more carefully and objectively this is studied, the more it justifies itself. For a year Cadorna had the full confidence of his country. The first check came with the initial success of the Austrian offensive in the Trentino-Asiago area in May 1916. As time went on, and signs of war-weariness became visible among the troops, Cadorna entered the strongest protest against the policy of the Govt., which, he said, permitted an anti-war propaganda which was detrimental to the morale of the army. Though these protests were largely justified, it must be admitted that a part of the responsibility for declining morale lay at Cadorna's own door, for he did not seem to have fully realised the strain of modern war upon the troops. The disaster of Caporetto led to Cadorna being transferred in Nov. 1917 from the command of the Italian armies to the newly formed Allied Military Council at Versailles. But before leaving his command he had organised the defences on the Piave-Monte Grappa front, and thus had made a stout resistance possible.

Cadorna came to Versailles under the shadow of defeat, but his personality and military insight soon impressed his colleagues and removed the initial handicap. It was a misfortune for Italy when, in Feb. 1918, consequent upon the appointment of the Caporetto inquiry commission, it was thought necessary to remove him from Versailles. As a result of the inquiry he was placed on half-pay on Aug. 29 1918, and four days later his definite retirement was gazetted.

In March 1921 Cadorna published a book dealing with his tenure of the post of chief of staff (*La Guerra alla Fronte Italiana*), which effectively answered much of the criticism that had been directed against his leadership. This work was followed by *Altre Pagine sulla Grande Guerra* (1925). But with the passage of time this criticism had already begun to lose force. More and more it was realised that Cadorna had fitted the Italian Army for war, and that he had conducted the campaign under grave handicaps. Perhaps the most serious defect in Cadorna's leadership was that he failed to secure the loyal co-operation of many of his subordinates. But his achievement was great, and he remains, in spite of the disaster which closed his career, the foremost Italian military figure of the War. On the sixth anniversary of the Italian victory (Nov. 4 1924), the newly created rank of marshal was conferred on him. Cadorna has literary gifts and among his writings is *Il Generale Raffaele Cadorna nel Risorgimento italiano* (1922). (W. K. McC.)

CAFETERIA: *see* FOOD SERVICE.

CAILLAUX, JOSEPH MARIE AUGUSTE (1863–), French politician, was born March 30 1863 at Le Mans. His father, Eugène Caillaux, was an engineer and represented the Dept. of the Sarthe first in the National Assembly and later as Senator; he was Minister of Public Works from 1873 to 1875 and Minister of Finance in the year 1877.

In 1888, after a brilliant academic career, Joseph Caillaux was admitted to the Ministry of Finance. Later he was appointed lecturer at the École des Sciences Politiques in Paris. It was not until 1898 that M. Caillaux, at the instigation of the Republican delegates of the Sarthe, decided to become a candidate for the *arrondissement* of Mamers. His eloquence, his genuinely democratic opinions, his force and readiness in argument, enabled him after a hot contest to defeat the Royalist member, the Duc de la Rochefoucauld-Doudeauville, by 1,800 votes. He continued to represent Mamers until 1917. In 1899, M. Caillaux' great political career began. Waldeck-Rousseau, a name still dear to Republicans, made him his Minister of Finance. During the 3 years that he held this office, M. Caillaux showed not only great financial but also great administrative ability. He inaugurated several important measures, such as the reform of the method of taxing alcoholic drinks, the increase in the scale of the inheritance tax and the reform of the sugar laws, thus introducing into French fiscal legislation the progressive policy which

characterised his future work. He left office in 1902, but four years later was re-appointed by M. Clemenceau. During this second term of office he introduced an income tax, the first serious attempt at a just and democratic form of taxation in France.

The Agadir crisis in 1911 marked the next important stage in his career. The Monis Ministry resigned in June and M. Caillaux was entrusted with the formation of a new ministry. As head of the Govt., he conducted with signal ability the difficult negotiations with Germany. No small part of his title to fame and the gratitude of his fellows is due to the fact that he succeeded in postponing the War which in 1914 was to overwhelm the world. In 1912, however, he was obliged to retire before the hostility of the Commission of the Senate, appointed to enquire into the Franco-German Treaty. In Nov. 1913 he returned to his former post as Minister of Finance in M. Doumergue's Government. Though his re-appointment was approved by public opinion in general, a virulent press campaign was started against him in the *Figaro*. Not only was M. Caillaux's policy in 1911 attacked but also his private life. Intimate letters which had passed between M. Caillaux and his wife before their marriage were published. The latter deeming her honour to have been assailed shot the editor, M. Calmette. M. Caillaux was forced to resign, and at the subsequent trial of Madame Caillaux defended her with such force and eloquence that she was acquitted. Had it not been for this affair, it is probable that he would have been asked to form an administration after the general election and the War might then have been averted.

On the outbreak of hostilities he was appointed paymaster-general to the forces and some months later was entrusted with an economic mission to South America. During his absence the campaign of calumny and insinuation broke out afresh. He was accused of desiring a premature peace and of caballing in secret against the Government. He returned to France in 1915, however, and entirely ignored the accusations. In July 1917 M. Clemenceau led the attack upon the Ribot Govt. and M. Malvy's administration. The Govt. was overthrown and M. Clemenceau came into power with the one idea to carry on the War, despite all obstacles. His one serious rival was Joseph Caillaux. M. Clemenceau, therefore, on Dec. 11 1917, demanded the suspension of Caillaux' parliamentary immunity, moving a vote of no confidence in the Chamber. If M. Caillaux had attempted to oppose the motion his cause would have been lost. He proclaimed his innocence in one of the finest speeches ever made in the Chamber, and was cheered to the echo by members of the Left. Nevertheless, he demanded to be heard in the Courts. His parliamentary immunity was suspended and on Jan. 4 1918 he was arrested. The case for the prosecution was based on vague rumours and more or less distorted conversations. It was said that Germany had counted upon M. Caillaux' support to secure favourable peace terms. Various cases of high treason were pending at this time and an attempt was made to connect these with the accusations against M. Caillaux. It was not until Feb. 1920 that he was brought before the Senate sitting as the High Court of Justice and indicted for "plotting against the security of the state abroad."

After a lengthy debate of the utmost vigour on both sides, the accusations fell to the ground one by one. By 213 votes to 28 the arguments of the Procureur-Général, Lescouvé, were refuted. Nevertheless, he was not completely exonerated. He was condemned to three years' imprisonment, the loss of his civic rights for ten years and to five years' residence within a zone to be indicated by the Govt., as well as the costs of the case amounting to about 53,000 francs. The venerable M. Demange, the senior advocate of the court, rose in his seat and said indignantly: "Remember, gentlemen, that you are condemning a man on a count on which he has not been defended." As he had already spent three years in prison M. Caillaux was released the next morning. He returned to Mamers and devoted his time to writing two books which appeared also in English under the titles of *My Prisons* (1921) and *Whither France? Whither Europe?* (1922). Their success was widespread and the popularity of the exiled politician increased.

The amnesty passed by the National Assembly in 1924 restored his political and civic rights to M. Caillaux. In 1925 he was asked by M. Painlevé to join his Govt. as being the one man capable of reducing French finances to order. He accepted the duty and it seemed that at last this difficult task would be accomplished. He attacked first the problem of inter-allied debts. He initiated conversations in London with Mr. Churchill and in Washington with the United States Debt Commission. But political considerations proved too strong. He was accused of belonging to the Radical Socialists. Serious friction arose, with the result that M. Painlevé handed in the resignation of the Govt. on Oct. 28 and formed a new Ministry, excluding M. Caillaux. The latter had, in the meantime, been elected Senator and president of the council of the Sarthe. He retired from office with dignity, preferring failure to the countenancing of measures which, in his opinion, would almost certainly prove ruinous to the country. In June 1926, after another Cabinet Crisis, M. Caillaux again became Minister of Finance. (A. Du.)

CAIRO, Egypt (*see* 4.953), the largest city in Africa, has a population estimated in 1925 at over 850,000. At the 1917 census the inhabitants numbered 790,939, of whom 79,867 were foreigners. Italians and Greeks each numbered over 15,000; there were 12,000 Turkish subjects, mostly Syrians, 8,252 French and 7,524 British, including Maltese and naturalised subjects.

Much has been done between 1910 and 1925 to improve the amenities of the city. A new main drainage system was made, the Bulaq and Zamalik bridges built across the Nile, motor roads constructed to Helwan, Alexandria and Upper Egypt, the tramway system extended and a garden suburb laid out near Qasr el 'Aini. The suburbs have extended considerably, particularly that of Heliopolis, where a large aerodrome was constructed during the World War. After 1918, Heliopolis became the chief air station in North Africa. The inland ports of Atar en Nabi and Rod el Farag, at the northern and southern ends of the city respectively, increased in importance during the War.

A progressive housing policy has been followed by the municipality since the end of the War; many private houses and blocks of flats have also been built, particularly on Roda Island and at Heliopolis. Several public buildings have been erected, including the Lord Kitchener Memorial Hospital for Women at Shubra, the Houses of Parliament in Shari Dawawin, a building for the Ministry of the Interior and an ophthalmic laboratory at Giza, a gift by the British in memory of Egyptians who lost their lives in the World War. At Zaaferan 40 ac. of ground were taken in 1925 for a hospital and a university.

While modern requirements received attention, care was taken of Arab monuments, a law passed in 1918 enlarging the scope of the department charged with the preservation of such monuments, so as to include all buildings dating from the Arab conquest to the reign of Mehemet 'Ali. Coptic ecclesiastical buildings and the Roman fortress of Qasr esh Sham at Old Cairo were specially cited. Important excavations were made at the Roman fortress; the mosque of Ibn Tulun was carefully restored, while the mosque of Bibars was rescued from being a slaughter-house and its great court was turned into a public garden. A public garden was also constructed round the Daher mosque. After the abolition of the British Protectorate there was, however, a slackening in the work of preservation, to which public attention was called in the summer of 1923, with good results. The palace of Mussafer Khan and the mosque of 'Abdin were restored and other urgent work put in hand. Pains were also taken to make the Royal Egyptian library fully representative of Arab literature: by 1925 the library contained over 100,000 volumes, about half being in the Oriental section.

Excavations conducted at the Giza and Saqqara pyramids and at Abu Roash, all places in the neighbourhood of Cairo, yielded valuable results. Certain of the finds were transferred to the Cairo Museum, to which were also brought the remarkable statues of the Pharaoh Akhnaton, found at Karnak, and many beautiful funerary objects from the tomb of Tutānkhamūn, including the golden coffin of the king. See E. Reynolds Ball, *Cairo of Today* (10th ed., 1926).

CALAIS, FRANCE (*see* 4.965), had in 1921 a population of 73,001. The tonnage of the port almost doubled between 1913 and 1918, in spite of the stoppage of civilian traffic, owing to the enormous quantity of war material that was dealt with. The port equipment was much improved to cope with military needs; a quay, 280 metres long, was finished in 1918, and the new west dock has a depth of from 26 ft. to 30 ft. on the sill. Work on the entrance to the port, which was stopped during the World War, was resumed in 1921, and the west jetty was nearing completion in 1926. By the construction of an elevator, canal boats of 300 tons can reach the large canal dock. The Dover-Calais mail and passenger service, stopped during the War, was resumed at the end of 1919.

Calais is the principal centre of the French lace trade. In 1923 goods worth 80,000,000 fr. were exported to the United States, as against 43,000,000 fr. in 1922 and 60,000,000 in 1913. The lace machines are driven by electrical power. Calais underwent some 60 aerial bombardments during the War; there were many casualties and a large amount of material damage was done, the Church of Nôtre Dame and the Town Hall being ruined. The town was awarded the Croix de Guerre.

CALCULATING MACHINES (*see* 4.972).—During the years 1910–25 great improvements have been made in these machines and in the art of calculating by mechanical means.

Machines designed to carry out all kinds of accounting work, in any currency or system of weights and measures, are used in banking, insurance, municipal, and many other offices in all parts of the world. Some are of large capacity, many are driven by electric motors, and some, *e.g.*, the Burroughs Duplex, have two sets of adding wheels that add two separate groups of figures simultaneously.

Many of the improvements effected have been in connection with automatic locking mechanism for preventing the movement of parts of the calculating machines when they should remain at rest, the mechanism for preventing overrunning of rapidly moving parts, and means for checking everything done by the machines and enabling them to work with the minimum of supervision.

Machines Described.—The Burroughs Adding and Listing Machine, invented by William Seward Burroughs in 1888, is a key-set, multiple-bank machine, with independent crank handle or motor operating means. Its adding mechanism includes a series of sectors, each pivoted near its centre, and carrying printing types at one end and, at the other end, a toothed segment with which the corresponding adding wheel is put into or out of gear during the operation of the machine. In operation the keys are set for each item which is then printed and added by a pull of the operating handle, the total being printed by a final pull, after depression of the total key.

The Sundstrand Adding and Listing Machine and the Dalton machine are key-set, independently actuated single-bank machines, with item and total printing apparatus. The successive depression of the keys, to set up an item, positions a number of corresponding stops to limit the subsequent movement of the totaliser-actuating racks and type members.

The Comptometer, invented in 1885 by Dorr Eugene Felt, is a key-driven machine, *i.e.*, the depression of a key actuates a lever which operates a train of gears rotating the numeral wheel in the register. The machine, consequently, is rapid in its operation. The register is in the front of the machine and is cleared by a single movement of the cancelling handle. Recent improvements of the Comptometer include the "controlled key" mechanism to prevent operators' errors, through their making partial key strokes, and signals designed to prevent a new calculation being attempted before the register is clear.

Experimental Work.—Many attempts have been made to design machines to multiply and divide numbers, however large they may be, by a method as direct and automatic as possible and thus reduce the mental work of the operator. Leibnitz made an attempt in this direction, and Thomas of Colmar's machine, which employed the stepped barrel of Leibnitz and was the early form of Layton's Arithmometer, was modified for the same purpose. Later, the Steiger-Egli (*see* 4.974) was brought into use about 1894 and the Mercedes-Euclid (German Patent Specification No. 209817) about 1909. Other machines designed for the same purpose include Monroe, Hopkins, Guy's, Brunsviga, and Muldivo machines. These have a totaliser carriage mounted on the machine and arranged to be moved laterally step by step, the movement being either manual or automatic. An actuating crank handle is moved in one direction for addition and multiplication and in the opposite direction for subtraction and division. Multiplication may thus be performed by successive entry in the totaliser of partial products formed by the machine. The partial products are formed by adding the multiplicand repeatedly in accordance with each digit of the multiplier and these products are registered upon the totalising counter in the correct denominational order, by a requisite movement of the carriage, so that the whole product is entered in the counter.

In the Monroe machine use is made, for controlling the number wheels, of special two-part toothed wheels, each part being moved axially under the control of a rocking plate actuated from the key-board (British Patent Specification No. 195694). The Brunsviga, Guy's, and Muldivo machines employ forms of Odhner's pin wheel with variable teeth. In the Hopkins machine multiplication is effected under the control of stepped plates grouped to represent the units and tens of the partial products.

A machine has been patented, by Alexander Rechnitzer of Vienna, designed to attain complete automatic action. Any two numbers to be multiplied together are set up on the machine and its motor is released, whereupon the partial products are entered automatically and the complete product is shown on the totalising counter. The completely automatic performance, however, of these operations necessitates the use of complicated mechanism. (See British Patent Specifications Nos. 4550 of 1910 and 18642 of 1912).

Combination Machines.—Several forms of combined typewriters and calculating machines have been introduced. The Ellis, Elliott-Fisher, Hopkins and Underwood-Hanson are examples. The Barbel system of automatic calculation uses a unique method. The figure keys of a typewriter are hooked to the figure keys of a calculator underneath. The values are registered by the counting of small steel balls which may be done at the rate of 80 per second. The balls are delivered to the counters by triggers and, during their passage, register their numbers upon dials connected electrically to the printing apparatus. After passing the counters, the balls are returned automatically to the tubes in which they are stored. The various operations in the machine are electrically controlled, current being supplied by a small electric generator in the machine.

Since 1910, automatic means have been brought into commercial use for compiling, classifying, and recording the numerous details of transactions (*see* BOOKKEEPING), which otherwise are entered in ledgers or on filing cards. The details are represented on cards by perforations in columns, the position of any perforation completely identifying one and only one of the details. In the Hollerith system, the cards are read electrically by being passed along contact brushes which complete the circuit when a perforation arrives. The cards are first sorted into groups by an electrical sorter, the passage of a card into its proper group compartment being controlled by the passage of current through the corresponding perforation in the card.

The tabulation of the details is the work of an electrical tabulator having totalisers which are actuated by means of electromagnets controlled by the contact brush circuits. The Hollerith system was designed for use by the U.S. Census Bureau and was used for dealing with the results of the British census of 1911. In the Powers system, similar cards are used, but reading is effected by longitudinally movable pins, which pass through the perforations in the cards, as these are presented to the pins.

Much has been done, especially since the War, in designing apparatus for use in anti-aircraft and naval gunnery, whereby the future positions of moving targets are predicted, use being made of the best data available.

Calculating Areas.—The principal commercial use, during

recent years, of area-calculating machines lies in the measurement of hides and sheets of leather. The machine generally employed is of the type known as the Sawyer machine, in which a summation of the peripheral motions of coaxial wheels beneath which the hide or sheet of leather passes is registered on a dial and may be stamped on the leather or hide. Improvements in this type of machine have been designed to enable the machine to deal accurately with sheets of very thin leather.

No new calculating machines of the harmonic type, to which Lord Kelvin's Tide-Predicting Machine belongs, have been invented since 1910. According to the British Assn. Reports, 1920, p. 321, harmonic predictions of the tides have been found to be unreliable for ports in estuaries or comparatively shallow seas. Research is being directed, therefore, mainly towards ascertaining the nature of the disturbing causes in shallow-water areas. (*See* TIDES.) The future of tide-predicting machines will depend largely on the results of this research. (T. E. L.)

CALCUTTA, INDIA (*see* 4.981), was until 1912 the seat of the Govt. of India, which was in that year transferred to Delhi. Calcutta became the seat of a governor in council, being thus on an equality with the other presidential capitals, and in 1924 the corporation was remodelled. This consists of 85 councillors, 75 of whom are elected by the ratepayers, with a mayor, deputy mayor and aldermen elected by the council. The population of the city and suburbs, including Howrah, was 1,327,547 in 1921, and is a mixture of many races and religions, the majority being Moslems. Many languages are spoken, of which Bengali is the chief. The town hall and part of the government offices accommodate the Bengal Legislature, and the Governor of Bengal lives in Government House, vacated by the Viceroy when Delhi was made the capital of India.

In Jan. 1912 the Bengal Legislature created an Improvement Trust. Since its creation it has carried out the clearing of insanitary areas, the widening and construction of roads, the chief being the north-south Central avenue, of which 1½ m. was opened in 1924; a playground in Shambazar, and parks in Cossipore and Karaya; great improvements in the Bhowanipur district; the provision of model dwellings for families dispossessed under these schemes; and the laying out of suburban land for private building. A Victoria Memorial, the conception of which was due to Lord Curzon, built on the site of the old jail, was opened in 1921. It is a domed marble building, chiefly Renaissance in style, which contains pictures, documents, etc., illustrating Indian history. In the grounds are statues of Queen Victoria and the Marquess Curzon and King Edward VII. Memorial Arch. The War Memorial to the lascars of Bengal and Assam is near Prince's Ghat. Several magnificent buildings have been erected in the commercial quarter, including the Royal Exchange; the Howrah railway station has been enlarged, and in 1924 it was decided to build a steel cantilever bridge over the Hooghly to Howrah. An iron reservoir, said to be the second largest in the world, has recently been finished at Talla, to the north of the city. In 1919 the Calcutta University Commission produced a scheme of reform. Calcutta suffered severely from the influenza epidemic of 1918, and for some years afterwards the death-rate from bronchitis was very high.

The trade of the port, which since 1911 has been under the control of a port trust, was much affected by the War, and owing to the position of the city there was little military traffic as compensation. Recently, after much variation, a real improvement has been noticeable. In 1913, owing to the increased trade, it was decided to build a new dock and quays below the Kidderpore docks, and four riverside berths with sheds, as a temporary measure. Work on the main scheme was begun in 1920, and the first portion with five berths, and also two graving docks, was expected to be finished in 1927. The limits of the port were extended 9 m. to the north in 1921. The Hooghly is a dangerous river and new shoals are constantly forming, but considerable improvements have been made by dredging and by lighting the river between Sangor and Kulpi. Vessels of 10,000 tons, drawing 28 ft. and more, ascend to Calcutta. A new storage depôt for petrol has been built at Budge-Budge.

CALCUTTA, UNIVERSITY OF.—The University of Calcutta was founded, together with those of Madras and Bombay, by an Indian Act in 1857—as the result of the famous educational dispatch of Sir Charles Wood in 1854—on the model of the University of London, then an "affiliating" university. After the report from Lord Curzon's universities commission in 1902 it was given teaching powers by an Act in 1904; and the university is still working entirely under the Acts above named save for the substitution by an Act of 1921 of the governor of Bengal for the governor-general as chancellor, and of the local government for the governor-general in council, as the determining authority for a number of university matters.

The university exercises almost complete control over the hundreds of secondary schools in Bengal by means of the matriculation examination, for which from 16,000 to 19,000 candidates present themselves annually; it exercises control over the "affiliated" colleges by determining the curricula and examinations in the faculties of arts, laws, teaching (education), science, medicine and engineering; and it carries on in Calcutta "post-graduate" teaching in arts and science and teaching in law in the university law college. A comprehensive survey of the university work was made by the Calcutta University Commission presided over by Dr. (now Sir) Michael Sadler in 1917–9. They found "the university system in Bengal fundamentally defective in almost every aspect," and that in so far as it did good work this was in spite of the method of organisation in vogue (*Report*, vol. 5, p. 302).

The system of secondary education was radically defective. The mechanical system of marking at the examinations, devised to secure uniformity of treatment, encouraged pure memorisation at the expense of intelligence, and tended to the deterioration of mental efficiency throughout the schools and university (*loc. cit.*, p. 345). The only changes of importance made since the report were the removal of an area with a radius of five miles in the Dacca district and of the province of Burma from the educational jurisdiction of Calcutta, and the creation of the University of Dacca (*q.v.*) and of the University of Rangoon in 1921. There are 45 "affiliated" colleges (spread over Bengal and Assam), including three in teaching, three in law, two in medicine and one in engineering, some of which, like the Presidency college, the Bengal Medical college and the Bengal engineering college, are maintained by Government, but of which the majority are maintained by private enterprise and missionary effort. The colleges differ very greatly in their level of efficiency. A large number of "post-graduate" courses are restricted to teaching for the M.A. and M.Sc. degrees, and others are specialised and advanced. The teachers of the post-graduate courses have produced a considerable amount of original work. The university has a number of endowed chairs and lectureships, and a very large number of benefactions for scholarships and prizes.

See Calcutta University Commission *Report*, 1919 (5 vol., with 8 vol. of appendices); Calcutta University *Calendars* up to 1924–5. (P. J. H.)

CALENDAR: *see* EASTER, FIXED.

CALGARY, Canada (*see* 4.1004), had in 1921 a population of 63,305. In 1925 it was estimated at 75,000. It is the centre of the ranching and grain-producing region of central and southern Alberta, a distributing point for the mining districts in the mountains, and the western general headquarters of the Canadian Pacific Railway. The Canadian National Railways has large workshops there, and it is an important station of the Royal Canadian Mounted Police. Large water-power stations, lumber-mills, lighting plants, banks, wholesale houses, hotels, churches, private and public schools and a large public creamery, all go to constitute a flourishing city. Natural gas is piped from the Bow Is. field, and electric power is developed from the Bow river. An institute of technology and art was opened in 1916. Four miles south of Calgary is situated the Agricultural Experimental Station, maintained by the Provincial Govt., one of the largest of its kind in the world. Calgary is fast growing as a manufacturing city, and its industrial products include beet sugar, soap, furniture, boilers, farm implements and miscellaneous

machinery. Several meat-packing factories have been established. The city stands near an oil-field of growing importance and a large oil refinery has been built.

CALIFORNIA (*see* 5.7a).—In 1920 the population was 3,426,861 as against 2,377,549 in 1910, an increase of 1,049,312, or 44·1%. The population in 1925, as estimated by the U.S. Census Bureau, was 4,021,320. The urban population (in places of 2,500 or more) in 1920 was 2,331,729, an increase during the decade from 61·8% to 68% of the total population. Of the cities, three had more than 200,000 inhabitants in 1920: Los Angeles (576,673), San Francisco (506,676) and Oakland (216,261). The total land area is 155,652 square miles.

Political History.—Between 1910 and 1925 many changes were made in the constitution and government of the state. In response to a popular movement, the Legislature, elected in 1908, passed a law giving the voters more direct control of the political parties at the primary elections. This led in 1910 to the election of Hiram W. Johnson as governor on a platform opposing the "special interests." The new administration carried through legislative changes which were both numerous and far-reaching. In addition to legislative enactments, 78 constitutional amendments were approved during the period 1910–25. Among the more important were those of 1911 providing for the initaitive and referendum, the recall (including the recall of judges), increased powers to the state railway commission and the adoption of the short ballot; provision for the free distribution of text-books in elementary schools, in 1912; the authorisation of a minimum wage law for women, in 1914; the enlarging of the operations and support of the public schools, in 1920; and a budget law, in 1922.

Important legislation included a Working Men's Compensation Act; limitation of the working hours for women to 48 a week; a Teachers' Pension Act; provision for the cure of drug addicts; a Mothers' Pension Act; a Blue Sky law, designed to protect investors from unscrupulous promoters; the Webb Alien Land Holding Act, to prevent Japanese from holding real estate; provisions for absent voters; regulation of stages and automobiles as common carriers; a compulsory part-time education law raising the compulsory school age limit from 15 to 16 years; and provision for the vocational re-education of disabled men.

While these Acts were generally recognised as having high social value, many of them added materially to the rapidly increasing cost of government. In 1910 the cost of state government was $14,866,850; in 1920 it was $36,125,456; and in 1924 $57,944,154. By a constitutional amendment in 1910 the system of taxation was so changed that state expense was to be borne by taxes on corporations, which were, on the other hand, relieved of county and local taxation. In 1919 the problem of governmental cost was made an object of special study and legislation, and in 1921 a remedy was sought by the consolidation of many state boards and commissions into a few state departments and also by raising the rate of the tax on corporations. This action brought forward the problem of state expense as an acute political issue, and resulted in the adoption of a constitutional amendment providing for an executive budget, and in the election of Friend W. Richardson as governor on a platform of strict economy. The prosecution of this programme divided the state into two political camps, one urging the full discharge of the social and educational responsibility of government, the other demanding relief from the burdens of heavy taxation.

Education.—The number of pupils enrolled in the public elementary and high schools rose from 513,319 in 1914 to 1,019,739 in 1924. In the latter year there were 977 kindergarten, 18,861 elementary and 9,291 high school teachers in the public school system. Expenditures for public education have increased enormously, rising from about $6,000,000 in 1910 to $75,576,031 in 1924. Much of the increase was due to the introduction of the free textbook system and to the construction of buildings.

Agriculture.—In 1920 there were 29,365,667 ac. in farms, of which 11,878,339 ac. were improved land. The total acreage had fallen to 27,565,440 in 1925. The average acreage per farm decreased from 316·7 in 1910 to 249·6 in 1920 and to 202 in 1925, but the value per acre increased from $47.16 in 1910 to $94.77 in 1920 and to $114 in 1925. In 1920 the total value of all farm property was $3,431,021,861: this value had fallen to $3,161,818,824 in 1925. There were 4,219,040 ac. under irrigation in 1920. In 1925 the total value of all farm crops was $458,469,000: the following table shows the production and value of certain crops in that year:—

	Production	Farm Value
Hay	5,621,000 tons	$77,556,000
Cotton lint	60,372,000 lb.	12,980,000
Beans	4,080,000 bu.	16,728,000
Barley	32,240,000 bu.	24,180,000
Rice	4,738,000 bu.	8,055,000
Wheat	11,475,000 bu.	16,956,000
Potatoes	6,510,000 bu.	13,020,000
Corn	3,026,000 bu.	3,517,000

Fruit growing is by far the most important branch of agriculture. The chief crops are oranges, apples, lemons, grapes, prunes and peaches. In 1925 the total value of the fruit crop was $216,164,000.

Pastoral Industry.—The value of dairy products for the fiscal year 1923–4 was $118,647,544, distributed as follows:—

Butter	$37,513,481	Ice Cream	$12,247,904
Cheese	2,096,135	Milk and Cream	66,790,024

The following table shows the number of live stock slaughtered and the principal products of the same for the calendar year 1923:—

Slaughtered		Products	
Beeves	549,155	Fresh Beef	293,443,739
Calves	175,419	Fresh Veal	24,763,322
Sheep	1,607,538	Fresh Mutton	60,682,334
Hogs	1,187,767	Fresh Pork	105,894,358
		Cured and Salted Pork	44,077,673

During 1925 the wool clip was 17,150,000 lb., valued at approximately $5,800,000.

Minerals.—The total value of the mineral production in California in 1924 was $374,620,789. The production of gold decreased from $17,398,200 in 1919 to $13,150,175 in 1924, which was approximately 30% of the gold output of the United States. The silver output was 3,555,153 fine oz., valued at $2,381,952; copper, 52,089,349 lb., valued at $6,823,704. The value of the non-metallic minerals was practically three-fourths of the total value: the chief item was petroleum, which, in 1924, produced 228,933,471 bar., valued at $274,652,874. Cement production reached 11,655,131 bar., valued at $23,225,850.

Industry.—The total value of manufactured products in 1923 was $2,215,281,250, in producing which there were employed 246,154 workers, who received $353,183,000 in wages. The principal industries were petroleum refining, $267,382,871; canning and preserving, $170,620,075; slaughtering and meat packing, $102,568,576; lumber and timber products, $82,228,916; planing mill products, $82,228,916; printing and publishing, $72,012,079; motor vehicles, $67,160,192; bread and bakery products, $60,401,871; and motion-picture production, $54,332,060.

Communications.—The total railway mileage operated in the state on June 30 1924 was 16,439, of which 3,155 m. were electric railways. The chief lines are the Southern Pacific; the Atchison, Topeka and Santa Fé; the San Pedro and Salt Lake; and the Western Pacific. After 1910 there was a rapid improvement in highways. The state highway system in 1924 had a total mileage of 6,400. The use of motor vehicles expanded rapidly between 1910 and 1925, and on Aug. 1 1925 there were 1,382,821 automobiles and motor vehicles in the state.

(O. C. C.)

CALIFORNIA, UNIVERSITY OF (*see* 5.22).—During the period 1910–25, the University of California grew to such an extent that in 1925 it stood first in number of students among American universities. On Nov. 1 1925 the enrolment was as follows: at Berkeley, in the colleges of Letters and Science,

Engineering, Agriculture, Chemistry, Commerce, Jurisprudence, Medicine (part), Education and Architecture, 8,726 undergraduates (4,757 men and 3,969 women) and 943 graduates (484 men and 459 women); at San Francisco, in the Hastings School of Law, schools of Medicine (part), Dentistry, Pharmacy, Hooper Foundation for Medical Research, 656 students; at Los Angeles, in the southern branch (instruction in lower division), 872 students, and in the teachers' curricula, 1,108 students, making a total, less duplicates, of 11,197. There were in the university extension division courses, 13,792; in the agricultural extension courses, 5,625; in the summer session and intersession courses, 6,436, and on the university farm, 530, making a grand total, less duplicates, of 37,480.

Many new buildings were erected in this period, including the Boalt Hall of Law (1911), costing $190,000, partly the gift of Mrs. Elizabeth Josselyn Boalt as a memorial to Judge Boalt and partly subscribed by the lawyers of California; Agriculture Hall (1912), costing $267,000; Benjamin Ide Wheeler Hall (1917), costing $700,000; and Hilgard Hall (1917), costing $350,000, both the gift of the people of California; Gilman Hall for the Chemistry Dept. (1917), costing $197,000; Sather Tower (1914), costing $200,000, in addition to $25,000 for the bells; the University Library (1917), costing $1,442,000, of which $730,000 was bequeathed by Charles Franklin Doe; Stephens Memorial Hall (1921), costing $300,000, provided for by popular subscription as a memorial to Henry Morse Stephens, for 17 years a professor in the university; Le Conte Hall (1922), costing $500,000, housing the Physics Dept., a gift of the state; Haviland Hall (1923), costing $350,000, of which $250,000 was provided by bequest of Mrs. Anna N. Haviland; Stadium (1923), costing $1,361,000, made possible by public subscription; and Hesse Hall, costing $41,750, and Veterinary Science Hall, costing $11,500, built from the general funds of the university.

Dr. Benjamin Ide Wheeler resigned the presidency in July 1919 after 20 years of service. Dr. David P. Barrows, head of the Political Science Dept., who then succeeded, resigned in 1923 to resume instructional work, and Dr. W. W. Campbell became the tenth president.

Mrs. Phoebe Apperson Hearst, for 22 years a regent of the university, died April 23 1919. Among her many gifts to the university were the Hearst Mining Building, Hearst Hall; scholarships amounting to more than $30,000; contributions to the Anthropological Museum, $130,000; and the swimming pool for women. Hearst Hall, destroyed by fire, is being rebuilt as a memorial to Mrs. Hearst by her son, William Randolph Hearst, at a cost of more than $1,000,000. The endowment of the university in 1924 was $9,593,354, yielding a gross income of $362,542. The total assets, including real estate and improvements, were $33,834,997. The total income for the year ending June 30 1924 was $9,591,498. (W. M. H.)

CALIPHATE (*see* 5.23).—There has been much diversity of opinion in the Moslem world on the subject of the Caliphate since the 1st century of the Mahommedan era, but only one theory—that of Sunni orthodoxy—has obtained more than temporary or local realisation (*see* MAHOMMEDAN INSTITUTIONS, 17.411). This theory of the Sunni Caliphate grew out of the actual political facts connected with the establishment of the vast Arab empire stretching from the shores of the Atlantic to Transoxiana; it assumed that all believers would always live under one Moslem ruler, who would be of the tribe of Quraish (to which the Prophet himself had belonged), and for nearly nine centuries the Caliph was actually a Quraishite. But the empire remained undivided for little more than a century, and broke up into a number of independent states; so that by the 10th century the authority of the Caliph in Baghdad hardly extended beyond the walls of that city, and he himself was a puppet in the hands of his Turkish mercenaries. The theory, however, survived its failure to realise itself and even independent monarchs recognised the Caliph as the source of all authority, and would apply to him for a diploma of investiture or a title of honour, in order that their position might be legitimatised and the tender consciences of their subjects satisfied. After the last Abbasid Caliph in Baghdad was put to death by the Mongols in 1258, a shadowy continuation of the dynasty was set up in Cairo under the protection of the Mameluke Sultans and, though the Caliph was now powerless to exercise any influence on political affairs, he was still regarded in popular sentiment as the only legitimate source of authority, and requests still came for titles and diplomas from independent princes. On the other hand, particularly after the Mongol conquests, a new theory of sovereignty was devised by the Mahommedan legists, who began to represent the authority of the ruler as derived directly from God Himself, "Who giveth the kingdom to whomsoever He wills, and raiseth whomsoever He wills to honour." No authorisation therefore from the Caliph was any longer held to be necessary, and the legists impressed the duty to obedience to any ruler who had established his position by force of arms.

Development from 13th Century.—Accordingly, from the latter part of the 13th century onwards, independent Sultans—Maghrebins, Indians, Seljuqs and even Turkomans and Shaybanids—began to assume to themselves the title of Caliph in addition to other high-sounding titles and this title, which in earlier ages had been considered to be the exclusive prerogative of one supreme sovereign, now came to be applied to any number of princes, some of whom were persons of quite insignificant status. The rising power of the Ottoman Sultans naturally fell in with the prevailing fashion, and we accordingly find that the title Khalīfah was applied as early as 1362 to Murad I., and afterwards to each one of his descendants on the Ottoman throne. There is, therefore, no justification for the legend that the first of the Ottoman Sultans to assume this title was Selim I., and still less historical evidence is there for the story that after his occupation of Cairo in 1517 the dignity of the Caliph was transferred to him by the last of the Abbasid Caliphs, Mutawakkil. This legend was first put forward in 1787 by D'Ohsson and passed unchallenged from one European history to another, and was adopted by Turkish writers also, and in modern times it became a commonplace in the propagandist literature of the Mahommedan world in support of the Ottoman claim to the Caliphate. As the Ottoman conquests extended the boundaries of their enormous empire, it became clear that the Turkish Sultan was the only Mahommedan monarch possessing territories, power and wealth commensurate with the dignity of so exalted a title, and the same halo of glory gathered round Constantinople as in former centuries had been associated with Damascus and Baghdad.

The Ottoman Diplomacy.—The Ottoman Sultans do not appear to have attached much importance to the title of Khalīfah until in the 18th and 19th centuries Turkish diplomatists found it convenient in their relations with Christian Powers to make use of the false analogy current in Europe between the Caliph and the Pope, and to claim for the Sultan spiritual authority over Moslems who were not actually his subjects. Abdul Hamid II. (1876–1908) especially emphasised this claim, and from the outset of his reign endeavoured to obtain recognition of himself as Caliph by sending emissaries to Egypt, Tunis, India, Afghanistan, Java and China. His deposition in 1908 did not entail the abandonment of this policy, and in the treaties made between the new constitutional Government in Turkey and the states which between 1908 and 1913 annexed territories formerly provinces of the Turkish empire, *e.g.*, Bosnia, Hercegovina, Libya, Bulgaria and Macedonia, it was stipulated (in regard to the first three) that the name of the Sultan should continue to be mentioned in the public prayers as Caliph, and that in all of them the appointment of Moslem ecclesiastics should be authorised by the Shaikh ul Islam in Constantinople.

When Turkey entered into the War in 1914 a further attempt was made to make political use of the Turkish claim to the Caliphate by the proclamation of a Jihād in which all Moslems were called upon to fight in defence of the Khalīfah and were threatened with the punishment of hell if they supported his enemies. The lack of response to this appeal revealed the unreality of this assumption of authority, but many Moslems, especially in India, were undoubtedly distressed at the fact of hostilities between Turkey and the governments under which they themselves lived, and after the Armistice in 1918 much sympathy was aroused

for the Caliphate, and fears were expressed lest the terms of peace should cripple the power of Turkey.

Abolition of Sultanate and Caliphate.—In Nov. 1922 the National Assembly declared a republic and abolished the Sultanate; Mahommed VI. was deposed and his cousin, Abdul Majid, elected Khalīfah of all the Moslems, but the exact nature of his functions had not been clearly defined before he was sent into exile in March 1924 and the Ottoman Caliphate abolished altogether. A few days later King Hussain of the Hejaz was proclaimed Caliph in Mecca and Transjordan, and received some recognition in Palestine and Syria; but in the following Oct. he abdicated, just before the victorious Wahhabis entered Mecca.

Strong protests against the action of the Turkish Govt. were made in Egypt, India and Java, and great consternation was aroused by the disappearance of an institution which for so many centuries had served as a rallying point for the ideal of the unity of the Moslem world. Many proposals have been put forward for dealing with this new situation; the most conservative body of opinion refuses to accept the action of the National Assembly and still regards Sultan Mahommed VI. as the only legitimate Caliph, maintaining that the Sultanate and the Caliphate are inseparable. Some of his supporters who had organised on the model of one of the religious orders a movement for his restoration, were tried and condemned at Angora in Aug. 1925.

Future of the Caliphate.—Caliph Abdul Majid has been able to retain the sympathy of only a small band of supporters, who wish the spiritual functions of this head of the community to be free from any contact with political organisation. Others, whose opinions are most clearly voiced by the theologians of the great Mahommedan University of Al-Azhar in Cairo, hold that the post has now become vacant, and that representatives of all the Moslem races and communities in the world should elect a new Caliph; such a congress was proposed for March 1925, but it has been postponed for a year. They propose to revive the primitive practice of election as exemplified in the appointment of Abū Bakr, the first successor of the Prophet; for the legists have never abandoned the theory that the office of the Caliph is elective and, though actually from the middle of the 1st century of the Mahommedan era, almost every Caliph has nominated his successor (except when a new dynasty has been instituted), the fiction of election has been preserved in the ceremony of *bay 'ah*, or paying allegiance to the new Caliph. These persons also cling to the orthodox Sunni doctrine that the Moslem world must always have an Imām, or leader, who as head of the community can alone perform certain functions, such as the proclamation of a general Jihād, and delegates to the Qādīs, or judges, his powers of executing judicial and disciplinary functions, without which authorisation their decisions and marriage contracts are held to be invalid.

Indian Suggestions.—Meanwhile the field has been opened for fresh speculations on the subject, and an Indian scholar named Muhammad Barakatullah has put forward a scheme for the election of a Caliph who is to be merely the spiritual head of Islam, having no concern with politics; he is to be president of a council of learned persons, elected by religious organisations throughout the Moslem world, who are to be heads of departments, *e.g.*, the Ministry of Religion (for the organisation of mosques, schools and religious foundations), the Ministry of Finance (with control of the religious taxes to be used for the maintenance of the Caliphate and the support of charities), the Ministry of Education and Research, and a department of propaganda and missionary organisation. The future Caliphs are to be elected from among the members of this council.

Contrary Views.—There are other Moslem thinkers who agree with the Turks in holding that there is no longer any need for such an institution in the Moslem world, although they do not sympathise with the religious policy of the Turkish Republic. From the 2nd century of the Mahommedan era there have been Moslem teachers who have maintained that the Caliphate lasted only 30 years, *i.e.*, up to the death of Ali in A.D. 661, and that from that date there has only been the rule of temporal monarchs. This was the view of al-Nasafī (*ob.* 1141), one of the greatest legists of the Hanafī school, whose exposition of Moslem doctrine used to be the accepted text-book in Turkey, and the same opinion was adopted by the Turkish legist, Ibrahim Halabī (*ob.* 1549), who compiled the Ottoman code of law which was authoritative up to recent times. In India this doctrine has also found exponents. Such persons deny the need of a Caliph in the modern world, and their point of view has recently received emphatic expression in a work on *Islam and the Principles of Government* by one of the 'ulamā of Egypt, Shaykh 'ali 'Abdur Rāziq. He maintains that the Caliphate was based entirely upon force, and has no authorisation either in the Qur'ān or the teaching of the Prophet. Containing as it does a somewhat violent attack upon the whole body of the 'ulamā, this book has aroused much attention.

There were in 1926 three Caliphs in exile—Sultan Mahommed VI., 'Abdul Majid and King Hussain; the Sharif of Morocco is recognised as Caliph by his subjects, and four petty chiefs in the Malay Archipelago enjoy the title. Each of these has his own supporters, but a large part of the Moslem world is indifferent to the claims of all of them.

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CALMETTE, GASTON (1858–1914), French journalist and writer, was born at Montpellier July 30 1858. In 1884 he joined the staff of *Le Figaro*, and in 1894 became editor at a time when the journal, which had started as an aggressive and half-frivolous periodical, was becoming the mouthpiece of the extreme Right and of the party known as "les Ralliés". Calmette helped to make *Le Figaro* an important political factor, without allowing it to slip back into its former pamphleteer style. He attracted much notice in 1913 and 1914 as the originator of the bitter attacks on the policy of M. Caillaux; especially with regard to M. Caillaux's attitude in the Rochette case of 1911, in which it was alleged by *Le Figaro* that the director of public prosecutions had been influenced by the Ministry to delay the course of justice. As a result of these newspaper attacks Mme. Caillaux called at the office of *Le Figaro* on March 16 1914 and shot M. Calmette dead. *See* CAILLAUX, J. M. A.

CALORIMETER: *see* GAS, MANUFACTURE OF.

CAMBON, JULES MARTIN (1845–), French statesman (*see* 5.85), when ambassador in Berlin from 1907 till the outbreak of the War, was instrumental in signing, Nov. 4 1911, with A. von Kiderlen-Waechter, the convention about Morocco. During the years immediately preceding the War he was acutely apprehensive of the Kaiser's intentions, and sent repeated warnings to his Government. In 1920 he was chosen President of the Council of Ambassadors.

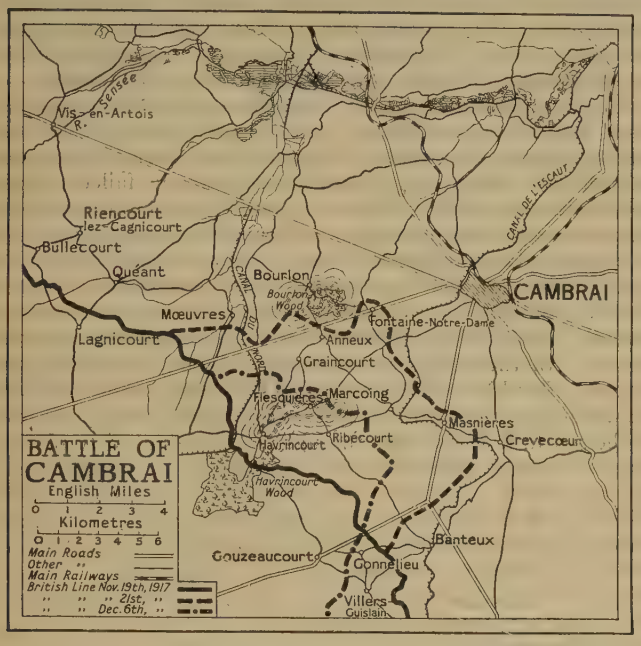
CAMBON, PIERRE PAUL (1843–1924), French diplomatist (*see* 5.85), died in Paris May 29 1924.

CAMBRAI, BATTLE OF.—In the history of the World War of 1914–8 this battle, fought in Nov.–Dec. 1917, stands out as a landmark in the history of warfare. On Nov. 20 1917 the British III. Army launched an attack, based on a new method, with an initial success so striking that on the morrow the bells of London were rung in joyous acclaim of the "victory." Little more than a week later, on Nov. 30, after the hopes of exploiting the success had already faded, there came a German retort so full of menace that the public thereafter showed a strong distaste for premature celebrations. Yet if the battle in itself was a tragedy of error and missed opportunities, its eventual effect on the fortunes of the Allies was beneficent—it pointed the way to the victorious method of 1918.

Origin of the Battle.—The question of the origin of the Cambrai operations is of primary historical importance, both because of the outcome, and because of the method of Nov. 20. The initial source is to be found in the third battle of Ypres, which opened on July 31 1917 and died away three months later in the swamps of Passchendaele. The lesson of these operations was that the method of an overwhelming artillery bombardment stultified its own objects by rendering impassable the ground over which the advance was planned to follow. If the

ultimate appreciation of this lesson by the High Command paved the way for the Cambrai method, the initial impulse came from another source, where the lesson had been absorbed within three days.

On Aug. 3 1917 an alternative proposal was drawn up at Tank Corps Headquarters by the chief general staff officer, Col. Fuller. The preface to it contained this significant example of prevision: ". . . from a tank point of view the third battle of Ypres may be considered dead. To go on using tanks in the present condition will not only lead to good machines and better personnel being thrown away, but also to a loss of *morale* in the infantry and tank crews through constant failure. From an infantry point of view the third battle of Ypres may be considered comatose. It can only be continued at colossal loss and little gain. . . ."



Then came the alternative proposal, to restore British prestige, before the winter set in, by a tank blow against St. Quentin, as a strategical prelude to an advance towards Valenciennes the following spring. Discussion of this project brought out the objection that it required a combined British and French operation, which might lack the simplicity and smooth working essential to a novel method. Therefore, on Aug. 4, a second project was framed, for a great tank raid south of Cambrai. The word raid should be stressed, for, as originally conceived, the object was " to destroy the enemy's personnel and guns, to demoralise and disorganise him, and not to capture ground." As the preliminary notes stated, "the duration of the raid must be short—eight to twelve hours—so that little or no concentration of the enemy may be effected for counter-attacks."

Had this plan been followed there would have been no need to lament Nov. 30. For the raid a force of six tank battalions supported by " one, or better two," divisions with extra artillery, was suggested, operating on an 8,000 yd. front. The object, as proposed, was " to raid the re-entrant formed by the L'Escaut Canal between Ribécourt-Crèvecoeur-Banteux." The raiding force was to be divided into three groups, the main one to scour this canal-enclosed pocket, while the smaller groups formed offensive flanks on each side to protect the main operation.

The detailed project, from which the foregoing are extracts, was taken to Gen. Byng, commander of the III. Army, on Aug. 5. On Aug. 6 Byng went to G.H.Q., saw the commander-in-chief and suggested an attack with tanks on Sept. 20. Sir Douglas Haig is understood to have been favourable to the idea, but counter arguments, for concentrating every possible man in the Ypres area, seemed to have delayed its adoption. However, the continued lack of definite success at Ypres lent emphasis to an alternative, and on Sept. 7, as a result of a consultation at III. Army Headquarters, a letter was addressed by Tank Corps Headquarters to G.H.Q. asking that the tanks might be withdrawn from the Ypres area, and suggesting two operations, one on the I. Army front and one on the III.

On Sept. 11 G.H.Q. approved the withdrawal of the bulk of the tanks and gave instructions to the Tank Corps to reconnoitre the Lens front (I. Army). After a report and project had been submitted to G.H.Q. the area was changed back to Cambrai, and on Oct. 25 the first general conference on the Cambrai operation was held. The date had been fixed for Nov. 20. Among the factors which induced the British command to approve the Cambrai scheme were the need of disarranging the enemy's plans of withdrawing troops from France to strengthen the Austro-German thrust against Italy, and the urgency of striking any such blow before the stream of German reinforcements released by the Russian revolution could swell to its full strength. Despite the heavy drain on British resources, caused by the Ypres offensive, these arguments prevailed.

The Plan Adopted.—The basis of the tactical plan was the use of a mass of tanks in a surprise onslaught, to replace the customary method of an intense preparatory bombardment by artillery. The historical interest of the Cambrai scheme centres around two points, the general plan and the tank plan.

The III. Army plan was (*a*) to break the German defensive system, the famous Hindenburg line, in the neck of land between the Canal de l'Escaut and the Canal du Nord; (*b*) to seize Cambrai, Bourlon Wood and the passages over the river Sensée; (*c*) to cut off the Germans in the area south of the Sensée and west of the Canal du Nord; and (*d*) to exploit the success towards Valenciennes. The force allotted for this ambitious plan was the III. and IV. Army Corps, comprising six divisions and part of another, the Cavalry Corps of two divisions, 381 fighting tanks and approximately 1,000 guns. They were to be employed on a front extending from Gonnelieu to Havrincourt Wood. The German defences opposing them consisted of the Hindenburg line system, and behind this the Hindenburg Reserve line and the unfinished Beaurevoir-Masnières line. Thus of the original project there remained only the fundamental idea—the massed tank surprise, the tank method and the locality.

In the alterations to the original plan lay the germ of disaster. The raid had been transformed into a large-scale offensive, with far-reaching aims. Instead of scouring a pocket and withdrawing, an organised advance was to be made up a narrow lane bounded by two canals. As protection to a raid, these became a danger to such an attack, circumscribing the action of the tanks and preventing the formation of tank offensive flanks. Otherwise the ground was good, and ideally chosen indeed for the original purpose, being mostly rolling downland, excellent for tank movement. It was marked by two features, the Flesquières-Havrincourt ridge and Bourlon Hill.

The fundamental weakness of the plan was not topographical, but the almost complete lack of reserves. To undertake such an important operation in such a condition was surely a violation of one of the cardinal axioms of war. There were local reserves, naturally, in most divisions, but there was no general reserve, unless the two cavalry divisions can be considered such—and, apart from their limited strength, the futility of so regarding them was amply shown in their fresh inability, in face of modern weapons, to influence the action.

The six divisions employed in the initial attack were all that the III. Army commander had at his disposal, for a plan that visualised a penetration beyond Cambrai towards Valenciennes. It is difficult to understand what was in mind as to the future, for without reserves complete success could only mean the creation of an excessively deep and narrow salient, requiring many divisions to hold it. It is true that the Guards and one or two other divisions could be made available, and were ultimately brought to the scene, but they were too far away for prompt intervention. The situation indeed had some reminder of Loos. The French also moved a special force forward in readiness to co-operate, but their aid was not called upon.

If the excuse be that the third battle of Ypres had drained the British of reserves, then it surely reflects on the choice of that swamp-like area and the failure to try earlier the method that at Cambrai unlocked the doors to decisive success. On the other hand, it may be urged that G.H.Q. put an initial time-limit of 48 hours on the operation. To this the reply is that if the lack of resources was appreciated, the objectives were excessively ambitious, and that the powerful raid originally proposed was far more in accordance with the principle of security than an offensive involving occupation of newly consolidated positions.

Turning now to the tank plan, the problems were to gain surprise, to cross the wide and deep obstacle of the Hindenburg line and to ensure co-operation between the infantry and tanks for their common security. Careful organisation and the absence of a preliminary bombardment contributed to the accomplishment of the first object. The difficulty presented by the Hindenburg line was overcome by devising super-fascine, huge bundles of brush wood, which were carried on the nose of each tank and released on reaching the edge of the Hindenburg trenches; the tanks, working in sections of three, had thus the power to cross three such successive obstacles. Thirdly, a strictly drill attack was worked out and practised, by which in each section an advanced guard tank moved about 100 yd. ahead of the two main body tanks, keeping down the enemy's fire and protecting the main body tanks as they led the infantry forward. The infantry, moving in flexible file formations, followed immediately behind the main body tanks. While the tanks cleared a way for them through the deep belts of enemy wire and subdued the hostile machine-gun fire, the infantry acted as "moppers-up" to the tanks and were also ready to protect them from the enemy's guns at close quarters. The one fault of the tank plan was that, against expert advice, the tanks attacked on the whole frontage instead of against selected tactical points, with the result that no tank reserve was kept for use in the later stages.

The Battle.—The preparations for the battle were made with great skill and secrecy, while to mislead the enemy as to the scale and frontage of the attack, gas and smoke attacks, dummy attacks with dummy tanks, raids and feints, were carried out on a wide front both north and south of the real sector of attack.

At 6:20 A.M. on Nov. 20 the tanks and infantry moved forward to the attack on roughly a six-mile front, achieving complete surprise and a demoralising initial success at all points, save in the left centre in front of Flesquières. The cause of this one serious check appears to have been that the 51st Div. here adopted formations of its own instead of conforming to those devised by the Tank Corps and adopted in all the other divisions. Whatever the reason, the result was that the infantry fell too far behind the tanks, lost the gaps in the wire and were stopped by machine-gun fire. This loss of touch lay also at the root of the losses which befell the tanks when they came over the ridge and under the close fire of several German batteries, for infantry accompanying them could have picked off the gunners.

But the effect of this battlefield incident has been unduly magnified. On the right the 12th, 20th and 6th Divs. secured their objectives rapidly, though the 12th had severe fighting at Lateau Wood. The 29th Div. passed through and captured Masnières and Marcoing, securing the passage of the canal at both and even the bridge intact at the latter. On the left the 51st and 62nd Divs. made a brilliant advance, advancing by nightfall as far as Anneux, over 2 m. in rear of Flesquières. The Flesquières resistance was thus only an islet, cut off and overlapped by the waves which swept round its flanks and on to Marcoing, Anneux and even to the edge of Bourlon Wood. A penetration of 5 m. had been made—the equivalent of months of heavy fighting and heavier losses on the Somme and at the third battle at Ypres. Decisive success was within the grasp of the British forces, the enemy's main defence systems had been overrun, only a half-finished line and the open country lay beyond. But the original divisions and the tank crews were exhausted, and apart from one squadron of the Canadian Fort Garry Horse the two cavalry divisions could contribute nothing toward fulfilling their rôle of exploitation.

On Nov. 21 local reserves made some further progress. The village of Flesquières fell at 8 A.M., and the 51st and 62nd Divs. pressed rapidly on, clearing the German salient formed by this resistance on the first day and carrying the tide of the British advance as far as Fontaine-Notre-Dame, 1½ m. beyond the high-water mark of Nov. 20. But on the right, little ground was gained—a relieving German division had arrived just in time to occupy the rear defence. The High Command's time-limit of 48 hours had expired, but owing to the menace of the uncaptured Bourlon Hill, to the new British position, as well as to the hope of an enemy withdrawal and the desire to relieve the enemy pressure on Italy, the commander-in-chief decided to continue the offensive, placing a few fresh divisions at the disposal of the III. Army. But the Tank Corps, the essential cause of the early success, was tired out, men and machines—all had been staked on the first throw. The fresh attacks met with more failure than success against an enemy now braced to meet the danger.

The German Counter-Attack.—On Nov. 22 the Germans recaptured Fontaine-Notre-Dame; on the 23rd, the 40th Div. with tanks captured the whole of Bourlon Wood, but the attempts on Bourlon village and Fontaine-Notre-Dame failed. Bitter and fluctuating fighting followed; Bourlon and Fontaine-Notre-Dame were won and lost again, and meanwhile there were signs of a strong German counter-thrust. In the early morning of Nov. 30 the blow fell, the German Army commander, von der Marwitz, making a convergent attack against the northern and southern flanks of the salient which the British advance had created. In the north, round Bourlon Wood, the attack was stopped after bitter fighting, but in the south, where the blow fell on the joint of the salient and also on the weakly held front to the south, it broke right through. This was a finely planned surprise assault, unheralded by any preliminary bombardment, and made more effective by the cloud of gas and smoke shells. Villers Guislain and Gonnelieu soon fell and the thrust penetrated deeply behind the old British front line as far as Gouzeaucourt, overrunning gun positions and headquarters. Disaster was only averted by the superb counter-attack of the Guards Div., which recaptured Gouzeaucourt, and later of the 2nd Tank Bde., which brought out the value of this arm for defence.

Fresh attacks on Bourlon and Masnières failed, but further German progress was made towards Villers Plouich. The British position in the Masnières-Bourlon salient was thus rendered so precarious that on the night of Dec. 4–5 most of the salient was evacuated and the line drawn back roughly to the Flesquières ridge. Although the result left the British with a slight gain of ground on balance, and better still had a helpful influence on the Italian campaign, Cambrai would be remembered mainly as a tragedy of mistaken aims and lost opportunities, were it not for its revelation of a new key to victory, turned to effect in 1918.

BIBLIOGRAPHY.—Lt.-Col. C. H. Rowcroft, *The 9th Hodson's Horse at Cambrai, 1917* (1917); Maj.-Gen. T. T. Pitman, *The Part Played by the British Cavalry in the Surprise Attack on Cambrai, 1917* (1923); Col. W. H. F. Weber, *A Field Artillery Group in Battle* (1923).

(B. H. L. H.)

CAMBRIDGE, England (*see* 5.90).—The architectural amenities of the town, as distinct from the university, were increased by the erection of the County Hall in Hobson street (1913), a Wesleyan church at the corner of King street and Short street (1913), and a handsome gate-house to the Leys School (1914). An institute of agricultural botany on the Huntingdon road was inaugurated in 1922.

The University.—In spite of the incidence of the World War, the period 1910 to 1925 must rank as one of great activity in the university. On constitutional proposals of more than ordinary moment, such as those of conferring greater legislative power on resident university and college teachers with the partial disfranchisement of the senate and the electoral roll (1910 and 1920), or the admission of women to degrees, but not to full membership of the body academic (1923), the university maintained a conservative attitude, but in matters secondary only to these in importance it followed a policy of continuous reform.

The courses of study for honours, and more especially for pass

men, underwent considerable revision. After prolonged deliberations, Greek, as a compulsory subject, was dropped from, and other noteworthy changes were effected in, the previous examination (1919); the regulations governing the pass degree were entirely remodelled (1920); several of the honours examinations, notably the classical tripos and the oriental languages tripos, were reconstituted with a division into two parts, the first of which does not normally carry the B.A. degree with it. New triposes were established in anthropology (1913) and geography (1919), while the medieval and modern languages tripos, greatly enlarged in scope, was split into the modern and medieval languages tripos and the English tripos (1917). The university further recognised the value of graduate studies by establishing the degrees of Ph.D. (1919) and of M.Litt. and M.Sc. (1920). A series of enactments (1912–4) made several changes in the mode of procedure to the degree of D.D. and threw it open to others than those in Holy Orders of the Church of England.

The increasing diversity of studies resulted also in the establishment of new professorships, readerships, and boards of studies: professorships of English literature (1910), genetics (1912), Italian (1919), naval history (1919), French (1919), physics (1919), aeronautical engineering (1919), physical chemistry (1920), biochemistry (1921), and animal pathology (1923); readerships in Spanish, modern history, geography, agriculture, agricultural physiology, physiology, morphology of vertebrates, petrology, pharmacology, electrical engineering, geodesy, biochemistry, preventive medicine and experimental psychology.

Aids to learning and research of a more material nature were provided by the erection and augmentation of numerous institutes. The engineering laboratory on the north side of Downing street was twice enlarged and finally removed to a completely new site behind Scroope terrace, Trumpington road (1920–1). Part of the buildings thereby vacated, as well as new buildings erected close to them, were taken over by the neighbouring chemical laboratories. On the south side of Downing street sites were found for the School of Agriculture (1910), the Museum of Archaeology and Ethnology (1910–5), the Psychological Laboratory (1913), the Physiological Laboratory (1914), the Forestry School (1914), the Molteno Institute of Animal Parasitology (1921), a low temperature station for research in biochemistry and biophysics (1922), and the Sir William Dunn School of Biochemistry (1924). The Arts School, off Benet street, a fine brick building faced with stone, designed by G. Hubbard, which contains a number of lecture-rooms and also houses several departmental libraries, was opened in 1911. In that year the university accepted the Government's proposal to take charge of the Solar Physics Observatory, then at South Kensington, and the necessary accommodation, in close proximity to the existing observatory on the Madingley road, was completed in 1913. Field laboratories in connection with the agricultural and other departments on the Milton road came into use in 1910–1.

Emmanuel, Queens', Sidney Sussex, and Clare colleges added to their fabric and the chapels of Sidney Sussex and Corpus Christi colleges were enlarged and redecorated. Wesley House, a post-graduate theological college for the training of accepted candidates for the ministry of the Wesleyan Methodist Church, was opened in 1925; and Cheshunt College, a theological seminary which was removed from Cheshunt to Cambridge in 1905, found permanent quarters at the end of Bateman street (1915).

Effects of the War.—The immediate effect of the World War on Cambridge University, 16,000 alumni of which were engaged on active service, was to reduce enormously the numbers of teachers and students. The place of those who had gone was, spatially, taken by cadet battalions and officers attending staff courses. The absorption of many university teachers by government departments and the first-hand acquaintance with academic training gained by a still larger number of servants of the Crown greatly advanced the co-operation between university and state, which had already begun practically with government grants to the schools of agriculture and forestry and to the departments concerned with instruction of medical students (1914).

The cessation of hostilities did not effect any weakening of this tie; the Admiralty, the Air Ministry, and the War Office organised temporary and permanent training schemes in Cambridge for officers. When the university, confronted with a serious decline in the value of money and an abnormal increase in the number of students, was left with the unpleasant alternatives of a serious financial deficit, or an equally serious diminution of its educational efficacy, the Govt. accorded it, in 1919, a temporary annual grant of £30,000, which was raised to one of £85,000 in 1925. At the same time, it appointed a royal commission, which reported in 1922, and whose recommendations a statutory commission was, in 1925, still engaged in putting into practice. The two principal aims are the creation of a Regent House of resident instructors and other officers of the university and colleges, with powers almost as great as those of the present senate; and the concentration of all formal teaching in the university, which will exercise this function through newly erected faculties and derive the necessary funds from increased taxation of the colleges and permanent government grants.

(B. W. D.)

CAMBRIDGE, Mass., U.S.A. (*see* 5.96), increased in population only 4·6% in the 10 years after 1910, reaching 109,694 in 1920 (91·6 males to 100 females); but more rapidly in the next five years, to 120,053 in 1925. The foreign-born numbered 33,296 in 1920, a decrease from 1910; about half of them were from Ireland and Canada. Manufactures increased much more than the population, whether measured by value of products or by number of wage-earners. The value was $44,227,000 in 1909; $127,865,000 in 1919; $185,524,463 in 1923. The number of factory employees rose from 15,260 in 1909 to 22,500 in 1919 and to 25,674 in 1923. With the transfer of the packing industry to the Middle West, slaughtering and meat-packing, formerly the leading industry, almost disappeared. At the top of the list in 1919 were confectionery and ice cream, bread and other bakery products, electrical machinery, printing and publishing (book and job), foundry and machine-shop products. A city-planning board was created by ordinance in 1913. In 1915 the Massachusetts Institute of Technology moved from the site in Boston, which it had occupied for 50 years, to a tract of 50 ac. on the Cambridge side of the Charles river. (*See* HARVARD UNIVERSITY.)

CAMDEN, N.J., U.S.A. (*see* 5.101), had 323 industrial plants in 1925, with a varied output including steel pens, soups, talking-machines and battleships. During the World War the New York Shipbuilding Corp. delivered more ships than any other yard in the country, and made the world's record for rapid construction in the collier "Tuckahoe," which was launched on the 27th day after work was begun on the laying of her keel. The population in 1920 was 116,309, of whom 8,500 were negroes and 20,354 foreign-born; in 1925 it was 128,642, according to the official estimate. The value of the factory output was $49,138,000 in 1909; $218,165,000 in 1919; $180,766,319 in 1923. Enrolment in the public schools increased during the 10 years 1914–24 nearly twice as fast as the population.

Camden's water supply comes from 136 artesian wells. Trolley and 'bus service are co-ordinated in a unified system. The commission form of government was adopted in 1923. In 1925 the Hotel Walt Whitman, a community enterprise, was opened, a large convention hall was under construction, a civic centre was being developed as part of a comprehensive city plan, the first municipal pier had been built, a movement was under way to make Camden a world airport and a new bridge across the Delaware to Philadelphia, the longest, broadest, highest and heaviest suspension bridge in the world, was nearing completion. Walt Whitman's grave is in Harley Cemetery and his home in Mickle street is kept as it was during the last years of his life.

CAMERON, JAMES DONALD (1833–1918), American politician (*see* 5.109), died at his country home, Lancaster county, Pa., Aug. 30 1918.

CAMEROONS (*see* 5.110).—In 1911 some 107,000 sq. m. of French Equatorial Africa were added to the German colony of Cameroon or Kamerun, as it was called, as compensation for the recognition by Germany of a French protectorate in Morocco. In 1914–6 Cameroon was conquered by French and British

native troops, and by the Treaty of Versailles, Germany renounced all her rights over it. The country had been provisionally divided into French and British spheres, and in May 1919 the Supreme Council gave the mandate to administer it to France and Great Britain. It was unequally divided, France obtaining five-sixths of the country. The terms of the mandate were not approved by the Council of the League of Nations until July 20 1922. Delay had been caused by negotiations between the mandatory powers and the United States; these negotiations ended in U.S. citizens being given equal economic rights in the Cameroons with nationals of the members of the League. The

area added to the Cameroons in 1911 was not included in the mandated territory, but was in 1919 restored to French Equatorial Africa.

The British sphere is a long strip of territory adjoining Nigeria with an area of about 31,000 sq. m. and a population (1924) of 660,024 natives and Arabs and 77 Europeans. The British sphere includes in the north the emirate of Dikwa (Dikoa), formerly German Bornu, and in the south Mt. Cameroon, the hill town of Buea and Port Victoria. This portion is known as Cameroon province. The whole sphere is administered as part of Nigeria, Dikwa possessing a large degree of autonomy.

The cocoa, rubber and banana plantations established in the Victoria district by the Germans (with 48,000 ac. under cultivation) were in Nov. 1924 sold by auction in London, realising £224,670. There are considerable forest areas in which are mahogany, ebony and other valuable timbers. The chief exports are cocoa and palm kernels; two-thirds of the imports are cotton piece-goods. Deficits in the public finances are made good by the Nigerian treasury. Slave-raiding, reduced latterly to kidnapping, and slave-trading had been almost stamped out by 1925. Progress was made in hygienic conditions and education.

The French sphere has an area of some 160,000 sq. m. and a population estimated (1924) at 1,500,000. It includes Duala and Kribi, the chief ports of the Cameroons, and is administered as a separate entity by a commissioner aided by a council. In 1921 the French transferred the capital from Duala to Yaunde, a town occupying a comparatively healthy position on the central plateau 110 m. south-southeast of Duala, with which it was connected by railway. The chief exports are palm kernels and palm oil, cocoa, rubber, timber and cattle. Lack of adequate means of transport hindered the economic development of the country. A small military force (under 2,000) was maintained.

See I. von Puttkamer, *Gouverneursjahre in Kamerun* (1912); *Reports on the British Sphere of the Cameroons* (1922) and subsequent Annual Reports issued by the Colonial Office, London; also the Annual Reports on the French Sphere published by the French Govt. and by the League of Nations. (F. R. C.)

CAMEROONS, OPERATIONS IN.—The German forces in the Protectorate at the outbreak of the World War were commanded by Col. Zimmerman, an able and resolute soldier, and consisted of approximately 200 Europeans and 1,550 natives in the military force and 40 Europeans and 1,255 natives in the police force. Some hundreds of settlers were available, as were a number of sailors from ships which made for the Cameroons estuary when war was declared. Considerable numbers of natives were trained as *askaris* during the campaign, and to some extent local levies co-operated, though the natives generally were hostile to their German masters. These forces were scattered, the main portion of them being about Duala, the chief port.

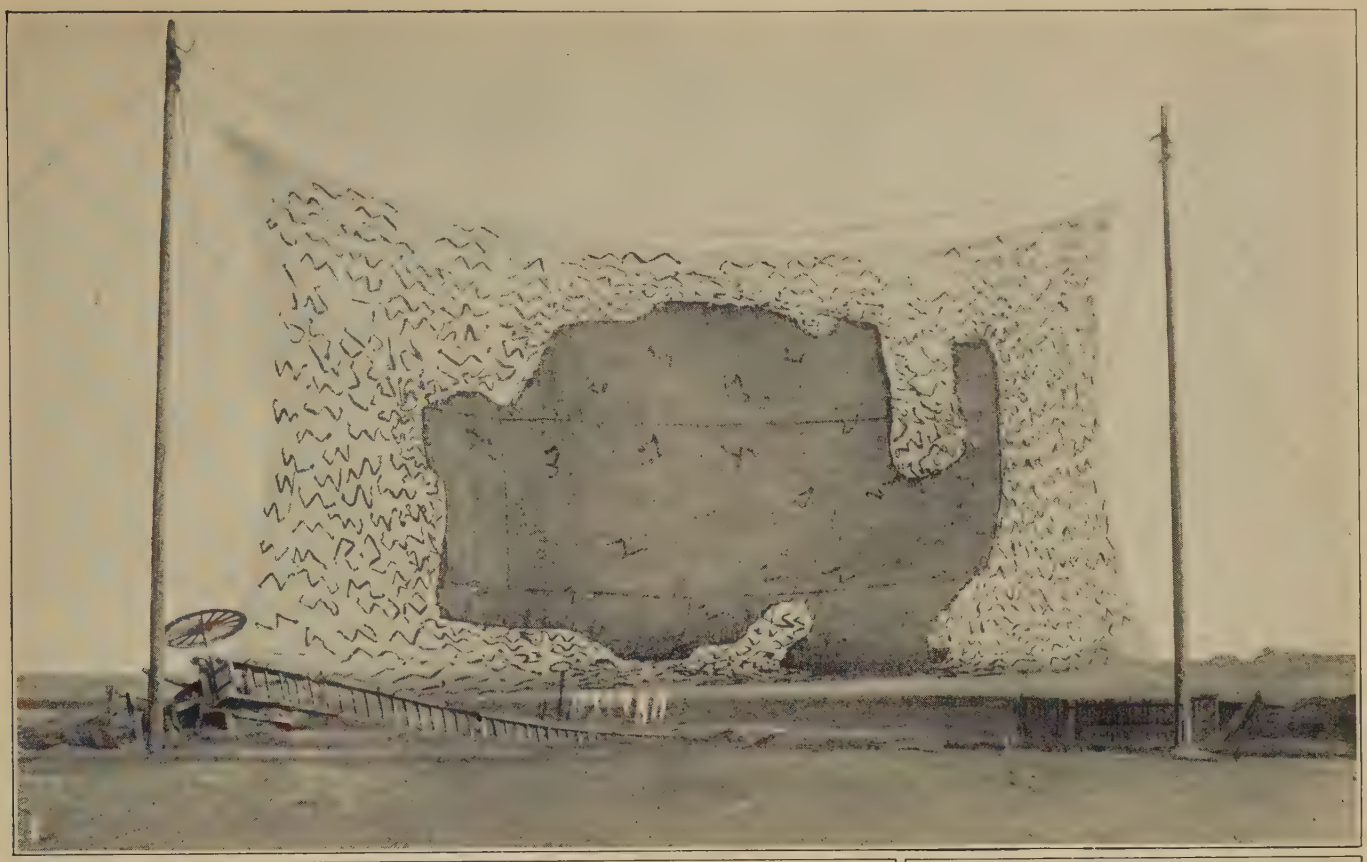
The offensive was initiated by the Allies. Bonga and Singa, the most advanced enemy posts in the two salients, were captured by the French on Aug. 6 and 7 1914, a German offensive being thus forestalled by Gen. Aymerich, the French commander-in-chief. Two French columns were then dispatched. The one (Hutin) north along the Sanga, with Lomie as its objective, the other (Morrison) moving west on Dume from Singa along the Lobaye. These enemy posts were in the centre of the Cameroons. On Sept. 21 Gen Largeau in the north occupied Kuseri in the Lake Chad region.

British Movements.—Meanwhile British forces had moved from Nigeria, and a column under Capt. Fox crossed the frontier on Aug. 25, and unsuccessfully attacked Mora, a hill post in the north held by Capt. von Raben. A French column (Brisset), sent to co-operate with Fox, occupied Marua south of Mora on Dec. 12, with the result that the Lake Chad region was cleared of the enemy, except the garrison of Mora, which gallantly held out through all the campaign, surrendering upon terms at its conclusion. Unsuccessful attempts to storm the place were made between Aug. 23 and Sept. 15 1915.

Two other British columns invaded the Cameroons on Aug. 25. One (Lt.-Col. Maclear) moved from Yola on Garua, was heavily defeated and retired to Yola, its commander having been killed; the other entered the Cameroons at the southern end of the northwest border, and, surprised by the enemy from Duala, sustained a severe reverse with 168 casualties. The troops employed were Nigerian natives under British officers.

Anglo-French Offensive.—About the middle of Sept. an Anglo-French expeditionary force, 4,300 strong, formed in equal proportions from British and French negro troops, and under the British commander-in-chief, Maj.-Gen. Sir C. M. Dobell, embarked at different ports, and, forcing the barrier at Duala, bombarded that port on Sept. 26. On the surrender of the port on the following day 400 Germans and 30,915 tons of shipping were captured. Col. Zimmerman withdrew to Edea, 40 m. to the southeast. Three columns were at once directed in pursuit of the enemy at Edea which, after continuous opposition, was occupied on Oct. 26. A French garrison under Col. Mayer was installed at Edea, the German commander-in-chief having retired to Yaunde, 100 m. east, on a plateau beyond the forest belt.

Mayer, owing to the weakness of his force, being condemned to passive defence, the British forces proceeded to clear the country between the Cameroons estuary and Nigeria. By the end of 1914 the whole of the northern railway and Buea, the enemy administrative capital, had been occupied. On Jan. 5 1915 Mayer beat off an attack on Edea with heavy loss to the attackers. Elsewhere the Allied offensive had almost ceased.



DEVICES USED IN MILITARY CAMOUFLAGE

FIG. 1. Field Gun cover, of fish netting, with painted "scrim" centre, and strips of painted canvas. Such a cover is erected horizontally over a gun. FIG. 2. Imitation tree as observation post. The original tree can be seen on the left. FIG. 3. Imitation tree, as in Fig. 2, with side cut away to show position of observer.

(Fig. 3. Crown copyright.)

Hutin's column alone had made some progress, and he had been joined by a small Belgian contingent. Reorganisation was effected and Brig.-Gen. Cunliffe was appointed to command the Allied troops in the north, where the enemy was taking the offensive. Reinforcements reached Gen. Dobell at Duala in February.

A concentric advance upon Yaunde was decided upon, but was begun prematurely, largely in consequence of the usual difficulties which beset allies who endeavour to co-operate for the first time. On April 7 a British column under Col. Haywood moved east and Mayer left Edea on May 1. On May 3 Haywood, moving north of Mayer, captured Wum Biagas after 18 hours' fighting. The two columns then joined forces under the command of Col. Mayer. On May 25 Mayer resumed the advance, but was strongly opposed in the dense bush. When Yaunde was still 40 m. distant, dysentery became rife and withdrawal began, and on June 28 Mayer was back in the Edea district. In April Gen. Cunliffe in the north invested Garua, held by Capt. von Crailsheim, a daring and skilful soldier. Cunliffe captured Garua on June 10, and on June 28 occupied Ngaundere, some 300 m. northeast of Yaunde. Here, simultaneously with the return of Mayer to Edea, a halt was called. Hutin occupied Lomie—150 m. south-southeast of Yaunde—on June 25 and Morrison took Dume a month later.

The general Allied offensive was resumed, and by early Oct. Gen. Dobell was moving in from the west, Cunliffe from the north and Hutin and Morrison from the east. The maximum Allied strength, about 15,000, was now disposed against the enemy, whose forces were estimated at 10,000 (inclusive of 700 Europeans). The opposition was, as before, vigourous and protracted. On Oct. 9 the British re-took Wum Biagas, and on Oct. 30 the French occupied Eseka, the railhead.

The British force emerged first from the forest belt and on Dec. 17 were at Mangâs in open country and about 50 m. west of Yaunde. On Dec. 21 the French column, which had had severe fighting and many casualties, reached Mangele's 20 m. southeast of Mangâs. The British troops were instructed not to await Mayer's arrival at Mangele's, and accordingly pushed straight on for Yaunde, which Col. Gorges entered unopposed on Jan. 1 1916.

Conclusion of the Campaign.—From Dec. 22 opposition by the enemy had ceased. Col. Zimmerman, as soon as he knew that the Allied columns were clear of the forest, and that Cunliffe and Aymerich were approaching, decided to give up the contest. He evacuated Yaunde and, together with the governor and 823 Germans, including civilians and his troops and carriers, headed southwest for Spanish Guinea, of which the nearest point was 125 m. distant. He was pursued, and fought a rear-guard action on Jan. 8.

The next force to reach Yaunde was Brisset's column, followed by Aymerich's troops. Cunliffe's forces had had very stubborn fighting during the closing phase of the campaign, the most difficult operation being the capture (Nov. 4–5) of Banyo, a hill fortress some 200 m. north of Yaunde and on the edge of that corner of the Cameroons, the region towards the Cross river, where German resistance was continued to the last. In this quarter the enemy continued vigourously to dispute Cunliffe's advance, and when, on Jan. 1, Yaunde had fallen, the latter's advance troops were still 40 m. distant from that objective.

Col. Zimmerman eluded the columns which had been sent to the borders of Spanish Guinea and were waiting to bar his entry into neutral territory. The first part of his forces, quickly followed by the rest, entered Spanish territory on Feb. 4 and with the surrender of the gallant garrison at Mora on Feb. 18, the conquest of the Cameroons was complete.

See E. Dane, *British Campaigns in Africa* (1919); H. C. O'Neill, *The War in Africa* (1919); Maj.-Gen. Sir C. Dobell, *The Campaign in the Cameroons, 1914–6* (1922). (J. J. C.)

CAMOUFLAGE.—The word camouflage, in the broad sense of military deception, is applicable to all stratagems designed to mislead the enemy. In the following account it is used in the restricted sense of deception practised by artists.

I. MILITARY CAMOUFLAGE

The application to war of camouflage, as thus defined, is by no means novel; dummy guns have been successfully employed to mislead an opponent on occasion ever since guns became a normal part of military equipment. Many historical instances could be brought forward in which camouflage was practised by individuals as an expedient. But it was not till the World War that it was practised by armies as a policy.

A transitional stage between the spasmodic use of camouflage in emergencies and its regular and systematic use is marked by the painting, or other treatment, of coast defence forts to blend with their surroundings, in order to render them less conspicuous from the sea. The well-known chequered black-and-white of the Spithead forts was an attempt to mislead the enemy as to the exact location of the gun embrasures. The same artifice was used in the case of the loopholes of blockhouses in the South African War of 1899–1902.

A further stage was reached in the adoption of uniforms coloured to blend with the usual or typical colours of the countryside in a theatre of war. The first of these was the Indian khaki (*see* 15.770), and after the experience gained in the South African War, when the importance of concealment came into great prominence, the British and most other armies adopted dust-coloured, light-blue, grey or grey-green uniforms.

Hitherto deception in war had been limited to the comparatively simple task of deceiving the human eye, at a considerable distance and for a short time. In the World War its rôle was extended to circumventing the camera in addition to deceiving for long periods the eyes of observers armed with powerful glasses, and for the first time in history a military unit was organised for the definite purpose of practising scientific deception.

This policy was initiated by certain French artists serving in a French battery toward the end of 1914. The interest of a French commander was aroused and his sympathy enlisted, with the result that a "section de camouflage" was formed early in 1915, for the purpose of assisting units in the concealment of battery positions and other military works, and the construction of concealed posts of observation. The success attained by this section led to the organisation of the British camouflage service, as a unit of Royal Engineers, early in 1916.

Principles and practice may be dealt with under three heads: (1) the concealment of gun positions and the like from the enemy's aeroplanes; (2) the concealment of observation posts and machine-gun emplacements from direct view; and (3) miscellaneous applications of camouflage.

Protection Against Air Observation

The purpose of camouflage is to render objects indistinguishable or unrecognisable by means of imitation or disguise. Concealment in the limited sense of "hiding from view" is not the primary aim. The ideal is non-interference with the natural or normal aspect of the locality as viewed from the air, with which the enemy has become familiar through the agency of visual observation and photography, the latter being the more accurate. A photograph will always record something. The art of camouflage lies in conveying a misleading impression as to what that something signifies. The photograph records colours and accidents of ground (such as bare earth, vegetation, woods, etc.) in terms of light and shade, forming a patchwork or pattern of black and white meeting in varying intensities of grey. A cultivated district presents a regular chess-board pattern, with large rectangular expanses of monotone, the only accidents to break the monotony being large hedges, banks or houses with their attendant shadows. Broken ground, such as demolished villages, shelled areas or patchy vegetation, presents a highly complex pattern, full of merging lights and shades.

Photographically, the effect of colour is not so marked or important as the effect of light and shade. Earth is toward the white end of the scale and grass or vegetation toward the black—not because of their respective colours but on account of the amount of contained shadow or "texture." Contrasts in tone are much accentuated on snow and the effects of shadows are

more marked. Consequently it is essential, when judging the colours of a locality, to view it vertically and not obliquely as one is accustomed to see a flower bed.

Therefore the most practical method of planning the concealment of any work is to plan it with reference to a recent photograph which records the ground pattern, and the natural facilities for concealment which exist in the locality. Such facilities abound in a neighbourhood whose photographic pattern is complex. Any slight error in exact reproduction may escape notice in the prevailing complexity, because detection depends on comparison, and comparison is rendered difficult by the very intricacy of the pattern.

There are certain characteristic clues which betray new work to the reader of aerial photographs. They are disturbance of soil; tracks; shadows; regularity; blast marks of guns. To achieve success these clues must be suppressed from the very beginning; conversely, if deception is to be achieved by the use of dummies, these clues must be supplied.

Shadows.—The form of any erection, or excavation, is revealed in a photograph by the shape of the shadow cast. Two intersecting planes, *e.g.*, the two sides of the roof of a building, will show differently on the photograph (except for a very brief period every day) because they receive light at different angles, and therefore reflect it differently. It follows that an artificial reproduction of locality must be erected parallel to the contours of that locality, or in other words the planes of the imitation and the real must not intersect. A mound must be imitated by a mound, and a flat surface by a flat surface. Any departure from this principle is most easily detected in a photograph taken when the sun is low, the shadows being long in consequence.

Regularity.—No shape in nature is of regular outline; consequently anything of a regular shape in a photograph invites scrutiny because it must be the work of human hands. In a battery position, regularity is usually displayed in the geometric shape of the gun-pit and the regular spacing and alignment of the guns.

Summary.—To sum up the theoretical conditions which govern the concealment of gun positions, and other works, from the enemy in the air, the material of which the camouflage is composed must at all times appear on the photograph like the object or surface it represents, and likewise appear natural to the observer's eye. As to material, it must be light, strong, impervious to weather, fireproof and easily manufactured. Disturbances of soil, tracks, shadows, blast-marks and regularity must never seem associated with an active gun position or occupied work.

Natural materials such as branches, grass, etc., are of little use for camouflage purposes if protection from view is required for more than two or three days, for, when withered, they become very conspicuous. The most satisfactory cover is afforded by some form of net having an opaque centre of a boldly irregular shape, with a border becoming decreasingly opaque towards the edges. Such a cover is illustrated in fig. 1 (plate). The centre should be only so opaque as to prevent the object underneath (gun or excavation, as the case may be) being visible from the air and the border opaque enough to mask the shadow of the object without casting a shadow itself. Such a cover is erected at a suitable height above the object to be concealed, and parallel with the contour of the ground. It follows that the higher the erection the greater must be the area required to cover object and shadows. Evidence afforded by tracks is perhaps the most difficult of all to eliminate. Positions which are admirably concealed in every other way, are betrayed by the tracks leading up to them, so much so, that it is often possible to count the number of guns in a battery by the paths leading to each gun-pit and to distinguish between gun positions and other works.

The following afford good illustrations of methods of concealing approaches to positions in the open: (*a*) Leading the track close past the gun position and on to join an existing track, the connection to each pit being treated with camouflage material or cut grass, etc. (*b*) Similarly, but close in front of the gun-pits in order to use the track to hide blast marks. This method has the disadvantage of restricting traffic while the guns are in action. (*c*) Siting a battery in the midst of an existing network of tracks, taking precautions to reproduce on the camouflage any path interrupted by a gun-pit. It is not practicable to conceal long trenches. If a covering sags or differs materially in tone from its surroundings the mere length and regularity will betray it.

Material and Production.—The principal desiderata in camouflage material are durability and portability. It is almost inevitable that production must be standardised in the case of operations on a large scale. It is possible to deal individually only with a few special positions and the exterior of observation posts and the like. Square, woven, weather-proofed fish netting provides the most portable foundation. For a field gun 30 ft. x 30 ft. is sufficiently large as larger sizes than this become unwieldy and difficult to erect. Wire netting is more durable and therefore best suited for large works. Small rolls—30 ft. x 6 ft.—are a convenient size. Open meshed canvas (scrim) is very suitable material for use on the ground and in conjunction with wire or fish netting. Fireproofing should be adopted if possible.

For colouration, sunproof dyes are the ideal medium, failing this, water paints. Oil paints are a source of danger owing to their tendency to cause spontaneous combustion in stacked material. In order to achieve standardisation it will probably be necessary to adopt four appropriate colourations, viz., all vegetation, all earth, and two mixtures of vegetation and earth.

Protection Against Direct Observation

The concealment of observation posts, machine gun nests, etc., is comparatively simple, being merely an adaptation of the craft of theatrical property-making. Natural features may be selected, in places from which good observation can be obtained, and these must be copied exactly. At night, the real is removed and replaced by the imitation, *e.g.*, trees, sand-bags, mile-stones, mounds of earth, chimney-stacks, walls. The copy is a thin outer shell containing a bullet-proof lining in order to give confidence to the occupier. The loopholes, when subject to scrutiny at short range, can be made quite invisible by the use of gauze, which though painted to resemble the exterior of the O.P., remains transparent from the inside. This method should only be adopted when absolutely necessary, because gauze interferes with vision—especially through glasses; in other cases care must be taken to give the loophole an irregular shape.

The following conditions govern the successful employment of such observation posts, particularly in the case of the more elaborate examples such as trees.

1. Concealed access is essential.
2. The works connected with installation must, like other works, be concealed from the air.
3. They should not be erected in places that are normally subject to heavy shelling, for the reason that careful observation will be prejudiced and accidental damage will probably reveal the observation post to the enemy.
4. Provision must always be made to prevent daylight showing behind the loophole, thus rendering it transparent to the enemy.
5. The comfort and security of the observer must always be studied, otherwise the full value of the observation will never be obtained.

Imitation trees (figs. 2 and 3 on plate) can be designed either to accommodate an observer at a good height above the ground, or to conceal a long periscope, the user of which is protected in a strong dug-out. In the former case the observer has a better view, but is uncomfortably cramped. The periscope is limited in respect of magnification, field of view and clearness of vision, in proportion to its length (*see* Periscope). On the other hand advantage may be taken of its length to obtain high command with comparative security, or increased security with low command. Further, with suitable mountings, it can be used as an instrument of precision in conjunction with map and compass. Provision should always be made to give bullet-proof protection to the periscope when in use, and to allow of its being lowered for cleaning and safety when not in use.

Miscellaneous Application

The following are examples from the World War. In the dummy attack, series of painted silhouettes made of stout millboard

Fig. 1

Fig. 2

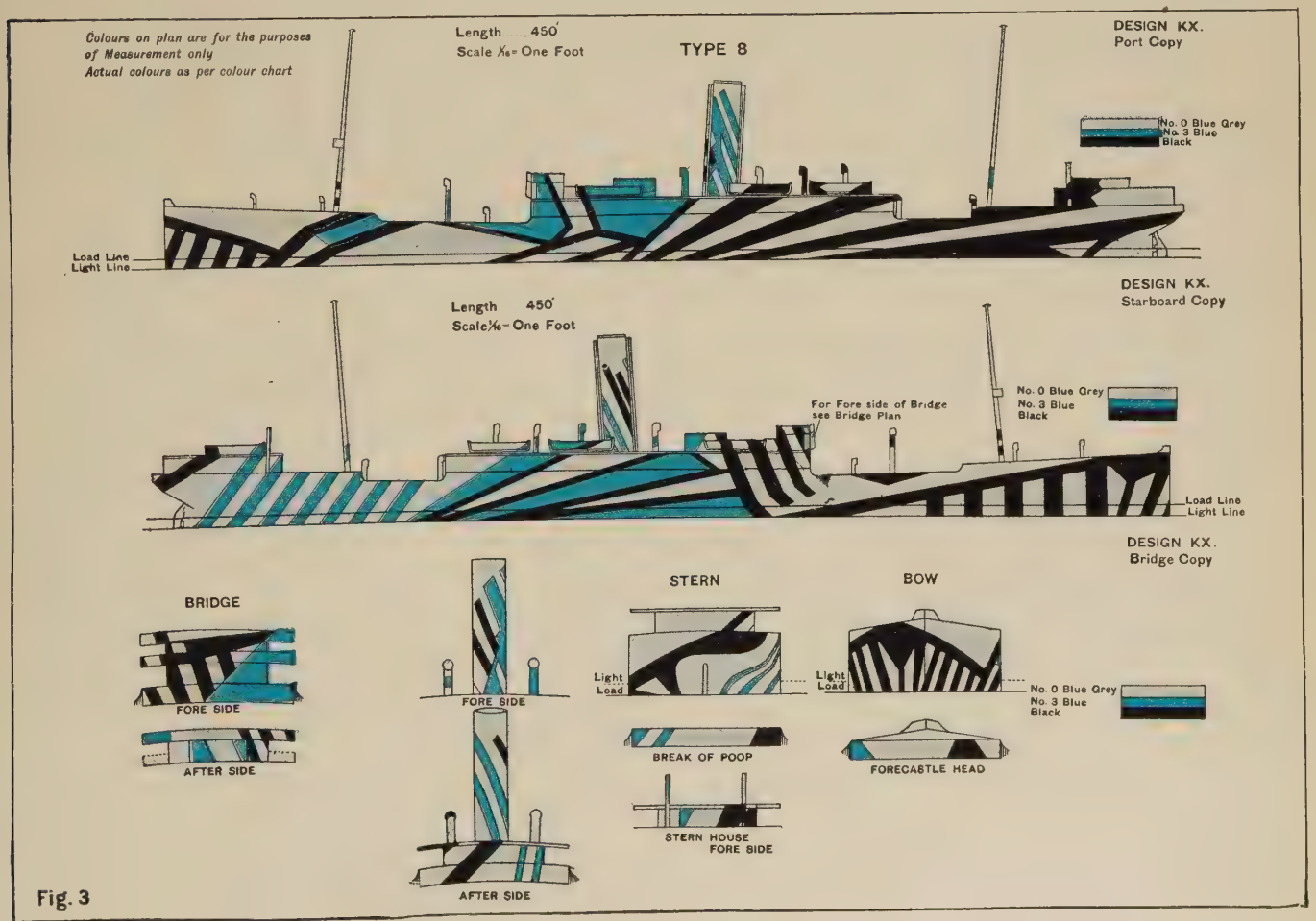


Fig. 3

DAZZLE PAINTING

FIG. 1. A dazzle-painted merchant vessel, as seen through a periscope. FIG. 2. The same vessel painted gray. FIG. 3. Typical plan as issued to painting contractors under the Dazzle Scheme (1-5th scale of original).

representing the various postures of advancing troops, were mounted in frames, which could be raised or lowered from places of safety, so as to represent the waves of an attack. This was to draw fire off a real attack. Dummy heads made of papier mâché were used for location of enemy snipers, the exact position of whom could be gauged by producing the alignment of the holes of exit and entry of the sniper's bullet. Sniper costumes painted and garnished with local material enabled a skilful wearer to attain close proximity to the enemy without detection.

The screening of roads from observation by the enemy is not in the province of camouflage, in that no deception is attempted. It is unnecessary to erect a screen which is completely opaque in order effectively to conceal traffic on a road. A screen consisting of wire netting with two-thirds of the surface covered with interlaced strips of canvas is sufficient—especially if a chequered effect of black and white be adopted. (F. J. C. W.)

II. NAVAL CAMOUFLAGE

Camouflage on various lines, but with the invariable idea of reducing visibility, had been attempted in the British Navy for many years before the World War. None of these schemes had met with any success, and each in turn had been abandoned after furtive trials. The two factors which led to this abandonment were, first, the failure to realise that anything in the nature of invisibility at sea is impossible of attainment, and, secondly, the inability of the proposers of these schemes to provide definite instructions of a practical nature by which vessels could be painted with some degree of consistency.

The Board of Admiralty eventually adopted a partial form of camouflage by painting all vessels a light grey as opposed to the black hulls and light upper works previously in force. But even this simplest form of all protective measures was somewhat haphazard in application, since the individual vessels of a squadron varied considerably in colour, ranging from a light bluish grey to a dark slate according to the ideas of the commander.

It was not until 1917, during the height of the submarine peril, that a practical scheme having a definite end in view and formulated on scientific lines was put forward and officially adopted by the British authorities. This scheme embodied entirely new ideas on sea camouflage, and was rescued from the early decease which had attended all its predecessors by the fact that the proposer was able to supply designs to scale in large numbers, all bearing out a central idea. It was called for distinction's sake in official documents "dazzle painting."

Objects.—The sole object of dazzle painting was so to distort the normal appearance of a vessel that her actual course became a matter of doubt in the mind of a submarine officer, the estimation of a vessel's true course being the prime factor required to ensure a successful attack.

Application.—Dazzle painting was intended primarily for application to merchant ships. These vessels were in far greater need of protection than warships owing to their slow speed and vulnerability and also to the fact that the enemy were making a concerted attack on England's supplies of food and materials essential to the conduct of the World War. Warships as a rule possessed high speed and were moreover protected by destroyers, a type of vessel which, while being the most deadly opponent of the submarine, was comparatively immune from attack. A certain number of war vessels were, however, dazzle painted. These were chiefly ships engaged on convoy work, although a certain number detailed for special duties such as mine-laying and patrol service valued this special form of protection.

At first sight it would appear impossible to treat a vessel with paint in such a way that an experienced seaman could be deceived as to her actual course, but dazzle-painted ships proved that this could be done. Juxtaposition of violently contrasting colours, black and white predominating, combined in accordance with the laws of perspective, could make it extremely difficult to judge the accurate inclination of a vessel even at a short distance.

Colouration.—In the early stages of dazzle painting a large range of colours was employed to achieve the end in view. Experience showed that this could be attained by a much smaller number, and toward the end of the War the principal colours in use were black, white and blue, these being employed in varying intensity. A factor which led to the simplification of the colours used was the knowledge that the German naval authorities had introduced the use of colour screens in their submarine periscopes with a view to reducing the camouflaged ship to a silhouette, and so neutralising the effect of the colours used. These screens, however, had no effect whatever on a design depending solely on black, white and blue for its contrast. Shortly after its adoption by the Admiralty dazzle painting was ordered under the Defence of the Realm Act and the whole merchant service was ordered to be painted. Numbers of war vessels operating with merchant ships were also painted: these comprised chiefly convoy cruisers, sloops and destroyers. The 10th Cruiser Squadron, engaged in blockade duties, was also painted. These vessels were specially liable to attack, being at sea for long periods and constantly under slow speed or altogether stopped.

On the introduction of the scheme a considerable volume of maritime opinion was directed against it from lack of a proper grasp of its objects and because it appeared to render a vessel more conspicuous than was the case when painted grey. In point of fact, at the date of the submission of the scheme the proposer, who was on patrol duty in the Channel, had noted that all transports were painted a dead black from water-line to truck. The opposition, however, rapidly disappeared as soon as the objects of the scheme were thoroughly grasped and the rapidly increasing numbers enabled seamen to judge for themselves the difficulties of accurately estimating the exact courses of dazzle-painted ships met with at sea.

Extension of Use.—Soon after the establishment of the Dazzle Dept., inquiries were made by the Allied maritime governments as to the efficacy of this new form of defence against the submarine. The French Ministry of Marine attached three officers for training under the new scheme and shortly afterwards set up a similar department in Paris. The U.S. Navy Dept. asked that an officer might be sent to Washington; shortly after his arrival a dazzle department was formed to deal with U.S. shipping. The Belgian Govt. arranged for all their merchant vessels to be dealt with directly in the British department. Complete sets of plans were forwarded to Italy and Japan. All U.S. destroyers and other patrol vessels in European waters were painted from plans supplied from the British department.

The number of vessels saved by this device can never be definitely ascertained, as it cannot be known how many attacks were broken off by enemy submarines owing to wrong position having been taken up as a result of inaccurate estimation of the vessel's course due to the dazzle painting. But the rapid expansion to all Allied merchant shipping showed that the authorities were satisfied that it played a great part. Approximately 4,000 merchant ships were painted and upwards of 400 war vessels, engaged principally in convoy and patrol duties, were also painted. The total cost of painting amounted to some £2,500,000. (N. W.)

CANADA (*see* 5.142), a Dominion of the British Empire and a member of the League of Nations. Its area is 3,797,123 sq. m., including the water area, or 3,729,665 without it; its population (1921 census), 8,788,483.

I. POLITICAL HISTORY

The year 1911 saw the end of a long period of Liberal rule. During the previous half century Canada had been governed, with but slight interruption, by two Prime Ministers, Sir John A. Macdonald and Sir Wilfrid Laurier. Laurier had come into power in 1896 and held office until 1911. The chief issue in the election of that year was a proposed agreement for reciprocity in trade with the United States. In 1854 a treaty had been made under which Canada had enlarged her markets. It was to endure for at least 10 years, but when this period ended the United States, to the chagrin of Canada, abrogated the treaty, chiefly, it seems, because of the British sympathy with the South during the Civil War; but partly because Canada was said to be the chief gainer. From this time freer trade with the United States had been an object of desire to all political parties in Canada.

The Reciprocity Issue.—It seemed therefore that when, in 1911, Mr. Taft, the President of the United States, proposed, and public opinion in the United States supported, a renewal of reciprocity, Canada would agree. This was the opinion of Sir Wilfrid Laurier. Reciprocity was to have two aspects: free trade in a wide range of natural products and raw material and an identical tariff on certain manufactures, including automobiles, farming implements and cutlery. There was to be no formal treaty and either side might end the pact at any time. The opponents of reciprocity pressed the point that Canada might first be exploited under the more highly developed system in the United States and then find the door for freer trade suddenly closed upon her.

In Sept. 1911, though it was still two years before the end of its term, Parliament was dissolved. Railway interests urged against reciprocity that lines running east and west, built at great cost to the nation, would suffer by diverting western traffic southward to the United States; finance feared dominance by New York; national sentiment feared political absorption by the United States. It was urged especially that, as against Great Britain, the United States would have a privileged position in Canadian trade. Advocates of reciprocity denied all these results. Eastern Canada was alarmed while the West was for freer trade, and the result of the election was that the Conservatives, led by Mr. Robert L. Borden, carried 138 seats to 88 for the Liberals and Sir Wilfrid Laurier resigned.

Naval Defence.—The Govt. of Mr. (Sir) Robert Borden was destined to face the crisis of the World War. Canada had long been urged to share in naval defence, and with a frontage on both the Atlantic and the Pacific and the open coasts of the lower St. Lawrence, she was particularly vulnerable to attack by a hostile fleet. On the other hand, most of her population lived remote from the sea coast. The rapid increase of the German Navy had alarmed the whole British Empire. If Canada was to aid in naval defence, growing national sentiment favoured a Canadian Navy, built, if possible, in Canada, controlled by Canada, but available in emergency as auxiliary to the British fleet. Sir Wilfrid Laurier, always having in mind that his fellow French Canadians centred their political thought wholly in Canada and were opposed to adventures in parts of the world where her interests were not affected, had moved cautiously. In 1910 he had created a Naval Department. There was to be a Royal Canadian Navy which should fly the white ensign and the national flag of Canada. But before anything effective could be done he was driven from power.

In 1912 Sir Robert Borden visited England for a conference with the British authorities, who convinced him that, in view of Germany's preparations, there was an emergency in naval affairs which did not permit of awaiting the formation of a Canadian Navy. In consequence, in Dec. 1912, the Prime Minister submitted to Parliament a proposal to build three warships at a cost not exceeding £7,000,000, to be placed at the disposal of the King for naval defence. The plan of a Canadian Navy was not abandoned, but was postponed in view of urgency. The proposal was hotly debated. Even the mild naval policy of Sir Wilfrid Laurier had aroused a nationalist group in Quebec which scented imperialism. Its leader, Mr. Henri Bourassa, was as fiery as his grandfather, Joseph Papineau, had been in 1837, when his attacks on arbitrary official rule led to armed rebellion. Though formerly a Liberal, Bourassa had assailed Laurier's dominance in Quebec. But now his Conservative allies went farther in naval policy. The session of 1913 saw determined obstruction, which led to the adoption of the closure in debate, already found necessary in England. The House of Commons, by 101 votes to 68, supported the naval bill which, however, failed to pass in the Senate. Thus on the eve of the World War Canada was giving almost no aid in naval defence.

The World War.—On the outbreak of the War Canadian opinion was at once clear. To the measure of her strength she was ready, in an hour of deadly peril, to fight side by side with Britain in a great cause. It should be said that Canadian national opinion demurred to the widely received view that Canada went into the War blindly "to help England," as the phrase ran. The desire to stand by England was indeed dominant in the public mind, but conviction went deeper than this. Canada was looking, for herself, at the issues of the War, and, like England, was convinced of the German menace to freedom. When, for a breathless day or two, it seemed doubtful whether Britain would declare war, there were some in Canada who talked of Canada's entering it on her own account, an impossibility under the conventions of the Dominion Constitution. The point is worth mentioning because it emphasises the growth of a national consciousness which became more marked as the War went on. Before Parliament met on Aug. 18 mobilisation had begun. One of the first acts of Parliament was to make a gift of 1,000,000 bags of flour to Great Britain, a gift which required 200 trains, each of 30 cars, to take to the ports. By Oct. a volunteer Canadian Army of 30,000 men had reached England, and a second contingent of more than 20,000 were drilling. The War Minister, Sir Sam Hughes, said that 150,000 were then eager to go. In all, Canada enlisted during the War 595,441 men; of these about 52,000 were killed in action and something like 10,000 died from other causes.

The events of the War are too complex and were too prolonged to find here more than mention. At the beginning it was doubtful whether non-professional soldiers could receive, in a short time, training adequate to meet in the field the professional German Army. When it was first proposed to send to Europe volunteer forces from Canada, Lord Roberts supported the plan less, as he said, because such a force would be effective in the field than to give to the world an illustration of the unity of the British Empire. In fact, after a training of less than a year, the regiments from the Dominions were found equal to the best battalions of Germany. The initiative acquired by the need of self-reliance in a younger society fully compensated for the longer disciplinary training of European regiments. In the end the four divisions of the Canadian Army Corps were placed under the command of Lieut.-Gen. Sir Arthur Currie.

The Canadians fought in some of the hardest battles on the Western Front; in 1915, in April at the second battle of Ypres, and later in the further severe fighting in that region; in 1916, at St. Eloi, Sanctuary Wood and other points and in the prolonged battle of the Somme; in 1917, at the taking of Vimy Ridge and in the desperate struggle in mud and slime which ended in the taking by the Canadians of Passchendaele, on the Ypres salient; in 1918, in driving back the Germans after their success near Amiens in March until, early in Aug., the Canadians helped to break the German lines and, with heavy losses, pressed the Germans back, cutting through a part of the supposedly impregnable Hindenburg line in Sept. and finally, after the great battle of Arras, taking Cambrai on Oct. 9. When the Armistice came on Nov. 11 the Canadians were at Mons, whence the British had begun their great retreat in 1914.

Developments in Canada.—Meanwhile in Canada the War was the one dominant interest. The destruction by fire of the Parliament Buildings at Ottawa on Feb. 3 1916 disorganised for a time the machinery of government. New buildings were occupied in 1920. The term of five years of the Canadian Parliament expired at the end of 1916, but by consent of all parties it was prolonged for a year. By the end of 1916 a lull had come in voluntary enlistment and Sir Robert Borden proposed to enforce conscription. The Prime Minister urged that the pledge of support to the men facing death at the front required the drastic method of raising 100,000 new troops by compulsion. This developed an issue which has since played a large part in Canadian politics.

Canada is unique in having a population of French and of British origin, united in a single Federal state, with one of the provinces almost wholly French. French Canadians cling to the language, the religion, the laws and the traditions derived from the older France. Their impulses and instincts are not the same as those of the English-speaking Canadians; their ancestors became British subjects by conquest, without any root in the culture and outlook of the nation to which they were tied. But

while they remain French, in the sense that they are devoted to the culture of France, during more than a century and a half they have had no political tie with France. Meanwhile France herself has changed; she has broken with her ancient faith and even persecuted its adherents and she has become a republic; while the French in Canada still cling to the Roman Catholic faith and to the principle of monarchy. The expectation that, with France and Britain allied, the French Canadian would feel doubly called to share in the War was not realised. Many French Canadians had the outlook, expressed by the President of the United States, that their homes were in America and that Europe must be left to settle its own disputes. While Sir Wilfrid Laurier himself gave strong support to the War, in Quebec, as in no other Canadian province, there were voices making another appeal. M. Bourassa, in his well-written newspaper *Le Devoir*, denounced alike German and British imperialism. None the less French Canadian volunteer regiments served in the War with the spirit of that military France from which their ancestors came.

Conscription.—By May 1917 the Govt. of Sir Robert Borden had adopted conscription. The Liberal leader's position was difficult. He was in ardent sympathy with the aims of the Allies. If, however, he should support conscription he would endanger his position among his own people of the Province of Quebec. In Jan. 1917 he issued an appeal to all Canadians to forget party differences in pursuit of victory in the War. As to conscription, he urged that, on so vital an issue, the example of Australia should be followed and a plebiscite taken. This attitude lost him many Liberal supporters outside of Quebec and his resolution in favour of a plebiscite was defeated in the House of Commons, by 118 to 55, with the minority almost wholly from Quebec. When, finally, after announcing conscription, Sir Robert Borden asked Sir Wilfrid Laurier to join in a coalition, with half the Cabinet Liberals, he declined. He could not face Quebec as a supporter of compulsory service.

On other grounds Quebec was resentful and suspicious. In 1913 the Conservative government of the neighbouring province of Ontario had adopted severe restrictions on the use of French as the language of instruction in the bi-lingual schools, most of them at points in Ontario adjacent to the Province of Quebec. In Ottawa, the Federal capital, in particular, this action was bitterly resented. Canada is in Federal affairs bi-lingual, with English and French on an equal footing. Many French families live in Ottawa but, since it lies in Ontario, it has the school law of that province, and the new regulation forbade the use of French as the language of instruction for all but very young children. The French are particularly sensitive as to the use of their language, and the new rule was challenged in the courts. An ultimate appeal to the Privy Council brought the decision that jurisdiction in respect of the language to be used in the schools lay entirely with the provinces. When some schools in Ottawa continued to defy the law, their grants from the Govt. were cut off. The resentment aroused by this dispute was increased by gibes from some quarters at Quebec's backwardness in aiding in the War. When conscription was enforced, riots and bloodshed in the city of Quebec led to its occupation by troops. There is little doubt that Sir Wilfrid Laurier judged rightly that his own Quebec would desert him should he support conscription. In 1918 a motion was introduced in the Quebec Legislature for secession from the rest of Canada, but so extreme a step was not encouraged by any considerable section of opinion.

A Coalition Formed.—In Oct. 1917 a coalition government was formed under Sir Robert Borden, with seven Liberal members. Dissolution followed and Sir Wilfrid Laurier fought his last campaign with but few of his former followers supporting him, except in Quebec. The coalition won by 137 to 93 and 62 of the minority were from Quebec. The election of 1917 was noteworthy, in that for the first time women voted in a Federal election. A War Franchise bill passed in 1916 gave votes to women who had relatives serving in the War, the qualifying clause being removed in 1918, when women who had reached the age of 21 received the franchise. The provinces, which control their own franchise, also gave votes to women. During the War knighthoods and other honours were freely distributed by British ministers in the name of the King, especially in connection with services relating to the War. In England the principle is deeply rooted in social life, but to many it seemed alien to the life of Canada, and, in the end, sharp protests culminated in an undertaking by the Canadian Prime Minister to request the King not only to cease conferring hereditary titles on citizens of Canada, but also that other honours should only be given on the advice of his Canadian ministers. Since that time the giving of such titles has ceased in Canada.

The Prohibition Issue.—The period of the War brought with it great social changes. The agitation of many years in the cause of prohibition was reinforced by the sense of waste which the liquor traffic caused, during the War. A wave of opinion in favour of prohibition swept over both the United States and Canada. The United States dealt with the problem as a national one and in the 18th Amendment to the Constitution decreed prohibition for the whole nation, so that it lay no longer among the issues to be settled by the state legislatures. In Canada jurisdiction in respect of the liquor traffic is divided, under the British North America Act, between the Federal and the provincial authorities. The Federal authority has control over manufacture and export, the provincial authorities over sale. The Federal Govt. would not prohibit manufacture and export because of the refusal of the Senate, an appointed body, to endorse restrictive legislation passed by the Commons.

The Federal Govt. left to the provinces the right to control importation and their right to regulate sale was never challenged. The result of the control of sale by the provinces is that each one has its own type of restriction. In Ontario the law is severe; the Govt. alone may import and sell, and then only for medicinal purposes, as certified by a physician. Private persons may, however, without cost, obtain licences to brew beer for their own use. A beer weaker than lager, containing about 4% of alcohol, may be sold retail. In parts of Ontario the grape is easily grown and the law provides that the wine of the province may be sold by the manufacturer in bulk direct to the consumer for his own use. Quebec, in contrast with Ontario, while closing the bars and closely restricting the traffic, did not prohibit it.

The sale of wine and spirits was made a government monopoly. On whisky and other strong drinks the tax is heavy; on wines it is not, with the aim, which appears to be successful, of encouraging the use of light wines. The laws in the other provinces vary from the severity of Ontario to the freedom under government control of Quebec. Monopoly of sale by government is making the traffic a source of revenue in all the provinces. A province may at any time remove or increase restrictions by an Act of its Legislature. In contrast, therefore, with what is possible in the United States, prohibition might disappear in Canada within a few months. The issue is still acute in political life. Rural areas seem fairly content with prohibition; opposition is chiefly urban, but all parties seem to oppose the return of licenced drinking places.

Post-War Politics.—The War unsettled the two old political parties and led to the organisation of dissatisfied elements into new groups. Of these the most powerful was that of the farmers, who took the name of Progressives and were especially strong in the West. They favoured freer, if not free, trade and, indeed, proposed free trade with Great Britain. The Labour party and the Socialist party have never been strong in Canada, but in the spring of 1919 Labour agitation brought on a general strike in Winnipeg. All public services were put out of commission and during five weeks Winnipeg was the scene of a struggle unprecedented in Canada. The scenes of violence and intimidation which accompanied the closing down of the street car system and the blocking of the means of distributing supplies aroused sharp antagonism and caused the strikers to lose all public sympathy. Citizens volunteered to carry on these services with so firm a resolution that the movement was defeated and Winnipeg returned to its normal activities.

A provincial election in Ontario in 1919 showed the strength of the farmers and brought a surprising defeat of what seemed a strongly entrenched Conservative Government. Of 110 seats it held only 24; the Liberals had 30; and the Farmers' party and Labour combined secured 56, thus giving them a small majority. With the Hon. E. C. Drury as Prime Minister, a new administration was formed dominated by the Farmers' party. Mr. Drury found difficulty in forming a Cabinet composed of men sufficiently experienced for the tasks of government. No one doubted his own integrity, but his Cabinet had weak elements. After lasting for four years it went to the country in 1923 and the Conservatives returned to power with a large majority. In two other provinces, Alberta and Manitoba, the unsettlement of the other parties led to the coming into office of Farmers' governments which at the end of 1925 still endured and seemed to command confidence.

Sir Wilfrid Laurier died in Feb. 1919. The cleavage in the Liberal party on the issues of the War left him a rather lonely figure during his last two years and the problem of a successor was not easy. Quebec was the chief Liberal stronghold and it resented the action of those Liberals who had broken with Sir Wilfrid Laurier. The choice went to Mr. William Lyon Mackenzie King, Minister of Labour under Sir Wilfrid Laurier and a sharer of his attitude on conscription. Mr. Bourassa, leader of the Nationalists in Quebec, is the grandson of Papineau, the rebel of 1837; Mr. King is the grandson of Mackenzie, who in the same year had led a rebellion in Ontario and had had a price put upon his head. The coincidence is interesting as showing that in Canada, as in South Africa, liberty under British institutions is a great reconciler.

A General Election.—Membership of the Imperial War Cabinet and of the Peace Conference at Versailles, added to his duties as Prime Minister, had worn down the strength of Sir Robert Borden. In 1920 he resigned and was succeeded as Prime Minister by Mr. Arthur Meighen, a member of his Cabinet. Mr. Meighen had a difficult task. The coalition was in process of disintegration, chiefly on the issue of the tariff, and one by one the Liberal members were retiring. It was in vain that, when dissolution came in 1921, the foundation of a so-called "Liberal and Conservative party" was announced. The Liberals were returning to their former allegiance or joining with some Conservatives in the Farmers' movement. In the election of Dec. Mr. Meighen stood stiffly for Protection and suffered overwhelming defeat. The Conservatives carried 51 seats and the Liberals 117, among them the entire representation of Quebec, and there was the new and advanced group of 65 Progressives. Labour remained weak, returning only two members. Over both parties Mr. King had a majority of one. He took office but his path was difficult. Though he reached a working arrangement with Mr. T. A. Crerar, the Progressive leader, this support was always conditional.

Representation.—The census of 1921 showed what is always desired in scantily peopled countries, a satisfactory increase of population. The principle of representation in proportion to numbers is applied to the Canadian House of Commons. Quebec has always 65 members and those from the other provinces are in proportion to the number from Quebec. A redistribution follows each census and that of 1922 showed the marked increase in population in the west. The members from Nova Scotia and Ontario were reduced by two and one respectively. New Brunswick, Prince Edward Island and Yukon remained unchanged, while the increases in the west were Manitoba two, Saskatchewan five, Alberta four and British Columbia one. Such changes indicate that policy must be adjusted to the needs of the relatively larger agricultural population of the west. Though increased expenses probably justified the measure, there was sharp criticism of the action of Parliament in 1921 in increasing the pay of members from $2,500 to $4,000 for each session.

The Liberal Govt., which carried its budget in 1923 by a majority of only one, had always to confront an adverse majority in the Senate, to which only Conservatives had been appointed during the Conservative régime. This situation is always a feature of Canadian political life when a government long in power quits office. In 1923 the Senate showed great activity in respect of railway policy. Sir Henry Thornton, the head of the vast government railway system, with more than 20,000 m. of lines, proposed to build 26 small branch lines, chiefly in the west, as feeders of the trunk lines. The House of Commons endorsed the building of the lines at an estimated cost of $29,000,000 but the Senate objected that, while a few of the lines might be needed, it was unwise to increase an already crushing burden of debt at a time when trade was depressed. The cost, it was also urged, would go far beyond the estimate. When the Senate rejected the proposal, its action caused sharp criticism of a body not directly responsible to the people. Since that time the Liberal party has been committed to the reform of the Senate, a well-worn cry of the party in a minority in that body.

Removal of Cattle Embargo.—The loss of purchasing power in Europe after the War so lowered the price of wheat as to make the market price cover little more, and often less, than the cost of production. This brought severe depression in western Canada. The cattle industry found some relief when, in 1922, after prolonged discussion, the British Govt. removed the embargo on the importation of live cattle from Canada. It had endured for 30 years, though the cause—disease in Canadian cattle—had long since disappeared. Canadian cattle can now be sent across the ocean to be fattened in England for slaughter. The relief in this direction was timely, for the farmers of the United States were complaining of Canadian competition. In 1922, on the plea that both land and labour were cheaper in Canada, Congress empowered the President to proclaim a tariff against Canadian grain and cattle which should represent this difference. At first the duty on wheat was 30 cents a bushel, and on oats 15 cents, but in 1924 the President increased the duty on wheat to 42 cents, with proportionate duties on other produce and on sheep and cattle. The duty on wheat affected but slightly the Canadian producer, since the price is determined in the world market, but that on cattle was a heavy blow, owing to the great distances for which cattle must be carried to other markets.

When, in 1922, Mr. Crerar, the Progressive leader, retired, the new leader, Mr. Robert Forke, had to face discontent in his own party on the ground of undue subservience to the Liberals. In 1924 a so-called "ginger group" was formed of some 10 Progressive members and their support was so uncertain that at last in 1925, more than a year before the term of five years had expired, Mr. King appealed to the country on the plea that he needed a decisive Liberal majority.

The Election of 1925.—This appeal gave the country an opportunity to consider the effect upon Canada of the long strain of war and of unsettlement after war. The public debt had been increased to an amount which represented about $300 for each inhabitant of Canada. The cost of government had risen to about $1,000,000,000 yearly when Federal, provincial and municipal taxes were included and there was a large deficit on the two great railway lines united to form the Canadian National Railways. Burdens so heavy necessarily hampered commerce. While the farmers, competing in an unprotected world market, complained of the high prices paid to the protected manufacturer, he in turn complained that the tariff was so low as to enable the mass production of the United States to close Canadian factories, and that Canadians, unable to secure employment at home, were going in considerable numbers across the frontier. The reduction of one-third of the tariff in favour of British imports, it was claimed, was ruining especially the textile industry.

This cleavage on the tariff fortified sectional cleavage. The Maritime Provinces resented the more rapid development of the provinces further west. In the previous election Quebec had sent only Liberals to Parliament and this unanimity was rather on racial than on political grounds, in antagonism to English-speaking Ontario. The agricultural west thought it was being exploited by the industrial east. During the election in Oct. all these grievances found expression. The result showed a weakening of the hold of both the Liberals and the Progressives. The Conservatives, with 117, were the strongest party. The Liberals

had 102 and the Progressives 23, and there were 2 or 3 Independents. No party had a majority. Union between the protectionist Conservatives with low-tariff Progressives to turn out Liberals who denounce protection would involve a paradox. Mr. King consequently did not resign, but faced the new parliament, realising that on any question of confidence he would have the support of the Progressives. On June 28 1926, however, following the refusal of the governor-general to dissolve Parliament, Mr. Mackenzie King resigned, and his place was taken by the Conservative leader, Mr. Arthur Meighen.

Religion.—While the Roman Catholics have the largest single church membership, the total number of Protestants in Canada is greater by about one-half. Union among Protestants had long been urged, and in 1925 three groups, Presbyterians, Methodists and the minor body of Congregationalists, finally completed the organisation of the United Church of Canada. The union has the interesting feature that, while the traditions of Presbyterianism are linked with Scotland, and those of the Methodists are linked chiefly with England, in Canada they have united in one stream distinctively Canadian in type. Among the Methodists there was no movement against union. Many Presbyterians, however, opposed the break with the long traditions of the Presbyterian system. This opposition was chiefly in the cities of eastern Canada and, while the Methodist Church of Canada has disappeared, there is a continuing Presbyterian Church of Canada with less than one-quarter of its former membership.

The Canadian Annual Review of Public Affairs (Toronto, annually) gives full accounts, each year, of political and financial matters in Canada. *The Canada Year Book*, issued annually at Ottawa by the Govt. of Canada, gives elaborate statistics. On political events since 1911, O. D. Skelton's *Life and Letters of Sir Wilfrid Laurier* (New York, 1921) is a good account from the Liberal point of view. So also is J. W. Dafoe's *Laurier, a Study in Canadian Politics* (Toronto, 1922). The *Canadian Historical Review* (published quarterly at Toronto) is a guide to current literature relating to Canada. (G. M. W.)

II. CONSTITUTIONAL DEVELOPMENT

The incidents of Canada's constitutional development during the period 1910–25 are important. During the Imperial Conference of 1911, Dominion delegates for the first time were admitted to what Mr. Asquith termed the *arcana imperii*. That is to say, they were received at a special conference by Sir Edward Grey, who imparted to them important confidential information as to foreign relations. At the same conference it was resolved, on the motion of Sir Wilfrid Laurier, that the British Govt. should open negotiations with foreign governments with a view to securing liberty for any Dominion, which might so desire, to withdraw from the operation of a treaty affecting that Dominion, without impairing the effectiveness of the treaty for the rest of the Empire. A rather ineffective resolution was passed as to consultation with the Dominions respecting the negotiation of international agreements affecting them.

Boundary Waters.—The Boundary Waters Treaty between the United States and Canada, negotiated under the direction of Sir Wilfrid Laurier and submitted by him to the Canadian Parliament in 1911, established an International Joint Commission of six commissioners, three appointed by the President of the United States and three by His Majesty on the recommendation of the governor-general in council. Thus, the Canadian Govt. in substance, although not in form, appoints the Canadian commissioners. All important questions respecting rights in, and the user of, boundary waters are referred to this commission, which may also, with the consent of the governments of the United States and of Canada, exercise powers still more comprehensive, including the determination of all rights, obligations or interests of the United States or of Canada, either in relation to each other or to their respective inhabitants. In the relations between Canada and the United States this treaty is a landmark almost as notable as the Convention of 1818, which brought about disarmament upon the Great Lakes, and in effect upon the entire boundary line.

In 1912 Sir Robert Borden, the Prime Minister, and three of his colleagues attended a meeting of the Imperial Defence Committee at which the foreign relations of the British Commonwealth and the necessary safeguards against aggression were usefully discussed. In the same year the British Govt. gave assurances to the Govt. of Canada that, pending a final solution of the question of voice and influence in foreign relations, a Dominion Minister resident in London would be regularly summoned to the Committee of Imperial Defence and regarded as one of its permanent members; and that no important step in foreign policy would be undertaken without consultation with such representative.

In Oct. 1916 the Canadian Govt. established in London a Ministry of Overseas Military Forces with a resident minister. This Dept. was charged with the administration of military affairs overseas, and with the expenditure connected therewith. Eventually, it became an overseas Canadian War Office. Military operations in the field were under the final direction of British General Headquarters, but otherwise the Canadian forces serving in the War were administered as a thoroughly autonomous body, under the primary direction of the Overseas Ministry, with ultimate responsibility to the Canadian Govt. and Parliament.

Canadians and the Cabinet.—The Prime Minister of Canada was summoned to and attended a meeting of the British Cabinet in 1915. This was regarded as an event of constitutional significance. In 1917, however, a more important step was taken. The British Prime Minister called into operation the Imperial War Cabinet. It included the five Ministers of the British War Cabinet, the Prime Ministers of the Dominions and a representative from India. Thus ministers from all the self-governing nations of the Empire sat on terms of equality at a common council board, acting in co-operation and responsible to their respective Parliaments. Each minister or group of ministers represented a government, and the conference might fairly be termed a Cabinet of governments. In 1917 the British Govt. advanced the view that it had authority to requisition ships owned and registered in Canada. This view was effectively controverted by the Canadian Govt., who held firmly to the principle that in such case the executive power was properly vested in the Govt. of the Dominion. The legal power which undoubtedly existed was effectively limited by the controlling force of constitutional right.

Imperial War Conference.—The Imperial Conference sat as the Imperial War Conference in 1917 and 1918, and was occupied with questions not directly concerned with war measures and operations. In 1917 the question of immigration from India to the Dominions was considered, and the principle of reciprocity of treatment between India and the Dominions was adopted by resolution as a working basis. The most important contribution of the conference in that year was a resolution to which the British Govt. was a party. This recorded the conclusion that the readjustment of the constitutional relations of the component parts of the Empire, while thoroughly preserving all existing powers of self-government and complete control of domestic affairs, should be based upon a full recognition of the Dominions as autonomous nations of an Imperial Commonwealth and of India as an important portion of the same; should recognise the right of Canada, the other Dominions and India to an adequate voice in foreign policy and in foreign relations; and should provide effective arrangements for continuous consultation in all important matters of common Imperial concern, and for such necessary concerted action, founded on consultation, as the several governments may determine. This resolution, which formed the basis of future co-operation, gives distinct recognition to equality of nationhood between the Dominions and the mother country.

The principle thus established was carried to its logical conclusion at the Peace Conference of 1919, at which Canada, the other Dominions and India were distinctively represented by their delegates. There was serious opposition at Paris to such distinctive representation; but the insistence of the Dominions, with the strong support of the British Govt., eventually prevailed. The Imperial War Cabinet functioned at Paris under the designation of the British Empire Delegation. As a corollary

to representation it was determined that Canada, the other Dominions and India should be parties to the Peace Treaty and members of the League of Nations, and that the treaty should be signed by Dominion and Indian plenipotentiaries and submitted for approval to Dominion Parliaments. Thus, at the Council of the Nations, the British Commonwealth entered on a new stage of its existence and development. The situation so created may not be free from anomalies; but the governance of the British Commonwealth has been developed through effective practice based upon needs as they arise, and is not founded upon speculative theory or strict logic. The outstanding fact is that the Dominions and India secured a certain status in the family of nations. An eminent authority has declared that the Versailles Treaty is the Magna Charta of the Dominions.

In 1918 a resolution of the Conference acknowledged the inherent function of each Dominion Government and of India to enjoy complete control of the composition of its population by restricting immigration from any other communities. In the same year the Conference by resolution declared that the Prime Ministers of the Dominions should have the right to direct communication with the Prime Minister of the United Kingdom and vice versa. This principle was affirmed at the Conference of 1921.

Canada and the United States.—A Canadian War Mission had been established at Washington at the beginning of 1918. It was in effect, although not in form, a diplomatic mission, and during the last year of the War and the first year of reconstruction it proved of immense service. In view of this the Canadian Prime Minister discussed with British ministers in 1919 the right of legation, which was acknowledged by an arrangement announced to the Canadian Parliament in 1920. The proposed appointment of a Canadian minister at Washington was not to denote any departure from the principle of the diplomatic unity of the British Empire, and was wholly consistent with the general practice under which Canadian Ministers in their negotiation of treaties with the United States held for the time being an informal diplomatic status. Nor was there any advance upon the principle actually in operation in the International Joint Commission which deals with many matters formerly referred to diplomatic negotiation.

In 1921 the Canadian Parliament passed an important measure to define Canadian nationals, which was rendered necessary by the status of Canada under the Versailles Treaty and especially as a member of the League of Nations. In the same year the voice of Canada and of other Dominions with regard to the proposed renewal of the Anglo-Japanese Treaty exercised an important influence upon the subsequent course of events.

Washington Conference.—The President of the United States did not extend to Canada and the Dominions separate invitations to the Disarmament Conference (1921) at Washington. Precedent existed for separate invitations, and there was a question as to whether certain Dominions would not stand aloof. It was wisely decided that the absence of special invitations should be overlooked and that the Dominions should be represented at Washington by their special plenipotentiaries, to whom full powers should be issued under the practice established at Paris in 1919. In the result the status and distinctive consideration that the Dominions had received at Paris were accorded to them at Washington. In the formal parts of the treaties the special representation of each Dominion was recognised; and each Dominion plenipotentiary signed on behalf of his Government.

The Canadian Model for the Irish Free State.—The agreement (Dec. 6 1921) between Great Britain and Ireland, that was subsequently ratified by Imperial Statute, provides that the Irish Free State shall have the same constitutional status as the Dominions and that its position in relation to the Imperial Parliament and Government shall be that of the Dominion of Canada. By Article 1 of its Constitution it is declared to be "a co-equal member of the Community of Nations forming the British Commonwealth of Nations."

The Treaty Power. A question having arisen with respect to the signing and ratification of treaties which concern only the interests of one Dominion, the whole subject was under consideration at the Imperial Conference of 1923, when principles were formulated and procedure laid down which should govern such cases and which fully recognise the right of each Dominion to negotiate and enter into a treaty affecting only its own interests, but not without due consideration of its possible effect on other parts of the Commonwealth or on the Commonwealth as a whole. Such a treaty, imposing obligations on one part only, should be signed by a representative of the Govt. of that part. The ratification of such a treaty is effected at the instance of the Govt. concerned.

The Anglo-French Treaty of 1919 (Defence of France) which was ratified by the British Parliament, but which never came into force as the corresponding Treaty between the French Republic and the United States was not ratified, provided that it should impose no obligation upon any of the Dominions unless and until it should be approved by the Parliament of the Dominion concerned. The Security Pact (Locarno, Oct. 16 1925) between Germany, Belgium, France and Great Britain, provides (Article 9) that it shall impose no obligation upon any of the British Dominions or upon India unless the Govt. of such Dominion or of India signifies its acceptance. In the one case Parliament, in the other case the Government, must approve. At Locarno (as at Lausanne) the Dominions did not take part in the negotiations and it does not appear that they were invited to do so. Thus at Locarno there was a distinct departure from the spirit of the 1917 resolution and from the precedent established at Paris. The reasons for such departure have not been made public.

Summary.—Apart from this incident, the development up to the end of 1925 may be summarised as follows:—

1. During the War each Dominion received a recognised place in the War Council of the Commonwealth and took an active part in the co-operation and direction of the Commonwealth's war effort.
2. The British and Dominion governments have definitely agreed that the principles of autonomy and equal nationhood shall govern their future political relations, and that the Dominions shall have an adequate voice in foreign policy and relations.
3. At the Paris Peace Conference and at the Washington Disarmament Conference there was distinctive representation of the Dominions; their plenipotentiaries were appointed upon their own nomination and the treaties were signed on behalf of the respective Dominions.
4. The Dominions entered into international affairs as members of the League of Nations with equal representation in the Assembly, and with such recognised status as would enable them to be represented on the Council.
5. Under suitable arrangements approved by the British Govt., and without departing from the principle of diplomatic unity, Canada became entitled to appoint a Minister Plenipotentiary at Washington who would be the ordinary channel of communication between the governments of Canada and the United States, and who would act upon instructions from, and report direct to, the Canadian Government.

In effect the British Commonwealth may be regarded as a league of nations, owning a single allegiance. In all essentials touching its continued existence and development there must be a real unity among its members, based upon the ideals of liberty and autonomy and upon close and sympathetic co-operation between the Commonwealth governments, and each, with due regard to its own point of view and special interests, must survey the aspects of external relations from the higher standpoint of Commonwealth unity and welfare.

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III. DEFENCE

After 1910 Canadian military organisation changed very much. Its two most important features were the final war organisation, and the peace organisation which succeeded it. The principal military effort of Canada from 1914 to 1918 consisted in the organisation and maintenance of the Canadian Corps, consisting of the I., II., III. and IV. Canadian divisions and corps troops. This force, while technically an army corps of the British Army, differed from other army corps in that it was an integral tactical unit, moving and fighting as a whole.

War-time Organisation.—Its high tactical value resulted mainly from (*a*) great mobility, aided by two additional mechanical transport companies (for machine-gun battalions and engineer brigades); (*b*) high and consistent infantry strength, due to each division having three brigades of four battalions of 1,100 men each, one engineer brigade of three battalions in each division (eliminating the necessity of supplying working parties from

infantry) and to the possession of its own system for handling reinforcements; (*c*) staffs almost double strength and staff officers constantly interchanged; (*d*) an unique machine-gun organisation, comprising two motor machine-gun brigades with the corps and one machine-gun battalion of 96 guns with each division, also a machine-gun headquarters at corps headquarters; (*e*) enlarged signal service; (*f*) high strength in permanently attached artillery (corps troops included one extra divisional artillery unit and one extra brigade of field artillery); and (*g*) mechanicalisation during stationary periods by extended use of light railways, husbanding strength of men and horses. Other Canadian formations in France were the Canadian Cavalry Brigade and Canadian Railway Troops, which included headquarters, 14 battalions and four operating companies, making a total of nearly 15,000 men and several supply units. There were Canadian sections with the I. and III. Echelons of G.H.Q., the former supplied liaison between Canadian units, G.H.Q. and the Canadian Ministry in England.

The Canadian Army Medical Corps operated in France, England and Salonika, supplying the regular medical services with the corps and other troops and also 14 general and seven stationary hospitals, four small forestry corps hospitals, 12 convalescent hospitals and one mobile laboratory. The Canadian Forestry Corps operated in England and France with 24,000 all ranks. The Canadian Army Dental Corps had a strength of 903 all ranks. Special formations were the Accountant General's Branch, the Canadian Army Pay Corps and the Department of the General Auditor. Canadian troops in France and England were administered by the Minister of Overseas Military Forces of Canada with a headquarters in London.

Post-War Organisation.—During the session of 1922 a National Defence Act was passed, consolidating the Naval Service, the Air Board and the Dept. of Militia and Defence into the Dept. of National Defence. The Act became effective by proclamation on Jan. 1 1923. Under it there is a Minister of National Defence and a deputy-minister; a Defence Council was constituted to advise the minister. The senior non-civil officer is the chief of the general staff.

Military Forces.—The small permanent military force is used for the maintenance of organisation and the instruction of the non-permanent troops, who constitute the first line fighting force. For purposes of training, discipline, mobilisation, etc., the country is divided into 11 districts, each district under permanent commanders with small staffs. Infantry is organised on a regimental system with active and reserve battalions (122 in all), perpetuating by their names the pre-War militia regiments and units of the Canadian Corps. The organisation of other arms is such as to provide for the formation of complete divisions with the necessary depots for reinforcements. The strength of the permanent militia was limited by the Militia Act Amending Act of 1919, to 10,000, but the authorised establishment in 1924 was less than 3,500. Royal schools of instruction are conducted at all stations of the permanent force; the Canadian Small Arms School is the only school, however, which is an independent unit of the permanent force. The total establishment of the non-permanent militia in 1925 was 10,568 officers and 112,893 other ranks. A reserve militia has also been established.

Naval Service.—The Royal Canadian Navy and its reserve forces are under the direction of the Director of Naval Service, who is a member of the Defence Council. The service consists of permanent headquarters at Ottawa, and the Royal Canadian Navy, Naval Reserve and Naval Volunteer Reserve. In 1925 the personnel of the navy was 73 officers and 394 ratings. The majority of the men serve under seven years' engagements. A proportion of the officers serve periodically in ships of the British Royal Navy, and training courses are arranged for selected officers at the instructional schools of the Royal Navy. The Royal Canadian Navy consisted in 1924 of two destroyers and four minesweepers in commission and one light cruiser and two submarines in reserve. Naval training establishments and dockyards are maintained at Halifax and Esquimalt. The naval reserve consisted in 1924 of 70 officers and 430 men, and the volunteer reserve of 70 officers and 930 men. In 1925 and 1926 the naval service was in process of reorganisation.

Air Force.—The Royal Canadian Air Force in 1924 included a directorate under the control of the chief of the general staff which has its headquarters at Ottawa, and units at Vancouver, B.C.; High River, Alta.; Winnipeg, Man. (with operating bases at Victoria Beach, Norway House and The Pas); Camp Borden (the main training base); Ottawa, Ont.; and Dartmouth, N.S. The strength of the force on March 31 1924, was 61 officers and 262 men. Its functions were air force training and operations, the control of commercial flying and the conduct of flying operations for civil branches of the government service. In 1925 and 1926 the force was in process of reorganisation. (A. Cu.)

IV. FINANCE

In 1911 the net public debt of the Dominion of Canada was $335,996,850; in 1920, $2,248,862,624 and on March 31 1924, $2,417,783,275. In 1911 the interest on the public debt was about $13,000,000; by 1920 it had risen to $138,824,782, reduced in 1924 to $133,198,052. War pensions, the growth of population, increasing government activities, railway deficits and rising prices, all added to public expenditure, quite apart from the vast sums raised during the War for the maintenance of the army. The expenditure in 1911 on account of the consolidated fund was about $80,000,000. In 1924 it was $324,813,190. To this latter sum must be added various capital expenditures and railway deficits, which brought the total expenditure of 1924 to $370,589,247. The national wealth of Canada in 1921 was estimated at $22,195,000,000 and the national income of 1922 at some $4,000,000,000. The amount of income assessed for income taxes in 1922 was $1,463,000,000, and in 1924 it was $1,108,000,000. This latter change reflects the fall in prices and the depression in trade that began in 1921.

The financial problem of the country was made more difficult by the burden of the vast railway system which had to be taken over by the Govt. soon after the War. At the end of 1924 the Canadian National Railways, a combination of practically all the systems not included in the Canadian Pacific Railway, had about $914,000,000 worth of securities outstanding in the hands of the public. Not all of these securities were guaranteed by the Govt. but all must be reckoned among the national obligations. The railway requirements are met in part by direct advances from the Govt. and partly by the sale of guaranteed bonds, which become indirect public liabilities.

Sources of Revenue.—Customs duties provided the largest source of revenue in 1925. Additional revenue was obtained by the imposition of war taxes, the most productive of these being the sales tax, introduced in 1920, which was payable by manufacturers at the rate of 5% of their monthly sales. The income tax, introduced in 1917, is calculated at a normal rate of 4% with a surtax which rises to 65% on incomes over $1,000,000 per annum. Allowances include $1,000 per annum for a bachelor, $2,000 for a married man and $500 for each dependent child. A war tax on business profits was introduced in 1916 but discontinued at the end of 1920. Other war taxes included stamps on commercial documents and various luxury taxes.

Loans.—Canada was still a considerable borrower abroad in 1925, but it is important to note that after 1914 the greater part of these borrowings were from the United States, instead of from Great Britain which had supplied almost all the foreign capital borrowed by Canada before 1914. The increase in the prosperity of the country is clearly shown by the following table giving the sales of Canadian bonds in Canada, Great Britain and the United States by five year periods from 1905 to 1924. Percentages of the total for each period are shown in parentheses.

Period	Canada	G.B.	U.S.A.	Total
	(in millions of dollars)			
1905–9	158(21·7)	535(73·5)	35(4·8)	728
1910–4	199(15·2)	951(72·7)	157(12·1)	1,307
1915–9	2,222(71·6)	116(3·7)	768(24·7)	3,106
1920–4	1,330(57·4)	18(0·8)	967(41·8)	2,315

(A. J. Gl.)

Banking

The main circulating media in Canada consist of Dominion notes, issued by the Dominion Govt. and bank notes, issued by the chartered banks in virtue of the terms of the Bank Act. Under the Dominions Notes Act, 1914, passed just before the outbreak of the World War, Dominion notes were issuable up to a total of $50,000,000 with a cash reserve of 25%, any notes in excess to be fully backed by gold.

As amended by the Finance Act, 1914, and the Dominion Notes Act, 1915, the redemption in gold of Dominion notes might be suspended by an order-in-council; whilst the volume of notes against which only a partial reserve was required was increased. The Finance Act, 1923, continued the order-in-council suspending convertibility, at the same time making permanent the system inaugurated by the Finance Act, 1914, by which Dominion notes could be advanced to the chartered banks against approved security. Thus the Canadian dollar, though at par with gold, had not by March 1926 been made redeemable at sight in gold; on the other hand, the Canadian Finance Ministry had been given some of the attributes of a central bank of issue.

The Note Issue.—The chartered banks may at all times issue notes up to an amount equal to the sum of their paid-up capital and the holding of gold and dominion notes in the Central Gold Reserve. Up to 1923, under special War regulations, the banks also possessed the right at all times to issue excess notes, up to 15% of the paid-up capital and reserve of the bank issuing the notes. This right to issue excess notes was then confined again to the period originally contemplated by the Bank Act, *i.e.*, to the crop-moving season from the beginning of Sept. to the end of February. Such excess notes are taxable at the rate of 5% per annum. The notes are secured by the maintenance of a Bank Circulation Redemption Fund, to which each bank contributed an amount equal to 5% of the average amount of its notes outstanding, and by the gold and Dominion notes in the Central Gold Reserve, constituted under the supervision of trustees, three of whom are appointed by the Canadian Bankers' Assn. and one by the Ministry of Finance.

The Chartered Banks.—Canadian commercial banking is in the hands of the chartered banks, incorporated under the Bank Act, first passed in 1871, and revised decennially. During the present century, the amalgamation movement resulted in a considerable diminution in the total number of banks; their number fell from 34 in 1900 to 25 in 1913, and was further reduced to 10 in 1925, the reduction being particularly marked in the years 1922–5. During this last period, one of depression following the post-War boom, some of the smaller banks showed marked weakness. The case of the Home Bank, which suspended payment in Aug. 1923, in particular revealed great maladministration; the bank had to be liquidated, the Bankers' Assn. and the government having to come to the assistance of the depositors, though the association advanced on the security of assets of the bank. In spite of the pressure of the Progressive party in the Dominion Legislature, the revision of the Bank Act in 1923, though resulting in several amendments, did not produce any fundamental changes.

Inspection of Banks.—But in 1924, in consequence of the Home Bank revelations, the important principle of government inspection of banks was incorporated in the Bank Act, a new section 56A being added. This section, which provides for annual inspection and report to the Minister of Finance, gives the Minister of Finance power, in case the inspector is satisfied that a bank is insolvent, and so reports, to request the Canadian Bankers' Assn. to appoint a curator to supervise the affairs of the bank, and such request shall have the same effect as if the bank had actually suspended payment.

Whilst the economic set-back from which Canada was suffering during the post-War period affected the banks and caused a recession both in the number of branches and the volume of business, the Canadian banking system had long ceased to be a purely domestic one. It has expanded to the West Indies, Central and South America, France, the United States and elsewhere. Whilst loans current in Canada fell off between Oct. 1921 and Oct. 1925, from $1,243,000,000 to $906,000,000, current loans elsewhere than in Canada increased in the same four years from $156,000,000 to $227,000,000. Canadian deposits increased in the same period by $50,000,000 and deposits elsewhere by $61,000,000. The total assets and liabilities in the four years increased from $2,806,000,000 to $2,882,000,000. (T. E. G.)

V. EDUCATION

The British North America Act, which was passed in 1867, placed education under the provincial Legislatures, subject to "any right or privilege with respect to denominational schools which any class of persons have by law in any province at the Union." Ontario, Quebec, Alberta and Saskatchewan provided separate schools for Catholics and English Protestants, but in Manitoba, although there were separate schools until 1890, there was only one system of public free schools in 1926; an arrangement to which the French Catholic population never acceded and which did not satisfy all parties.

Difficulties in Ontario and Quebec.—In Ontario, a school regulation passed in 1912 provided that all instruction, excepting in the first form, should be in English. The claim was made by the Catholic minority that this regulation was an invasion of their rights, but it was still in force in 1926. In Quebec, where education is under Catholic and Protestant sub-departments, there has grown up a third group, the Hebrew, living mostly in Montreal and treated as Protestant, although not entitled to representation on school boards or to separate schools. It is making an effort to obtain recognition and the matter is now before the courts. In Montreal, the community of English-speaking Catholics, who felt that no satisfactory provision was made for them in the high-school system, in 1922 erected by private subscription a high school of their own. The sparsity of rural population, together with the many foreign-born in the western provinces, has necessitated a centralised system, and the departments of education continue to issue all instructions concerning the conduct of schools, leaving little to the discretion of the local school boards or trustees of separate schools.

Teachers and Teaching.—Teachers are appointed by the respective school boards. The maintenance of one-room rural schools was becoming difficult in 1925; it was not easy to obtain qualified teachers; the cost of living had increased, and there had been local agricultural depression. In Manitoba, for example, the annual cost of maintaining a one-room school-house was as high as $1,300; salaries varying from $850 to $1,100 were mostly paid by the district, a small provincial grant being available. The result was that a large number of schools had been closed altogether. In the rural districts of Quebec, where the Protestant population is very scattered, an effort was being made to consolidate schools and to provide free transportation for pupils. In Saskatchewan a number of schools had been consolidated into two-room schools, enabling two teachers to share work and living expenses. The western provinces made a great effort to replace the unqualified foreign-born teacher, too often found before 1918. Alberta appointed official school trustees where it was found impossible to obtain satisfactory appointments.

In Saskatchewan, instruction is allowed for only one hour per day in a language other than English. In Manitoba, the clause allowing bilingual instruction has been repealed, and good effects have resulted. These difficulties must not be emphasised without remarking that there were over 1,900,000 children in ordinary day schools in 1925, and that the percentage of illiteracy, much smaller than in 1910, was decreasing. Another circumstance affecting education is the evident effect of European systems. In the English-speaking communities one result has been the freedom of discussion enjoyed by teachers, and the recent violent controversy on this subject in the United States had few echoes in Canada. Among the French-speaking institutions receiving their inspiration from France, the universities have no Faculty of Arts; but the Bachelor's degree, given by the universities to graduates of junior colleges conducted by Catholic authorities and giving an eight-year course, has now been made prerequisite to all professional degrees and examinations for admission to professional associations.

The French-speaking model schools in Quebec were abolished in 1924 and replaced by two additional grades in the elementary schools. In Quebec the Catholic academies teach no classics, but the classical college course for the B.A. has been standardised and improved. The provincial government since 1922 has aided these institutions by annual grants of $10,000 each. The Ontario Adolescent Act requires school attendance up to 16 years of age, and some higher English schools have been opened to cover the post-elementary period. Since 1918 commercial and technical high schools have been instituted in most large centres, replacing for those attending them the regular high schools; these, with the agricultural colleges, are the only educational institutions which can legally be and are aided by the Dominion Government.

University Education.—In the universities, progress has been made both by growth and by federation. McGill University has absorbed Macdonald College and greatly extended its faculties, schools and departments. The University of Toronto has been reconstituted on a federal basis, and the Ontario Agricultural College affiliated to it. The French-speaking University of Montreal, long a branch of Laval University, was in 1920 granted a new charter. Western University, which changed its name to the University of Western Ontario, is now carried on in close co-operation with the municipal authorities of London, Ontario, and the neighbouring counties. The University of King's College was removed to Halifax and federated with Dalhousie. The western universities of British Columbia, Manitoba, Saskatchewan and Alberta have shown a remarkable growth.

Recent investigators suggest the need of more co-ordination between school and university courses, and propose that the schools give part of the arts course or satisfy matriculation standards co-ordinated with university requirements. It is probably fair to say, in surveying the whole situation, that the period 1910–25 has been one of the most remarkable in the history of Canadian education, marked so far as universities are concerned by unparalleled material growth, and in elementary education by remarkable improvement in methods, in public interest and in results. (A. Cu.)

VI. AREA AND POPULATION

The land and water areas of the Dominion, by Provinces and Territories according to revised calculations made in 1925 are given in table in next column.

The population increased from 5,371,315 in 1901 to 7,206,643 in 1911 and to 8,788,483 in 1921. In 1911–21, the net increase was therefore 1,581,840 and the rate 21·95%. Within the Dominion, the four western provinces increased in relative importance in 1911–21, the others declined. The heavy immigration movement accompanying the settlement of the western provinces was chiefly responsible for the increase.

With regard to natural increase, comprehensive statistics are lacking prior to 1921, but the net increase of births over deaths is set down at 853,566 for the decade 1901–11, and at 1,150,659 for the decade 1911–21. The population is of high masculinity as a result of the large part which immigration has played; notwithstanding the War, which, both by its check upon immigration and by the toll which it levied upon male lives, considerably reduced the excess of males, there was an excess in 1921 of 3 in the number of males as compared with females in each 100 of the population. Through the same causes, the Canadian median age has been increasing and in 1921 was 23·943 years or 5·144 years higher than in 1871.

Provinces and Territories	Land	Water[1]	Total	Population per sq. m. of land area
Nova Scotia	21,068	360	21,428	24·86
Prince Edward Island	2,184	..	2,184	40·56
New Brunswick	27,911	74	27,985	13·90
Quebec	690,865	15,969	706,834	3·42
Ontario	365,880	41,382	407,262	8·02
Manitoba	231,926	19,906	251,832	2·63
Saskatchewan	243,381	8,319	251,700	3·12
Alberta	252,925	2,360	255,285	2·33
British Columbia	353,416	2,439	355,855	1·48
Yukon	206,427	649	207,076	0·02
Northwest Territories:				
Mackenzie	493,225	34,265	527,490	0·006
Keewatin	218,460	9,700	228,160	
Franklin	546,532	7,500	554,032	
Total	3,654,200	142,923	3,797,123	2·41

[1] Exclusive of all tidal waters excepting that portion of the river St. Lawrence between Point des Monts and the foot of Lake St. Peter.

The subjoined tables assemble the more important facts of population growth by provinces. A post-censal calculation *pro formula* of the population as at June 1 in each year since 1921 gave the following results: 1922—8,940,150; 1923—9,082,840; 1924—9,226,740.

Racial Origin and Citizenship.—The problem of the assimilation of foreign immigrants, superimposed upon the basic division of the Canadian population into two great national groups, makes the statistics of origin of unusual significance. During the decade ended in 1921, the population of British stock increased from 3,896,985 to 4,868,903, or by 971,918, whilst the descendants of the original French colonists increased from 2,054,890 to 2,452,751, or by 397,861. The British "races" (using the latter term in the sense of original family habitat rather than of ethnic strain) increased from 54·08% of the whole population in 1911 to 55·40% in 1921, but the French declined from 28·52% to 27·91%. Those of alien race increased by 206,739, making them 15·43% of the whole, as compared with 15·94% in 1911. Foreign immigrants have been chiefly from Scandinavia, Russia and Austria. The Indian, who is treated as the ward of the Canadian Govt., numbered 111,597 in 1925, a slight increase having taken place during the period 1910 to 1925. Except in the northern regions the Indian population is almost wholly on reservations. Oriental immigration has been markedly on the decline in recent years owing to restrictive legislation. In 1925 it reached only 547. In 1921 there were 39,587 Chinese, 15,868 Japanese and 1,016 East Indians resident in Canada, 69.9% of the whole being in British Columbia.

Provinces, etc.	Population			Increase (+) Decrease(−)				Birth Rate 1924
				1911 over 1901		1921 over 1911		
	1901	1911	1921	No.	%	No.	%	
Nova Scotia	459,574	492,338	523,837	+ 32,764	+ 7·13	+ 31,499	+ 6·40	22·1
Prince Edward Island	103,259	93,728	88,615	− 9,531	− 9·23	− 5,113	− 5·46	21·1
New Brunswick	331,120	351,889	387,876	+ 20,769	+ 6·27	+ 35,987	+10·23	26·9
Quebec	1,648,898	2,005,776	2,361,199	+356,878	+ 21·64	+355,423	+17·72	32·2[1]
Ontario	2,182,947	2,527,292	2,933,662	+344,345	+ 15·77	+406,370	+16·08	23·4
Manitoba	255,211	461,394	610,118	+206,183	+ 80·79	+148,724	+32·23	23·9
Saskatchewan	91,279	492,432	757,510	+401,153	+439·48	+265,078	+53·83	26·4
Alberta	73,022	374,295	588,454	+301,273	+412·58	+214,159	+57·22	22·9
British Columbia	178,657	392,480	524,582	+213,823	+119·68	+132,102	+33·66	18·3
Yukon	27,219	8,512	4,157	− 18,707	− 68·73	− 4,355	−51·16	..
Northwest Territories	20,129	6,507	7,988	− 13,622	− 67·67	+ 1,481	+22·76	..
Royal Canadian Navy	..	..	485	..	..	+ 485	..	..
Total	5,371,315	7,206,643	8,788,483	1,835,328	34·17	1,581,840	21·95	23·4[2]

[1] 1923.
[2] Excluding the Province of Quebec, which is not included in the registration area.

Language is of an interest akin to that of race, especially as between the use of English and French, both of which are officially sanctioned in the province of Quebec and in the Federal courts and Parliament. Of a total population of 10 years of age and over in Canada amounting to 6,682,072, some 5,665,527 can speak English, leaving but 15·21% unable to speak the dominant language. The number speaking French, as mother tongue, is 1,757,193. A good deal of effort has recently been directed toward spreading bilingualism as a means of removing misunderstanding between those of British and French extraction in Canada. More than half the French-Canadians speak English, but less than 5% of the British-Canadians speak French. In 1921, 9·25% of the population of five years of age and over could neither read nor write, compared with 10·5% in 1911 and 14·38% in 1901.

Movement of Population.—An outstanding feature of Canadian progress has been the rapid growth of the towns, and particularly of the larger cities, at the expense of the country sections. In 1871 only 19% of the population lived in urban districts. The proportion has mounted steadily until in 1921 it stood at 49·52%. Particularly marked was the tendency in this direction during 1901–11, though the mainspring of the progress of that decade was agricultural development. The period 1911–21, again saw an intensification. Montreal and Toronto both passed the 500,000 mark in the 1921 Census. The small towns, as well as the farming communities, are helping to feed the cities, most of the older rural sections of Ontario and Quebec having lost population. Only on the prairies is a larger rural than urban growth taking place, over three-fourths of the entire rural growth of the past decade having taken place in Manitoba, Saskatchewan and Alberta, while most of the remainder occurred in British Columbia. The population of the 15 largest cities in 1921 was as follows:—

Cities	Population
Montreal, Que.	618,506
Toronto, Ont.	521,893
Winnipeg, Man.	179,087
Vancouver, B.C.	117,217
Hamilton, Ont.	114,151
Ottawa, Ont.	107,843
Quebec, Que.	95,193
Calgary, Alta.	63,305
London, Ont.	60,959
Edmonton, Alta.	58,821
Halifax, N.S.	58,372
St. John, N.B.	47,166
Victoria, B.C.	38,727
Windsor, Ont.	38,591
Regina, Sask.	34,432

(R. H. Co.)

Immigration and Settlement

During the years immediately preceding the outbreak of the World War the number of immigrants was steadily increasing. The war period was marked by a great decrease in immigration, particularly from Great Britain. At the end of the World War, Canada hoped to secure many capable immigrants from Europe, particularly as the Immigration Quota laws of the United States restricted both British and continental immigration into that country.

Instead of this desire being realised, however, immigration into Canada decreased from 1921 to 1923. Many new immigration policies were adopted in the years 1920–5, but no solution of this unsatisfactory state of affairs was discovered. During the 10 years following 1911, Canadian Govt. records show 747,170 American immigrants into Canada, while American Govt. records for the same period show the admission of 742,195 Canadians into the United States. After 1921 the exodus from Canada to the United States largely increased owing to the great prosperity of the United States and the high wages offered. No record was kept before March 1924 of the number of Canadians returning to Canada from the United States. During 1925 about 50,000 returned. The table in next column gives the official Canadian figures of immigrant arrivals from 1911 to 1925.

Land Settlement.—Immediately after the Armistice, Canada was confronted with the problem of repatriating her soldiers and sailors. The Canadian Govt. established the Soldiers' Settlement Board to assist her ex-service men to establish themselves permanently upon the land. Supervision and substantial assistance by way of loans from the Canadian Govt. enabled the definite settlement by the end of 1924 of 30,604 of these men, for which the Canadian people advanced over $100,000,000. So successful

Fiscal Years	Immigrant Arrivals from			
	United Kingdom	United States	Other Countries	Total
1911	123,013	121,451	66,620	311,084
1912	138,121	133,710	82,406	354,237
1913	150,542	139,009	112,881	402,432
1914	142,622	107,530	134,726	384,878
1915	43,276	59,779	41,734	144,789
1916	8,664	36,937	2,936	48,537
1917	8,282	61,389	5,703	75,374
1918	3,178	71,314	4,582	79,074
1919	9,914	40,715	7,073	57,702
1920	59,603	49,656	8,077	117,336
1921	74,262	48,059	26,156	148,477
1922	39,020	29,345	21,634	89,999
1923	34,508	22,007	16,372	72,887
1924	72,919	20,521	55,120	148,560
1925	53,178	15,818	42,366	111,362

was this national operation that, up to March 31 1924, $19,399,800 had been repaid. Recurring war disability and other causes withdrew from this scheme several hundred farms, subsequently made available for British settlers. Realising that this land settlement machinery was available, the Canadian Govt. made an agreement under the Empire Settlement Act with the Imperial Govt. to receive and care for 3,000 British families, to each of which the British Govt. loaned for farm equipment, etc., an amount not exceeding £300.

During the first year of the scheme, 1925, 482 families were received and placed upon the land. Owing to the increased cost of the passage to Canada, a further agreement was made under the Empire Settlement Act. The Imperial and the Canadian governments agreed to share the greater part of the expense of the journey from England to Canada, thus enabling a selected British immigrant to cross the Atlantic to Halifax, St. John or Quebec for £3; the expense for further distances into Canada was in proportion, the farthest destination being Vancouver, which could be reached for £9. Unfortunately, the agreement applied only to persons of agricultural experience, so that its effect was limited.

(J. O. S.)

VII. PRODUCTION, INDUSTRY AND TRADE

The expansion of wheat production is the most striking feature of Canada's economic development after 1910. In the years immediately preceding the World War Canada was passing through a boom period. Optimism was rampant, and, under the stimulus of lavish land and cash grants, railways were rapidly pushed into new and thinly settled areas, some 10,000 m. being added to the railway system in five years. In the period 1910–4 immigrants numbered about 1,660,000, and in the same period wheat production was doubled. The next great stimulus came from the War. The annual exportation of wheat, which averaged 92,500,000 bu. in the period 1912–4, reached 150,000,000 bu. valued at $366,000,000, in 1918. The immediate post-War period saw a continuance of this development, and in 1925 the yield was about 400,000,000 bu. from 22,000,000 ac., valued at about $450,000,000—an increase since 1901 of 300% in area, 600% in yield and 1,100% in value.

A most important contributory cause of this expansion was the plant-breeding research of the Dominion Govt. Experimentalists, notably Dr. William Saunders and his son, Dr. Charles Saunders. In 1903 the world-famous Marquis wheat was evolved, and in 1918 upwards of 300,000,000 bu. of it were raised in North America. The fame of Marquis wheat is chiefly due to its earlier ripening, heavy yield, weighty and plump kernel, whiteness and baking strength, which enable the baker to obtain a maximum number of loaves to the sack of flour. To it probably more than to any other single factor did Canada owe her high place among wheat producers in 1925. The supremacy of Marquis wheat, was, however, challenged by the Garnet wheat (a cross between Preston A and Riga M), which promised to mature in 10 days less than the Marquis—100 as compared with 110. This quicker maturing, if established, would bring under cultivation vast new areas where the winters are

abnormally long and the summers abnormally short, though hot (*see* AGRICULTURE; SCIENTIFIC DEVELOPMENT).

The following table shows the great increase in the production of the principal field crops between 1910 and 1925:—

	Acreage (000's omitted)		Yield in bushels (000's omitted)		Value (000's omitted)	
	1910	1925	1910	1925	1910	1925
Wheat	9,295	22,000	149,990[1]	400,000[1]	$112,973	$450,000
Oats	9,864	14,670	323,449[1]	515,000[1]	114,365	206,000
Barley	1,834	4,000	45,148[1]	112,000[1]	21,400	55,850
Rye	84	851	1,544[1]	15,500[1]	1,084	9,316
Flax for seed	477	1,128	6,538[1]	9,500[1]	7,899	19,000
Corn (Maize)	328	1,000	..	..	10,135	39,000
Hay	8,515	10,000	15,497[2]	15,163[2]	149,716	167,000
Total	30,397	53,649			417,572	946,166

[1] Bushels. [2] Tons.

Adding minor crops, the total area under field crops in 1926 approximated 57,000,000 acres. It is officially estimated that the area suitable for agriculture approaches 300,000,000 acres.

Wheat Pools.—The War entirely dislocated the machinery by which the agriculturists of Canada conducted their business. Before the War grain exchanges such as the Wheat Pit of Winnipeg were the normal agencies for marketing grain, which was collected at country points, assembled in large quantities at the terminal points, and distributed among the mills of America and Europe. Insurance against fluctuation in price was developed by the system known as future trading, which made possible the financing of grain by the banks without incurring undue risks. So disturbing were War conditions that in May 1917 the price reached the peak figure of $3 a bushel as contrasted with only 94 cents in May 1914.

The consequent clamour among consumers, and the urgent War needs of the Allies, resulted in the co-operative intervention of the British and Canadian Governments as buyers and controllers. Out of these conditions of war upheaval came a remarkable development of co-operative marketing. Voluntary wheat pools were organised in each of the three prairie provinces, with a total membership in respect to the 1925 crop of 125,000 out of 255,000 farmers, and a control of about 200,000,000 bu. of wheat, about one-half of the total crop, and about 150,000,000 bu. of other grain. Instead of using the former channels of trade these farmers turned over their wheat to their own selling organisation, and all farmers ultimately received the same average price based on the official grading of the wheat supplied. The wheat pools seek to acquire their own elevators at country centres, thus replacing the elevator-owning companies who formerly held the trade. Two of the co-operative companies with a capital of $16,000,000, mostly provided by the wheat growers themselves, owned 450 and 323 country elevators respectively in the licence year 1923–4, as well as large store elevators at the head of the Great Lakes and at Buffalo (*see* CO-OPERATION, AGRICULTURE).

Stock Raising.—As contrasted with grain-growing, the Canadian stock-raising industry only advanced at a moderate rate. Three factors have tended to restrict the industry: (1) The invasion by wheat and mixed farmers of the ranch areas of Alberta and of areas formerly condemned as "bad" or "alkali" land; (2) the high protective tariffs of the United States, which deprived Canadian livestockmen of their best market; and (3) the British embargo on Canadian store cattle imposed in 1896 and retained until 1923. Nevertheless, the number of beef and dairy cattle increased by some 30% between 1910 and 1925; in the latter year beef cattle numbered about 5,500,000 head, and dairy cattle some 3,750,000 head. More rapid development was shown in the horse-breeding industry, and the number of horses in 1925 approximated 3,500,000. Sheep increase slowly in number, probably because of the fencing problem and, especially in the West, the danger from wolves. The annual value of the live-stock products as a whole was officially estimated for 1925 at $500,000,000.

Forestry.—In Canada's commercial growth the forest industries stand second to agriculture, and in 1925 there were over 3,100 saw-mills at work. The annual production of lumber from 1905 to 1925 varied between 3,200 and 4,900 million of feet, board measure. As well as providing the raw materials for saw-mills and pulp-mills, the forests of Canada provide annually about 16,000,000 railway ties, 1,000,000 poles for telegraph, telephone and power lines, 14,000,000 fence posts, and over 8,000,000 cords of firewood, together with piling, round mining timbers, wood for distillation, charcoal and excelsior manufacture, bark and wood for tanning extracts, maple sugar and wood for the manufacture of artificial silk. Quebec, Ontario and British Columbia are the chief producing provinces. The total value of the annual output of forest products is about $300,000,000, United States buyers taking more than all other customers combined. Because of propinquity and the comparative exhaustion of United States home supplies, this preponderance is likely to continue, but British purchases are increasing.

Minerals.—Coal and iron are generally regarded as the basis of industrial strength. To these, in the case of Canada, may be added water power and petroleum. Upon the coal of Nova Scotia and the iron ore brought to it from Wabana in adjacent Newfoundland, are based the iron and steel industries of Sydney and New Glasgow; and at the other end of the Dominion, the coal fields of the Crow's Nest Pass district and Vancouver Is. support the smelting industries of British Columbia. An economic development of high national importance is the effort to free Central Canada, Ontario and Quebec from dependence upon imported coal by the rapid development of hydroelectric power from Niagara and other sources, the establishment of coking plants, and the wider distribution of Nova Scotian and Albertan supplies. Canada has long been the world's principal source of nickel, asbestos and cobalt. Mineral production was greatly accelerated during the War, exports of metals, which averaged $27,000,000 in value in the three years before the War, reaching by 1918 a total value of $92,000,000. An outstanding feature has been the rapid increase of gold production, especially in Ontario. Petroleum production was not very large in 1925, but an extensive drilling campaign was being carried on in the western areas, particularly in the Mackenzie and Peace river basins.

The progress of mineral production in the period 1910 to 1925 is shown in the following table:—

	Quantity (000's omitted)		Value in $ (000's omitted)	
	1910	1925	1910	1925
Gold	..	1,730 oz.	10,225	35,768
Silver	31,983 oz.	19,494 oz.	17,107	13,469
Nickel	37,271 lb.	73,150 lb.	11,181	24,140
Copper	56,598 lb.	112,526 lb.	7,209	15,813
Lead	32,988 lb.	253,964 lb.	1,237	23,238
Zinc	..	111,010 lb.	235	8,469
Coal	12,797 tons	13,022 tons	29,812	49,024
Asbestos	76 tons	260 tons	2,459	8,700

Industry.—Canadian policy is increasingly directed to the home conversion of raw materials into finished products. This policy is assisted by the almost inexhaustible supply of these raw materials from lands, forests and mines, by the enormous resources of water power, and by the readiness of Americans to apply their capital and business enterprise to Canadian industry. (In 1925 there were over 700 American branch plants in Canada carrying an investment of $150,000,000.) The concentration of population in the region of the lower Great Lakes and St. Lawrence, the nearness of the American coal-fields, and the rapid development of water-power resources go far to explain the fact that some 75% of Canadian manufacturing establishments are situated in Ontario and Quebec, in such centres as Montreal, Toronto, Hamilton, Ottawa, Oshawa, London, Kitchener and Quebec. A lesser industrial advancement has been made in Winnipeg (Manitoba), Vancouver (British Columbia) and St. John (New Brunswick).

Within the period 1910–25 Canada became second only to the

United States as a producer of pulp and paper. The output increased fivefold in value; in 1923 it was worth more than $122,000,000, over 100 mills being in operation. The iron and steel industry is favoured in an especial degree by the abundant supply of cheap hydroelectric power, which helps to offset the disadvantage that nowhere in Canada are workable deposits of coal and iron found in juxtaposition, and also by the abundance of nickel, chromium, molybdenum and other metals used in the manufacture of alloy steels.

The insufficiency of the earlier returns prevents an exact statement of the development in each industrial group, but the following table shows, as far as information was available, from the census returns, the numbers of employees in each group in 1910 and 1920, and the value added to raw materials by processes of manufacture:—

Group	No. of Employees		Net value, *i.e.*, value of products less cost of materials (in million dollars)	
	1910	1920	1910	1920
Wood and paper	132,000	143,700	120	416
Iron and steel	48,558	146,200	61	365
"Vegetable" products	..	72,900	..	236
Construction, hand trades and repairs	..	89,000	..	200
Textile	72,672	99,700	64	193
Animal products	..	48,700	..	153
Non-metallic mineral	17,502	18,800	40	54
Non-ferrous metal		23,200		53
Miscellaneous	..	24,900	..	95

The War had a profound and lasting effect upon Canada's industrialism. The war demand was first felt in respect to shells, and brought new employment to many centres throughout the Dominion. Canada exported for the use of the allied fighting forces over 65,000,000 shells, together with many millions of fuses, fuse-parts, cartridge cases, percussion primers, exploder containers, and shell and adapter forgings. Of the 1,800,000 tons of steel used about 75% was produced in Canada. The forests of British Columbia, and to a lesser degree of Ontario, Quebec and New Brunswick, provided spruce for aeroplane purposes and for shipbuilding, while the mines supplied large quantities of copper, zinc, nickel, lead, asbestos, aluminium, carbide and other mineral products. The metals and compounds exported during the War period reached a total of 10,700,000 lb. and the total value of the exports of munitions and materials was $1,002,000,000. Annual exports increased from a value of $57,000,000 in 1915 to $388,000,000 in 1917.

Water-Power.—Another all-important new factor in Canadian industrialism was the revelation of the extent of available water-power. In the official records of 1910 no mention is made of this form of energy, but in 1925 every large industrial centre was served with hydroelectric power and had within easy transmission distance ample reserves for the future. The importance of this water-power to Canadian industry cannot be overestimated. It is capable of great development, and during 1925 alone 719,000 H.P. was added, bringing the total installation in the Dominion to 4,290,000 horsepower. The benefits of the new motive power are especially felt in the central provinces of Ontario and Quebec, where there is no coal. A significant contrast in method is presented in the two leading provinces. In Quebec the development was left in the hands of private corporations, while Ontario led the way in public ownership. Hydroelectric power commissions have been set up by the respective governments in Ontario, Nova Scotia, New Brunswick and the city of Winnipeg to operate power plants and transmission systems as publicly owned utilities.

Labour Conditions.—The following table of index numbers of rates of wages for various classes of labour in Canada is based on those of 1913 as 100:—

	Building Trades	Metal Trades	Printing Trades	Electric Railways	Steam Railways	Coal Mining	Common Factory Labour	Miscellaneous Factory Trades	Lumbering
1911	90·2	91·0	91·6	88·1	96·4	97·5	94·9	95·4	93·3
1913	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1918	125·9	155·2	123·7	142·9	133·2	157·8	152·3	146·8	150·5
1924	169·7	175·5	191·9	186·4	157·4	192·4	183·2	197·6	183·1

Prices rose greatly during the War period and reached their maximum in 1920, when, taking the level of 1913 as 100, wholesale prices stood at 243·5 and the cost of living at 192. By 1924 a considerable fall was recorded, wholesale prices in that year standing at 155·1 and the cost of living at 152. After 1920 wages in all groups decreased, and the tendency in 1925 was still downward, notwithstanding the higher rates offered in the United States, which induced a serious exodus of artisans from Canada.

The hours of labour in 1925 were generally as follows:—

Building trades	44	Carriage manufactures	44–55
Metal trades	44–50	Furniture and wood-cutting	44–60
Printing trades	46½–48	Rubber manufacture	40–55
Electric St. Rys.	44–48	Boots and shoes	48–55
Textiles	44–50	Automobiles	44–50
Clothing and miscellaneous manufacture	44–56	Common labourers	44–60
Meat packing	48–60	Coal miners	44–46
Pulp and paper making	48–50	Other miners	48–54

In 1907 the Canadian Parliament passed the Industrial Disputes Investigation Act, commonly called the Lemieux Act. The primary object of the Act was to further the settlement of industrial disputes through the appointment of a Board of Conciliation and Investigation, to which board—representing both interests—any employer or employee might refer a dispute. It was made unlawful for the employer to lockout or for the employee to strike pending the reference made to such board of conciliation, and any breach of this provision was made punishable by a fine. This Act worked to the advantage of both employers and employees, and there was general regret at the decision of the Privy Council in London on Jan. 20 1925, declaring that the Lemieux Act was *ultra vires* of the Canadian Parliament, holding that such legislation was only within the jurisdiction of the provincial Legislatures, some of whom have since enacted similar legislation, which however, can only be effective within the boundaries of a province.

Trade.—The great increase in Canada's trade from 1911 to 1924 is shown in the following table:—

Imports for Consumption and Exports of Domestic Produce

Year	(Millions of dollars)		(Per capita)		(Per capita at 1924 prices)	
	Exports	Imports	Exports	Imports	Exports	Imports
1911	274	453	$38.06	$62.82	$62.14	$102.54
1912	290	522	39.40	70.93	61.35	110.44
1913	356	671	47.26	89.17	73.30	138.30
1914	432	619	56.10	80.49	84.89	121.80
1915	409	456	52.08	57.99	74.10	82.51
1916	742	508	92.21	63.24	109.02	74.70
1917	1,151	846	144.75	103.48	125.77	89.91
1918	1,540	964	184.91	115.69	144.12	90.26
1919	1,216	920	143.48	108.48	106.37	80.43
1920	1,239	1,065	143.61	123.34	91.47	78.56
1921	1,189	1,240	135.31	141.12	122.16	127.40
1922	740	748	82.55	83.40	84.23	85.10
1923	931	803	101.84	87.75	103.24	88.96
1924	1,045	893	112.60	96.22	112.60	96.22

The outstanding feature of the period was the growth of trading relations with the United States, largely at the expense of that with the United Kingdom. Tariff obstacles on both sides have tended to alter the character of the trade, but its volume increases continuously. In 1925 Canada was second only to Great Britain in the list of overseas markets for exports from the United States. The directions of trade in 1910 and 1924 are shown in the following table (percentages of total imports and exports respectively are given in parentheses):—

	Canadian Imports from (in million dollars)		Canadian Exports to (in million dollars)	
	1910	1924	1910	1924
U.S.A.	218 (59%)	601 (67%)	104 (37%)	431 (41%)
Great Britain	95 (26%)	154 (17%)	139 (50%)	360 (34%)
Other Countries	57 (15%)	138 (16%)	36 (13%)	254 (25%)
Totals	370 (100%)	893 (100%)	279 (100%)	1,045 (100%)

Coal, iron ore and products, petroleum, cotton, rubber and other raw materials of industry are largely imported from the United States; the chief exports to the United States are wood pulp and paper. Canada's exports to Great Britain consist almost entirely

of vegetable and animal products, chiefly wheat and flour. With regard to imports, Canada is a large and increasing purchaser of British textiles and other manufactures. Assisted by treaty and tariff arrangements, a substantial increase has taken place in commercial intercourse with other British Dominions and Colonies, notably Australia, New Zealand, the West Indies and Newfoundland, as is shown by a comparison of the following table with the one given above:—

	Canadian Imports from (in million dollars)		Canadian Exports to (in million dollars)	
	1910	1924	1910	1924
British Empire	112	195	155	436
Foreign countries	258	698	124	609
Totals	370	893	279	1,045

Apart from the United States, the trading relations of Canada with foreign countries show the most promising results in the case of Japan, France, Belgium, Germany, Italy, Cuba, China and the Netherlands; and as the abnormal post-War conditions disappear Canada's trade with these countries should expand considerably. In this expansion the Panama Canal must take an increasing part, for in the transit of goods by sea between Vancouver and Liverpool it saves 5,666 m. and an ever-growing percentage of the wheat and other products of the western prairies may be expected to find their cheapest route to market via Vancouver and the Canal.

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VIII. COMMUNICATIONS

The chief development in communications in Canada since 1911 has been the great increase in railways on the Western prairies. In railway organisation, the outstanding event was the union of two transcontinental lines with the existing government railways, and their consolidation into a state railway company. In 1925 nearly 90% of the railway mileage was included in two systems—the Canadian Pacific and the Canadian National. The route mileage of the railways grew from 25,400 m. in 1911 to 39,788 m. in 1924: the Canadian Pacific Railway alone increased its mileage in Canada from 10,247 to 15,054. The prairie provinces of Manitoba, Saskatchewan and Alberta doubled their mileage, and accounted for 8,200 m. of the increase, whilst British Columbia, with an increase of some 2,500 m. progressed even more rapidly. The rate of growth has been, however, more rapid than the expansion of population, the number of miles per 1,000 inhabitants having increased from 3.52 to 4.42, an abnormally high figure. A feature of the Canadian railways is the large amount of mileage owned in the United States. In 1924 the Canadian Pacific had 5,117 such miles and the Canadian National 2,093 miles.

The following comparative figures show the growths in traffic, etc., from 1911 to 1924:—

	1911	1924
Revenue tons carried	79,884,000	106,429,000
Revenue tons mileage	16,048,478,000	30,513,819,000
Passengers	37,098	42,922
Locomotives	4,219	5,857
Passenger cars	4,513	6,849
Freight cars	127,158	226,163
Capital investment	$1,648,305,000	$3,413,866,000
Gross earnings	$188,733,000	$445,924,000
Operating expenses	$131,034,000	$382,484,000
Operating ratio	69·4%	85·8%
Number of employees	141,224	169,970
Salaries and wages	$74,614,000	$239,864,000

Over half the increased capital is accounted for by additional expenditures of the older government lines, the construction of the National Transcontinental and government advances to lines absorbed in the Canadian National. The remainder is chiefly in the form of securities in the hands of the public. The year 1924 was hardly a typical year in consequence of the poor harvest, and 1925 showed a great improvement in the operating ratio.

The railways have a much improved record for safety, as the following figures show:—

	1911	1924
Passengers killed 1 in	1,300,000	2,200,000
Employees killed 1 in	620	1,330

Whilst the Canadian Pacific has continued its expansion on sound lines and has maintained its dividends at 10%, it has now to meet the competition of two trans-continental lines organised as a government company and backed by the credit of the state. The Canadian National system is composed of the Intercolonial, the National Transcontinental, the Grand Trunk, the Grand Trunk Pacific and the Canadian Northern railways. The last named came under government control in March 1917, the Grand Trunk Pacific in March 1919 and the Grand Trunk in May 1920. The consolidation was rendered necessary by war financial stringency coming on the top of reckless over-building. Between 1918 and 1925 the roads composing the system had $674,975,273 invested in them, $534,026,156 of which was advanced by the government. In 1924 the system had an operating surplus of $17,244,000, but this meant a final deficit after interest had been paid of $54,860,419, only $497,656 less than the deficit in 1919 on the constituent lines. The operating surplus increased to $32,264,000 in 1925, but the final deficit was still heavy. Electric railways have developed considerably, the mileage increasing from 1,223 in 1911 to 1,736 in 1923.

The growth in the use of motor vehicles has been very rapid, the number registered increasing from 21,519 in 1911 to 653,121 in 1924. This expansion has necessitated a large expenditure on roads and, under the Canada Highways Act, 1919, the Dominion provided $20,000,000 to assist the provinces in road building. Grants are usually 40% of the cost of construction or improvement. By the end of 1925 some 8,000 m. had been or were being, constructed. The revenue for roads is assisted by registration and licence duties for motor-vehicles, chauffeurs, dealers, etc., each province having its own scale.

Shipping.—One of the most interesting features of Canadian development during the War period was the growth of shipping facilities for Canada's overseas trade. The phenomenal growth of her mercantile marine was indicative of the country's progress, but during the immediate post-War period construction of cargo steamers by the government outstripped the requirements of trade. In 1923 the tonnage of ships of Canadian registry totalled 1,230,830 tons as compared with 896,965 tons in 1911. In 1924 the Canadian Pacific operated, on lakes and ocean, a steamship service of 60 vessels, including car ferries. The National Board, under the name of the Canadian Govt. Merchant Marine, operated a fleet of 45 ocean steamships, which, however, involved the government in substantial losses.

The tonnage of traffic on the canals dropped from 38,030,353 tons in 1911 to 12,869,097 tons in 1924, mainly due to the transfer of traffic from the Canadian Sault Ste. Marie Canal to the United States Canal. Only the Welland and St. Lawrence Canals are holding their own. In 1925 a new Welland Canal with a depth of 30 ft. was being built, and a joint board of Canadian and United States engineers was investigating a similar waterway from the ocean to the head of the Lakes.

Telegraphs and Aviation.—The telegraph wire mileage increased from 168,017 in 1912 to 316,113 m. in 1924. In the field of wireless the stations in 1924 totalled 33,456, of which 31,609 were amateur receiving stations. Commercial aviation has received considerable attention, aeroplanes being of particular use as means of communication and transport with the northern areas not yet linked up with the railway system. In 1923 there were 69 licensed aircraft, by which 2,238 passengers and 17,600 tons of freight and express matter were carried. The aeroplanes are also employed in locating forest fires. (E. W. BE.)

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CANADIAN LITERATURE, ENGLISH (*see* 5.165). The literary history of Canada 1910–25, although it falls into three fairly well-defined periods—pre-War, War and post-War—may now be dealt with more conveniently as a whole. Of books relating to or growing out of the World War, most have been of ephemeral interest. Perhaps the best general survey is *Canada in the Great World War* (1917–21).

The most important achievement of the period was the publication of *Canada and Its Provinces* (1913, etc.), a comprehensive history of the country in 23 volumes, edited by Dr. A. G. Doughty and Dr. Adam Shortt, and counting among its contributors most of the recognised authorities in Canadian history, biography and economics. Another notable essay in Canadian history was the series known as the *Chronicles of Canada* (1920), in 32 volumes, edited by George M. Wrong and H. H. Langton, a series designed to present in attractive and at the same time authoritative form the outstanding events of Canadian history. A new and revised edition, with several additional volumes, of *The Makers of Canada*, is in course of publication, including an *Encyclopaedia of Canadian History*.

Of individual works, in history and biography, the more important were H. P. Biggar's *Voyages of Jacques Cartier* (1924), J. S. McLennan's *Louisbourg* (1918), Chester Martin's *Lord Selkirk's Work in Canada* (1916), G. C. Davidson's *North West Company* (1918), William Wood's *In the Heart of Old Canada* (1913), George M. Wrong's *Fall of Canada* (1914), James Douglas' *New England and New France* (1913), Goldwin Smith's posthumous *Reminiscences* (1910), *Life and Opinions* (1913), and *Correspondence* (1913), all edited by Arnold Haultain, Sir Richard Cartwright's *Reminiscences* (1912); the lives of Lord Strathcona by Beckles Willson (1915) and W. T. R. Preston (1914), O. D. Skelton's *Sir Alexander Galt* (1920) and *Sir Wilfrid Laurier* (1921), Sir Joseph Pope's *Correspondence of Sir John Macdonald* (1921), Sir Charles Tupper's *Recollections of Sixty Years in Canada* (1914), Mrs. Skelton's *Thomas D'Arcy McGee* (1925), L. J. Burpee's *Sir Sandford Fleming* (1915), John Boyd's *Sir Georges Etienne Cartier* (1914), Sir John Willison's *Reminiscences* (1919), E. M. Saunders' *Life of Sir Charles Tupper* (1916), Harvey Cushing's *Life of Sir William Osler* (1925), James Mavor's *My Windows on the Street of the World* (1924).

Of agencies which, each in its own way, have been making for the development of intellectual life and scholarship in Canada, none have been more important than the Public Archives, the Royal Society, the Champlain Society, and the Canadian reviews. The Archives perform a triple service, in collecting and safeguarding the manuscript treasures of Canada, in affording facilities for research to students and in publishing selected documents from the unrivalled collections. The Champlain Society devotes itself to the publication of important works bearing upon Canadian history, and the reprinting of old works in the same field. Among its publications are J. B. Tyrrell's editions of Hearne's *Journey* (1911), and David Thompson's *Narrative of his exploration . . .* (1916), Arthur G. Doughty's edition of Knox's *Historical Journal* (1914–6), Grant's and Biggar's edition of Lescarbot's *New France* (1911), William C. H. Wood's *Canadian War of 1812* (1920–3), and H. P. Biggar's *Champlain* (1922, etc.) (to be completed in six volumes), all admirable examples of Canadian scholarship. The Royal Society, in literature as well as in science, has become a stimulating influence in Canadian life. The *University Magazine* (which has since ceased publication), *Dalhousie Review* and *Canadian Historical Review* have afforded an invaluable medium for the publication of thoughtful and timely articles.

In imaginative literature, the outstanding books of verse of the period are Bliss Carman's *April Airs* (1916) and *Far Horizons* (1925), William Wilfred Campbell's *Sagas of Vaster Britain* (1914), William Henry Drummond's *Poetical Works* (1912), Marjorie L. C. Pickthall's *Drift of Pinions* (1913) and *The Lamp of Poor Souls* (1916), Frederick George Scott's *Poems* (1912), Duncan Campbell Scott's *Beauty of Life* (1921), Arthur J. A. Stringer's *Open Water* (1914), John McCrae's *In Flanders Fields* (1919), Norah Holland's *Spun Yarn and Spindrift* (1918) and *When Half Gods Go* (1924), Beatrice Taylor's *White Winds of Dawn* (1924), Charles Roberts' *New Poems* (1919), Louise Morey Bowman's *Dream Tapestries* (1924). In 1913 Dr. Wilfred Campbell brought out his anthology, the *Oxford Book of Canadian Verse*, and in 1916 Sir Andrew Macphail his *Book of Sorrow*. Here may also be mentioned the collection of *Folk Songs of French Canada* by C. M. Barbeau, translated by Edward Sapir (1925).

Fiction.—In fiction, probably the outstanding figure of the period is Mrs. L. Adams Beck, of Victoria, who writes fascinating tales of the Orient under her own name, and equally delightful historical stories under the pen-name of E. Barrington. Frederick William Wallace has written a number of stories, long and short, of the deep sea fishermen of Nova Scotia and the glorious days of the "Bluenose" clipper ship. In the Prairie provinces, a rather remarkable group of Scandinavian-Canadian novelists has been doing excellent work in the interpretation of the life of their people in the novel environment of the Canadian west. The outstanding names in the group are Martha Ostenso, Philip Grove and Laura Salverson. Of the older novelists, Sir Gilbert Parker, Ralph Connor (C. W. Gordon), Arthur Stringer, Harvey O'Higgins, Basil King and L. M. Montgomery must at least be mentioned. An exceptionally effective group of short stories is Marjorie Pickthall's posthumous volume *Angels' Shoes* (1923).

Children's books of distinct merit are Cyrus MacMillan's *Canadian Wonder Tales* (1918) and *Canadian Fairy Tales* (1922), Isabel Ecclestone MacKay's *The Shining Ship* (1918), T. S. Marquis' *The King's Wish* (1924), Marshall Saunders' *Jimmy Goldcoast* (1924), Helen B. Sandwell's *Valley of Colour Days* (1924), and the animal stories of Charles Roberts and Ernest Thompson Seton.

Essays in a variety of subjects are Sir Robert Falconer's *Idealism in National Character* (1920), J. L. Morison's *British Supremacy and Canadian Self-Government* (1919), W. L. Mackenzie King's *Industry and Humanity* (1918), R. M. MacIver's *Labour in the Changing World* (1919), G. M. Wrong's *The United States and Canada* (1921), W. G. Smith's *Canadian Immigration* (1920), A. H. Reginald Buller's *Essays on Wheat* (1919), W. H. Blake's *Brown Waters* (1915) and *In a Fishing Country* (1922), C. M. Barbeau's *Indian Days in the Canadian Rockies* (1923), A. MacMechan's *Old Province Tales* (1924), and *Headwaters of Canadian Literature* (1924), V. L. O. Chittick's *Thomas Chandler Haliburton* (1924), R. P. Baker's *History of English Canadian Literature to Confederation* (1920), Stephen Leacock's *Nonsense Novels* (1911), and *Sunshine Sketches of a Little Town* (1912), Lloyd Roberts' *The Book of Roberts* (1924), W. B. Basil King's *The Conquest of Fear* (1921), Peter McArthur's *In Pastures Green* (1916) and *Around Home* (1925), the last-mentioned published posthumously. (L. J. B.)

CANADIAN LITERATURE, FRENCH (*see* 5.167a).—The literary revival which took place in the 20th century continued to exert its influence in the period 1910–26, with Quebec and Montreal as the chief centres of intellectual activity.

Belles Lettres.—The most striking characteristic, however, was the increase in output of the more purely intellectual writing—philosophical, sociological and critical. Mgr. Louis Adolphe Paquet, a professor at the Laval University, perhaps produced the soundest and best written work of this kind. *L'organisation religieuse et le pouvoir civil* (1912), *L'action religieuse et la loi civile* (1915) *and Etudes et appréciations*, 4 vol. (1917–22), dealing with

social science and apologetics, are among his publications. Other writers on sociology and political economy were Henri Bourassa, the nationalist leader, and Edouard Montpetit, of Montreal University. Mgr. Camille Roy also continued to publish works of literary criticism. These include *Nouveaux essais sur la littérature canadienne* (1914), *Erables en fleurs* (1923) and *A l'ombre des erables* (1924). Henri d'Arles also assisted in the development of this *genre*. The result of this movement was to attract the attention of the public to the writers of French Canada and the creation of an indigenous literature, expressed in both prose and verse. Adjutor Rivard and Frère Marie-Victorin, the former in *Chez nous* (1914) and *Chez nos gens* (1918) and the latter in *Récits* (1919) and *Croquis laurentiens* (1920), wrote delightfully on French Canadian life.

Fiction.—Canadian novelists who formerly confined themselves to descriptions of the life and customs of their country tended to produce novels on serious questions and historical romances; but the only work of outstanding merit in this period is *L'appel de la race* (1922), by Alonié de Lestres (abbé L.-A. Groulx).

Poetry.—The school of poets which grew up in Montreal during the former period gradually dispersed. The members were united by no common inspiration, and therefore went their several ways. Albert Lozeau, who published in 1907 *L'âme solitaire*, produced a further two volumes of poems, *Le miroir des jours* (1912) and *Lauriers et feuilles d'érables* (1916), together with a prose series in three volumes, *Billets du soir* (1911, 1912 and 1918), the subtle and delicate style recalling that of his poetry. Paul Morin, in his *Le paon d'émail* (1911) and *Poèmes de cendres et d'or* (1922), displayed a talent, new to Canadian poetry, for describing beauty for beauty's sake as revealed in form and colour. Jean Charbonneau in *Les blessures* (1912) and *Les prédestinées* (1923); Albert Dreux in *Les soirs* (1910) and *Le mauvais passant* (1920); Englebert Gallèze in *Les chemins de l'âme* (1910) and *La claire fontaine* (1913); and Hector Demers in *Les voix champètres* (1912) have each in turn sought inspiration in the soul and in nature. But Quebec has produced the better nature poets. The scenery, the quaint customs, the retired life, of the Gaspé peninsula have been best interpreted by Madame Blanche Lamontagne, whose principal works are: *Les visions gaspésiennes* (1913), *Par nos champs et nos rives* (1917) and *La vieille maison* (1920). Alphonse Desilets of Quebec describes the same scenes without quite the same charm in *Mon pays, mes amours* (1913) and *Dans la brise du terroir* (1922). M. l'abbé Arthur Lacasse mingled religious poetry with natural description in his *Heures solitaires* (1916) and *L'envol des heures* (1919).

History.—Historical studies however occupy the first place in the prose of this period. Historians, already noteworthy in the preceding period, continued their work. A general study of the history of the Catholic Church in Canada by August Gosselin was published in the form of monographs on the Bishops of Quebec. This work, which was begun in 1910, was cut short in 1918 by the death of the author. Two professors of the Laval University of Quebec have done some very valuable research. Mgr. Amedée Gosselin, in his *L'instruction au Canada sous le régime français* (1911), made an interesting contribution to a little known subject. M. Thomas Chapais published in 1911 an excellent biographical study of the Marquis of Montcalm, who was defeated by Wolfe on the Plains of Abraham, outside Quebec, in 1759. In 1916 M. Chapais inaugurated, at the Laval University of Quebec, a course of lectures on English rule in Canada. They were published in a collected edition, *Cours d'histoire du Canada* (4 vol., 1919–23), and form a detailed political history of the country from 1760–1850. Although illuminated by a fervent French-Canadian patriotism, his method throughout is objective, and his conclusions carry great authority.

While M. Chapais was writing in Quebec the story of the English dominion, M. Lionel Groulx was delivering at Montreal University lectures on Canadian history more controversial in tone. Among those lectures, the following were published: *La Confédération Canadienne* (1918), *La Naissance d'une Race* (1919), *Lendemains de Conquête* (1920), *Vers l'Emancipation* (1921). The conclusions arrived at tend to be biased by the extreme nationalism of the author, but the work is enlivened by his vivid imagination and keen perceptions.

The work of the theatre is almost negligible. This form of literature appears to find difficulty in flourishing in Canada. French Canadian literature is launching out, however, in many other directions. A higher level of general culture and intelligence is providing native writers with an increasing public, and the universities of Quebec and Montreal have done much to enlarge the field of French-Canadian letters.

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CANAL: *see* RIVER AND CANAL ENGINEERING.

CANALEJAS, JOSÉ (1854–1912), Spanish politician, was born in Ferrol July 31 1854. Coming of a middle-class family, he graduated in 1871 at the University of Madrid, took his doctor's degree, and became in 1873 lecturer on literature. He entered his father's engineering works as general secretary and studied railway problems, but continued his literary work, publishing a history of Latin literature in two volumes. He was early attracted to politics, first as a Republican, then as a Liberal. Deputy for Soria in 1881, he became under-secretary for the Prime Minister's department in 1883, then Minister of Justice (1888), of Finance (1894–5), president of the Chamber in the Moret Administration, and Prime Minister and chief of the Liberal party in 1910. He was still in office when he was murdered in Madrid Nov. 12 1912. Canalejas was a remarkably consistent statesman. He believed in the possibility of a monarchy adopting a thorough-going democratic policy both in economic and in all civil and political matters. A sincere Catholic, he was nevertheless a strong anti-clerical, and a champion of the rights of the state against the encroachments of the Church.

CANBERRA, AUSTRALIA.—In 1909 the Commonwealth Govt. acquired from New South Wales an area of 912 sq. m. for the purpose of establishing a new federal capital. The territory is situated some 150 m. southwest of Sydney and 60 m. direct from the east coast. It is traversed by the Murrumbidgee and Molonglo rivers, on the latter of which is the site for the Federal capital itself. In 1913 a further area of 28 sq. m. was acquired at Jervis Bay, 70 m. east-north-east of Canberra, to be used for a port. The right to join the two places by a railway accompanied the transfer.

The actual vesting of the larger area in the Commonwealth Govt. dated from Jan. 1 1911, and the Jervis Bay area was formally taken over by an Act of 1915. The plan for the new capital was adopted after world competition, and before building was begun a water supply was provided by impounding the Cotter river. After the official commencement of work on March 12 1913 the main lines of the city were laid out and a considerable amount of afforestation was done, but this was practically stopped between 1916 and 1920.

In 1923 the director-general of works moved to Canberra and work was begun on Parliament House, which was nearly completed in 1926, and it was expected that Parliament would meet there in 1927. By the beginning of 1926 a considerable number of roads had been metalled and many miles pegged out; a number of bungalows and two hotels had been built in the residential quarters to accommodate the state officials; and a power house with a capacity of 1,350 kw. was supplying power and light to the brick, tile and cement works, carpenters' shops, houses and camps. Parks and avenues had been planted, sewage works and reservoirs constructed; and a school built at Telopoea Park. The railway from Queanbeyan to Canberra was opened for goods traffic in 1914, and for passengers in 1923. Before 1925 it had been extended to the power house and beyond, about eight miles in all. A survey had also been made for the line to Jervis Bay.

The estimated population of the Federal Territory in 1924 was 3,677. Much of the land not required for the capital had been

let on lease, about 24,000 ac. of it to ex-soldiers. The plan was to classify the whole of the lands in the territory with a view to granting them out on long leases, those referred to above being short leases of from 5 to 25 years.

CANCER RESEARCH (*see* 5.175).—This subject falls naturally into two periods divided by the beginning of the present century. From 1850 to 1900 investigation was on the clinical and anatomical sides and the great work of Virchow between 1850 and 1860 upon cellular pathology and upon the malignant new growths laid the foundation of our present knowledge concerning cancer. When it is remembered that staining methods for microscopical purposes were not introduced until about 1872 the accuracy of Virchow's descriptions becomes even more remarkable. Virchow laid great stress upon the importance of chronic irritation in the causation of new growths and in large measure this view still holds the field. Reference is made to it later. The rival theory put forward by Cohnheim about 1880 that new growths arise from embryological remnants included within the tissues owing to some slight error in development has, at the present time, few adherents. In the case of certain special varieties of tumour (teratomata, cysts), however, it is held to be a sufficient explanation.

Main Divisions.—As examination of cancer proceeded it became clear that it is not a single disease but rather a group of diseases having certain features in common. First there came the great division into (1) the carcinomata, growths built up on the type of squamous, columnar or spheroidal epithelium and (2) the sarcomata, growths built on the type of one of the members of the connective-tissue group. To these were added later (3) the endotheliomata, a group of somewhat undetermined characters, which are regarded as being derived from the flattened cells that line lymph spaces or channels or blood-vessels. In this way there has become recognised a long series of malignant growths with more or less defined microscopical characters.

Special Divisions.—Later it was found that the three main groups mentioned above were insufficient to include certain varieties of tumour arising in special organs, *e.g.*, muscle, lymphatic glands, testicle, adrenal, sympathetic ganglia, and special terms were applied to new growths originating in these parts. It was shown, further, that in some degree it is possible to correlate clinical with histological features, particularly so far as the primary growth is concerned. Thus it is probable that a primary cancer of external skin or of the lining to the alimentary tract between the lips and the lower end of the oesophagus will be a squamous-cell carcinoma, of intestine will be a columnar-cell carcinoma, of bone will be some variety of sarcoma, of cerebral meninges or of pleura will be an endothelioma. These tumours will breed true so that if secondary growths (metastases) are produced they will within limits, resemble the parent growth in histological characters.

Local or Constitutional Origin.—To this 19th-century period also belongs the great controversy whether the malignant growths are manifestations of a local or of a constitutional condition. The controversy is important in that treatment must depend largely upon the view held. If the disease be local in its origin it will be possible to eradicate it by surgery so long as it is dealt with before it passes from the local condition and becomes generalised. If, on the other hand it be a manifestation of a constitutional or blood condition, local surgery must be ineffective. The local view received and still receives the greatest amount of assent, but it is becoming more generally accepted, even by those who hold that cancer depends upon local mechanical irritation, that some biochemical change of the tissues is necessary and that this change may be brought about by conditions affecting the body as a whole.

Bacteriological Results.—The remarkable results of bacteriological research about 1880, too, were not without effect, for attempts were made to show that cancer depends upon a micro-organism. That micro-organisms were cultivated from new growths is certain, but the varieties were so diverse that, no doubt, they depended upon faulty technique or upon prior and accidental infection of the growth. Moreover, inoculation of these micro-organisms into animals failed to produce new growths, though in some instances tumour-like collections of inflammatory cells (torulae) resulted. It is now generally agreed that no bacillus or micrococcus in the accepted sense of those terms is the cause of cancer.

Cancer not "Infectious."—Again, certain appearances met with in microscopical sections were regarded by their discoverers as being of an animal nature, parasitic and causative of the condition. It is now agreed that these appearances are due to the inclusion of tissue debris in living cells. It follows from what has been said above, that cancer is not an infectious disease in the sense that tuberculosis, diphtheria, typhus fever and malaria are infectious diseases. Many enquiries were carried out upon the subject of "cancer houses" and "cancer localities." Examples were adduced in which several persons inhabiting a single house or numbers dwelling in the same locality were said to have died of cancer. Careful examination, however, failed to show that they could not be explained by the average age distribution of the population, by improved diagnosis or by errors of random sampling. While, therefore, there is nothing to show that special cancer houses and localities do not exist, there is no satisfactory proof of their occurrence.

The Present Century.—Since the year 1900 cancer research has entered upon a new phase largely owing to the fact that modern experimental methods have been adopted. Special laboratories devoted to cancer research were instituted and within a few years were at work at the Imperial Cancer Research Fund, The Middlesex Hospital, The Cancer Hospital (London), The Christie Hospital (Manchester), The Royal Cancer Hospital (Glasgow), The Samariterhaus (Heidelberg), The Crocker Foundation, The Memorial Hospital, The Rockefeller Institute (New York City), The Gratwick Foundation (Boston, Mass.). Recently a large institute for cancer research has been opened at Buenos Aires. In addition, associations for the study of cancer have been founded in several countries. These associations differ somewhat in their aims, but in most instances through their agency statistical and sometimes laboratory investigations are being carried out. The most important of these associations are the Cancer Sub-committee of the Health Section of the League of Nations, which, of course, is international; the Cancer Committee of the Ministry of Health in Great Britain; The British Empire Cancer Campaign; local committees in Manchester, Liverpool, Birmingham, Leeds; l'Association Française pour l'Étude du Cancer; Komite für Krebsforschung and similar bodies in Belgium, Holland, Austria and Japan. It must be understood that the institutions and associations mentioned above are exclusive of numerous bodies such as The Medical Research Council, various universities and teaching hospitals which further cancer research as part of their general activities, and often to a considerable degree, but have no special department devoted to the subject. One of the most recent decisions of The British Empire Cancer Campaign is the foundation of a *Journal of Cancer Abstracts and Reviews* in which publications directly or indirectly bearing upon the cancer problem will be analysed.

Passing now to consideration of the results obtained by this mass of workers on cancer during the first quarter of the 20th century it may be said that much of the labour has been spent on clearing the ground.

Heredity in Cancer.—In Chicago a laboratory was built and equipped on the most approved plan for investigating the question of heredity and cancer in mice. From three original mice, stocks were raised ultimately numbering many thousands of which the full history of each individual from birth to death was recorded including an account of the autopsy. The experiment has been in progress for some 20 years and by special breeding Miss Maud Slye has produced two strains, all members of which and no members of which, respectively, suffer from new growth. She has also produced familial proclivity to new growths of a special type, *e.g.*, squamous-cell carcinoma, or affecting a special organ, *e.g.*, the liver. From these experiments there can be no doubt that a hereditary factor obtains in cancer, but it is only by controlled work of the kind mentioned and intense inbreeding

that its existence can be demonstrated. Even in so segregated a population as that of Gol and Hemsedal, two parishes on the eastern slope of the mountains in the centre of Norway where intermarriage is common, the most that a study of 5 large cancer families in which 367 deaths had occurred between 1902 and 1921 showed was that the crude mortality rate from cancer for persons over the age of 35 was 18·2% for these families compared with 12·1% for the total population.

Other Statistical Enquiries.—Much time has been spent and many papers have been published on the question whether the incidence of cancer is increasing. It cannot be said that this question has been settled beyond dispute. Increased notification of deaths from cancer has undoubtedly occurred in practically all countries, but how far correction of the annual figures has to be made for increase of population, improved diagnosis, improved standard of health whereby a larger portion of the population reaches the cancer age, improved education and means of transport whereby a larger proportion of the population comes under observation and treatment, it is impossible to say. Nevertheless it is the opinion of most authorities that even if due allowance be made for all these factors there is still evidence of a gradual increase in the incidence of cancer particularly at more advanced ages. The opinion often expressed that cancer affects persons at an earlier age than formerly is apparently without sound foundation.

Primary Sites.—Statistical enquiries in various countries have shown that the commonest primary site of the disease differs considerably. Thus in England and Wales notified deaths from cancer of uterus and of breast are more numerous than from gastric cancer whereas the reverse is the case in Holland and Italy. This observation has been made the subject of exhaustive enquiry by the Cancer Sub-committee of the Health Section of the League of Nations with the result that it is fully substantiated but all endeavours to correlate it with habits of the respective peoples has failed entirely. It is said that the same peculiarity concerns descendants of the same nationalities when they have emigrated to another country and this point is receiving attention at the present time.

Duration of Cancer.—Another useful statistical enquiry concerns the natural duration of the untreated disease from reputed onset to death. Papers have been published giving the information derived from four different institutions in Great Britain. These have been collected and analysed statistically by the Cancer Committee of the Ministry of Health and present a base line against which all forms of treatment can be measured.

Distribution by Races.—Enquiries in all parts of the world have shown that cancer affects all races of mankind and examination of lower animals has demonstrated its occurrence in them also. It may not be, and certainly in the case of lower animals is not the fact, that all species and varieties are affected with equal frequency. Thus the mouse is the subject of cancer more frequently than the rat, and the rabbit and guinea-pig are far less frequently affected than either. Inasmuch as dogs, cats, horses and cattle are relatively more frequently attacked by cancer it is considered that it is a disease of domestication. Similarly there appears with great probability to be a higher incidence of cancer in the more civilised races of mankind.

Experimental Transmission by Grafts.—The observation that cancer affects the lower animals has rendered experimental work possible. The fact was first shown 40 years ago by Hanau who successfully transplanted a squamous-cell carcinoma from the vulva of a rat into the peritoneal cavity of other rats. Ten years later Morau succeeded in transmitting a mammary adenocarcinoma from a white mouse to other white mice. For many years the indications afforded by these experiments were not followed up, in part because of a doubt how far the analogy between growths in these lower animals and cancer affecting man holds good. Extensive research, however, carried out mainly by the Imperial Cancer Research Fund, proved clearly their essential similarity, and from that time much knowledge has accrued from the experiments on malignant tumours of the mouse and rat. Amongst the conclusions reached was that on the rigorous specificity exhibited by growths. Thus a tumour of the mouse will not grow if inoculated into the rat or vice versa. Under special conditions temporary growth may occur in those cross inoculations, but these exceptional cases do not invalidate the truth of the general statement.

Susceptibility and Resistance.—As might be expected much work has been done on the question of susceptibility and resistance to transplanted grafts in the hope that it might throw light upon treatment in man. Important differences were shown to obtain between spontaneous growths in respect of the ease or difficulty with which they can be transplanted into other animals of the same species. In some cases grafts take in nearly 100% of experimental animals, in others failure is consistent, even with the greatest care. It was found, however, that inoculation of a graft beneath the skin of the animal bearing the primary tumour (autologous grafting) is almost always successful. This indicates some peculiarity of the animal bearing a spontaneous tumour, but so far the difference has eluded explanation.

Blood Content.—It has been suggested that there is a larger amount of potassium in the blood and tissues of an animal bearing a spontaneous tumour. Supporting this view are the observations (*a*) that the blood and tissues of persons suffering from cancer contain more potassium than those of persons suffering from non-malignant diseases and (*b*) that if the potassium content of the blood of mice be raised by feeding them with potassium metaphosphate, transplanted grafts of a mouse carcinoma take in a larger proportion of cases, appear earlier and grow at a more rapid rate.

Immunity.—An important observation, repeatedly confirmed, is that if an animal spontaneously recover from a transplanted tumour it is immune to subsequent inoculations with the same tumour. This has been made the basis of innumerable attempts on the curative side, the most important of which consists in removal of a portion of the tumour, irradiation to a degree just sufficient to prevent growth of the cells on re-inoculation and then introduction of the irradiated mass beneath the skin of the original patient. In experiments on rats the method has been shown to confer a good degree of resistance against growth of inoculated grafts, though it is not so effective against established tumours. It has been found, also, that the tissue into which the irradiated mass is introduced is not without importance, introduction into liver or spleen being more effective than beneath the skin. Subcutaneously the method has been applied in man but the results are not conclusive.

In all experiments upon resistance and susceptibility to cancer a great subject of difference amongst workers lies in their view as to the essential factor concerned. Some investigators hold that it is the fluids of the body that are of importance, the cellular elements being subsidiary. For others the cells, and particularly the lymphocytes, are the prime factor in resistance; if the particular line of treatment adopted be associated with accumulation of lymphocytes locally, resistance is high; if lymphocytes be few or absent, resistance is low. Experiments can be adduced supporting or refuting either contention but if it be allowable to use the analogy of immunity and susceptibility to bacterial disease it may well be that tissue fluids and tissue cells take varying parts in the process according to circumstances as yet hardly understood.

Serum Treatment.—Here it is convenient to consider attempts at treatment of cancer by various sera. Influenced by a belief in the microbial causation of cancer and the efficacy of antisera produced against such a disease as diphtheria, earlier workers had endeavoured without success to treat the disease by injection of ascitic or other serous fluids derived from cancer patients. More recently attempts have been made in the laboratory to produce an antiserum by the usual methods and test its efficiency against cancer cells growing *in vitro*. The growing cancer cells were found to be killed almost instantaneously by this antiserum whereas normal cells were unaffected and the method was applied *in vivo*, with the addition that contact between the antiserum and the cancer cells was rendered more intimate and prolonged by combining venous and lymphatic

obstruction with introduction of the antiserum. Grafts were inoculated into the hind feet of rats and when they had reached a certain size the antiserum was introduced in the neighbourhood of one of the growths and was held in position to a large degree by constriction of the thigh. In a large proportion of cases the growth in this foot underwent absorption and not only so but at a little later date the growth in the other foot also disappeared. It would seem that the antiserum led to absorption of the growth to which it was locally applied and that in accordance with the general principle that absorption of a cancerous mass in an animal is associated with increased resistance to the same type of growth, absorption of the first growth in the treated foot led to absorption of the second growth in the untreated foot.

Criticisms.—The main criticisms of these important observations are (1) that the growth treated was of the transplanted and not of the spontaneous variety, (2) that the foot is by reason of its small size, large amount of bone and tendon, and smallness of its blood-vessels a region naturally somewhat unfavourable to growth of a transplanted tumour and (3) that the constriction, which, apparently, is essential to success, is itself an abnormal condition and might well turn the scale against a growth that was struggling for existence or at least was not growing freely. Workers with these animal tumours know well how widely the behaviour of grafts varies even under conditions that are apparently identical. Although the experiment is of great interest and full of suggestion it must not be assumed at present that it paves the way to an analogous treatment of cancer in man.

Tissue Culture in Vitro.—This method was popularized by Carrel. By its means it is possible to determine the action of various agents under controllable conditions. The technique itself is delicate. Originally the portions of living tissue were cultured in plasma, but the method has been simplified by adoption of a modified Ringer's solution with the addition of embryonic tissue juice. Subcultures must be made every two or three days, but under suitable conditions tissue can be kept alive and growing for prolonged periods. In 1922 the description was given of a ten-year old strain of fibroblasts originally obtained from the heart of a chick embryo and then in the 1860th generation; increase in size under the artificial conditions was as rapid as at first. Besides fibroblasts, large mononuclear cells and cartilage cells, each in pure culture, cardiac muscle from chick, duck, frog, etc., tissue from kidney, thyroid and from various animal tumours has been cultivated. It has been shown that foetal tissues are capable of growing *in vitro* 72 hours after death of the animal and in 1924 evidence was adduced that spleen, liver, kidney, ovary, lung and cornea from adult animals may develop *in vitro* many hours after death. The development very likely proceeds from surviving cells perhaps activated by the autolytic products of the dead ones. A remarkable point was shown in connection with *in vitro* cultures of kidney. It was possible to obtain cultures of fibroblasts or of renal cells and in each instance growth took place in all directions with production of a solid mass. But if fibroblasts were introduced into a mass already containing proliferated renal cells a tubulation occurred that recalled the microscopical structure of the kidney. This experiment may be correlated with the observation that in the growth of a transplanted tumour graft the stroma is furnished by the host and therefore that the microscopical appearance of the growth is determined largely by the fibrous tissue.

Experiments on Aetiology.—The frequency with which cancer of the tongue is associated with a jagged tooth or an ill-fitting denture, cancer of the lip with smoking of clay pipes, the occurrence of cancer of the skin in workers with paraffin and tar, of soot cancer in chimneysweeps, arsenic cancer, kangri cancer amongst the Kashmiri users of the kangri basket, cancer of the cheek amongst betel-nut chewers, cancer of the bladder in workers with anilin and around the parasitic ova in persons infected with bilharzia, are examples where irritation caused by a mechanical agent seems to bear a causal relation to the cancer.

X-Ray Cancer.—Of recent years X-ray cancer has been added to the list, and there is reason to believe that cancer of the skin may result from prolonged exposure to the gamma rays of radium. Lazarus Barlow has found minute quantities of radium to exist in a large proportion of cancers examined for the purpose, and produced in the gall bladders of rabbits a condition indistinguishable from cancer by introducing into the gall bladder human gallstones into which small quantities of radium had been introduced artificially.

Irritation and Cancer.—Subsequently Leitch produced cancer of the gall bladder in guinea-pigs by the use of gallstones or of small pebbles. The exact relation of the chronic irritation to the subsequent cancer is unknown, and there is no doubt that in an even larger number of cases chronic irritation occurs without any subsequent development of cancer. In most instances the chronic irritation must persist over a number of years and the actual cancerous condition is preceded by the formation of warty outgrowths and other local manifestations of cell destruction accompanied by cell proliferation.

Tar Cancer.—In the case of tar a cancerous condition has been produced in mice and rabbits, but hitherto never in rats, by repeated local painting with coal tar. The cancer is of the squamous variety and runs a normal course. Under the same conditions of painting the length of time before cancer supervenes varies between 3 and 18 months for individual mice. An observation that may have important bearings is that when growth has been produced in one part of the body by means of tar it is impossible to produce another cancer elsewhere by the same means. This is complementary to the experience derived from transplanted cancer in which resistance to one variety of new growth may coincide with susceptibility to another variety. Strenuous efforts have been made to isolate the carcinogenic principle in tar and crude paraffin oils but without success. On the other hand " tars " prepared from isoprene and acetylene by distilling at temperatures between 700° and 900° C. were some of the most effective cancer producers yet known. The same was true for " tars " produced by the same temperatures on various tissue derivatives.

Artificial Infection.—Fibiger succeeded in producing cancer of the stomach and tongue in rats by feeding them with cockroaches infected with spiroptera neoplastica, and Bullock and his collaborators produced a malignant condition in rats by feeding them with taenia crassicollis, a tapeworm infesting the cat. The sarcomatous growth occurred round the cysts formed in the liver by the tapeworm and was produced within a few weeks.

The Rous Experiments.—In the attempt to find some common factor behind these widely diverse conditions antecedent to cancer, attention was directed towards observations made by Peyton Rous on a chicken sarcoma that could be transmitted by inoculating with dead cells or, in the absence of cells, by a tumour extract that had passed through a Berkefeld filter. Subsequently Rous found two other varieties of sarcoma in hens which could be transmitted by filtered tumour juice. In each of the three instances the special characters of the original growth were repeated in the experimental tumours. He and his collaborators brought forward strong evidence that the filterable agent was a living but extremely small microbe.

Gye's Two Factors.—Although all attempts to discover a filterable virus in mammalian cancer had failed and successful transplantation can only be carried out by means of living cells, it occurred to Gye that two factors might be concerned in the production of one of these chicken sarcomata, viz., a filterable virus and a specific factor derived from the animal. By special means he separated the two and found that either alone was insufficient to produce a tumour but in conjunction they were effective. He then applied these results to four standard malignant tumours in rats and mice and one human mammary cancer with the result that he obtained from all but one mouse tumour a factor he regards as almost certainly a filterable virus which can replace the virus of the Rous tumour in the production of a chicken sarcoma. The failure to transmit mammalian growths in the same fashion as the Rous chicken sarcoma he ascribes to the more rapid destruction of the mammalian specific factor, probably by oxidation. For the last-mentioned conclusion he has brought forward experimental evidence.

These researches, which are still in progress, have led Gye to *look on cancer—using the term in its widest sense—as a specific disease caused by a virus (or group of viruses). Under experimental conditions the virus alone is ineffective; a second specific factor obtained from tumour extracts ruptures the cell defences and enables the virus to infect. Under natural conditions continued irritation of tissues sets up a state under which infection can occur.* The filtered material isolated by Gye and supposed to contain a virus, after subculture, was examined photographically by Barnard with special optical apparatus, ultraviolet light and, where necessary, quartz in place of glass. Barnard obtained and has published appearances of a particular agent in the culture medium which he and Gye regard as the virus under discussion.

Filterable Virus.—This work, without doubt, is of great importance but caution must be exercised in its interpretation. The occurrence of unsuspected minute bodies in what are regarded as normal animals has been shown in monkeys, rabbits and guinea-pigs, *e.g.*, in the work on lethargic encephalitis, and Rivers and Pearce while investigating varicella found in rabbits a filterable virus which, at first thought by them to be that of varicella, proved ultimately to be indigenous in rabbits. This possibility must be eliminated before Gye's observations can be taken to prove that his filterable virus came from the sarcoma as distinguished from the chicken. Moreover Rivers and Pearce also found that rabbits bearing intratesticular growths of a transplantable tumour, first discovered in syphilised rabbits, are immune to their rabbit filterable virus, though the virus infects the growth itself and multiplies therein.

Specific Factors.—It may be that filterable viruses peculiar to certain animals exist but are unable to produce tumours until some " specific factor " is present, or that a filterable virus peculiar to new growths exists but also requires the presence of a specific factor, or it may be that the filterable virus inhabits the tumour and is, in a sense, accidental. It is clear that some stimulus for the increased and atypical multiplication of cells which characterises the new growths is necessary but it seems that much more work is needed before it can be accepted that a filterable virus is aetiologically connected with all varieties of malignant new growth. For the sarcomata—with their many histological and clinical resemblances to infective and inflammatory conditions—causation by a particular filterable virus is more easily acceptable and it will be noted that Gye's experiments, with a single exception, are concerned with sarcomata. The great merit of his work lies in the experimental evidence it affords of the interaction between an extrinsic and an intrinsic factor in tumour formation and the definiteness it aims at giving, at all events in certain instances, to the characters of the extrinsic factor.

Concluding Remarks.—Most of the work on biochemical lines is unsuited for remark here, and of the remainder much consists of diagnostic tests for cancer that have been put forward. Unfortunately none of these has stood the test of time. In view of the general belief that cancer in its earliest stages can often be successfully treated by surgery and of the frequency with which the disease first comes under observation at a stage when operation is impossible, a reliable diagnostic method is urgently needed. X-ray examination has facilitated diagnosis of internal cancer particularly when affecting the alimentary tract, but search must still continue for some chemical test applicable at an early date in the disease. Brief reference must be made to Dawson's recent work on the melanomata; from a consideration of all the data, and especially the pigment-forming function of epithelial cells, he concluded that the melanomata, usually termed melanotic sarcomata, are epithelial and therefore carcinomatous.

Action of Radium.—In treatment, research has been directed chiefly toward the action of radium and X-rays. At first employed empirically the scientific basis of their action is being discovered by degrees. The X-ray spectrum has been mapped out, and by means of apparatus of very high voltage (180–200 kv.) rays of wave-length and penetrating power approximating to the very short waves of gamma radiation have been produced. The biological action of rays of different wave-length has been studied and radiological treatment is becoming more scientific.

There are still wide gaps in knowledge both on the physical and the biological sides and though immediate results can be foretold with some degree of accuracy in certain varieties of cancer, late results often appear to be fortuitous. Upon the whole, however, treatment of cancer by radiation is a method with which the clinician has to reckon. This is more than can be said concerning medicinal or dietetic methods, none of which has been supported so far by evidence that can be regarded as sufficient to warrant its serious consideration. (W. S. L.-B.)

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CANEVA, CARLO (1845–1922), Italian soldier, was born at Tarcento (Friuli) April 22 1845, and entered the Italian Army in 1866. He served in the African campaign of 1897, and in 1902 was promoted lieutenant-general. Caneva commanded one side in the much-discussed manoeuvres of 1911, his opponent being Cadorna and it was probably owing to the result of the manoeuvres, in which Caneva was declared victor, that he was selected to command the Tripoli Expeditionary Force in Oct. 1911. Caneva was given a thankless task, being sent to occupy the coast towns in the belief that the Turkish garrison, unsupported by the tribesmen, could be easily overcome. He was speedily undeceived, and for a time could do nothing, as he had no transport and was hampered by orders from home. In spite of these handicaps he was generally considered to have carried the waiting policy too far. He was recalled in Sept. 1912, and retired shortly afterwards. He presided over the commission that was appointed to enquire into the Caporetto disaster of 1917. He died Sept. 25 1922.

CANNES, CONFERENCE OF (Jan. 6–13 1922), a meeting of the Supreme Council of the Allies with the primary object of

considering the Anglo-French suggestions regarding reparations, which had been drafted at the preliminary Conference of London on Dec. 18–22 1921 (*see* LONDON, CONFERENCE OF). At Cannes, however, the reparation question entered on a new phase through being brought into connection with a project for the general reconstruction of Europe, and with another project for an Anglo-French pact. In regard to reparations the conference opened with a criticism of the Anglo-French suggestions by the French Minister of Finance, who was supported by the Belgian representative. After long and complicated discussions this resulted in a modification of the London suggestions, but a deadlock was avoided, and representatives of Germany, as well as the Reparation Commission, were summoned to Cannes to make proposals on the basis of the agreement finally reached as between the Allies.

The wider questions of security and reconstruction were broached by Mr. Lloyd George in a memorandum submitted to M. Briand on Jan. 4, before the formal opening of the Conference. Mr. Lloyd George's thesis was that the three problems of reparation, security and reconstruction were inter-related, and that any general scheme for European reconstruction must include Russia. In the same document he offered to conclude an agreement by which Great Britain would pledge herself to assist France with all her forces in the event of unprovoked German aggression upon French soil. In effect this was an offer to revive the Anglo-French Guarantee Treaty which had been signed simultaneously with the Versailles Treaty (*see* VERSAILLES, TREATY OF) but had not come into force because that had been conditional upon the ratification of the parallel treaty between France and the United States. At the same time Mr. Lloyd George warned M. Briand at the outset that the British Empire would not be willing to incur military commitments in Central and Eastern Europe.

On Jan. 6 Mr. Lloyd George introduced in the Conference a resolution for the convening of a general Reconstruction conference to which both Soviet Russia and the United States were to be invited, and this resolution was adopted by the Supreme Council, together with an outline agenda. Meanwhile M. Briand had been making counter-proposals in regard to the Anglo-French pact. The guarantee, he declared, must be reciprocal, and it must be supplemented by a technical military convention. While this second condition would probably have proved an insuperable obstacle from the British point of view, M. Briand was violently attacked in the French Senate and Chamber, in the belief that he was giving way unduly to Mr. Lloyd George. On Jan. 11 he was recalled to Paris by the President of the Republic, M. Millerand, on the 12th he resigned and therewith the work of the Cannes Conference was brought to a sudden stoppage. Its main results were the provision for the Genoa Conference and the avoidance of a deadlock over Reparations.

See British White Paper, *Resolutions adopted by the Supreme Council at Cannes, Jan. 1922, as the basis of the Genoa Conference* (Cmd. 1621 of 1922); A. J. Toynbee, *Survey of International Affairs, 1920–3* (1925). (A. J. T.)

CANNING (*see* 10.612).—Several factors have tended to develop the food canning industry in various countries of the world during the period 1910–25, and although the United States maintained the leading position, keen competition arose from other foreign countries, particularly from the British Dominions. Undoubtedly the chief cause for the remarkable advance—quite 100% in many countries—was the great disturbance in economic conditions occasioned by the World War, which gave rise to a range of new problems, not only in providing food for the various armies, but in supplying the needs of the people of the various belligerent nations.

I. IN THE UNITED STATES

According to the U.S. Census returns, the value of canned foods packed in the United States increased from $139,000,000 in 1909 to about $550,000,000 in 1923. After due allowance is made for changes in price levels, these figures show that the output of canned foods increased during that period about two and a half times. The quantity of canned fruits, vegetables and soups increased from 41,000,000 cases of 24 cans each in 1909, to 110,000,000 cases in 1923. Corresponding figures for fish, shellfish and meat cannot be given, because quantitative statistics for the pack of 1909 are not available. Canned foods have thus come to occupy a more important place in the diet, which is thereby broadened, and the consumption of seasonal foods is less and less confined to short periods of the year. This increased production was made possible by improvements in canning machinery. Cans which were formerly made by hand were in 1925 made by machine at the rate of 12,000 per hour. Machines developed for the various steps in canning have replaced hand labour, cheapened and speeded up production, and contributed to the sanitary condition of the plant, while the raw product, by means of motor-trucks, is brought long distances to the factories without loss of quality. There has been a pronounced tendency to remove canning plants from large cities, in which the majority were formerly located, to smaller towns, and to establish them in areas producing products to be canned. This makes it possible to can the products within a shorter time after harvesting, and in that way to secure a higher quality.

The method of canning is, briefly, as follows: the raw product, after proper cleansing, peeling, trimming, etc., is placed in the can, usually with sufficient water, syrup or dilute brine to cover the product and facilitate penetration of heat. The raw product or the liquid surrounding it is usually preheated, or else the can is passed through a steam-box or vacuum chamber before sealing, in order that the contents may be heated sufficiently and the can eventually show a substantial vacuum. The can is then sealed and processed (sterilised) in steam or hot water. During the years 1910–25 fundamental changes were made in the character of the cans employed. The soldered can, formerly used exclusively, was largely superseded by the open-top or sanitary can, which is sealed by crimping the ends to the body of the can, the seam being made tight by rubber composition or paper gasket. With this type of can no solder is employed except on the side seam, which is soldered on the outside.

The temperature required for sterilisation varies with the nature of the food to be canned. Acid products, such as fruits, need be heated only for a short time in boiling water, so that all portions of the contents come to a temperature of at least 180° F. The acidity of the fruit suffices to prevent bacterial spores from germinating, and it is only necessary to destroy the vegetative form of bacteria. Substances of lower acidity, such as meat, fish, shellfish and the majority of vegetables, must be heated to a higher temperature in order to destroy bacterial spores. The length of time required for sterilisation depends on the rate at which the heat penetrates the product. Such penetration is most rapid in foods containing a free liquor, and slowest in closely packed solids, and in products of a pasty consistency.

The canning industry has led the way in the organisation of co-operative industrial research, having been the first in the United States to provide for research on such a basis. Laboratories established by the National Canners' Association in 1913 have made fundamental contributions to the knowledge of sterilisation and other processes of manufacture. The Bureau of Raw Products Research, organised later, has been instrumental in greatly increasing the attention given by government and state investigators to the agricultural questions involved in raising crops utilised by the canning industry. In several universities, also, investigations relating to food poisoning and the vitamin content of foods have been financed by the industry, the results of which have appeared in scientific literature. It had been assumed that the nutritive value was diminished by the canning operation, through destruction of the vitamins. These investigations, however, showed that the anti-scorbutic vitamin (vitamin C) is destroyed to a less extent by the canning operation than by cooking in an open vessel, as is customary in the home. Canned foods are therefore richer in vitamin C than the same varieties of foods cooked by the ordinary kitchen methods, while retaining the same content of the other vitamins. Broadly speaking, the nutritive value of canned foods is substantially the same as the nutritive value of the same foods cooked in the home from the raw product. (*See* MILK.) (W. D. B.)

II. IN THE BRITISH EMPIRE

The canning industry was of considerable importance in Great Britain during the pre-War period, and a large export trade in canned meats, fish and vegetables had been developed. War demands gave a great impetus to the industry, particularly in the production of canned "rations," hams, etc., for the British and Belgian armies. The export trade, however, was greatly reduced, but it quickly revived after the end of the War. Fruit canning

developed rapidly in the post-War period, model plants being set up in various parts of the country.

Australia, New Zealand, Canada and South Africa have made considerable progress in the canning industry, and during the post-War period trade has greatly increased. The industry has been in existence in Australia since the last decade of the 19th century, but the output was principally confined to home requirements to the end of the World War. As a result of the government scheme for the settlement of ex-soldiers, canning plays a very important part in the development of the soft fruits industry in the Dominions. In several of the states, such, for instance, as Queensland, New South Wales and Victoria, the respective governments have advanced large sums for the erection of modern plants with which to deal with the produce of the orchards. Considerable attention is paid to stemming, grading, weighing and packing, and the methods employed make any handling of the fruit unnecessary. War demands stimulated the exports of dried and preserved fruits, and the trade greatly increased during the post-War period. The following table gives the values of exports of dried and preserved fruits for the years 1913, 1917–8 and 1923–4:—

	1913	1917–8	1923–4
	£	£	£
Dried fruits	31,000	265,000	1,238,000
Preserved fruits	21,000	255,000	621,000

New Zealand.—In New Zealand the process of manufacture is under careful supervision and is subject to the provisions of a strict law against adulteration. Canned sheep tongue is an important item of export: other packs include ox-tongue, boiled mutton, boiled beef, corned mutton, corned beef and meat extract. Boiled mutton has a large sale, mainly for ships' stores, but other lines had not been extensively developed by 1926.

Canada.—The Canadian export trade in preserved foodstuffs greatly increased after 1910. Packing and canning factories were established and close attention was given to grading and standardisation. The chief commodity is fish, although canned tongues, fruit, tomato soup, milk powder and other articles of food are making considerable progress. The total value of the fisheries production of Canada in 1924 was approximately $45,000,000. This total represents the value of the product as marketed, whether fresh, domestically prepared or factory made. The fish includes salmon, halibut, cod and lobsters, a large proportion of which is canned. The first fish canning plant was established on the Pacific coast in 1863, but the fruit canning and by-products industry is of much later growth. During the period 1922–5 British Columbia salmon canneries experienced severe competition in the British market from Japanese and Siberian salmon, and have had to look to other markets, particularly France. In Newfoundland the canning of fish products was only in the initial stages in 1925, except in the case of lobsters. Lobster canning was, however, owing to over-fishing, subjected in 1924 to a close season of three years. The canning of codfish, salmon, codfish tongues and halibut was developed during the post-War period, and in 1925 a small export trade was carried on in these products.

South Africa.—In 1910 the Union of South Africa imported an appreciable quantity of dried fruits of various kinds, but progress in the canning and dried-food industry was so rapid and sustained that by 1925 not only were all local requirements met, but a considerable export trade had been developed. The Govt. imposes certain regulations regarding grading, etc., with which all exporters must comply before their produce is permitted to leave the Union. Fruit canneries are established in many of the principal towns throughout the Union, the chief centres of the industry being Durban, Port Elizabeth and Cape Town, with the Paarl and Worcester districts of the Cape Province. The canning of crayfish is of great importance. The lobster occurs in abundance on the coast of South West Africa, and four large factories were started in 1924 at Lüderitz Bay. Great advances were quickly made and an extensive export trade both to the United Kingdom and the Continent developed.

Federated Malay States.—In the Federated Malay States the pineapple is extensively grown for canning purposes; the chief planted areas are in the neighbourhood of Singapore where several large canneries engaged in the preserving of the fruit have been established. The local industry is very large, as will be seen from the following official figures, showing the exports from Singapore:—

		Quantities	Value
1919	Cases	255,873	3,286,001
1920	Cases	446,890	7,177,976
1921	Cases	662,360	6,210,383
1924	Tons	39,203	8,873,977

The rise in the value of exports in 1920 was due partly to the post-War revival of trade, and partly to the fact that supplies of tin plate, practically unobtainable during the War, were available. The principal country for export is the United Kingdom, but Canada, British India and the United States of America absorb fairly large quantities.

III. IN OTHER COUNTRIES

In Italy, where the canning industry is firmly established, the export of canned fruit and vegetables, particularly tomatoes and cherries, has shown a steady increase, the general standardisation, packing and canning being most efficient. Before the War, France also had many canning establishments and exported a large quantity of sardines, vegetables and preserved fruits. During the post-War period she began to re-establish her trade and by 1925 was regaining a number of her lost markets. Norway's canned fish and meat industry is of great importance to the country. From 1895 until the outbreak of the World War, the fish-canning trade expanded at an exceptionally rapid rate, and by 1925 Norway was one of the leading exporters of canned fish. This expansion is clearly instanced in the exports of brisling sardines, the main product of the industry, which are about 22,000,000 kegs yearly. Norway has over 200 canneries employing some 6,500 hands. The total weight of canned goods exported during 1924 was 40,249 metric tons, of which 28,202 tons were smoked sardines, 5,061 tons unsmoked sardines and 5,389 tons kippers. Canning machinery is exported from Norway to other countries engaged in the industry.

Spain, Portugal and Siberia are all engaged in the canned sardine industry, while Spain and Portugal also devote considerable attention to canned fruits, the exports of which are increasing. In Belgium the canning industry rapidly developed after 1910. The oldest and the most flourishing branch is that of canned vegetables. The manufacture of canned fruits on a very large scale has been developed largely in co-operation with British firms. An industry which has made great strides is the manufacture of canned and crystallised fruit, in which 22 manufacturing firms were engaged in 1925 as against less than 10 before the War. The works engaged in the preparation of canned and dried fish are located for the most part along the coast, and specialise in sprats and sardines and shellfish.

Japan, through the organisation of a large trust of canned provision merchants, has become important in the canned crab and salmon trade. In 1923 she shipped to America and Europe 220,000 cases of crab, but in 1924 the output somewhat decreased and the value fell from yen 50 to yen 40 per case. As a result of the influence of the trust, however, and also of improved packings, the industry in 1925 showed signs of greater expansion. (A. F. W.)

CANTEEN.—The term is chiefly used for the bar or general shop attached to barracks, but it is also used for other places where food is provided, *e.g.*, in connection with factories and workshops. Canteens exist, too, in warships. In a less-known sense, a canteen is the small tin utensil carried as part equipment in marching order for cooking, eating or drinking.

Service Canteens.—Prior to 1914 canteens were generally worked in the British Navy by a ship committee, and in barracks as a regimental institute, but with the rapid growth of new units after the outbreak of the World War, it was found desirable to have a central organisation to provide canteens for barracks, hutments and for all the expeditionary forces. Much experience in this direction had been gained in the South African War, where the canteens had done much for the comfort of the troops, and yet made tremendous profits, providing capital sums spent for the sailors' and soldiers' benefit on the Union Jack Club, Union Jack Hostel, etc.

From 1915 onwards, the Expeditionary Force Canteens became a vast organisation, providing right up to the front lines, for officers and men, good shopping facilities and rest and

recreation centres, and for officers excellent hotels. Mention must be made of the auxiliary work of the Y.M.C.A. and the Church Army, which carried on similar work on a very large scale both at home and abroad.

With the American Army, the canteen work was largely carried out by the Y.M.C.A. and by the U.S. Red Cross, already established in France, and to a certain extent by regimental institutions. In Great Britain, the outcome of the canteen organisation was the Navy and Army Canteens Board, which, since the War, has taken over nearly all the naval and other service canteens. A few units particularly situated still manage their own canteens on the old lines.

Civilian Canteens.—In Great Britain the need for providing canteens for industrial workers is widely recognised and an Act of Parliament of 1916 empowered the Home Secretary to require employers to provide canteens or messrooms when it appears that such are necessary for securing the welfare of the workers. The exact words are in section 7 of the Police, Factories (Miscellaneous Provisions) Act, 1916:

> The occupier shall provide and maintain for the use of all persons employed in a factory and remaining on the premises during the meal intervals a suitable messroom, which shall be furnished with (*a*) sufficient tables and chairs or benches with back rests; (*b*) adequate means of warming food and boiling water; (*c*) suitable facilities for washing, comprising a sufficient supply of clean towels, soap and warm water. The messroom shall be sufficiently warmed for use during meal intervals.

Welfare Pamphlet No. 2 issued in 1924, by the Stationery Office, London, gives advice on the provision of these accessories, the information being accompanied by plans of model canteens.

CANTIGNY, a small village in northeast France, west of Montdidier and 18 m. south of Amiens, was the scene of the first U.S. offensive in the World War. After the great German advance in March 1918, the 1st Div. of the American Expeditionary Force, under Gen. Bullard, relieved two French divisions in the Picardy section of the Allied front. The German line ran west of Montdidier, and, immediately facing the American front, formed a small salient of which Cantigny was the nucleus. It was decided to reduce the salient, and for this task the 28th Regt. with 150 men of the 1st Engineers were detailed, supported by French tanks. On May 28, at 6.45 A.M., after an hour's artillery preparation, the U.S. Infantry advanced on a front of 2,200 yd., and in 45 min. they had overcome the German defences, capturing 250 prisoners. The Germans made fierce counter-attacks, extending over three days, but failed to retake the position. The total casualties sustained by the American forces in this operation were 45 officers and 1,022 men. (*See* GERMAN OFFENSIVE).

CANTON, China (*see* 5.218), suffered perhaps more damage as a result of the Chinese internal wars of 1924 and 1925 than any other Chinese city. Under the governorship of Dr. Sun Yat-sen (*q.v.*), heavy taxes were imposed for the upkeep of the army. These were naturally detrimental to the city's trade, though the important silk exports were maintained. Many merchants, however, gave up business here and transferred their operations to Hongkong.

Since 1910 a new quarter has sprung up west of the river, and a bridge has been built between Canton and Honam. The population in 1925 was variously estimated between 500,000 and 900,000. The Canton Christian College, begun in 1905, subsequently expanded until it possessed about 50 buildings on a site of 350 acres. The Women's Department was opened in 1913, the College of Arts and Sciences in 1915 and that of Agriculture in 1921. In 1914 a Board of Conservancy Works of Kwangtung, appointed particularly to deal with flood prevention, was started by the Chinese Govt. the difficulties of Canton as a port having become more and more obvious. Thereafter a sluice was built on the north river and a floodgate on the east river, and about 18 m. of dikes were dug. Plans for improving the harbour and approach, and regulating the west and north rivers, were under consideration at the end of 1925, and several miles of quays had been constructed. The railway of Hankow reached Shihwan in 1919, but at the close of 1925 it was in a very bad state of repair, while the working of the line to Kowloon, opened in 1911, was constantly interrupted for military purposes during the stormy days of 1924 and 1925. In 1924 there was a severe outbreak of smallpox, and other diseases were brought by the troops, among whom they were rife. A Health Department which was started failed owing to the disturbed conditions and financial difficulties.

Disorder in the City.—Civil war was carried on in and around the city from 1921 onwards, and in 1924 there were conflicts between the troops of Sun Yat-sen, holding the city, and the Cantonese merchant volunteers, who banded themselves together to resist the orgy of taxation imposed to pay for the large numbers of troops, and declared a general strike, which spread all over the province, in May. In Oct. the merchant volunteers were attacked by the government troops in the most crowded part of the city with artillery; over 400 houses were burnt and a number of noncombatants killed. The volunteers, who were greatly outnumbered, were defeated and disarmed. The communist element, in a loosely organised trades union, obtained control. During the fighting in the city some 50,000,000 dollars' worth of damage was done. By the end of 1925 effective connection with Peking had been severed and a boycott on British shipping from Hongkong had been declared, supplies being received from Vladivostok.

CAPEK, KAREL (1890–), Czech dramatist and novelist, was born at Malé Svatonvice in Bohemia (Yugoslavia) Jan. 9 1890. He is perhaps best known as the author of the successful play *R.U.R.* (1920; Eng. trans. 1923), in which he satirises the mechanical tendencies of modern civilisation, and *The Life of the Insects* (1921; Eng. trans. 1923), a spectacular play written in collaboration with his brother Josef, and satirising various phases of modern society. He also attracted much attention with the *Makropulos Affair* (1922), a play dealing with longevity. Of his fiction the best is contained in *Painful Tales*, a collection of short stories which deserve comparison with Maupassant, and in his two novels, *The Manufacture of the Absolute* (1923) and *Krakatit* (1924; Eng. trans. 1925). He achieved considerable success with his series of feuilletons, *Letters from England* (1924; Eng. trans. 1925), *Letters from Italy* and *Concerning the Nearest Things* (1926), all of which are distinguished by powerful imagination and sparkling wit.

CAPELLO, LUIGI (1859–), Italian soldier, was born on April 14 1859. His career until he became a general officer was passed in the infantry. During the World War he conducted in Aug. 1916 the attack which led to the capture of Gorizia. As commander of the Gorizia zone II. (VIII., VI. and II. Corps) he conducted the first phase of the Italian offensive in May 1917. In June he was given command of the II. Army and in Aug. he directed the attack on the Bainsizza plateau, but his desire to continue the attack led to differences with Cadorna, his commander-in-chief, who favoured a defensive disposition. It is probable that Capello's faith in his own method of meeting the enemy counter-attack prevented his wholehearted co-operation with Cadorna. After his retirement in July 1918 he took some part in politics and supported Fascism but later joined the Opposition and, in Nov. 1925, was arrested on a charge of complicity with Zaniboni in the plot against the life of Mussolini.

CAPE PROVINCE (*see* 5.225), the largest and most thinly populated of the provinces of the Union of South Africa, has an area of 276,966 sq. miles. Population (1911) 2,564,965; (1921) 2,782,719. In 1921 the white inhabitants numbered 650,609, an increase of 68,232 since 1911, roughly 28,000 males and 40,000 females. The discrepancy in the increase was due to a steady migration of men from the Cape to other provinces of the Union, chiefly the Transvaal. Of the 2,132,110 non-white inhabitants in 1921, Asiatics numbered 7,696, Bantus 1,640,162 and mixed or other races 484,252. The "coloured persons," as they are officially called, form a distinct and important element in the community. Of the Bantus 938,990 lived in the Transkei, a purely native area under special jurisdiction. Many parts of the province are arid or semi-arid and, the Transkei apart, the population is mainly in the fertile south and southeast coast regions.

Administration.—The affairs of the province are managed by a provincial council elected for three years and not subject to dissolution save by effluxion of time. The council elects its own chairman and an executive committee of four, not necessarily members of the council. It has powers of legislation on subjects specifically assigned to it; its enactments are called ordinances and are not valid if repugnant to any Act of the Union Parliament. There is no separate judiciary or police force or civil service, and harbours and railways are under the control of a separate department of state. The New Cape Railway from Worcester to Mossel Bay, 209 m. long, the chief privately owned line in the Union, was bought by the Govt. in Aug. 1925. The chief executive officer, styled the administrator, is appointed by the Union Ministry. He holds office for five years and is irremovable. The Union Ministry also appoints the provincial auditor and an attorney-general as legal adviser.

The first administrator was Sir Frederic de Waal, who had been Colonial Secretary in the last Ministry of Cape Colony. He was twice reappointed, being succeeded in 1926 by Mr. Adrian P. J. Fourie, Nationalist member of Parliament for Somerset East. During the period 1910–25 the province showed a progressive spirit, particularly as regards education. There arose, however, such an increase in provincial expenditure (not in the Cape alone) that the Union Parliament passed an Act in 1922 limiting the subsidy to be paid to not more than 3% over the amount due in the preceding year. In the schools the bilingual requirements gave rise to a little friction; in 1921 the council passed an ordinance providing that the medium of instruction up to standard IV. should be the "home language" of the scholar. In place of High Dutch, the local form of the language, called Afrikaans, is taught. Education for all European children between the ages of 7 and 16 is compulsory; primary education, since 1920, has been free up to and including standard VI. Both primary and secondary education is provided for all races. In 1924 there were 137,000 white and 167,000 non-white pupils.

There was, in the period 1910–25, considerable agricultural and industrial development, as well as a period of unhealthy inflation after the World War, followed by reaction. An event which caused a deep and lasting impression on the public mind was an epidemic of influenza in 1918. It was estimated that a quarter of the inhabitants of the province suffered, and the deaths were very numerous. In 1925 much opposition was aroused by Gen. Hertzog's proposal to withdraw the franchise from the natives, as it was in the Cape only that natives had the right to vote.

Finance.—The revenue, apart from the subsidy, is derived mainly from transfer duties, licences (trade, liquor, motor, etc.) and a provincial property tax. The average revenue 1915–6 to 1919–20 was £567,000; it had risen to £1,261,000 in 1922–3. The Union Govt. subsidy in 1915–9 averaged £1,085,000, and was £1,569,000 in 1922–3. The sudden rise in the figures was the reflection of educational demands. The average expenditure on education in 1915–6 to 1919–20 was £1,224,000; in 1922–3 it was £2,514,000. *See* SOUTH AFRICA.

See also the following reports issued at Pretoria by the Union Govt.: *Report of the Provincial Administration Commission 1915* (1917); *Report of the Provincial Finances Commission* (1923).

(F. R. C.)

CAPE TOWN (*see* 5.252b), capital of the Cape Province, and seat of the Legislature of the Union of South Africa. In 1913 all the suburban municipalities except Wynberg were incorporated in the city, which extends for 17 m. across the Cape peninsula, from Table Bay to False Bay, and has an area of 59 square miles. The population, including suburbs, was 161,570 in 1911 and 207,404 in 1921 (of whom 113,202 were whites). The chief feature of the period since 1910 has been the development of the suburbs and the making more accessible the natural beauties of the peninsula, enterprises in which the municipality took the lead. Cape Town in the season (Oct.–March) is the chief pleasure resort of South Africa. In Oct. 1918 influenza caused over 7,000 deaths in the city in three weeks.

On the sea front at Table Bay a promenade pier (1,500 ft. long) and esplanade (1,000 yd.) were completed in 1914. The pier replaces the old central jetty, and is in a line with Adderley street and Government avenue, the principal thoroughfares. To the Houses of Parliament, in Government avenue, a new wing was added (1910). At the foot of the avenue is the National Art Gallery. The Max Michaelis collection of Flemish and Dutch masters—presented to the Union in 1912 is in "The Old Town House," in Greenmarket square. The building, a fine example of colonial Dutch 18th-century architecture, was transferred to the Govt. in 1916. The castle has been cleared of disfiguring additions and restored approximately to its 18th-century condition.

Rondebosch, five miles from the centre of the city, is the chief residential suburb. It contains Groote Schuur, formerly the property of Cecil Rhodes, since 1910 the official residence of the Prime Minister of the Union. In 1918, on the incorporation of the South African College (founded in Cape Town in 1829) as the University of Cape Town, a site for new buildings was granted in the grounds of Groote Schuur. Building operations began in 1921. In 1925 the Prince of Wales was installed as chancellor of the university. In 1912 a Rhodes memorial was unveiled at Groote Schuur by Earl Grey. In front of the memorial, a granite temple in the Doric style approached by a flight of steps, is the equestrian statue of "Physical Energy" by G. F. Watts. In the temple is a bust of Rhodes. Not far from Rondebosch, at Kirstenbosch, are the National Botanical Gardens, established 1913.

Since 1913 Cape Town has ranked second to Durban as a seaport in respect to cargo, but it retains first position for passenger traffic and, as the port whence the raw gold from the Transvaal is shipped, its exports greatly exceed in value those of Durban. Long-needed improvements in Table Bay harbour were undertaken in 1924. In 1913 the tonnage of ships entering Table Bay was 3,965,000 (3,251,000 being British); in 1923 the figures were 4,007,000 (3,299,000 British); in 1924 they were 3,964,000 (3,202,000 British). See Juta's *Directory of Cape Town* (Cape Town, 1926.)

(F. R. C.)

CAPE TOWN, UNIVERSITY OF.—The foundation dates from April 2 1918, when the council, created by Act 14 of 1916, received a bequest from Sir Julius Wernher of £250,000 and a donation of £250,000 from Mr. Otto Beit, who added £50,000 to a lapsed bequest by Mr. Alfred Beit. By 1921 a special appeal for funds had raised about £280,000, inclusive of £50,000 for the Jameson Memorial Hall. Pending the erection of buildings on the site provided by the Government at Groote Schuur, the university carries on its work in the buildings formerly occupied by the University of the Cape of Good Hope, of which it is the successor. The university created in 1925 chairs in commerce, fine art and accounting. The faculty of law was strengthened by a third professorship and arrangements were made to take over classes in architecture, hitherto conducted by the Cape Institute of Architects and the School of Art controlled by the Education Department.

CAPITAL, EXPORT OF.—This expression denotes investment of capital abroad by a country or its inhabitants. The term may be applied either broadly to the gross amount of capital so invested during a given period, or more narrowly to the net amount, represented by an excess of capital invested externally over capital concurrently invested in the country from outside. Export of capital is not an export in the ordinary sense, since it is rarely possible to indicate particular goods which represent the investment of capital; it is to be regarded rather as an item in the international trading balance sheet of a country.

British Investments Abroad.—British investments abroad were built up by an almost unintermittent export of capital between the end of the Napoleonic wars and the outbreak of the Great War. Sir George Paish estimated that at the end of 1913 the amount of capital publicly invested by British citizens in the colonies and foreign countries amounted to over £3,700,000,000, to which should be added a large amount invested privately, bringing the total to about £4,000,000,000. Of the amount publicly invested, Sir George Paish found that some £1,780,000,000 was invested in British Dominions and possessions, some £754,000,000 in the United States, and some £764,000,000 in other

foreign countries on the American continent. A comparatively small amount (less than £200,000,000) was invested in European countries—mainly Russia, Spain and Turkey. Sir George Paish estimated that no less than £1,521,000,000 was invested in railways; £959,000,000 in Government securities; £273,000,000 in mines; £244,000,000 in land, investment and finance companies; £147,000,000 in municipal loans; and £145,000,000 in commercial and industrial securities.

Other European Countries.—Several other European countries emerged as exporters of capital during the 19th century. Apart from Holland, which had established her position earlier as an investing country, these included France, Germany, Belgium and Switzerland. The amount of French capital invested externally was estimated in 1912 at some fr. 40,000,000,000 to fr. 42,000,000,000. French investors tended to concentrate their investments in Europe, Egypt and the French African colonies; and showed a marked preference for Government bonds including Russian Government issues which were held very extensively. They also held considerable investments in South America, Mexico and the Transvaal.

The amount of German investments was variously estimated at £1,000,000,000 to £1,250,000,000 before the World War: A large part was represented by Russian bonds, railway and industrial securities; and German investors had large interests in Austria-Hungary, Italy, Rumania and the Balkans. They also had substantial interests farther afield, in the United States and Canada, South America and the Far East.

The position then before the World War was that Great Britain, and to a smaller extent France, Germany and some other European countries, had built up substantial external investments and were in the habit of adding to them year by year through the export of capital. Apart from these no other countries exported capital on balance, though some capital importing countries also invested capital abroad.

United States.—Among these countries was the United States, which, during the two decades before the War, had invested considerable sums in the development of industries in Canada, in Mexico and Cuba; and had also repurchased from Europe considerable amounts of American railway securities. The flow of capital, however, continued, on balance, to be into the United States. At the outbreak of the War in 1914 European holdings of American securities were probably between $4,500,000,000 and $5,000,000,000. American external investments probably did not exceed one-third of this amount.

Changes Due to the War.—The War wrought enormous changes in the sphere of international indebtedness, changes, the extent of which cannot even now be precisely gauged. The initial shock to the credit system at the outbreak of war caused an immediate stoppage in the normal flow of capital from lending to borrowing countries and gave rise to demands on the part of the former for the repayment of maturing obligations. The borrowing countries experienced at first great difficulty in making remittances, as was indicated by the position of the exchanges.

Later, as purchases of war supplies by the belligerents increased, this difficulty disappeared and the exchanges turned in favour of the borrowing countries. From that time the European belligerent countries were confronted with an increasingly serious problem of financing their purchases abroad. It was a problem much more serious for the Allies than for the Central Powers, because the latter were largely cut off from the possibility of importing from countries out of Europe; but it applied to the Central Powers in connection with their purchases from European neutrals.

Great Britain bore a large part of the burden of financing the external purchases of the Allies prior to the entry of the United States into the War, and an account of the arrangements made forms part of the history of British War finance (*see* GREAT BRITAIN). So far as purchases could not be paid for out of ordinary credit items in the trade account they were met out of money obtained (*a*) by selling abroad holdings of foreign securities (*b*) by borrowing abroad on the market or (*c*) by borrowing from foreign or Dominion Governments. Each method was adopted so far as practicable, the last becoming commoner as more countries joined the Allies.

In view of the magnitude of British investments overseas it might have appeared that vast sums could be raised abroad by the sale of securities if not by borrowing. The extent to which investments could be realised was, however, in fact comparatively small. Only exceptionally did it prove possible to sell any of the sterling securities which represented the bulk of British holdings, and sales were for the most part limited to securities expressed in (or convertible into) foreign currencies—particularly American dollar securities. The sale of these securities proceeded to some extent in response to ordinary economic motives, and subsequently the British Government itself organised the acquisition, by purchase or on loan, of suitable dollar and other securities which could either be sold abroad or used as collateral for advances.

In the course of its operations the so-called American Dollar Securities Committee purchased American and Canadian dollar securities to the value of £184,266,540, and obtained the deposit on loan of others valued at £100,290,052. More important in amount than the sale of American and other securities was the direct borrowing by the floating of loans abroad and by arrangements with foreign bankers or with governments. The aggregate external debt of the British Government amounted at March 31 1919 to £1,364,850,000 at par of exchange. Of this £840,822,000 represented debt owing to the United States Government, £91,808,000 was owing to the Canadian Government and £113,500,000 represented loans from certain Allied Governments, which could be regarded as available to be set off against debts owed by the same Governments to Great Britain.

Britain, France and Germany as Creditor Nations.—While dollar securities were being sold abroad and money was being borrowed, advances were being made to European Allies and to certain of the Dominions, the aggregate nominal amount of these advances being undoubtedly in excess of the amount raised abroad by selling securities and by borrowing. Regarded as a commercial asset, however, these advances are by no means equivalent in value to the amount realised by the sales of dollar securities and by external borrowings. Their commercial value cannot even yet be exactly estimated. On the whole, it is clear that the creditor position of Great Britain at the end of the War was considerably, though certainly not fundamentally, impaired.

The effects of the War upon the creditor position of France were more disastrous owing to the extent to which French capital had been invested in Russia and other countries affected by the War. In addition to incurring considerable debts to private interests abroad, the French Government borrowed very heavily from the British and United States Governments. A settlement with regard to the latter debts had not been made in 1926.

Germany, like France, had large investments in Russia which were lost. She also suffered from the sequestration of German property and enterprises in the territory of hostile countries, though to some extent this was set off against property of those countries in Germany sequestrated by the German Government. Like the Allies, Germany incurred heavy debts in certain foreign countries, notably Holland, Sweden and Switzerland; and she mobilised salable foreign securities with a view to effecting payments abroad. On the other hand, she advanced large sums to her Allies, but had to forego her claims to repayment as one of the conditions of peace. Her defeat in the War resulted in the loss of her position as a capital exporting country.

Position of Neutrals.—The urgent demands of the European belligerents for supplies of many kinds provided an exceptional opportunity for countries which were in a position to take advantage of it. This applied to a considerable extent to some of the neutral countries of Europe, especially Holland, Sweden and Switzerland; but their capacity to furnish supplies on loan or otherwise was restricted by economic difficulties resulting from their position in the war area. It was estimated nevertheless with regard to Switzerland that by the end of 1918 she had lent the Allies fr. 400,000,000 and the Central Powers fr. 200,000,000, and that she had at the same time repurchased securities in French, German, English and Austrian hands to the value of

at least 800,000,000 francs. The experience of Holland and Sweden was not dissimilar.

The United States as a Creditor Country.—The country which above all others was in a position to furnish supplies on credit and to repurchase securities was the United States. It has already been indicated that for some years before the War, America had been investing capital abroad, although she was not a balance and capital exporting country. Clearly, however, her financial strength was increasing and it was only the great demand for capital for internal development which kept her from becoming a capital exporting country. The War greatly hastened her progress in that direction. She was able to repurchase with ease from Europe large amounts of American securities, the aggregate being estimated at $2,000,000,000 up to the end of 1918. Private loans were also floated in the United States to the amount of $1,500,000,000 while advances by the United States Govt. to the governments associated with it in the War exceeded $7,300,000,000 at the end of 1918. The exact commercial value of the government advances remained to be determined and is not yet completely settled. It was clear, however, at the end of 1918 that the United States was no longer on balance as a debtor. During the following years she rapidly established her position as a great creditor. After the Armistice Europe needed large quantities of foodstuffs and other supplies for which payment could not be made in cash. The United States was able and willing to furnish the goods and did so to a large extent on open credits from the banks. These advances were subsequently in large part funded in various ways. To some extent they were liquidated by further sales of European owned dollar securities, of which it is estimated that $500,000,000 were repurchased in 1919 and 1920. A certain quantity of South American, Canadian and other sterling securities were also purchased in America.

Flotations of Capital.—Flotations of capital were effected in the United States to a vast aggregate amount on behalf of foreign Governments and Municipalities whether Canadian, South American, European or other; and large sums were invested in industrial undertakings especially in Canada and South America. The amount of new flotations of capital in each year from 1920 to 1925 is computed by *The Financial and Commercial Chronicle* to have been as follows:—

Foreign Issues Placed in U.S.A. Excluding Refunding Loans
(*In thousands of dollars*)

	1920	1921	1922	1923	1924	1925
Canada and Canadian Provinces and Municipalities	45,780	75,982	98,984	26,308	132,365	49,158
Other Foreign Govt. and Municipal	191,000	329,270	416,305	186,845	570,945	540,781
Total Foreign Govt. and Municipal	236,780	405,252	515,289	213,153	703,310	589,939
Canadian Corporate Issues	107,795	106,115	40,476	29,631	97,850	94,511
Other Foreign Corporate Issues	39,925	15,150	80,445	24,100	195,410	398,735
Grand Total	384,500	526,517	636,210	266,884	996,570	1,083,185

The flotation of new foreign capital issues fell off markedly in 1923, owing largely to distrust arising out of the French occupation of the Ruhr. Following the settlement on the lines of the Dawes Report, which increased confidence in the stability of Europe, the amount of new issues rose to unprecedented figures in 1924 and 1925, when very large sums were lent to European governments and municipalities as well as to industrial enterprises. Parts of these new issues were, however, subsequently sold back to Europe.

American foreign investments (exclusive of debts owing by foreign governments to the United States Govt.) are estimated in 1925 to have been as follows:—

	Government Guaranteed Obligations	Industrial Securities and Direct Investments	Total
	$	$	$
Canada and Newfoundland	1,125,000,000	1,420,000,000	2,545,000,000
Latin America	915,000,000	3,225,000,000	4,140,000,000
Europe	1,665,000,000	450,000,000	2,115,000,000
Asia and Oceana	442,000,000	280,000,000	722,000,000
Totals	4,147,000,000	5,375,000,000	9,522,000,000

By far the greater part of these investments has been made since 1914, and when account is taken of the fact that foreign holdings of investments in America have been reduced to comparatively small proportions by the repurchase of some $2,500,000,000 of securities, and further of the debts owing by European governments, the magnitude of the change which has occurred in the financial position of the United States is clearly apparent. New York has in fact been for some years the principal centre of the world's capital market and has been able to provide immense quantities of capital to borrowers of all nations. Whether America will continue to export capital at the same rate or whether a rising standard of consumption and the demand for capital for internal purposes will restrict the amount invested abroad is by no means certain.

France and Germany in post-War Finance.—For the time being at any rate Europe has ceased to be able to provide large amounts of capital for other parts of the world, and on the whole the flow is at present rather into than away from Europe. The resources of France have been fully taken up with the restoration of the devastated areas. Germany has been borrowing heavily for reconstruction, and having regard to reparation payments is not likely to be in a position to invest capital abroad for many years.

Recovery of the London Market.—On the other hand, Great Britain has been in a position to resume the export of capital, though on a reduced scale. The external debt incurred during the War was reduced by over £200,000,000 between March 1919 and March 1921, since when further substantial reductions have been made. During 1920 considerable blocks of South American, Chinese and other foreign securities were purchased at low prices from the Continent, although at the same time other securities were being sold to the United States and also to Canada until the imposition by the latter country in the autumn of 1920 of an embargo on importation of securities. Considerable flotations of capital were also made for British possessions and foreign countries, as indicated by figures compiled by *The Economist*, shown in tabular form: "New Capital Issues in London."

Estimates of the actual export of capital based upon an analysis of the balance of trade indicate that in 1920 the nominal amount may have been as high as in the years immediately preceding the War, when it approached £200,000,000 per annum. In the following years, however, the amount fell off, reaching only £153,000,000 in 1923, £63,000,000 in 1924 and £28,000,000 in 1925. The general depression of trade has affected British industry severely, and while the aggregate accumulation of capital has certainly been much reduced, it is probable that a much larger proportion has been invested in Great Britain.

New Capital Issues in London

	For British Possessions	For Foreign Countries	Total
	£	£	£
1920	31,639,800	7,888,400	39,528,200
1921	90,577,800	22,223,900	112,801,700
1922	74,924,200	55,233,100	130,157,300
1923	92,722,900	44,754,700	137,477,600
1924	72,276,900	52,436,800	124,713,700
1925	60,919,000	16,276,500	77,195,500

During the greater part of 1925 it was felt to be necessary to maintain an embargo upon the issue of new foreign and colonial loans in London. This was consequent upon the measures taken

to restore the gold standard and was intended to prevent a strain on the foreign exchanges at a time when owing to incomplete adjustment of internal prices imports into the United Kingdom were likely to be unusually great and exports unusually small. The embargo was not statutory, but was effected by arrangement with the Bank of England which used its influence with the big issuing houses.

In Nov. 1925 the embargo was held to be no longer necessary and was withdrawn. Its withdrawal was followed by the placing of a large number of new foreign and colonial issues in London. Whether this is the beginning of a revival of the export of capital remains to be seen, but there can be little doubt that such a revival will result sooner or later from a recovery of world prosperity which will cause a renewed demand for British exports.

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(C. K. H.)

CAPITALISM.—Upon the concept of "Capital" in political economy theoretical dispute is interminable. To mix in that discussion is not to the present purpose. "Capital" is most briefly described as wealth used in producing more wealth; and "Capitalism," as the system directing that process. This latter term came into general use during the second half of the 19th century as a word, chiefly signifying the world-wide modern system of organising production and trade by private enterprise free to seek profit and fortune by employing for wages the mass of human labour. No satisfactory definition of the term has yet been found, though nothing is more familiar or important than the thing itself. Arthur Young (1792) calls capitalists "moneyed men." Coleridge as early as 1823 distinguishes them as having "labour at command." This aspect, seized upon by Karl Marx, is emphasised as a main distinction by economists whether favourable or hostile to individualist enterprise. The expression "Capitalism" is of Socialist origin and was used at first with an implication of reproach. It has been accepted with increasing confidence by those whom it meant to stigmatise; and is now the name—as opposed to Socialism—of a predominant economic system, always improving its sinewy and flexible organisation, adopting higher social ideas, and strongly progressive in effect. As the ruling alternative to Socialism it claims to be more modern in thought, more creative in method, more fertile in result, surer of the future because more capable of raising the average level of material prosperity and happiness, while enhancing the vigour, variety and zest of life by a richer play of personal initiative.

In this sense the economics of Capitalism are so deeply involved with politics and all sociology that it was regarded until lately as a subject unfitted for scientific treatment. While the Socialist indictments were elaborately considered, the statement of the positive case for Capitalism was much neglected. Only in recent years has it begun to be found under a separate heading in works of reference. It is still excluded from the latest re-issue of the English *Dictionary of Political Economy*. After some hesitation it has been rightly included and treated at length in the new post-war edition of the massive German compilation, *Handwörterbuch der Staatswissenschaften*. It was not amongst the thousands of headings in the eleventh edition of *The Encyclopædia Britannica*, though introduced into the Supplement of 1922. It demands unquestionably a separate article in an encyclopaedia not confined to economics, as more narrowly interpreted, but dealing with all the aspects of life.

1. *Capitalism in Action.*—It is extraordinary that the reality and practice of Capitalism have received not a tithe of the attention devoted in our time to Socialist theory. Science has been defined as accurate description of observed results. Modern Capitalism offers to accurate description a subject to be studied like physiology. It is more nearly a universal force than any other, spiritual or material, yet known. It operates and extends amidst all races, colours and sects. It is active more or less in all nations. Even Soviet Russia, after plunging through catastrophe in the hope of fulfilling the anti-capitalist dream has found itself compelled to recognise private ownership of the land—including the superiority of richer peasants over poorer—and to restore private trade to a considerable extent in towns. The only anti-capitalist Government is driven to seek loans from capitalist nations. In consequence of these lesssons, the Socialist and Communist pleas for the overthrow of the existing system of private property and free enterprise are more decisively rejected by a large majority of the world. Capitalism prevails more strongly than ever, in at least six-sevenths of the world. In the remaining part—the immense Eurasian territories of the Soviet Republics, more truly called the Soviet Empire—a still more complete reversion to private ownership and trade is to be expected, though the residue of State control seems likely to remain larger in the Russian system than in Western societies. Elsewhere private enterprise animates economic life in all the continents and impels their interlinking traffic. It is the strongest factor and the pervading influence in the daily affairs of all civilised peoples.

Everywhere the soil which feeds all other human activities is in the hands of private owners whose numbers have largely increased, especially in Eastern Europe and Russia, since the World War. Mines everywhere are worked by capitalist enterprise. Transport by land, sea, inland waterways and air is conducted generally by private direction utilising the funds supplied by hosts of individual investors. The dense towns and cities with their factories and workshops; with their swarming populations sustained by work for wages; with their myriad agencies of distribution by middlemen; with their conditions of housing, supply and conveyance—all these are creations of modern Capitalism. It is the agency whereby the intellectual achievements of thought and invention enter into the practical service of human life in all its forms at all its moments by means of an inconceivable number and innumerable variety of mechanisms ranging from engines of giant mass and power to the most minute and delicate devices. The tall chimney appears as a symbol at Rome and Athens, at Jerusalem and Benares, at Peking and Tokyo. This enormous enhancement of the productivity of human hands has brought into being some hundreds of millions of civilised populations who could not have existed and subsisted without it. As it has enlarged and altered out of recognition the white societies, Capitalism reaches into the depths of the newer continents and is stirring the most ancient Asiatic peoples. As an agency working ever more widely, yet ever more intensely, to transform by creative revolution the activities and conditions of mankind, to change ideas and stimulate effort over all the world, history has never known anything to approach the material power and saturating influence of modern Capitalism in bringing applied science to bear on life in the machine-age.

2. *Freedom of Individual Enterprise.*—This freedom to undertake risk and accumulate possession, is the breath and the life-blood of this system. Its edifices, its productive plant, the interconnecting chains of traffic and networks of communication by which goods and services are exchanged, different needs in all their multiplicity mutually supplied—all these to an overwhelming extent are created at the cost of private persons; and the complex organisations of human intelligence and labour required to work this system function under private ownership and control. Governments may facilitate and assist—as they may hamper and impede—the exertions of free enterprise; but Governments derive their own funds from taxes levied directly or indirectly on individual effort; nowhere has the State itself become a separate wealth-making power; nowhere has Socialism been able to make itself in the least degree a working substitute for modern Capitalism. The Bolshevik experiment rejected in agriculture by that 90% of the Russian people whose preference for private ownership is invincible, is especially inferior in industrial efficiency. This is why the Russian Communists by paradox feel the need of foreign capital for loans to postpone the collapse of anti-capitalism or disguise the reversion to its opposite.

3. *Rise of Machine Industry.*—The impartial history of Capitalism, not yet written, deserves many volumes by a Gibbon of economics. Only recent phases can be dealt with in this place. A golden age of equality and harmony is a dream of the future, but has never been a reality of the past. In dimmest prehistoric times the exceptionally competent individual must have been relatively more powerful than now; useful enough to be deified by his fellows. The superior craftsman and artist, possibly the superior director of average labour, emerged in the making of flint weapons and tools. Acquisition like leadership went with strength and skill. From the beginnings of recorded history, rich and poor appear. Kings and chiefs, able warriors and civil administrators, priests, merchants commanded the labour and services of the mass of men. In that sense, Egypt and Babylonia, Greece and Rome were full of capitalism and of every kind of private ownership including its extreme form, slavery. The Middle Ages passed through feudalism and serfage. The Renaissance and the Reformation alike carried Capitalism and the wages-system into wider development and more detailed activities. On the one hand the Renaissance enriched all creative ideas and multiplied desires; while the voyages of discovery opened the epoch of world-trade with its new classes of merchants and makers and its necessary retinue of middlemen superseding more and more the direct contact of producer and consumer usual in the more local intercourse of medieval times. On the other hand, acute economists have insisted that after the Reformation the spirit of Calvinism and Puritanism developed thrift, exertion, method, diligence, and all the other efficient qualities of what we call acquisitive individualism, to a degree, which prepared the ground for modern Capitalism.

Then in the latter half of the 18th century came the industrial revolution which has worked and spread with cumulative effect through five generations of invention and social change. Fixed and mobile machines, steam-power, oil-power and electric energy with its long-distance transmission of signs, sounds, light, heat and propulsion—these, purchased and directed by free enterprise in the economic sphere, are the present instruments of capitalist organisation in the 20th century as already very generally described. There is as much difference between the contemporary world and the world of a little more than a century ago as between the 18th century and the higher stone-age of ten thousand years before. The strong characteristics of the present phase are as follows: First the magnitude of capitalist operations far exceeds former example: the vigilance of their intelligence-departments must reach to the ends of the earth; trade and investment are international; every manufacturing nation, even the United States with all its self-supplying resources, seeks to derive raw material or choice commodities from every region of the globe and to find in every one of them a market for goods or money. Second, larger aggregates of labour are directed by larger corporations and companies, amalgamated or federated. With its trusts and syndicates and other ways of consolidating interests, capitalist management is forming into fewer but more massive units. The relations between employers and employed depend more and more upon impersonal system, less and less upon individual attachments or dislike; though exceptional personality as in the case of Mr. Henry Ford is more important than ever for progressive efficiency of production on the capitalist side and for promoting payment, welfare-work and other encouraging conditions in the way most likely to induce labour to give its best effort. Thirdly, though Capitalism concentrates the control while extending the scope of its operations as Karl Marx foresaw, the company-system confounds his chief expectation by immensely increasing the number of participating investors—multiplying small shareholders, and widening the social basis of the system.

4. *Early Abuses and Surviving Prejudice.*—The sharpest points of Socialist criticism were originally thrust against admitted and gross abuses in a period which has passed away. The worst of these evils have been remedied in most countries and remaining defects are as remediable. The positive case claims that Capitalism to-day in its altered working is not only the most productive economic system possible in the present state of society but that it is the most conducive to social welfare and progress.

During the last few decades and especially since the World War, the improvement in the character of the system has been in fact sweeping. That when the Marxist creed was framed much of his terrible indictment was true must be confessed by those who think his constructive theories fantastic. Machine-industry still in the crude beginnings of its evolution was like Milton's animals emerging at creation, half in the earth and half out of it. Many of its aspects were deformed and its effects vile. Swarming populations were huddled into mazes of mean streets, alleys and courts, put up and linked on without civic plan and regardless of health and decency. Throughout Great Britain the foul slums had already appeared and presented a scene of ugliness and squalor such as civilisation had never beheld. The large majority of the adult workers, and more than half their children, were totally uneducated. The Factory Acts were only just beginning to build up what became one of the finest codes of humanitarian legislation in the world. Before the first Act was passed, parliamentary committees had exposed the horrors of child-slavery in the mills; women stood at the loom from morning to night sometimes for 15 and 16 hours.

As the common soldiers had been called "food for cannon" in war, the common people at this time were "food for factories" in peace. The defensive efforts of Trades Unionism were still scattered and feeble. The employer was in an absolute sense the "master." As profits rose and fell hands were thrown on the streets or taken on again. The hours of all labour were cruelly long and wages wretchedly low. Capitalism at that phase was in fact a wrongful exploitation of flesh and blood. We must not lay all the blame on the capitalists. Narrow lights were usually all they had. The prevailing classical economists taught that unrestrained competition was the spring of effort and the key of progress; that the poor in the lump must always be cheap; that labour by fatalism would always breed fast enough to keep wages at the lowest level required for human subsistence. In the leading industrial nations these conditions and ideas have been swept away long since in a manner that Marx could not foresee; but the memory of former wrongs and evils still prejudices the name of Capitalism.

5. *The Creativeness of Capitalism.*—Now, while much remains to be done the working of the system is incomparably more satisfactory and enlightened maintaining the industrial masses of most white communities, but above all in America, at a higher level of prosperity and convenience than ever was reached before. Temporary post-War conditions shadow the European picture; but it is true even in Europe that the workers generally are better paid for shorter hours than in any previous period; that they are better fed and educated, housed and clothed; that they are better secured against all the preventable ills of human life; and that their opportunities for advancement and enjoyment have largely increased. Take first the question of creative success. Capitalism claims that however great may be the rewards it acquires for itself, it results in higher earnings, cheaper consumption and more various advantages than labour could have obtained otherwise; and this because, by ceaselessly seeking extension, improvement, novelty, by seizing on every idea likely to cheapen costs and enlarge turnover, by looking vigilantly for the ablest persons, the system is dynamic and progressive through the rule of its nature.

More surely and quickly than ever before the backward or stationary methods in business are eliminated by energetic and resourceful rivalry. Freedom of enterprise is the creative element in economic life. It stimulates the originality of idea, ingenuity of method, boldness of attempt that the routine of public administration tends to fetter or stifle. The capitalist in this way shares the spirit of the adventurer, to whom pursuit of the personal idea is the breath of his being, and of the artist for whom freedom of individual expression is the vital condition of creativeness. Capitalism swarms with imagination in action. Every day thousands of heads in business relying on their own

perception and courage are taking decisions and risks from which any public official or committee would shrink. Fresh initiative and invention never can be the characteristics of government departments, least of all under democratic conditions where the dread of hostile criticism is a continual deterrent from attempting any purpose, however successful in the long run, which at first only appeals to a few or to one. Again the swift use of time is part of the essence of success in private enterprise. Public officials and offices have to wait until "opinion is ripe"—until they can count upon the approval of the many, and that commonly takes a long while. For these reasons, Capitalism gives to economic life a vigour of impulse and creative fertility which no other method yet suggested seems likely to supply in anything like the same degree. By comparison—argue the modern advocates of individual ownership and direction—Socialism would mean at least arrested development, and probably an actual decline in general prosperity and welfare. Many a great undertaking employing thousands of workers has sprung from the idea of a single mind or from the intrepid judgment of a single character finding beforehand amongst other men little support or none.

6. *Vital Elasticity of Capitalist Organisation.*—Further, capitalist enterprise large and small concentrates in a million ways particular minds on particular problems. The needs, desires of every day in a civilised society, the new wishes always being awakened by new things offered, these are as the sands for number and as the sea for endless changes of shade and motion. Consider the numbers of capitalist persons who are engaged on making in gross and detail the countless adjustments between supply and demand in their infinite variety. Conceive all the different processes of specialised intelligence that are involved. It becomes impossible to imagine in the present state of science how this living maze of private activities, each bent upon some one part of supply and demand, could be replaced under any form of Socialism by officials and committees without the same scope for personal initiative and contrivance—thus lacking the acute attention and supple adaptability that the present system on the whole compels. This is a chief ground for the conviction of thoughtful interpreters of Capitalism in every great industrialised nation that private enterprise is not only the most powerful force of economic creativeness but also the most elastic means of economic organisation for adjusting supply and demand.

Private Capitalism makes overseas investments. In any country it may provide funds for developing the productiveness of other countries; of regions thousands of miles away; building railways, opening mines and oil-fields, financing plantations—as for rubber—founding banks. British investments, for instance, in North and South America, in Asia, Africa and Australia—above all in United States railways during the generation after the Civil War—have done more than anything else to provide British labour with an abundance of cheap and varied food on the one hand, and on the other with cheap raw material to the benefit of employment and wages. Once more, we find it not easy to see how any kind of Socialist State could make overseas investments in this way, or conduct inter-connected banking, or maintain the present complex and sensitive mechanism of credit—that most wonderful achievement of creative Capitalism—or provide and allocate the fresh capital required for enterprise and industry, for employment and wages. Under the present system, that fresh capital is furnished by the private accumulations made possible by freedom of private action.

7. *Progress of Labour-Enhancing Equipment.*—Turn to another aspect—progressiveness in equipment. Modern Capitalism results from the steam-driven or electric machine dependent on coal, oil or water-fall. The rapid increase in our own time of the part played by mechanism in comparison with hand-labour is not less marvellous than were the beginnings of industrial invention. It is stated, for example, that in the most modern engineering shops 80% of the work is done by the machines and only 20% by the attendants. One attendant may now keep in play several machines doing the former work of scores of men. The eagerness of private capital to perfect equipment has given increasing stimulus to invention. In any Socialist State political pressure arising from fear of unemployment would have prevented that State, were its democratic opinion genuinely free, from pushing technical progress to the utmost as Capitalism largely does. By the astonishing increase of miracles in metal, performing their intricate processes as though actuated by a mysterious intelligence of their own, the present productiveness of manual effort is enormously raised by contrast even with the latter part of the 19th century. This means that supply is cheapened, demand widened, the conveniences of life made more numerous and accessible, while employment is steadily enlarged in civilisation as a whole, and human well-being is energetically advanced in all material respects.

Other characteristics of Capitalism, especially in the United States, where it shows its highest powers of technical progressiveness and many of its best effects on the conditions of work, are the standardisation of models and parts, the speeding-up of processes, and the elimination of waste whether of material or time. These things are now made the subject of close and even subtle study. Nothing human we know ever can be finally perfect; ideas always advance beyond achievement. But when we look at such large effects of Capitalism as are unquestionably good, every dispassionate thinker must admit that the system is as prodigious in ingenuity as tremendous in power. The present writer holds it to be altogether improbable that production and exchange in the modern world could have been as progressively organised by any other means.

8. *The Human Factor and the American Example.*— We pass here to another and deeper part of the examination. We have studied the working of modern Capitalism as a means of animating production and facilitating exchange, stimulating demand and adapting supply; and we have seen reason to think that any extensive attempt to replace it by public ownership and management would mean something far less plastic and fertile, incapable of the same degree of wealth-making power and distributed prosperity. But what is the effect of Capitalism on the labour it employs—that is upon the large majority of human beings where the system prevails? How far does it serve the greatest good of the greatest number? Again we must note —though ideals must always move ahead however far practical improvement marches—that since the time when Socialism formulated its charges and framed its dogmas, there has been a surprising change for the better in the principal matters of wages, hours and provisions for personal health and physical security. A steady general movement has reduced working time, and raised money-earnings, still more real earnings as measured by purchasing-power. That any system of public ownership and official control could enable a less amount of labour to enjoy an equal buying-power is an assertion out of the region of proof and any man is free to think it as far beyond credibility. This is, of course, a central point in the discussion.

It cannot be said any longer that capital habitually and necessarily extracts from labour an undue effort for an unjust reward; that manual workers are demonstrably and usually paid less than that part of the value which they contribute to the selling-price of the common product; or that average labour could hope to earn more or as much per hour if the creative aid of free enterprise were abolished. "Exploitation," in the sense of the old-fashioned Socialist phrase, when the evil fact prevailed, is no longer a ruling accompaniment of the economic system in the leading capitalist nations. No doubt, the success of labour in securing the utmost proportion of the selling-price compatible with production at a profit differs much in different countries. On the European continent, as in Germany, wages on the whole bear a lower ratio to profit than in Great Britain where various convergent influences—trade unionist pressure reinforced by political power on the one hand, and on the other, a unique degree of freedom from indirect taxation coupled with large contributions by the minority of direct taxpayers to popular benefits—enable the working-classes to exact as full a payment in proportion to output as can be given without threatening the disappearance of profit and the debility of enterprise.

In America, however, where what we may call the new or reformed Capitalism is in operation on the largest scale, high wages are accepted and welcomed as a vital principle of creative capacity in a way that Europe is only just beginning to comprehend. But what is the inference? Obviously that Capitalism everywhere can follow where America leads—that Capitalism as a system is by way of becoming a more willing and vigorous instrument for the greatest good of the greatest number than original Socialism could imagine. In the United States over a hundred millions of people have reached common standards of comfort and enjoyment far above the best known in Europe and immeasurably above any social achievement in the world's history. As has been said this gigantic example in the United States of wealth-making with a large-minded distribution of the proceeds, is the result of equipping man-power with all the mightiest and nicest aids of machine power. Models and parts of the things to be made are standardised to cheapen repetition and replacement; all unserviceable complications are cut out; the processes of production are speeded up while more and more waste is eliminated. Far as that remarkable process has already gone, its further possibilities are seen to be very wide. Profits are sought not by making high prices an object in themselves but by reducing prices in order to enlarge demand and quicken turnover. In American enterprise individual abilities find the freest scope, the promptest recognition and the amplest reward.

The welfare of the workers is seen to by bringing into the factory system more safety and health, more lightness and brightness. Expert research into the possibility of improving mechanism, processes and use of materials is more widely and liberally encouraged than anywhere else. The spectacle of hosts of American workmen with their own motor-cars is a thing that would have staggered Karl Marx, most of whose generalisations drawn from the temporary conditions of mid-Victorian England are confounded by 20th century America in general and particularly by the methods of Mr. Henry Ford. As an instance of the extent to which material progress may increase moral resources it may be noted that more money is spent in America on education than in all the other nations together. It need hardly be said that we must not conceive a too ideal picture even of the United States. Not all the fields of American industry are Elysian fields. American thinkers assert that in some coal-areas in America relations between Capitalism and Labour are harsher than in western Europe; and that in other industries the example of the most progressive employers is far from being sufficiently followed. Some European experts protest that superabundance of wealth and material are still causing more wastefulness in certain directions than the scientific anti-waste movement is removing in other ways. But on the whole the American scene is magnificent in economic achievement and full of human promise. As against the culmination of the success of private enterprise in the United States, the only example of thorough Socialist attempt on a large scale is Russia as we see it.

9. *The Widening Social Basis of Capitalism.*—Above all, perhaps in significance for social advantage are the modern facts which refute the prediction that wealth would be concentrated in fewer and fewer hands until Capitalism more and more isolated was either terminated by helpless surrender or overthrown by the insurgent violence of the exploited masses. Taking civilisation as a whole the relative numbers of those personally interested in the maintenance of private enterprise grow every day. Under the company system we have seen continual and accelerating reinforcements of the ranks of small investors and owners of every kind. Hosts of people who work for salaries and fees prefer the private system and decisively reject the other, many of them no doubt as much desiring the further reform of Capitalism as opposed to its abolition. This movement has begun to act on labour proper in a manner that is one of the more suggestive revelations of our time. The United States is far ahead on this line also but it only leads the progressive ideas of Capitalism elsewhere. It is estimated that the number of small stockholders in the United States will be 20,000,000 in a few years more. Large numbers of workers have holdings in the concerns which employ them. In some cases, thousands of workers contribute their savings to nourish capitalist enterprises and are members of the corporations they serve. In one large motor concern over 90% of the employees are buying stock on the instalment plan. In another business the investments of the workers give controlling power. Yet another company's employees doubled in one year their holdings of its stock. It would seem difficult to overestimate the importance of several influences belonging to this novel development.

With bigger wages for bigger output there is incentive to thrift; a spur to energy and aspiration; a discipline of character; an interest in the business as a whole and in the wider life which it serves; a stimulus of economic intelligence; an added sense of responsibility; and a gain to the spirit of existence. It must be remembered that the actual majority of the population in France are small capitalists whether as property owners or rentiers. In Great Britain, on the one hand individual investors in company shares are a big aggregate; while, on the other hand, many millions of the working-class population, probably a third of the whole, are interested in the public funds through the War Certificates and Savings Banks deposits. Lively interest is aroused by plans for profit-sharing and co-partnership. The familiar instalment system in the United States and building societies in Great Britain have induced some millions of persons in the last half-decade to become private owners by buying the houses they live in. In Great Britain as in Germany the schemes for associating labour by consultative committees with the management of industry are more or less officially encouraged, while in the United States the voluntary action of capital has made a beginning with the same method. This movement as yet is rather an experiment than a power; but later, in connection with stock-holding by labour and other methods of profit-sharing, the method of joint councils may well arrive at epoch-making results.

10. *Summary of the Present Position.*—We may now state the salient features of a full view. Capitalism generally in its worldwide undertakings has risen to this height and breadth of productive and distributive success. Where Capitalism is most powerful, as in the United States, labour is more prosperous than at any previous phase of history and asserts a better individual status. Where wealth thus created is most abundant, either the provision for education is more liberal, as in the United States, or as in Britain the evils belonging, amongst the workers, to sickness, accident, disablement, widowhood, orphanage and old age, are mitigated by State-aid maintained by increased taxation chiefly levied on the capitalist classes. While Capitalism does in fact tend to concentrate into fewer and larger organisations the total number of investors has grown rapidly. The capitalist system is indeed built pyramidwise, but instead of coming to a last hopeless attempt to stand upon its apex, according to the Marxist vision, it broadens its basis more than it raises its altitude. The original Socialist predictions have been falsified, with the usual irony of human anticipation.

11. *Capitalism and Unemployment.*—None the less we must take account of revised Socialist criticism and inquire into its validity. Charges to some extent contradictory have been partly answered in passing. Capitalism is still accused of responsibility for avoidable unemployment, arising from the periodic alternations of climaxes and depressions in trade activity, of " booms " and " slumps," to use the coarse but telling jargon. It is certain, however, that though there must always be some tidal movement of rise and fall, the former violence of these rhythms is now much abated in times of peace owing to longer experience and fuller knowledge; to swifter information in every part of the globe of what is happening in every other; to quicker transport, the better-calculated control exercised by the great trusts and syndicates as indirectly by the great banking combinations; and to the better adjustment altogether of the world-forces of supply and demand. These improving tendencies, we must note, belong in their nature to a condition of peace. General war in the modern world is a catastrophe necessarily followed by an exceptional mass of unemployment in the countries where trade

and finance have been most severely dislocated by hostilities. Extreme Socialists blame capitalism for war as for every evil. They are deluded. Racial passions, fears and claims are main causes of war far older than capitalism, which though in some of its forms sharing and even stimulating the bad or mad feelings existing without it, is on the whole amongst the more pacific influences, especially in its form of international finance. Before the War chronic unemployment in a country like Germany had been reduced to about 2% of a volume of labour continually expanding. This shows that the higher figure in Great Britain was not due to any defect necessarily inherent in capitalism.

The United States at the same time was subject as it were to larger and looser forces which have since been restrained. Unemployment is far from being only a question of economics. It is profoundly affected by biology in the shape of a lower or higher birth-rate and by policy in the shape of more or less restricted emigration or of tariffs. Psychology plays its part, as in the changes of taste and fashion, which throw out particular bodies of workers from time to time. As nothing suggests that official management of industry could have created the extent of employment now existing in the world, so there is no reason to believe that the most complete State control could make the movements of rise and fall in trade milder than they have become. No human system, let us repeat, can hope to be perfect. Before modern capitalism existed—for instance, in medieval times often absurdly regarded as a golden age—the chronic unemployed abounded as beggars and vagabonds; while every bad harvest diminished work in the towns; and recurrent famine meant disaster for urban labour as well as rural.

12. *The Questions of Speeding-up, Subdivision and Monotony.*—Frequently capitalism still is accused of injuring the physique of the worker by the modern intensity of speeding-up in machine production; the mind and moral being of the worker by a remorseless monotony. The first indictment generally seems untrue, and the second very exaggerated. As regards human health the statistics for many manufacturing centres are more favourable than they have ever been in history. For instance, the industrialisation of Germany after 1871 was followed by an increase of longevity. The average duration of individual life was raised from about 37 years in the decade 1871–80 to about 47 years in 1900–10. Though sanitation plays its part here, capitalism is evidently no obstacle to the progress of sanitation any more than to education or of any other good human purpose. The wealth it makes supports these things. But then it is repeated that machine-industry at least injures the mind and spirit of the worker by extreme subdivision of effort, involving an eternal repetition of work on small parts and thereby a soul-killing monotony. We come to a very interesting discussion where the worst conclusion of the argument would cut both ways. In fact this general injury to the cheerfulness of the workers is not to be observed. Their demeanour at football or baseball matches and at the cinema or on any of their holiday occasions does not confirm the theory of their psychic depression. On the one hand, those workers who execute with their own hands and repeat endlessly only one small part of a process of manufacture are in sight of the manifold and stirring organisation of the whole. More and more, as in America, the miracles of the machine quicken their intelligence, especially as their education advances. Again, millions of the more expert artisans work in teams, as it were, on mechanisms of colossal power and intricate cunning which are always dramatic. The linotype operator, yet again, repudiates the suggestion that he is a more soul-less being than the old compositor who set type by hand, while no chauffeur will admit that he is less intelligent than the old coachman.

13. *"Socialism no Solution"—Capitalism or "Erewhon."*—In any case this particular argument against capitalism is a tool which turns its other edge against the user. So far as the modern subdivision of machine industry is disadvantageous, that is evidently the result of the whole modern movement of technical science and not of the capitalist application. Under Socialism a factory would be still a factory. Public ownership would have to take over the buildings and plant, and pursue the same methods of mechanical efficiency, with all such monotonies of minute repetition as are now denounced. Without destroying the basis of industrial employment and of the manufacturing towns Socialism could not do otherwise; and therefore by no possibility could it make such large changes for the better in the average conditions of human life as it is accustomed to assume.

Some anti-capitalist thinkers say, indeed, that the whole system of industrial civilisation is a mistake; that it has brought into being excessive masses of people who are only a higher kind of automatic machines; that man loses his true happiness and deepest faculties and strongest character when divorced from nature and the soil; that the country originates the abilities which the town devours; and that the true solution, as in that profound satire "Erewhon," is to destroy the machines, prohibit their revival, and to return to agriculture and handicraft. This is a fascinating vision of ideal romance, and it sounds a moving chord to the ear of imagination; but as a practical argument it offers no escape. It comes too late. The industrial revolution is there, far advanced, and irreversible except by some catastrophe which would engulf all white civilisation. Labour on the soil means monotony and repetition of another kind with a harder life. Variety and leisure are far from the traits of the French peasant's existence. No average town-worker afflicted by the evils imputed to capitalism is willing to go back to the spade and the plough. On the contrary, agricultural labour is more attracted by the towns; while, further, the prosperity of farming and pasture depend on supplying the swarming populations called into being by capitalist industry. These interrelations of machine civilisation must be accepted. The real problem is to make the best of them.

14. *Reformed Capitalism Likely to Prevail.*—The Russian example and the failure of Socialism everywhere to reach any kind of constructive success have resulted in a ruling and strengthening conviction that the suppression of private enterprise and its replacement by official control would be a leap in the dark with the presumption of coming to grief. The old-fashioned centralising Socialism with its army of bureaucratic agents would mean a slow sterilising régime fatally influenced by political patronage, discouraging initiative and repressing independent personality. That this plan would be unendurable is felt by the younger Socialists. Their Guild system, however, with self-rule for each industry, raises many more difficulties than it solves. How could the same work in the same factory become more pleasurable than now because the State or a guild owned it? Human nature is not so constructed. How could the big guilds adjust their exchanges, their relative claims to importance and reward, without formidable disputes? What would happen to the smaller miscellaneous industries? To picture this theory as a key to natural harmony is a myth. Who would entrust savings, did they continue practicable, to Socialist banks, and who would invest by preference in a Socialist country?

Private accumulation being impeded or prevented, how could democratic ownership and control keep in flow the supplies of fresh capital always needed for progressive industry and enlarging employment? If any national total of such fresh capital were available at all, how could it be allocated to meet the competing claims of different publicly owned industries? If the present possessing classes were abolished, so that annual revenue could not be raised from them as now, and direct taxation consequently were applied to the multitude, how would the people like that change? Would not hope be frustrated and subversive discontent aroused when it was found immediately that the part of the social dividend distributed to the average worker was disappointingly limited, low indeed, by comparison with the dream, and lower than the highest rates of wages now paid? The large majority of thoughtful men acquainted with the creation and management of business are utterly persuaded that every imaginative alternative to capitalism yet proposed for advanced societies, would either be a practical recipe for chaos or for a cruder order amounting to a throwback in civilised organisation. It is thus probable that for a long time to come social progress will seek its goal not in Socialist proposals inspired

by obsolete criticism of former conditions now so largely removed or remedied or shown to be remediable under the system of private enterprise; but rather in the development of the present tendencies of what we have called the new or reformed capitalism.

15. *Remaining Defects and Problems.*—Some of the strongest defenders of capitalism as the best system are yet amongst the frankest analysts of its remaining defects and abuses. These defects and abuses are in the way of correction by the convergent power of several growing forces—scientific thought, public criticism, the political power of democracy, the consequent pressure of legislation and the enlightened self-interest of capitalism itself. More and more subject in society to the conscious sovereignty of the greatest number seeking their greater good, intelligent capitalism sees that it must set itself in every way to serve the common interest. It must work so that its preservation shall be recognised as a vital part of the common interest. One broad remaining defect is that very many employers everywhere, especially of the older school, still fail to recognise that where capitalism stakes money, labour, taken as a whole, to a vastly larger extent, stakes life. Labour on the initiative of wise capitalism must be taken more and more into partnership by profit-sharing schemes, by extending stockholding amongst employees, by joint councils not impeding the executive, but entitled to discuss general questions of policy or management and furnished with all details of costs and profits. Evasion of publicity with regard to costs of production and real profits is the mother of suspicion. A more hardy frankness must come.

In some countries, certainly in Great Britain, the chief complaint against excessive profits comes rather from the consumers. They complain of middlemen even more than of "rings"; and political action in Great Britain distinctly tends toward restraining prices thought unfair. The threat of interference is in itself some deterrent; and the consumers have no belief that labour control would mean cheaper supply. Yet public opinion insists strongly that trusts and syndicates shall not exploit the consumer in the temper of the old monopolies. Capitalist concentration may safely result in any extent of profit to the promoters so long as, by lower not higher prices, and by more assiduous services, it conduces to the plain advantage of the general community. Other evident and even glaring problems are inherited wealth, the "idle rich"; pretentious and wasteful ostentation or what is called "prurient luxury"; efforts to acquire oligarchical or even pro-consular power over the nominal forms of political democracy by the influences of money. All these things the rightly judging majority of capitalists condemn as wrong in principle and most dangerous to the system. The man who makes his own wealth is looked upon with approval or tolerance by public opinion, and the most dazzling fortune personally achieved is apt to be admired rather than censured.

But it seems tolerably certain that democracy will restrict severely the possibilities of passive inheritance; and will prevent or limit the enjoyment of the advantages of wealth by those not contributing to its creation by personal usefulness. Even on this question, which affords a facile means of appealing to popular indignation, we must discriminate. We must remember as a rule the "idle rich" do not represent idle riches. Their money is for the most part invested in productive enterprise, and their personal waste in its effect upon the community is by comparison an inconsiderable mischief. Nevertheless wealth without work, however its actual evil may be magnified in popular imagination, is seriously obnoxious to democratic susceptibility. The case for active capitalism is fortified by every measure public and private tending to restrain the power of money in the hands of indolence. That excess of personal indulgence described as "prurient luxury" has been known in all ages under all systems, and occurs in the present day under capitalism, Bolshevism, Fascism, Kemalism as an abuse not only of the corrupting possibilities of private wealth but of the equally corrupting possibilities of every kind of political and social influence wherever those who possess it seek to gratify a vicious habit. This immemorial disease has no moral relevance to modern capitalism as a system, and could not be cured by the abolition of private wealth. It is a problem of personal morals which has recurred under every social system, and can only be grappled with by methods not inspired by economic considerations.

Lastly, it must be recognised that a different kind of abuse is the broadest blot on the capitalist system. In cases no longer so common but still not infrequent, the providers of capital, taking no part whatever in the active management of business, are content to receive big dividends without extending any kind of profit-sharing or co-partnership to the salaried experts and workers for wages who in combination produce the dividends. The principle promising to spread in the future is that the interest on passive capital should be limited to some definite though not grudging figure; and that the bulk of the profit should be divided amongst those whose exertions and contrivance create it.

16. *The Future of Capitalism.*—While prophecy is vain, "probability is the guide of life." We must frame our estimate of what is probable, as well as of what is attainable and ought to be attained. As Socialism inspires vivid dreams, Capitalism for its moral vindication must have ideals as definite and more practicable. There is a rising supremacy of liberalising public influence. Advanced social thinkers who are yet strongly opposed to Socialism believe that private enterprise which they hold to be the best wealth-creating force is in gradual process of becoming also the best wealth-distributing system in a way that will raise the average of human prosperity to the highest attainable level. They anticipate therefore that the interest on money itself will be limited by maximum rates never so low as to discourage saving and investment; that the directing ability of active capital must remain entitled as now to large rewards in proportion to success in enterprise; but that as the education of democracy progresses labour will not only receive wages steadily increasing relatively to profits, but will everywhere share in the division of profits; while becoming more and more associated in consultative councils with the management of industry, and enjoying every possible opportunity to rise from the ranks.

In this fashion, therefore, capitalism would realise in the end all that is really sound in the practical ideals of Socialism while preserving that creative play of free ambition and adventure which is most surely stimulated by the chances and prizes of personal success expressed in terms of high income and acquired fortune whether large or small. To consider private profit in itself as sordid or immoral is superficial. Artists as usually as capitalists dream of large gains and splendid habits. Poets, dramatists and novelists, painters and architects, musicians, actors, still seek, or at least readily receive, as in fact they always have done, the largest personal gains that the demand for their achievements can bring. On the basis of more and more intimate partnership between capital and labour as here contemplated, methods of arbitration and conciliation would prevail and the lingering barbarism of strikes and lock-outs would disappear. The total yield of industry would be so largely enhanced by the fullest energy and harmony of common effort, that the earnings of the average might be far higher than now but the rewards of exceptional success not less ample nor even less dazzling. That freedom which maintains inequality does in fact lift the general level of existence, which forced equality would depress. Nevertheless, there is an ardent tendency throughout civilisation to insist that the privileges of society shall only be enjoyed by those who sufficiently participate in its activities and duties; that up to a reasonable age personal work must go with wealth.

Nor is this all. As capitalism for its own sake must be an instrument for applying the results of science to the general advantage, its function in that respect is becoming ever more effectual and hopeful. From the dirt and crudity, the utilitarian ugliness and social miseries of the generations immediately following the beginning of the machine-age, we are moving towards a smokeless civilisation commanding more sovereign and more subtle powers than we yet possess. The disappearing smoke is a physical symbol of the disappearance of moral evils in human relations and conditions. The machine which in some industries already does four-fifths of the work must come to perform nine-tenths of it in most industries. It is bound to eliminate the coarser

kinds of heavy manual toil. We may reasonably expect that amongst the advanced industrial nations whom America is leading, every worker will become on the one hand a skilled man using fine touch with understanding, and on the other hand an associate of capital, taken into counsel on the general conduct of business, sharing profit and responsibility. Evolution in this manner seems more likely to be the general way of the world instead of revolution whether by legislation or violence. While maintaining all the energy and nimbleness of free private enterprise, enlightened capitalism, consciously working everywhere towards the ideals here described, can bring about so large an improvement upon the best social conditions at present existing that Socialism, no longer able to promise a new heaven and a new earth by comparison, will cease to think it worth while to seek a change. Not conflict between capital and labour but their real partnership in counsel and profits is the sure path of social vision between theories leading into the unknown or violence that either plunges into a morass or heads for a precipice. One of the deep problems is not economic. Capitalism in the past has contributed too much to ugliness in the world. The capitalism of the future must seek to enter into the service of art and beauty.

BIBLIOGRAPHY.—The classic work on economic freedom is Adam Smith's *Wealth of Nations* (1776). Much of his argument as to the value of private enterprise and initiative remains valid. Alfred Marshall's *Principles of Economics* (8th ed., 1920) and *Industry and Trade*, 2nd ed. (1919), contain a masterly analysis of the principles underlying the existing economic system. In a brilliant essay on "The Social Possibilities of Economic Chivalry," published in *Memorials of Alfred Marshall* (1925), he contrasts the sterility and the deadening influence in the long run of governmental management of industry with the elasticity of private enterprise.

An excellent account of economic tendencies and their practical operation is given in a recent work by an American economist, Professor F. W. Taussig—*Principles of Economics* (1921–2).

Besides these general treatises, other recent works which bear directly on the form of the economic system, and which are written from a scientific standpoint, include: Edwin Cannan, *The Economic Outlook* (1912); R. G. Hawtrey, *The Economic Problem* (1926); D. H. Robertson, *The Control of Industry* (1923); J. H. Jones, *Social Economics* (1920). M. H. Dobb in *Capitalist Enterprise and Social Progress* (1925) makes an acute critical analysis of the place of the *entrepreneurs* in the evolution of the present industrial system.

The above-mentioned books are all academic in outlook and treatment. Very few of those who are or have been engaged in industrial or commercial enterprises have utilised their experience and practical knowledge to write in defence of capitalism against the onslaughts of its Socialistic critics. Amongst such works the following are of special importance: *My Life and Work* (1922), by Henry J. Ford and S. Crowther, gives a very valuable first-hand account of the methods by which one of the greatest and most successful modern businesses has been built up.

Both in *Confessions of a Capitalist* (1925), by Sir E. J. Benn, and in *The Case for Capitalism*, by Hartley Withers (1920), a vigorous defence of capitalism is put forward from a practical point of view. A. Shadwell in *The Socialist Movement*, 2 vol. (1921), urges the superiority of private enterprise.

A number of important books dealing with the history and theory of capitalism have appeared in German, of which the following may be mentioned here: Fritz Gerlich, *Geschichte und Theorie des Kapitalismus* (Leipzig, 1913); J. Strieder, *Studien zur Geschichte Kapitalistischer Organisationsformen* (Munich, 1914); Werner Sombart, *Der Moderne Kapitalismus*, 2nd ed. (Leipzig, 1919); this is a very comprehensive work characterised by much originality of ideas and clearness of exposition, in which is set out the history of modern Capitalism down to the end of the 18th century, together with a brilliant analysis of the chief psychological and other factors governing its origin and progress. Richard Passow, *Kapitalismus* (Jena, 1918); Karl Bücher, *Die Entstehung der Volkswirtschaft* (1918–9); Georg von Below, *Probleme der Wirthschaftsgeschichte* (1920); O. Spann, *Der Wahre Staat* (1921); L. Pohle, *Kapitalismus und Sozialismus*, 3rd ed. (Leipzig, 1923), a good defence by the Professor of Economics at Leipzig of capitalism on economic and general grounds, and a critical account of the theoretical but especially of the practical errors of Socialism. August Pieper, *Kapitalismus und Sozialismus als seelisches Problem* (1924); J. Walcher, *Ford oder Marx* (Berlin, 1925), a comparison of the consequences to the whole community, and above all to the working classes, that would result from the adoption on the one hand of the principles advocated and applied by Henry Ford, and on the other of the destructive and barren tenets of Karl Marx.

Among French and Italian works consult: C. Gide, *Principes d'économie politique* (1910); D. Bellet, *La machine et la main-d'œuvre humaine* (1912) and *Crises économiques* (1918); A. Aftalion, *Crises periodiques des surproductions* (1913); Yves-Guyot, *L'industrie et les industriels* (1914); N. Colajanni, *Il progresso economico* (1913); G. Arias, *Principii di economia commerciale* (1917). (J. L. G.)

CAPITAL LEVY.—During the first year of the World War it was thought in Great Britain that a loan policy should take the first burden of its cost, but as soon as it became obvious that the War would be a long one, it was equally clear that the amount of the war debt would reach figures quite unprecedented in financial history. There was the apparent impossibility of meeting the cost from current resources, either by taxation or by loan, and also a strong desire to avoid the evils of currency inflation. Great Britain had so long been regarded as a very wealthy country that it seemed that its accumulated wealth might well be laid under toll.

Early Suggestions for a Levy.—The first suggestions for a levy in Great Britain seem to have been made by Mr. W. Watson Rutherford (Nov. 19 1914) in the House of Commons. He proposed a 5% tax on capital, which would produce £500,000,000 and be taken in kind in the case of shares or real estate. He thought that the majority of persons would gladly pay if they understood that the levy was to take the place of a high income tax. It was put forward therefore as a sound business proposition. Sir Thomas P. Whittaker, M.P., in May 1915 proposed a 2½% levy to raise £250,000,000, which was described as an attractive proposal, but very difficult to carry out. Professor A. C. Pigou, one of the earliest academic supporters of the scheme, incorporated a detailed proposal for the special taxation of earned income to balance the special levy on objective wealth and thus make the whole scheme logical.

Development of the Plan.—The theory of "commutation," or the "business deal," did not, however, long hold the field. A considerable degree of inflation was taking place, and many were preoccupied with the inevitable fall in prices expected after the War. It was obvious that the repayment of £1,000,000,000 of debt at such a time involved far less real production and effort than the repayment of a similar amount when the price level should be lower in years to come. Moreover, what was a tolerable burden of interest at a high level of prices would become intolerable at some future period at a much lower level. It was said that "where we had borrowed one pair of boots we should really be repaying two," for, the debt being in sterling, sterling would in future have a much greater purchasing power with a lower price level. The proportion of the debt charge to the national income at that time was probably not more than one-eleventh or one-twelfth, whereas if the price level went back to its pre-war position that same sterling debt charge might represent one-sixth or one-seventh of the same real national income. Everything else in the national income might go down with the price level, but the debt charge could not. It was urged, therefore, that the opportunity to make a very substantial reduction in the indebtedness by a special levy on individual fortunes should not be missed.

During the last two years of the War the case for the levy became reinforced by two powerful semi-ethical considerations. In the first place enormous fortunes were being made, despite heavy taxation by income tax, super-tax and excess profits duty, at a time when large numbers of people were impoverished through the War, and it was considered to be wholly unjust that people who were able to avoid the fighting line should in addition secure a much greater personal wealth than they had at the beginning of the War.

Moreover, conscription brought into prominence the so-called contrast between "life" and "wealth," and it was said that conscription of life on the part of the able-bodied should be matched by conscription of wealth on the part of the rich. Simultaneously, the argument arose that the War was one brought about by the old and fought by the young, that the old would chiefly benefit, and that it was unfair for the young to bear first the burden of fighting, and then, for the rest of their lives, by a toll on their effort and production, the burden of interest payments to those who had never borne their physical share of the conflict. These and other arguments led to considerable discussion.

Approval of the principle of the levy was at first not confined to any particular political party. Mr. Bonar Law at one time showed a definite leaning towards the proposal, and a small group of economists were in favour of it on broad grounds. The chief battle-ground of controversy was the question of the practicability of carrying through so gigantic a financial operation without dislocating the delicate financial mechanism of the country, bringing about a wholesale slump in stock exchange prices, robbing industry of credit, and generally undermining the whole foundation of stable values upon which the idea of the levy rested.

Proposed Levy on War Wealth.—After the War the discussion took a specific direction, viz., it proposed to confine the levy to "war fortunes." It was realised that a capital levy would tax two fortunes of £20,000 identically, although one might have been reduced from £50,000 owing to the War, while the other might have been built up from practically nothing. The capital levy, therefore, was seen to work considerable injustice, judged from purely ethical standpoints. The proposal for the moment thus became limited to the levying of a tax upon fortunes, which by a common public sentiment were regarded as specially fit for such a burden. It was soon, however, agreed to be administratively impracticable to examine every individual circumstance and to decide in which particular cases the increase was actually due to the War, so that a new proposition was put forward that *anybody* who had had an increment in his fortune between 1914 and 1919 would probably be a suitable subject for such a tax.

Report of a Select Committee.—Early in 1920 post-War inflation and the great amount of the floating debt, with its continual renewal in cost and competition, created a difficult and dangerous situation. It was thought that a special levy would raise from £500,000,000 to £750,000,000 and, by reducing the floating indebtedness, would conduce to stability. A select committee of the House of Commons considered the question early in 1920. Its report was not conclusive, but, in any case by May 1920, the financial situation had definitely turned, prices declined, and it was thought to be positively dangerous to adopt such a highly difficult expedient at such an unpropitious time.

Resumption of the Capital Levy Proposal.—Under those conditions the financial objections to a general capital levy became stronger and more pronounced on many sides. Apart from a few supporters in academic circles, the programme became almost entirely identified with the Labour party, and the grounds upon which it was put forward were also gradually shifted. It was no longer specially urged as a composition by the taxpayer for his own future liabilities. The main dynamic argument with the Labour party was the fact that the heavy interest charges included in the Budget necessitated such high rates of direct taxation and such pressure for reductions in taxation that it became impossible to budget for any substantial new programmes for social reform, and to incur greater expenditure on housing, education, pensions, etc.; it was clear that the burden might delay expansion indefinitely. It was thus desired to relieve the Budget of a large part of its annual interest on the expenditure side, in order to allow room for expenditure on other objects.

On coming into power the Labour party appointed a special committee to consider questions relating to national debt and taxation (the Colwyn Committee). Eminent academic witnesses who had previously supported the scheme assumed that the opportune moment had passed, and others, because it appeared that the net yield would be inadequate, having regard to the disturbance and risk entailed relinquished the idea.

Summary.—The chief financial and economic contentions on the two sides for and against a levy may now be set out. The ethical considerations that once loomed so large became later less prominent. The chief objections may be classified as follows:—

1. *Repetition.*—A successful levy, although definitely aimed at relieving war debt, can give no guarantee against repetition for other purposes in the future, and possibly even in the near future. No ordinary assurance against this possibility is of any use because no Government can bind its successor. Indeed the more successful the levy, the greater may be the incentive to repeat it. The consequence of this would be that under a fear of repetition the accumulation of capital would be restricted and slow, and, in consequence, all industrial progress must be retarded.

Against this view it has been contended that repetition is not a thing to be feared, because no one would think of imposing a special charge of this character except in a great emergency. In the event of a great emergency it would be a positive advantage to have the national accounts cleared of such indebtedness, and to be able to enter upon a war without a colossal debt. All war loans have conditions attached to them which are honourably observed by Governments, and there is no reason to suppose that a similar assurance cannot be given to the taxpayer so that any economic effects through fear of repetition could be avoided.

2. *Effects on Prices.*—The second main contention is that the financial operation would be so huge, that the attempts to carry it out on practical simultaneous lines must destroy its own basis by depressing prices. If the treasury were satisfied to take only cash this would involve putting large blocks of shares on the market, for which there would be no ready sale, panic prices would ensue, and confidence would be destroyed. If, in order to avoid forced sales, the Government were to take stocks and shares in payment, they would find themselves with large miscellaneous holdings in industry which they could not realise without disastrous consequences. The mere passive holding of securities is no relief to the Budget.

It has been rejoined that the notion that a large quantity of securities must be put on the market and result in depressing it, is quite mistaken. It is merely a matter of synchronising the supply of securities with the demand, for whenever debt is redeemed an investor will be ready in the market to buy securities that are on sale, either by taxpayers or the Government. It is true that the banks and finance houses could talk the market into a state of panic, but if they were determined to support the scheme with their good-will, depression of prices would be quite unnecessary.

3. *Damage to Individual Businesses.*—The third contention is that the ordinary business in private hands could not pay a large levy without encompassing its own destruction. It could not divide its business, and would be forced to raise mortgages or debentures which, in view of the uncertain financial future, could only be obtained on onerous terms.

A counter contention to this takes the following form: If a business were really valued at a figure necessitating a payment to the Government, it would also have sufficient credit to raise a mortgage and the charge or levy would be evidence of the fact. The money for this would be forthcoming in the market because of the funds set free by the redemption of debt. The utmost difficulty that could arise would be some slight redirection of capital. In all cases of hardship, or where a business was likely to be inconvenienced, the Government would grant payment by instalments. Against this it has been replied that a levy honeycombed with instalments and special cases would be very similar to a special income tax, but levied on an insecure and unfair basis. Such a system, it is urged, would take 10 or 20 years to bring to a definite conclusion.

4. *Valuations Impracticable.*—The next contention is that so much of the wealth of the country is held in contingent titles, such as life interests and reversions, and that the valuation of these would make an insoluble problem. However actually correct the valuation may be at the time, the results would be belied by subsequent events, and wherever duty was being paid by instalments there would be overwhelming demands for adjustments. These would be sufficiently important to reduce the levy to chaos.

5. *Repayment of Part of the Debt Makes the Repayment of the Remainder more Difficult.*—The fifth argument relates to the deflationary effect of the levy itself. It is stated in some financial circles that the sudden cancellation of £3,000,000,000 of debt according to the programme of the Labour party, would remove from businesses a very large amount of collateral security. This would cause credit to be withdrawn and restricted. In other cases credit would be withheld, and prices would fluctuate with disastrous effects on business enterprise and employment.

Against this it is contended that the argument is a gross exaggeration. Only a small proportion of the war loan is used as the actual basis of credit operations, and many people who so use it have other securities which can be used instead. Again, credit is much more largely personal, and does not depend upon collateral of this kind. Moreover, others contend that deflation can only be brought about by operations through the Bank of England, and the inability of an individual borrower to be granted a loan means that, in practice, a loan is given to someone else because the banks have this credit available. The total amount of effective credit, it is said, cannot be affected by the demands of the particular borrowers.

6. *Future Saving Impaired.*—The sixth contention relates to the effects of redistribution of wealth upon future saving. The idea that the wealth-accumulating classes would have not only to give up a part of their existing fortune, but also to suffer rates of tax in future as high, or higher, would, it is said, strike at the root of all thrift and lead to national wastefulness, because the other classes of the community would not themselves save an equivalent sum.

Against this it is stated, however, that the outlook is too serious for any ordinary arguments about the redistribution of wealth to avail. Money must be taken where it is to be found. Whatever the immediate disadvantageous effects of the levy, the dynamic effects in future are by far the more important. Greater good to the community would come about by relieving the worker and the middle classes

of some of the burden of taxation or by expending state funds on proper social purposes. This would lead to greater productivity, to lower rates of taxation and to greater general average prosperity.

7. *The Price Level Argument.*—In the next place, the price level contention is disputed. The idea that it will be an advantage to repay debt before the price level falls, must be qualified by the fact that the operation of the levy itself would bring about lower prices and thus make the remaining £4,000,000,000 sterling of the debt charge a much more onerous charge than would otherwise be. In view, however, of the denial that the price level will be necessarily lower in the long run, this contention is not accepted. But in so far as it might prove to be true, it is said that it would be so much to the advantage of the workers to have higher real value in their earnings that the whole country would gain. It is said that there are more factors making for a rise in prices than for a fall in the long run, and therefore future repayment may be easier than present repayment.

8. *The Net Annual Relief.*—In the last place the opponents of the levy say that the whole basis of the programme is fallacious, because it has been assumed that the effect would be to set free the whole of the interest on £3,000,000,000 of debt, say £150,000,000 a year, and allow of expenditure programme to this amount, or of a reduction of taxation *pro tanto*.

It is stated that this view ignores the progressive features in the existing income tax, supertax and death duty schemes. Taking large sums away from individual fortunes would reduce their taxpaying power in future, and the revenue side of the Budget would also be seriously affected, so that all that could be reckoned upon would be a certain *net* saving. One authority has estimated that, in the long run, out of a saving of expenditure of £140,000,000, something between £90,000,000 and £98,000,000 per annum would have to be set aside to make good the effects of the levy on future revenue, so that the net advantage to the Budget would have to be reduced to some £42,000,000 or £50,000,000 a year. No effective counter statistics have been so far put forward to alter this result.

The Rate of Levy.—The proposals of the Labour party were that persons with less than £5,000 should pay nothing, but that those owning more than that sum should pay on the following scale:

£	%	£	%
6,000	5	50,000	35
8,000	10	100,000	40
10,000	15	200,000	45
15,000	20	500,000	50
20,000	25	1,000,000	55
30,000	30	Above 1,000,000	60

Some authorities doubt whether the capital wealth of the country is sufficient for the operation of this scale to produce the £3,000,000,000 assumed.

The Levy in Other Countries.—There have been no first-class experiments abroad illustrating all the features of the levy as proposed for the United Kingdom. In 1920 in Czechoslovakia a levy was introduced which was to bring in £63,000,000 or about £5 per head of the population, with a low limit of exemption, *i.e.*, 10,000 crowns free, 1% on the first 25,000 crowns, and then on a progressive scale up to 30% on amounts over 10,000,000 crowns. The actual yield was £17,000,000 in the first two years, and the instalment system which was allowed gave it, as a matter of fact, the character of a heavy income tax. The results have been regarded as disappointing, and the consequent arrears in income tax are heavy.

In Switzerland in 1922 the Socialist party proposed a levy with the idea of devoting the proceeds mainly to social purposes. On a referendum the proposal was rejected in every canton, but while it was under discussion the effects upon financial conditions were very obvious.

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CAPITULATIONS (*see* 5.283).—For the most part the old capitulatory system was swept away by the World War nowhere more notably than in Turkey, where for centuries it had been the cause of endless disputes among the European Powers themselves as well as between those Powers severally and the Porte. The post-War position of capitulations may be briefly stated. Capitulations are still in force in Abyssinia, China, Egypt, Morocco and Persia; they may be said to exist in Bulgaria, as Art. 175 of the Treaty of Neuilly provides that the immunities and privileges of foreigners as well as the rights of jurisdiction and of consular protection enjoyed by the Allies and Associated Powers in Bulgaria by virtue of the capitulations, usages and treaties, may form the subject of special conventions between each of the Allied and Associated Powers and Bulgaria; Great Britian possesses extra-territorial jurisdiction in Bahrein, Hejaz, Kuwait and Muscat. The capitulations still in force may be thus summarised according to countries.

Abyssinia.—Austria, Belgium, France, Germany, Great Britain, Hungary, Italy and the United States have consular jurisdiction.

China.—Extra-territorial jurisdiction is enjoyed by Belgium, Brazil, Chile,[1] Denmark, France, Great Britain, Italy, Japan, Mexico, the Netherlands, Norway, Peru, Portugal, Spain, Sweden, Switzerland and the United States.

Egypt.—Capitulatory rights are possessed by Belgium, Denmark, France, Great Britain, Greece, Italy, the Netherlands, Norway, Portugal, Russia, Spain, Sweden and the United States. Rumania has limited capitulatory rights, and Persia has a consular court.

Morocco.—Great Britain and the United States retain capitulatory rights in the French zone; Italy and the United States in the Tangier zone. In the Spanish zone Great Britain, Japan, the Netherlands, Switzerland and the United States retain these rights.

Persia.—Extra-territorial rights are possessed by Argentine, Belgium, Brazil, Chile, Denmark, France, Germany, Great Britain, Italy, Mexico, the Netherlands, Norway, Spain, Sweden, Switzerland, the United States and Uruguay.

Since 1911 capitulatory rights have been abandoned in very many countries, notably as the result of the political and territorial changes effected by the War. In one instance alone—Tripolitania—were such rights relinquished prior to the War. The following summary reveals the extent to which capitulations have been abandoned since 1911:—

Albania.—By Great Britain, Feb. 6 1926.

China.—By Austria, Germany and the Soviet Union. Extra-territorial rights have also been lost by the subjects or citizens of the Succession States (Poland, Czechoslovakia, etc.), formed as a consequence of the dissolution of the Austro-Hungarian and Russian Empires.

Crete.—By Great Britain, Aug. 25 1914.

Egypt.—By Austria, Germany and Hungary.

Greece.—By Great Britain Aug. 2 1914 in territories acquired by Greece after the Balkan Wars of 1912–3.

Morocco.—In the French zone by Belgium, Bolivia, Costa Rica, Denmark, Greece, Italy, Japan, the Netherlands, Norway, Portugal, Russia, Spain, Sweden and Switzerland. In the Spanish zone by Belgium, Denmark, France, Greece, Italy, Norway, Portugal, Russia and Sweden. Austria, by articles 96–98 of the Treaty of Saint-Germain, Sept. 10 1919; Germany, by articles 141–143 of the Treaty of Versailles, June 28 1919; and Hungary, by articles 80–82 of the Treaty of Trianon, June 4 1920, have renounced their capitulatory rights.

Persia.—By Austria, the Soviet Union and Turkey. By the termination in May 1924 of the Greco-Persian Commercial Treaty of Oct. 28 1861 Greek rights in Persia lapsed.

Siam.—The protocol relating to jurisdiction, annexed to the general treaty with Siam of July 14 1925, has abolished the system of jurisdiction heretofore established in Siam for British subjects, who now become amenable to the Siamese Courts. In the interests of justice, however, cases may be evoked from the Siamese Courts and be dealt with by a British diplomatic or consular officer in accordance with English law (*see* SIAM).

Tripolitania.—By Great Britain in Oct. 1911.

Turkey.—By those signatories to the Treaty of Lausanne, July 24 1923, who possessed capitulatory rights in Turkey at the outbreak of the European War; and by Germany, Persia and the Soviet Union. The United States have agreed to abrogation in the (as yet unratified) treaty signed at Lausanne, Aug. 6 1923.

BIBLIOGRAPHY.—For the texts of the Treaties mentioned, excepting that with Siam, see H. W. V. Temperley, *The History of the Peace Conference at Paris*, vol. 6. (I. F. D. M.)

CAPOK: *see* CELLULOSE; FIBRES.

CAPORETTO, BATTLE OF.—The Italian offensive of Aug.–Sept. 1917 had reduced Boroević's armies to the limit of resistance, so much so that, as Ludendorff records, "the responsible military and political authorities of the Dual Monarchy were convinced that they would not be able to stand a continuation of the battle and a 12th attack on the Isonzo. . . . In the

[1] The Chinese Govt. do not recognise Chile's right to extra-territorial privileges; the question is still (1926) in dispute.

middle of Sept. it became necessary to decide for the attack on Italy in order to prevent the collapse of Austria-Hungary."

There was a clear difference of opinion on the Italian side as to the best way of meeting the forthcoming attack. Cadorna felt he must stand on the defensive. Capello, who commanded the II. Army, was anxious to anticipate the enemy's move by an attack northeast from his positions on the Bainsizza plateau. His army was in the main aligned for attack, for a continuation of the offensive which had been broken off in Sept. and he judged it impossible, given the difficulty of communications and the risk of imminent attack, to take up the positions best adapted for defence. In this idea he had the support of more than one of his corps commanders, but Cadorna did not think that he could throw in the forces necessary for such an attack when he was uncertain as to the direction of the forthcoming blow.

I. THE AUSTRO-GERMAN ATTACK

Disposition of Italian Forces.—Cadorna had received satisfactory reports concerning the *morale* of his troops. He had enough men, though a number of his units were below strength; and he had enough guns, in spite of the withdrawal of the Allied batteries, though he would have been glad of more heavy artillery. Between Monte Rombone and Monte San Gabriele, Capello had some 2,200 guns and nearly 800 trench mortars. North of Tolmino the line on the left bank of the Isonzo was held by Cavaciocchi's IV. Corps, whose left wing held the Plezzo basin and was in contact with the Carnia force on Monte Rombone. Next came Badoglio's XXVII. Corps, whose left wing, the 19th Div., raised to the strength of an army corps, held the lines opposite Tolmino. The other three divisions which completed the XXVII. Corps were across the river south of the Lom plateau. Behind Cavaciocchi's right and the 19th Div., on the mountains west of the Isonzo, lay the VII. Corps, newly reconstituted with units from other corps, and commanded by General Buongiovanni. On the right of the XXVII., holding the line as far as Monte Santo, were Caviglia's XXIV. Corps and Albricci's II. Corps.

The weak point of the Italian line was the Tolmino sector; the weakest part of this sector was at the junction of the XXVII. Corps (19th Div.) with the IV. (46th Div.), and the weakest position of all was that held by the right of the 46th Div., which was clinging to the slopes of Sleme and Mrzlivrh completely dominated by the enemy, and badly off for communications with its neighbours. The Tolmino sector was chosen for the main enemy attack, and here, owing to a complex of circumstances, the Austro-German forces won a success that led to a great Italian disaster. The Italian preparations were much handicapped by the illness of Capello.

The Attack Launched.—The main attack came in the direction anticipated, between Monte Rombone and south of Tolmino, and was conducted by a mixed German and Austrian army under General Otto von Below. The army, which was known as the XIV. Army, consisted of nine Austrian divisions and seven German, in four groups. The northern group of four divisions (three Austrian and one German Jäger) was commanded by Krauss, who had been called back from the Bukovina. Next came a group of three divisions (one Austrian and two German) under the German Von Stein, and a group of two German divisions under the German Von Berrer. South of these two central groups was a mixed group (one Austrian and two German) under the Austrian Von Scotti. East of Tolmino lay four divisions in reserve. Boroević had 20 divisions in his two Isonzo armies between Auzza and the sea. Below and Henriquez (2nd Isonzo Army) had some 2,500 guns and 500 trench mortars.

The bombardment began at 2 o'clock on the morning of Oct. 24 in wild autumn weather. There was a drizzle of snow on the high ridges, rain below, and mist everywhere. Towards dawn the fire died down, and it was thought on some parts of the defending front that the bad weather had counselled a delay in the attack. But the attackers were to make skilful use of the weather conditions, and only on Monte Rombone, on Krauss's extreme right, an attack in conjunction with the left wing of Krobatin's X. Army had to be given up owing to the snow.

Krauss's main attack was a straight drive through the Italian lines in the Plezzo basin, his first objective the Saga defile. But he meant to reach without delay the ridge of the Stol (6,467 ft.), which stood athwart a further direct advance. For this attack he detailed the 22nd Schützen Div., followed by a Kaiserjäger and a Kaiserschützen battalion, which were to go straight for the Stol, and by six battalions of the 3rd (Edelweiss) Div., which were to make for the Val Fella by way of the Wal d'Uccea. Krauss's left wing, the 55th (Bosnian) Div., attacked the Vršic-Vrata ridge, with the object of breaking through to the Isonzo and Caporetto.

Krauss's drive, after hard fighting, broke through the three front lines held by the Italian 50th Div., but the attacking troops were checked at the Saga defile. When evening fell, this position was still in the hands of the Italians, but the battle had gone badly for the defenders farther south, and a retreat to the Stol became necessary. Krauss's Bosnians had met with no success against the left wing of the Italian 43rd Div., but Stein's group had carried all before it. Stein opened his attack with his right wing, the Austrian 50th Div., at 7:30 A.M., attacking the Italian 46th Div. between Monte Nero and Vodil. A little later the Bavarian Alpenkorps, advancing from Tolmino, attacked the ridges east of the Passo di Zogradan, while Berrer and Scotti attacked farther south.

Success of the Silesians.—When both Stein's initial attacks were under way, the 12th Silesian Div., under Gen. von Lequis, was sent in between them. Lequis attacked in two columns, one on each side of the river, making for Caporetto, where it was hoped he would join with Krauss's Bosnians. Both columns were completely successful. The right-hand column, aided by the strong attacks of the Austrian 50th Div., pierced the extreme right of the Italian 46th Div., and pushed northwest with all speed. Across the river, where the Alpenkorps was making good headway on the slopes above the road, Lequis's left-hand column quickly reached the Italian second line, where the valley narrows below the hamlet of Foni. This line had been held until the eve of the battle by a brigade of the IV. Corps, but at the last moment the sector was transferred to the XXVII. Corps, and the Napoli Brigade was given to Badoglio to hold this important point. Only one battalion, however, was placed near the river. The rest of this regiment (the 76th) lay at the Zogradan Pass high on the ridge to the southwest, and the other regiment of the brigade (the 75th), together with the brigade command, was nearly 3 m. away, on the western slopes below Zogradan. The single battalion, of which only a platoon was on the road, seems to have been taken completely by surprise. It was run over by the Silesians, who proceeded on their way up the valley practically unmolested.

Meanwhile, the Alpenkorps, Berrer's two divisions and Scotti's right wing were breaking up Badoglio's left, while the latter's right, across the river, and Caviglia's corps were being strongly attacked by Scotti's left and Henriquez's right. The attack from Tolmino had been carried out with skill, speed and resolution, and by a capital error which has never been satisfactorily explained the Italian guns remained silent until too late. Definite orders had been given both by Cadorna and by Capello that immediately upon the opening of the enemy's bombardment the Italian artillery should open fire on the enemy's trenches and zones of concentration and that they should lay down a heavy barrage as soon as there were signs of movement. These orders were not carried out and, owing to great destruction of telephone wires, when the guns finally began, their fire was fitful and uncertain. And they were too late: the enemy's attack had already developed. Taken by surprise, puzzled by the comparative silence of their own guns and blinded by mist, the troops of the 19th Div. opposed only a weak resistance to the Austro-German attack.

Henriquez's attack on the Bainsizza plateau, although it met with some initial success, was readily repulsed. Badoglio had hoped to hold the enemy attack from Tolmino and turn the scale by a counter-attack on the Lom plateau with his three divisions on the left bank of the Isonzo. But he was not afforded the chance of attempting any such manoeuvre. It was long before he received any news of how the day was going on the front of the 19th Div., and from the beginning of the action he was unable to communicate with his divisions across the river. In a message sent to Army Headquarters at 4 P.M. he reported the enemy success south of Jeza, but said that he had no news from the commands of the 19th Div. and the IV. Corps, and that he was unable to communicate with anyone.

By 4 P.M. Lequis's Silesians were approaching Caporetto. The left-hand column was unmolested on its march. The right-hand column, which had cut in behind the Italian 43rd Div., was making the task of the Austrian 50th comparatively easy and brushing aside the spasmodic opposition of such small detachments as came in its way. Cavaciocchi had filled his front lines too full, and sent practically all his reserves across the river, in immediate support of the 43rd and 46th Divisions.

II. THE ITALIAN RETREAT

By evening the situation was very favourable to the attacking forces. Stein was pouring troops through the breach made by the Silesians and was making good headway with the Austrian 50th Div. on their right, while the Alpenkorps, Berrer and Scotti, had in several places gained the high ridges dominating the head of the Judrio valley. Krauss was still held up at Saga and Polounik and his Bosnians had gained no more ground. But the break-through between Tolmino and Caporetto had made the Italian positions untenable.

At Cividale, where Capello had his headquarters, and at the Comando Supremo in Udine, the first news that came from the IV. Corps and the absence of news from the XXVII. made a grave impression. Capello sent up the army reserves by the valley roads and dispatched Montuori to direct the "left wing" (the IV. and VII. Corps). By evening it was clear that the enemy had won a big success, though it was not yet clear to what an extent the whole Italian left was crumbling. There seemed good reason to hope that the advance might be blocked in the narrow valleys west of the Isonzo. But by nightfall both the IV. Corps and the 19th Div. were practically broken in pieces. The VII. Corps was beginning to be attacked at Luico, and its right was uncovered by the destruction of most of the 19th Division. The right wing of the 19th was still holding on Globocak and down to the river, and troops were being brought back from the left bank to strengthen this line. But it was obvious that the positions on the Bainsizza could not be obtained, and orders were given to Caviglia, who had taken over Badoglio's troops beyond the river, to prepare for a retreat across the Isonzo.

At the moment the most dangerous point appeared to be the extreme left wing, where it was clear that Krauss would try and push through the Val d'Uccea, the shortest way to the Tagliamento. Two Alpine groups had been dispatched to this sector the day before, and Cadorna gave orders that the Val d'Uccea must be blocked at all costs. He sent out orders for resistance on three successive lines, all radiating from Monte Maggiore, which was the key position, but at the same time, as a precaution, he directed that plans and orders should be drawn up for a general retreat to the Tagliamento.

The news on the morning of Oct. 25 was increasingly grave. Krauss was pressing upon the Stol, and finding a weak resistance; no stand was being made at Creda; Monte Matajur had fallen, practically undefended. Other positions were seriously threatened, and there was no confidence that they would be held, for it was now known in Cividale and Udine that the behaviour of some of the troops in the line had been very unsatisfactory, and that this unexpected lack of spirit was communicating itself to some of the reserves. These had a difficult task in getting to the scene of action, for as they marched up the narrow mountain roads they were met by ever-increasing masses of fugitives, the bulk of whom belonged to the non-combatant services. This unfortunate state of affairs undoubtedly hastened the break-up of Capello's whole left wing.

Preparations for Retreat.—On the afternoon of Oct. 25 Capello, who could fight no more against his illness, and had been told by

the chief medical officer of the army that he must resign his command, proposed an immediate retreat to the Tagliamento, arguing that it was useless to send more reserves into the chaos among the hills west of the Isonzo. Cadorna felt that unless he could delay the enemy advance down the Natisone and Judrio valleys he ran the risk of having his centre and right cut off. Montuori, who now succeeded Capello in command of the II. Army, thought that he could hold on a line from Monte Maggiore to Monte Carnizza and thence across the valleys to Monte Korada. Cadorna decided to attempt a further stand while warning Tassoni (Carnia Force), di Robilant (IV. Army) and the Duke of Aosta to hold themselves in readiness for retreat, but at midnight on Oct. 26 he was wakened to hear that Monte Maggiore had fallen. He at once drew up the orders for a general retreat beyond the Tagliamento and his plans were already matured for the longer retreat across the Piave which he foresaw would be necessary in order to get to a shorter line. The retreat began on Oct. 27, and two days later provisional orders and plans were issued for the further retirement to the Piave.

Fortunately for Italy, and for the cause of the Entente, the Germans and Austrians were outrunning their transport. Krauss complained that only he and Krafft von Delmensingen, Below's chief-of-staff, had been inspired by adequate ambitions for the attack. The objective had been Cividale, or at best the Tagliamento. Krafft thought they should have had the Adige in view. Krauss expressed the opinion that the real objective should have been Lyons. It must be remembered, however, that the transport difficulties were very great. Germany could not spare troops or material for an unlimited effort here and the unexpectedly weak resistance of the Italian II. Army could hardly have entered into the calculations of those who were bound not to take too many risks. Krauss admits that if Cavaciocchi had held the Stol in force his own move would have been frustrated.

The critical days for the Italians were Oct. 30 and 31, when the pressure from north and east threatened the flank and rear of the III. Army, whose task had been made more difficult by the premature blowing up, owing to a false alarm, of the permanent bridges at Casarsa and by the fact that the Tagliamento had come down in sudden and violent flood. But by the evening of Nov. 1 the last of the Duke of Aosta's troops had been successfully withdrawn across the river.

Cadorna's weakest point was the stretch of the river west of Tarcento, for which Krauss and Stein were making with all speed. Two divisions under di Giorgio had been dispatched to hold this line, but their march athwart the line of the retreat had been very difficult. Stein's troops were repulsed with heavy loss, but on the evening of Nov. 2 Krauss's Bosnians succeeded in crossing at Cornino and the following morning di Giorgio was strongly attacked at Pinzana. Two days later his left was pushed back still farther, endangering the line of retreat for the Carnia force and once more threatening the whole Italian line with envelopment from the north.

On the morning of Nov. 4 Cadorna ordered the retreat to the Piave and that night the troops holding the line of the Tagliamento resumed their march westward. The IV. Army in Cadore was now in a difficult position but di Giorgio and the other covering troops of the worn-out II. Army slowed down the enemy's advance and gave time for most of di Robilant's troops to get away from Cadore and come into line between the I. and III. Armies. But the greater part of Tassoni's Carnia Force was caught between Krauss's troops and Krobatin's X. Army.

III. THE RECOVERY ON THE PIAVE

New Italian Positions.—By Nov. 8 the bulk of the IV. Army was in line. On Nov. 9 and 10 the last covering troops of the II. and III. Armies crossed the Piave from Pederobba to the sea. The line chosen to defend the fortunes of Italy implied a withdrawal of the right wing of the I. Army. Pecori-Giraldi retired from Asiago and Gallio and based his right on the fortified lines of the Meletta group, giving up the XVIII. Corps to di Robilant, who held the line from the Brenta to the Piave and the short stretch of the river as far as the Montello.

Reserves were coming in fast from the depots, including the young class of 1899. French and British divisions were already in Italy and others were on the way. But Diaz, who took over the command from Cadorna on Nov. 9, had to face a situation that seemed almost desperate. The Italian armies had lost some 320,000 men in killed, wounded and missing, the number of prisoners being estimated at 265,000. The bulk of the II. Army had to be counted out altogether and the total number of troops to be reorganised and refitted was over 300,000. More than 3,000 guns had been lost and over 1,700 trench mortars. It seemed very doubtful whether these greatly weakened forces could resist the renewed attacks of the victorious armies which had followed so closely on their heels. Fortunately, the plans for defence had been well and truly laid by Cadorna in the limited time that was available and still more fortunately, as a result of the danger in 1916, he had caused elaborate preparations to be made in the Grappa sector. It was due to this forethought that resistance on the line now chosen was possible.

Diaz had little breathing space, though some days elapsed before the enemy could prepare for an attack in force on the new line, for Conrad, on the Trentino front, saw a chance and, though he was short of troops, struck at once while calling for reinforcements. He attacked Pecori's troops on Nov. 10 as they were preparing to come back to the line already indicated and continued his attack on the new positions. But 10 days' fighting brought heavy losses and no success. Meanwhile, Boroević had tested the river defences. He got troops across in two places but failed to make further progress, and on Nov. 16 an attack in force failed completely, the Austrians losing some 1,500 killed and nearly as many prisoners.

Conrad and Boroević were making no headway, but a very dangerous attack was being conducted by Krauss, between the Brenta and the Piave. Attempts to break through by the valley roads were quickly frustrated and persistent efforts to capture the all-important ridge of Monte Tomba-Monfenera, which runs down from the Grappa *massif* to the Piave, failed to pierce the thin Italian lines. The struggle at this point lasted for five days, Nov. 18–22, and the Italian IX. Corps, under Ruggeri Laderchi, fought a great fight. The critical day was Nov. 22, when Krauss's Bosnians and German Jäger made a final effort to break through. The attacking columns reached the crest of Monte Tomba, but their bolt was shot. In the evening, Ruggeri Laderchi counter-attacked and drove the enemy off the ridge, except at one point. Next day reserves arrived and the line was firmly established.

Meanwhile, in the Grappa sector, Krauss had attacked on Nov. 21 with his centre and right, but after a week's fighting, in spite of reinforcements drawn from Stein and Krobatin, he had to call a halt. A fresh attack was preparing when the situation was eased by the arrival of the British and French divisions which had hitherto been waiting in reserve. On Dec. 2 three British divisions under Gen. the Earl of Cavan, took over the Montello sector and a similar French force under Gen. Duchesne relieved the IX. Corps in the Monte Tomba region. It was expected that both these points would be the object of early attack, but as it turned out they were both left unmolested. Conrad and Krauss continued their attempts on the mountain front, but Krauss confined his efforts to the Grappa sector. Krauss could not immediately renew his attack, but on Dec. 3 Conrad, reinforced but still complaining that he was starved for means of attack, opened a heavy bombardment on the curve of the Italian front from Monte Sisemol to east of Monte Badenecche.

Next day he pinched up the Meletta-Badenecche salient and took Monte Fior and Castelgomberto in the rear and the day following he pushed down towards Foza. The position was critical, but the Italians succeeded in establishing a new line farther south, covering Valstagna and the mouth of the Frenzela valley. On Dec. 23 after careful preparation, Conrad launched a new attack on the lines between Monte Sisemol and the Frenzela valley. He gained a big initial success, taking both Col dell 'Orso and Monte Melago and cutting off a large number of prisoners. The next day the Italians counter-attacked and retook both the

hills. They established themselves firmly in their reserve lines and repulsed another attack, the last, on Christmas Day.

Krauss's Final Effort.—Meanwhile, between Conrad's two efforts, Krauss had made a determined attempt to drive the Italians off Monte Grappa. His command had been increased to 10 divisions, six Austro-Hungarian and four German and he did not spare his troops. He opened his attack on Dec. 11 by a push on each wing; from the Brenta valley and Monte Pertica against Col della Berretta, and against both sides of the Col dell 'Orso-Solarolo salient. On the left, in spite of repeated attacks that lasted 10 days, his German divisions made little headway, but on the right, at the end of four days' hard fighting, he had taken Col Caprile and Col della Berretta. Four days more and he was in possession of Monte Asolone, which looks down the Valle di Santa Felicitá to the longed-for haven of the plain. This was the term of the Austrian advance. On Dec. 20 the Italians counter-attacked and won back a good deal of the lost ground, the last move in the long struggle. Krauss accepted failure for the moment, hoping for an early spring offensive farther west. Five days later the snow came, the heavy winter fall that was a month late. The invaders had been favoured by the tardy coming of winter, which greatly prolonged the strain on the sorely-tried armies of Italy. But it gave also to the defending troops the chance to remake at once a shaken reputation. They took the chance and their recovery was a remarkable feat of courage.

Conclusion.—The narrative has indicated briefly the causes which led to the Italian disaster. The defending troops were subjected to a very severe trial; but it would seem clear that failure and disaster might have been largely averted if the preparations against the Austro-German attack and the actual conduct of the defence had been different. To sum up, there were too many troops in the front lines and too few in the "battle positions." Cadorna had not succeeded in making all his subordinates grasp the principles of defence in depth or of "elastic" defence. And, given the erroneous dispositions of the defensive lines, the reserves were too far back. The Italian Armies on the Julian front had been constantly on the offensive. They had had no recent practice in meeting an attack on the grand scale. It was this lack of practice, no doubt and a false confidence based on obsolete experience, which led to the belief that even if the opening phases of the battle were unfavourable to the defence, there would be ample time to restore the situation.

When retreat became inevitable, the prospects might well have seemed desperate to those who had to organise it. For the army, long used to the war of positions that had been the rule for 28 months, was in no condition to move. The retreat, with all its confusion, its mistakes and its tragedies, remains an astonishing achievement. The resistance which followed it, when the retiring armies turned and stood at bay on the mountains and on the Piave, was the greatest of Italian victories.

BIBLIOGRAPHY.—W. Örtel, *Vormarsch in Oberitalien, vom Isonzo zur Piave (1917)* (1918); V. Coda, *Dalla Bainsizza al Piave (Oct.-Nov. 1917)* (1919); L. Cadorna, *La Guerra alla Fronte Italiana* (1921). *See* also WORLD WAR: BIBLIOGRAPHY. (W. K. McC.)

CAPPS, EDWARD (1866–), American classical scholar, was born at Jacksonville, Ill., Dec. 21 1866. He was educated at Illinois College, where he took the degree of A.B. in 1887, and at Yale University, where he received that of Ph.D. in 1891. In 1890 he was appointed tutor at Yale. He was professor of Greek language and literature at the University of Chicago from 1892 to 1907. In 1903 he was special lecturer at Harvard, and during the next two years studied at Athens, and Halle, Germany. During 1906–7 he was managing editor of *Classical Philology* and in 1907 was called to Princeton University as professor of classics. In 1914 he was president of the American Philological Assn. and in 1917 was Turnbull lecturer on poetry at Johns Hopkins University. In 1918 he was appointed head of the American Red Cross commission to Greece, and became also chairman of the managing committee of the American School of Classical Studies at Athens. In 1920 he was appointed Minister to Greece, resigning in March 1921, and returning to Princeton. He is a leading authority on the Greek theatre.

His works include: *The Greek Stage according to the Extant Dramas* (1891); *From Homer to Theocritus* (1901); *The Introduction of Comedy into the City Dionysia; a Chronological Study in Greek Literary History* (1903); and *Four Plays of Menander* (1910). He was editor-in-chief of the University of Chicago decennial publications, 29 vol., and became the American editor of the Loeb Classical Library.

CAPUS, ALFRED (1858–1922), French author (*see* 5.296), produced his last play, *L'institut de beauté*, in 1913 and was elected a member of the Académie française in the following year. He died in Paris Nov. 1 1922.

CARBON, SYNTHESES OF (*see* 5.305).—The technical synthesis of organic compounds has only attained importance during the present century. It is still convenient to retain the artificial distinction between inorganic and organic chemistry, whether one includes the chemistry of all carbon compounds in the latter branch or considers only such compounds of carbon as contain atoms of carbon directly united to hydrogen, nitrogen or other carbon atoms.

The artificial production of urea (Wöhler, 1828) by isomerisation of ammonium cyanate showed that products of animal metabolism might be produced without the intervention of "vital force" and eventually it was recognised that any carbon compound of known constitution may be built up from carbon itself. The majority of organic compounds are still obtained from animal or vegetable sources or by distillation of oil and coal, but several products, formerly obtained by the distillation of wood are being rapidly displaced by synthetic products from carbon (coke).

Direct Syntheses.—Carbon unites directly with hydrogen, silicon, oxygen, sulphur and fluorine, whilst carbides of many metals are known and are usually produced by heating coke with a metallic oxide in the electric furnace. As actual or potential sources of organic compounds, methane, the oxides of carbon and calcium carbide are of greatest importance.

Methane yields certain substitution products on chlorination from methyl chloride, CH_3C_1 to carbon tetrachloride, CCl_4. The first of these yields methyl alcohol on hydrolysis. Carbon monoxide unites directly with caustic soda yielding sodium formate; the latter can be decomposed into hydrogen and sodium oxalate. Complete reduction of carbon monoxide gives methane, by incomplete reduction it is possible to make methyl alcohol. Carbon dioxide, with ammonia (*q.v.*), is a source of urea; further, it unites directly with sodium, giving the oxalate.

Acetylene.—Calcium carbide and water give acetylene (*q.v.*). This hydrocarbon unites with water in presence of acids and mercury salts giving acetaldehyde, $CH_3.CHO$ which can be polymerised to alcohol, $CH_3.CHOH.CH_2.CHO$; on loss of the elements of water, the latter compound gives crotonaldehyde, $CH_3.CH{:}CH.CHO$. Oxidation of acetaldehyde yields acetic acid, $CH_3.CO_2H$, from which, by removal of the elements of water, acetic anhydride is produced. If, in addition, the elements of carbon dioxide are also removed, acetone is formed. $2CH_3.COOH = H_2O + CO_2 + CH_3.CO.CH_3$. Butyl alcohol can be obtained from crotonaldehyde by catalytic hydrogenation.

$$CH_3.CH{:}CH.CHO + 4H = CH_3.CH_2.CH_2.CH_2OH.$$

Acetylene also combines with chlorine giving tetrachloroethane, $C_2H_2Cl_4$, from which hexachloroethane, C_2Cl_6, trichloroethylene, C_2H_3, pentachloroethane, C_2HCl_5, and dichloroethylene are obtainable. Hydrolysis of trichloroethylene gives chloroacetic acid, $CH_2Cl.COOH$, an intermediate in indigo synthesis. Calcium carbide reacts with nitrogen at a high temperature giving calcium cyanamide, CN_2Ca, from which urea is obtainable (*see* CYANAMIDES; CYANIDES).

Formates have been manufactured synthetically for several years before 1926; in the case of the other simpler carbon compounds the sources of supply afforded by natural products appeared to be sufficient, and confusion and delay were occasioned by disregard of the thermodynamic principles underlying gas reactions and lack of knowledge with regard to catalysts.

Using Van't Hoff's *reaction isochore*

$$d \log_e K/dT = -Q/RT^2$$

the equilibrium attained in a reaction involving gases may be

calculated for an absolute temperature T if the heat of reaction, Q, at that temperature is known. This is possible if the heat of reaction at some definite temperature is known as well as the variation of the molecular heats of the reacting substances with changing temperature. Thus, if the data are available, one may calculate in advance whether a reaction is likely to take place under experimental conditions.

Velocity of Reaction.—Velocities of reaction which are low at ordinary temperatures may be accelerated by heating; at the same time, the equilibrium is often displaced in a direction contrary to that desired. An example is afforded in the synthesis of methyl alcohol, $CO+2H_2=CH_3OH+27{\cdot}2$ Cal. Catalysts are ineffective at ordinary temperature; on heating, equilibrium is displaced from right to left. On the other hand, since $K=p_1p_2^2/x$, where p_1,p_2 and x represent the pressures of carbon monoxide, hydrogen and methyl alcohol respectively, it is evident that increase of pressure will displace the equilibrium from left to right. Thus Matignon (*Bull. soc. chim.*, 1925, iv. 37, p. 827) calculates that at 227° C. (T = 500) if $p_1=1$ (atmosphere) and $p_2=2$, then $x=0{\cdot}06$, but if $p_1=50$ and $p_2=100$, then $x=7{,}000$. x is reduced to 0·8 for the same values of p_1 and p_2 at 427° C. (T = 700). Evidently for a given reaction and catalyst there will be an optimum temperature from the point of view of yield; above this temperature the equilibrium is unfavourable; below it, the velocity of reaction is too small.

Applying these principles, Matignon shows that the following syntheses should be capable of accomplishment: aliphatic alcohols generally; a lower one, *e.g.*, CH_3OH, being transformed into the next higher homologue, $C_nH_{2n+1}OH+CO+2H_2=C_nH_{2n+1}CH_2OH$; ethyl alcohol from ethylene and water; hexane from ethylene and hydrogen; acetone from ethylene, carbon monoxide and hydrogen; and propyl alcohol from ethylene and methyl alcohol. Little hope exists of reducing carbon monoxide to formaldehyde, making ethyl alcohol from methane, carbon monoxide and hydrogen or converting methane into a mixture of ethane and hydrogen.

Methane.—Berthelot (1856) first synthesised methane, hydrogen mixed with the vapour of carbon disulphide being passed over red-hot copper, $CS_2+2H_2S+8Cu=4Cu_2S+CH_4$. Brodie (1873) obtained methane by passing electric sparks through a mixture of carbon monoxide and hydrogen whilst Sabatier and Senderens (1902) reduced both carbon monoxide and dioxide to methane using nickel (250°–300°) or cobalt as catalyst.

Bone and Jerdan (1897) first obtained methane by the direct union of carbon and hydrogen; they found it was the only hydrocarbon produced on leading hydrogen over pure carbon at 1,200°. Berthelot had previously found that carbon unites with hydrogen at the temperature of the electric arc; he doubted the results of Bone and Jerdan. M. Mayer and V. Altmeyer (1907) studied the reaction between carbon and hydrogen in presence of nickel and cobalt as catalysts; the equilibrium, $C+2H_2 \rightleftarrows CH_4$, was approached from both sides and, at 475°, the partial pressure of the methane actually exceeded that of the hydrogen.

The direct production of methane from carbon and hydrogen is not promising, the gas occurs in large quantities naturally (oil-wells, mud volcanoes, fire-damp, etc.) and synthesis could be more readily effected by complete reduction of carbon monoxide by hydrogen, both being formed in the water-gas reaction. Processes based on this reduction have been patented by Elworthy. Methane can also be obtained by decomposing aluminium carbide, Al_4C_3, with water.

Syntheses from Methane.—The use of methane as a source of other carbon compounds is restricted, chlorination to methyl chloride and hydrolysis of the latter to methyl alcohol have been mentioned above. The regulated chlorination of methane has formed the subject of patents by Walter (1909) and Pfeiffer and Szarvasy (1910). Another use of methane might be its oxidation to formaldehyde, $CH_4+O_2=CH_2O+H_2O$. Bone (1903) obtained small amounts by oxidation at 409°–500° in contact with porous tile and applications of the reaction have been patented by G. Glock (1898), Hansmann and Co. (1906) and the Verein für Chemische Industrie in Mainz (1913). Experiments carried out at the Royal Naval Cordite Factory, Holton Heath (Report of the Department of Scientific and Industrial Research, 1924–5), lead to the conclusion that formaldehyde would be recovered in too dilute solution for economical concentration. The chlorination of methane has also been studied at Holton Heath; the production of carbon tetrachloride on a large scale appears to be practicable as, also, that of methyl chloride under certain circumstances. Traun (British patent 156148) states that methane is oxidised by carbon dioxide to formaldehyde at 500°–700° (up to 56% conversion). H. Dreyfus (British patent 226243) proposes the realisation of the reactions, $CH_4+CO=CH_3.CHO$ and $CH_4+CO_2=CH_3.COOH$, at 12 to 50 atmospheres and temperatures of 120°–300°, the catalysts consisting of finely-divided iron or nickel carbonate, the latter being preferably mixed with finely-divided nickel or iron.

Carbon Monoxide.—The oxides of carbon are formed by the combustion of carbon in air or oxygen or by the reaction between coke and steam at a high temperature. ($C+H_2O=CO+H_2$, $C+2H_2O=CO_2+2H_2$.) Formation of carbon monoxide is favoured by a high temperature, equilibrium in the reaction, $CO_2+C \rightleftarrows 2CO$, being displaced from left to right with increasing temperature. The reversibility of the reaction was discovered by H. Sainte-Claire Deville (1864) and afterwards studied by Boudouard (1901), Schenck and Zimmermann (1903), Rhead and Wheeler (1910, 1912) and Jellinek and Diethelm (1922). Increased pressure favours production of carbon dioxide; at 1,000° and 1 atmosphere the amount of the latter gas is only 0·7% (by volume), but at 200 atmospheres this amount becomes 47·7%. (Calculated by Jellinek and Diethelm.)

Carbon monoxide is reduced by hydrogen in presence of a catalyst to methyl alcohol or methane; according to E. R. Lush (British patent 180016), carbon monoxide and hydrogen yield formaldehyde when passed rapidly over a catalyst of copper, nickel and aluminia under certain conditions. With potassium hydride, potassium formate is produced and carbon liberated (Moissan, 1902); caustic potash gives potassium formate ($CO+KOH=H.COOK$, Berthelot, 1856), whilst sodium alkyloxides yield sodium salts of fatty acids, *e.g.*:—

Phosgene.—Phosgene (carbonyl chloride, $COCl_2$) is formed by direct union with chlorine under the influence of light or on a suitable catalytic surface. Losanitsch and Jovitschitsch (1897) submitted mixtures of carbon monoxide, water, hydrogen, methane, hydrogen sulphide and ammonia to a dark electric discharge obtaining respectively formic acid, polymeric glycolaldehyde, acetaldehyde, thioformaldehyde and formamide.

Formates.—Berthelot's synthesis of potassium formate was followed by the production of formates from carbon monoxide using caustic soda (Geuther) and soda-lime (Merz and Tibiriçá, 1880). De Lambilly (British patent 3735, 12604—1893) prepared ammonium formate by leading carbon monoxide and damp ammonia over pumice or charcoal at 80° C. to 150° C. M. Goldschmidt (German patent 86419—1894) obtained a nearly quantitative yield by using a ground mixture of caustic soda and slaked lime at 6 or 7 atmospheres pressure and 150°–170° C.

Aqueous alkaline solutions were used by R. Koepp and Co. (British patent 7875—1904 and 772—1906) and claims were made for a reaction between alkaline carbonates and carbon monoxide. Exposure of fresh surfaces of the caustic soda is essential and may be effected by stirring, a small amount of water being subsequently added (Elektrochemische Werke in Bitterfeld, German patent 179515—1905). Further patents introduce no essentially new principle, *e.g.*, Meister, Lucius and Brüning (British patent 8012—1908; G. A. Hempel, German patent 248254). The nitrile of formic acid, HCO_2H, is hydrocyanic acid, HCN. (*See* CYANIDES.)

Oxalates.—The formation of oxalates from formates, $2H.COOK=H_2+C_2O_4K_2$, by heating above 400° was known in 1840. (Dumas and Stas, Peligot.) Several applications have been made of this reaction. Goldschmidt (German patent 111078) heats sodium formate with its own weight of carbonate to 360°; Elektrochemische Werke (German patent 144150) use previously made sodium oxalate. Koepp & Co. (German patent 161512)

use 1% alkali at 290°–360°. The Elektrochemische Werke (German patent 204895) heat in vacuo at 280°, the Gesellschaft für Chemische Industrie in Basle pre-heat the vessel and keep the temperature above 400° throughout the course of the reaction (U.S. patent 995041) although Landshoff and Meyer (German patent 269833) lay stress on keeping the reaction at 385° to 400°. C. Bochringer und Söhne (German patent 229853) add a small amount of boric acid, G. A. Hempel (U.S. patent 1070806) makes and decomposes the formate in the same vessel.

Methyl Alcohol.—Realisation of the reaction, $CO+2H_2=CH_3OH$, under the influence of an electric discharge has been recorded by Solvay and Slosse (1898) but Sabatier and Senderens were unable to arrest the reduction of carbon monoxide at the methyl alcohol stage. Patents were taken by the Badische Anilin und Soda-Fabrik (German patents 293787, 295202, 295203) for the reduction of the oxides of carbon by hydrogen in the presence of catalysts (*e.g.*, cerium, chromium, cobalt, manganese, molybdenum, osmium, palladium, titanium, zinc, their oxides and salts, carbides of iron, molybdenum and tungsten) with the object of obtaining liquid hydrocarbon mixtures suitable as fuel. The reactions are generally described as carried out at about 300°–400° under 100 atmospheres pressure.

Synthol.—Products of this nature ("Synthol") have been examined by Fischer and Tropsch and found to contain fatty acids, methyl, ethyl and propyl alcohols, various aldehydes, ketones, esters and hydrocarbons (Brennstoff-Chemie, 1923, 4, p. 276). E. R. Lush (British patent 180016—1921) found that methyl alcohol, as well as formaldehyde was formed from carbon monoxide and hydrogen, and G. C. Calvert (1921) claimed production of methyl alcohol in good yield by reduction of water gas. G. Patart (French patent 540343) patented carrying out the reaction between one volume of carbon monoxide and two volumes of hydrogen at 300°–600° under high pressures in presence of metals, their oxides or salts.

The patents of the Badische Co. (British patents 228959, 229714, 227147, 231285, 237030, 240955) claim a process for manufacturing methyl alcohol very similar to that of Patart. Stress is laid on removing iron and nickel compounds from the reacting gases as well as the ordinary catalyst poisons; the catalyst masses must be free from iron, nickel and cobalt, or alternatively they should only be present in traces provided that there are present at the same time other metallic catalysts which will prevent the iron, nickel or cobalt giving rise to methane or other hydrocarbons.

Contact masses consisting of mixtures of metallic oxides which cannot be reduced under the operating conditions of the reaction may be used; the most basic of the oxides employed must predominate in a mixture. Contact masses practically free from the alkali metals or from mixtures of non-reducible oxides and a metal may be used. When a mixture of two or more metals whose oxides are reduced by hydrogen on carbon monoxide at ordinary pressures below 550° are employed, metals of the fourth to seventh groups, as well as boron, are excluded. The Badische Co. specifies pressures of 50 atmospheres and upwards and temperatures of 200°–600° C. When contact masses containing a difficultly reducible metallic oxide, with a little potassium carbonate are employed, higher alcohols are also formed; this takes place more readily on increasing the percentage of carbon monoxide and diminishing the rate of flow. Besides the plant at Merseburg, fresh units are to be opened at Ludwigshofen and Oppau; the production of methyl alcohol by the Badische Co. is estimated at about 15,000 tons for 1925 and 25,000 tons for 1926. The Patart process is to be exploited in France in the near future. (With regard to priority, see *Chem. Trades Jour.*, 1925, 76, pp. 699, 754. *Cf.* British patent 180016, *v.s.*)

Patart, in laboratory experiments, attained regular production of methyl alcohol at 400°–420° C. and 150 to 250 atmospheres using zinc oxide as catalyst (*Chemie et Industrie*, 1925, 13, i., p. 179). E. Audibert (*ibid.* 186) utilises the suboxides of certain elements and describes the results when employing contact masses obtained by reducing uranium trioxide (UO_3) and chromic oxide (Cr_2O_3) respectively, in contact with copper in both cases. With an uranium suboxide and gas remaining in contact with the catalyst 60 to 80 sec. conversion was 8 to 10 per cent. In these experiments, temperatures of 220°–250° and 280°–300° and a pressure of 200 atmospheres were employed; the surplus gas was found to contain 1–2% carbon dioxide and up to 1% methane; the ratio $H_2:CO_2$ showed a small increase of 3–4 per cent. The condensed liquid was nearly pure methyl alcohol. The chromium suboxide at 325°–350° gave a mixture of water, methyl alcohol and other organic compounds.

Carbon Dioxide.—This gas can be used for the synthesis of carbamide (urea). Basarow (1870) obtained it by heating ammonium carbamate (the product obtained thus, $2NH_3+CO_2=NH_2.COONH_4$) to 130°–140°. Dexter (1882) passed ammonia and carbon dioxide through a hot tube. Fichter, Steiger and Stanisch (1916), finding the initial rate of urea formation accelerated by a small amount of water, conclude that ammonium carbonate is the immediate source of urea,

$$NH_4.COONH_4+H_2O \rightleftarrows (NH_4)_2CO_3 \rightleftarrows CO(NH_2)_2+2H_2O$$

Above 135°, only the second equilibrium need be considered, the ammonium carbamate disappearing. Matignon and Fréjacques (1920–2) find urea formation is accelerated by catalysts at lower temperatures; they are without benefit at 150°.

The Badische Anilin und Soda-Fabrik carry on the manufacture, apparently at 130°–140°. Their suggestions include the use of silver- or lead-lined autoclaves; acceleration by catalysts, *e.g.*, charcoal, sugar or carbamide itself; and addition of 10–20% ammonium carbonate. The equation shows that the reaction is incomplete, unaltered ammonia and carbon dioxide and, subsequently, water can be distilled off under reduced pressure. (British patents 23939, 24042, 24117 of 1914, 145060, 182331.)

Fréjacques (French patent 527733) heats ammonium carbamate to 145°–200°, *e.g.*, 2 to 4 hours at 150°, allows the temperature to fall to 65°–100° and removes carbon dioxide, ammonia and water, carbamide remaining in the autoclave. Urea is also manufactured from calcium cyanamide. The isomerisation of ammonium thiocyanate gives thio-carbamide, $CS(NH_2)_2$. It is used in the rubber and synthetic resin industries and is manufactured by the British Cyanides Co., Ltd.

Carbon dioxide unites directly with sodium yielding sodium oxalate. Haupt claims a process of spraying molten sodium with pre-heated carbon-dioxide. (German patent 286461.)

Acetylene.—(*See* 1.137.) This is obtained by the action of water on calcium carbide, ($C_2Ca+2H_2O=C_2H_2+Ca(OH)_2$); there is an extensive literature relating to generation and purification of the gas.

Acetaldehyde, Acetic Acid and Acetone.—Addition of the elements of water to acetylene gives acetaldehyde. $CH:CH+H_2O=CH_3.CHO$. Oxidation of acetaldehyde yields acetic acid, $CH_3.COOH$. Distillation of calcium acetate gives acetone . . . . $(CH_3COO)_2Ca=CaCO_3+(CH_3)_2CO$, which may also be formed by catalytic decomposition of acetic acid, $2CH_3COOH=H_2O+CO_2+(CH_3)_2CO$.

Other products may also be obtained, thus acetaldehyde can be polymerised to alcohol, removal of the elements of water from the latter compound gives crotonaldehyde and catalytic hydrogenation of crotonaldehyde yields butyl alcohol. $2CH_3.CHO\rightarrow CH_3.CHOH.CH_2.CHO\rightarrow CH_3.CH:CH.CHO\rightarrow CH_3.CH_2.CH_2.CH_2OH$. Acetone vapour is decomposed in contact with certain metallic oxides giving methane and ketene, $CH_3.CO.CH_3=CH_4+CH_2:CO$, and ketene can be used as an acetylating agent, $R.OH+CH_2:CO=R.OCO.CH_3$. From sodium acetone and acetylene a tertiary alcohol of the constitution $(CH_3)_2C(OH).C:CH$ is obtained which can be employed in the manufacture of isoprene.

Acetylene was first converted into acetaldehyde by solution in sulphuric acid (specific gravity 1·35), dilution with water, and distillation (Lagermark and Eltekow, 1877).

Kutscherow (1881) used water and mercuric bromide, Erdmann and Köthner (1898) passed acetylene through boiling dilute sulphuric acid to which mercuric oxide had been added.

N. Grünstein (1910) proposed the technical preparation of acetaldehyde from acetylene with the aid of mercury compounds in acid solution, working at a lower temperature than had been usual in laboratory experiments. His first patent, German patent 250356, was followed by others (German patents 253707, 253708, 267260, 270049). Several patent applications by the Consortium für elektrochemische Industrie in Nürnberg were withdrawn but Fr. Bayer and Co. patented the use of aromatic

sulphonic acids in place of the mineral acids usually employed. (German patent 291794.)

The oxidation of acetaldehyde by air to acetic acid is slow at ordinary temperature, moreover, acetaldehyde, b.p. 21° C. is very volatile. Grünstein, in conjunction with the Chemische Fabrik Griesheim-Elektron overcame this difficulty by dissolving the acetaldehyde in a large excess of acetic acid and blowing in air or oxygen at 70°–100° C. Catalysts (*e.g.*, 0·1% UO_3 on weight of acetic acid) enable the use of a temperature of only 30° (British patent 17424—1911, 8076—1912; United States patent 1081959; German patent 261589; French patent 440658). Meister, Lucius and Brüning suggested the use of increased pressure together with a catalyst (British patent 10377—1914).

Patents referring to special points in converting acetylene to aldehyde have been numerous since 1915. Thus those of H. Dreyfus (French patent 479656) and Union Carbide Co. (United States patents 1213486, 1213487) relate to low hydrogen ion concentration, Acieries et Forges de Firminy (British patent 124194) to electrolytic regeneration of acid liquids containing mercury salts, Deutsche Gold- und Silber-Scheide Anstalt (German Patent 334357) to the interaction of steam and acetylene at high temperatures in pressure of a catalyst, Société anonyme de Produits chimiques (Malétra) (British patent 140784) and Tokyo Industrial Laboratory (Japanese patent 38752—1921, *Chem. Soc. Abstr.* 1922, 1, p. 523) to use of ferric compounds and of Société chimique des Usines du Rhône (British patent 238520) to acid solutions of ferrous and copper sulphates with metallic mercury.

Increased demand for acetic acid and acetone during the War was met by Canadian Electro Products, a subsidiary of the Shawinigan Water and Power Co. of Montreal. According to J. T. Rooney (*Chem. & Met. Engineering*, 1920, 22, p. 847) absorption vessels of acid-resisting iron were used to contain 60% sulphuric acid at 70° to which yellow mercuric oxide had been added, for dissolving the acetylene. The crude acetaldehyde was concentrated to 99–100% and oxidised by air under pressure at 60°, manganese acetate being used as a catalyst. The vapour of acetic acid was decomposed into acetone, water and carbon dioxide by passing over iron balls coated with lime at 485°.

Acetylene is absorbed by acetic acid in presence of mercury salts with production of ethylidene acetate, $CH_3CH(OCOCH_3)_2$ (Griesheim-Elektron, British patent 14246—1913; compare Consortium für Elektrochemische Industrie, British patent 182112). This compound is decomposed above its boiling point giving acetic anhydride, $CH_3.CH(OCOCH_3)_2 = CH_3.CHO + (CH_3.CO)_2O$. (Bosnische Elektrizitäts A.G.), The production of acetic anhydride in this way has been further developed by the Société chimique des Usines du Rhône.

Ethyl Acetate.—Tischtschenko (1906) observed the production of ethyl acetate from acetaldehyde under the influence of aluminium ethoxide, $Al(OC_2H_5)_3$. Improved methods of carrying out the reaction $2CH_3.CHO = CH_3.CO.OC_2H_5$ have been patented by the Consortium für elektro-chemische Industrie (German patents 277111, 277187, 277188, 285990, 286812).

Butaldehyde and Butyl Alcohol.—These compounds can be obtained by the catalytic hydrogenation of crotonaldehyde in presence of 20–25% water or steam. (N. Grünstein, British patent 147118.) Nickel (5–15%) on pumice or kieselguhr is used as catalyst, optimum temperature 110–120°. Formation of high boiling products is minimised by using a large excess of hydrogen.

Ethylene and Ethyl Alcohol.—The hydrogenation of acetylene usually proceeds completely to ethane or ethylene, when formed, partially polymerises. Efforts to overcome these difficulties have been made by W. Caro; Lane, Ryberg and Kinberg; Traube. As a product of the distillation of coal, ethylene is produced in large quantities at gas-works and coke-oven plants. Concentration of ethylene has been effected by selective absorption by charcoal (Bury at Skinningrove) with a view to alcohol production. The Compagnié des Mines de Bethune, who manufacture ammonia by the Claude process, have adopted a different method. (*Chimie et Industrie*, 1925, 13, i, 718.) The hydrogen obtained from the coke-oven is purified by liquefaction of ethylene and benzene. The ethylene is absorbed in sulphuric acid to form ethyl sulphuric acid which is hydrolysed on dilution and heating, the ethyl alcohol being distilled off. The residual dilute sulphuric acid is used for the manufacture of ammonium sulphate.

Acetylene and Chlorine.—Several compounds obtained with the help of acetylene and chlorine find application as solvents and, more recently, for synthetic purposes. Berthelot and Jungfleisch (1869) obtained an addition product of acetylene and antimony pentachloride, $C_2H_2.SbCl_5$, which gives dichloroethylene, CHCl:CHCl, on distillation; with excess of antimony pentachloride, tetra-chloroethane, $CHCl_2CHCl_2$, is produced. The latter compound loses hydrogen chloride on treatment with alcoholic potash giving trichloroethylene, $CHCl:CCl_2$.

Direct union of acetylene and chlorine may give rise to a violent reaction; to avoid this, the Salzbergwerk Neu-Stassfurt (German patent 174068) used sulphur chloride with a contact substance, *e.g.*, iron powder, and passed in acetylene and chlorine alternately. Tetrachloroethane, a liquid boiling at 147°C., was thus obtained; saturation at the boiling point before distillation gave hexachloroethane C_2Cl_6.

Various modified processes have been proposed. Tompkins (British patent 19568—1904) specified the presence of both antimony tri- and pentachlorides. Lidholm (British patent 22094—1905) diluted with carbon dioxide and exposed to the light of a mercury lamp. Griesheim-Elektron (British patent 13411—1907) used a solid diluent. Ornstein (British patent 2375—1911) led acetylene and chlorine at different places into previously prepared tetrachloroethane containing iron.

Trichloroethylene.—Removal of hydrogen chloride may be effected in various ways. Heating with milk of lime or slaked lime (Consortium, German patents 171900, 208834); thermal decomposition (Tompkins-and Clayton Aniline Co., Ltd., British patent 23780—1906); action of metal chloride at 300° (Griesheim-Elektron, German patent 263457); use of thorium oxide (Chemische Fabrik Buchau, German patent 274782); action of aqueous ammonia (Cie. d'Alais et de la Camargue, British patent 132755).

Dichloroethylene is not only formed by direct union of acetylene and chlorine (Griesheim-Elektron, British patent 16620—1912) but also by reduction of tetrachloroethane with aluminium, iron or zinc and water (Consortium, British patent 19576—1907). Of these compounds, trichloroethylene has become a synthetic reagent. Paterno and Oglialoro (1874) obtained dichlorovinyl ethyl ether by the action of alcoholic potash. $CHCl:CCl_2 + KOC_2H_5 = KCl + CHCl:CCl.OC_2H_5$. This, in turn, gives ethyl ethoxyacetate with an excess of the alcoholate, $CHCl:CCl.OC_2H_5 + C_2H_5OK + C_2H_5OH = KCl + C_2H_5Cl + C_2H_5O.CH_2COOC_2H_5$ (Geuther, 1873; Nef, 1897).

Imbert and the Consortium für Elektrochemische Industrie (German patent 216940) discovered that the last reaction proceeds in stages and gives a ready method of making ethyl chloroacetate. $C_2HCl_2.OC_2H_5 + C_2H_5OH = CH_2Cl.COOC_2H_5 + C_2H_5Cl$. Water may be used at this stage in place of alcohol (German patents 209268, 210502), but complete hydrolysis gives chloroacetic acid (German patents 216716).

Hydrogen chloride acts on dichlorovinyl ethyl ether giving chloroacetyl chloride. $CHCl:CCl(OC_2H_5) + HCl = C_2H_5Cl + CH_2Cl.COCl$. (Consortium German patent 222194). Reactions of this type have been studied by Compton and Vanderstichele (*Jour. Chem. Soc.*, 1920, 117, p. 691).

By heating trichloroethylene with sulphuric acid containing a little water, monochloroacetic acid is formed (Simon and Chavanne, French patent 519833, United States patent 1304108). The reaction is possibly due to formation of an intermediate addition product which is then hydrolysed. $CH_2Cl.CCl_2.SO_4H + 2H_2O = CH_2Cl.COOH + 2HCl + H_2SO_4$. Since the product is free from dichloracetic acid it is useful in the synthesis of indigo. Chlorinated propanes have been obtained by the action of aluminium chloride on mixtures of chloroform or carbontetrachloride with halogenated ethylenes (German patent 261689), *e.g.*, $CCl_4 + CHCl:CCl_2 = CCl_3CHA.CCl_3$.

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CARBURETTER: *see* MOTOR VEHICLES.

CARDIFF, WALES (*see* 5.316), had a population in 1921 of 200,262; the estimate for 1923 was 226,200. The city has grown largely since 1910, most of the numerous industrial establishments being grouped round the docks. Roath Park, the largest in Wales, has a miniature lighthouse in the lake as a memorial to Capt. Scott. New buildings in Cathays Park are the Glamorganshire County Hall (1911), and a Technical College (1916). Plymouth Great Wood (42 ac.), presented to the city by the late Earl of Plymouth, was opened in 1923. A large reservoir in Taff Fawr Valley, begun in 1911, was finished after the World War, and, at the end of 1925, a central power station was under construction at Treforest. A tuberculosis hospital, the Welsh national memorial to King Edward VII., was opened in Llandaff in 1913, and the National Museum of Wales has absorbed the Municipal Museum and Art Gallery, previously in the public library building. New churches include St. Luke, Canton (1911), St. Joseph, Cathays (1913) and St. Samson (1923). In 1912 the parish of St. Stephen was formed, in 1920 that of Upper Grangetown and in 1923 that of St. David. In 1922 the city boundaries were extended to include Llandaff and most of six other outlying parishes, and the area of the borough was thus increased to 13,649 acres. Cardiff has a considerable Roman Catholic population, and when Wales was made a separate Roman Catholic province in 1916, it became the seat of the archbishop.

CARDINALS, COLLEGE OF (*see* 5.321).—The Codex of Canon Law, ordered to be codified by Pius X. and promulgated by Benedict XV. by the Bull, *Providentissima Mater,* in 1917, contains perhaps the last word to be said concerning the cardinalitial dignity and the privileges and duties attached to the office of those who wear the *ruber galerus.* The matter is there so well digested that little further compression is possible or comment necessary.

The cardinals are described as the Pope's counsellors and adjutants in the three orders of 6 cardinal bishops, 50 cardinal priests and 14 cardinal deacons (the number symbolises the 70 elders). They are to be chosen freely from all countries for their doctrine, piety and prudence. At the moment (1926) the college contains 36 Italians, 8 Central Europeans, 2 Poles, 7 French, 5 Spanish, 4 North Americans, 2 English and one each from Ireland, Portugal, Holland and Brazil.

Prohibitions.—From their number the Code excludes bastards, even though legitimised by subsequent marriage, also those who have children or grandchildren by legitimate marriage themselves (this would have excluded the English Cardinal Weld) and also those who are related to a living cardinal by the first or second degree (this has been dispensed by Pius XI. in favour of Cardinal Gasparri's nephew). The cardinal bishop first in promotion becomes dean of the Sacred College, but only as first among equals. Cardinals are required to live in Rome, even the cardinal bishops of suburban Sees. Cardinals occupying Sees abroad are required to approach the Pope on arrival in Rome, and not to leave without his permission.

Cardinals enjoy a number of privileges, the chief of which are as follows:—

1. To hear and absolve in confession anybody, anywhere, even the Religious of both sexes, and even from reserved sins and censures, with a few very special exceptions such as revealing the secrets of the holy office.
2. To choose confessors for themselves and households on similar conditions.
3. To preach the word of God anywhere.
4. To celebrate or allow another to celebrate in their presence a mass on Maundy Thursday or three masses on Christmas night.
5. To bless religious objects everywhere with every Indulgence.
6. To erect with one blessing the Stations of the Cross in private or public oratories or churches, with all Indulgences included.
7. To celebrate on portable altars mass in their private houses and wherever they go.
8. To celebrate mass at sea.
9. To celebrate mass everywhere according to their own Calendars.
10. To enjoy the privileged altar daily.
11. To gain in their private oratories the Indulgences which are attached to public visits in the places where they are staying.
12. To give the episcopal blessing everywhere except in Rome and there in churches only.
13. To wear the episcopal cross and mitre and carry the pastoral staff.
14. To celebrate mass in any private oratory without prejudice.
15. To pontificate with throne and canopy anywhere except in Rome.
16. To receive the honours of the Ordinary everywhere.
17. To confirm abroad the word they have heard from the Pope.
18. To enjoy their oratories free from episcopal visitation.
19. To dispose freely, even by will, of the revenue of their benefices.
20. To consecrate everywhere altars, abbots, and the like with the exception of the holy oils (unless the cardinal is a bishop) and a holy place, without leave of the Ordinary.
21. To precede all prelates and patriarchs and legates except a cardinal legate in his own country.
22. To confer tonsure and Minor Orders.
23. To confer Confirmation.
24. To confer an Indulgence of 200 days upon persons under their protection.

The Interregnum.—The new Code contains the Constitution of Pius X. *Vacante Sede Apostolica,* which summarises most minutely the duties of the cardinals between one pontificate and the next. The cardinals have no power, except in matter of immediate business. The offices of the Cardinal Camerlengo and Grand Penitentiary continue during the Interregnum. The cardinals are required to meet and make the ceremonial arrangements for burying one Pope and for electing another. The ingress of the cardinals into conclave and their closure is minutely ordered. Secrecy is imposed upon all the cardinals and the conclavists under pain of excommunication. (The details of the conclaves electing Leo XIII. and Pius X. were pretty well known, but the conclaves electing Benedict XV. and Pius XI. have been kept a profound secret; their tendencies being judged by historians entirely on ante-conclavicular knowledge concerning the *Papabili* or probable candidates compared with the results.) By the *Commissum nobis* Pius X. abolished the veto claimed by the Catholic powers under an unwritten law. Pius XI. extended the time allowed to cardinals travelling to the conclave, from 10 to 15 days. During the 20th century the Red Hat has been enjoyed by British subjects in England, Ireland, Canada and Australia. The English-speaking cardinals are now the equal of those representing any Catholic power in any future conclave. (S. L.*)

CARDIOLOGY: *see* HEART, DISEASES OF THE.

CARIBBEAN, THE.—Events in the Caribbean region during the period 1910–26 were dominated by the steady advance of the political and economic power of the United States. This development dated from the Spanish-American War, which led to the annexation of Porto Rico in 1898 and to the occupation of Cuba by American forces from 1899 to 1902. Cuba's later independence was qualified by the Platt Amendment (*see* 7.604d) and by the lease to the United States of naval stations at Bahia Honda and Guantánamo.

The construction of the Panama Canal (*q.v.*) gave the United States another highly important vantage point in the region and brought virtually under American control the State of Panama. In Santo Domingo, where an American receiver-general had been placed in charge of the customs-houses in 1907, recurrent revolutions following Nov. 1911 led to the military occupation of the country by U.S. Marines in 1916. The American flag was withdrawn in 1926, leaving as a reminder of the occupation only good roads, good schools, quick communications and a well-trained constabulary, together with the receiver of taxes to safeguard interest payments on the external debt. A similar occupation of Haiti was authorised by President Wilson in 1915. Congress tacitly approved, as it did also in connection with similar situations in Costa Rica and Nicaragua. In each case there was increased local prosperity, accompanied by larger American investments. In 1917 the United States acquired by purchase the Danish West Indies (Virgin Is., *q.v.*) with the dual purpose of securing thereby another potential naval base in close proximity to Culebra, Porto Rico, and of preventing the installation in the Danish West Indies of what at the time was a great and growing European naval power.

Political Grouping.—The political units of the Caribbean in

1926 were classifiable into four principal groups, American dependencies, such as Porto Rico and the Virgin Is.; virtual protectorates of the United States, such as Cuba and Panama (with their own governments but subject to limitations imposed by treaties with the United States) and Santo Domingo, Haiti and Nicaragua (under partial control); independent republics, such as Guatemala and Venezuela; and, finally, insular and continental colonies of Great Britain, France and the Netherlands. The latter include Jamaica and French and Dutch Guiana. In all, these political divisions of the Caribbean owe allegiance to 15 different national flags.

In the British West Indies in the period under review, there has been a fuller appreciation of the advantages accruing from the connection with the home Govt., among which have been reciprocal trade agreements based on the principle of Empire preference. A West Indian contingent, over 20,000 strong, served in the World War under the British flag.

In 1920 the Prince of Wales, while visiting these islands, took occasion to state that Great Britain would not dispose of her West Indian possessions in part settlement of her World War debt. Under the Ottawa agreement (June 1920) the Dominion of Canada conceded to British West Indian products a tariff preference ranging from 25 to 50% while provision was made on a subsidy basis for greatly needed mail and steamship facilities. In return the Islands conceded extensive favours to Canadian products and trade. While sugar still remained king of the West Indian trade, a rapid development of the petroleum deposits in Trinidad took place.

Pan-Americanism.—In large part the problem of the Caribbean is involved in the question of pan-Americanism. In the decade 1915–25 Washington has been the scene of political and financial conferences and of press, good roads and better business conferences, in all of which, with the other republics of Latin speech, the republics of the Caribbean have been well represented and have sought and found their advantage.

The lessons of the decade have been many and varied. Only a few need be mentioned here. It is clear now, if there ever was room for doubt, that territorial propinquity creates special relations between countries; that the Panama Canal, quite irrespective of the Monroe Doctrine, has given the United States a profound and increasing interest in these islands and the bordering mainland; that United States control of the Caribbean is necessary to the naval protection and economic welfare of that region; that many of the islanders would rather be misgoverned by their own people than well governed from Washington; that the islands irrespective of political complexion, have become important natural markets on a great commercial highway of limitless possibilities; that to prevent foreign intervention the United States must make certain that legitimate outside interests are protected; and last, that inescapably the United States is charged with the task of assisting the countries of the Caribbean in their long-delayed quest of economic and political well-being.

Yet in spite of a more general recognition of the responsibilities that these lessons have driven home, it cannot be said that a systematic course of action has been followed. Four policies, however, have been proposed, and it may perhaps be said without injustice that all have been practised—intermittently. These are: regulation, as in Cuba and Santo Domingo; neutralisation, as in the Central American states; annexation, as in Porto Rico; and abstention, as in many quarters. Under these circumstances, the people of the Caribbean can hardly be blamed for regarding the policy of Washington as always individualistic and at times temperamental. To most observers it seems that abstention is impossible and that regulation is the most practicable; but to succeed, the policy of regulation must be systematically pursued.

The Political Future.—In view of these conflicting currents, the immediate political future of the Caribbean region is obscure. Notable changes in sentiment may, however, be noticed. In the United States 20 years ago there were individuals, and perhaps organised groups, who more or less openly sought the annexation of Cuba. In 1926 there were no such groups. On the contrary, there are many persons in Cuba who contrast the cost of government to the Porto Ricans under the American flag with the cost and quality of government under the Cuban flag and who sigh for at least fiscal control by the United States.

In countries like Cuba, Santo Domingo and Haiti, where there have been in the period under review internal upheavals followed by foreign intervention, the paramount question is that of the degree of political education and stability acquired as a result of these experiences of imposed political and fiscal restraints naturally so irksome. It may be suggested that there are signs of an increasing aptitude for the tasks of self-government and a growing appreciation of the dangers as well as the advantages of foreign contacts. In the main the answer to the basic questions that the actual situation propounds must be left to the future.

The increasing dominance of the United States in the Caribbean area cannot be ignored. It is almost daily emphasised. It is equally true that innumerable opportunities and even provocations to extend the flag over these islands have been presented and that they have been, without the slightest hesitation and with the practically unanimous approval of the American people, ignored or flatly rejected. It would seem that the charge of American imperialism—at least as far as the Caribbean is concerned—should no longer receive a respectful hearing.

An Era of Progress.—In the 20 years 1905–25, with extraordinary rapidity and probably finally, the Caribbean world has been removed from the list of "backward areas" in which it figured so long. Geographically, economically and politically, the islands of the American Mediterranean have entered into the closest relations with the great continental Power that has become at once the sponsor of their democratic institutions and the guarantor of their political independence. More than a century ago Thomas Jefferson foresaw it all, when he said that the islands of the Caribbean protected or menaced the mouth of the Mississippi. To-day the American seaway is not solely across the Atlantic Ocean, as it was when Jefferson lived, but also due south through the diversified islands of the Caribbean to the Panama Canal, the gateway to the markets beyond. (*See* PANAMA CANAL.) (S. B.)

CARICATURE (*see* 5.331), regarded merely as the comic pictorial interpretation of life, followed normal lines between the years 1910 and 1925, though the standard of representation greatly improved. In Great Britain *Punch* continued to reflect the prejudices rather than the judgments of the educated middle class, and remained at the head of humorous publications. A comparison of the various artists' work in that paper during the period under review is fraught with enlightenment, for artists whose drawings passed muster in 1910 had advanced almost beyond recognition by 1925. Regarded as draughtsmen J. A. Shepherd, George Morrow, G. L. Stampa, Frank Reynolds, Bert Thomas, Lewis Baumer, together with the regular cartoonists, Sir Bernard Partridge and L. Raven-Hill, were amongst the foremost black and white artists of the day.

On the other hand true caricature, that is, individual portraiture in which salient peculiarities are exaggerated with a view to making a definite comment, has never been generally appreciated in Great Britain since the early years of the 19th century, and since then has not taken a prominent, or at all events a popular, place in the pictorial art of the country. True caricature demands of the artist an uncompromising honesty, which expediency has done little to encourage, and which squeamishness has found difficult of acceptance. European caricature, however, unshackled by prejudice, is frequently vulgar and coarse, and it certainly typifies that "brutality of the intellect" which G. K. Chesterton, in one of his stories, once declared to be its moving spirit.

Sir Leslie Ward ("Spy" of *Vanity Fair*), who was "Ape's" successor, gradually reduced the physical exaggeration in his weekly caricature until it became a "mere" portrait. Amongst other occasional contributors to *Vanity Fair* in that paper's later years should be mentioned a gifted amateur, Roland le Strange, who under the signature "A-O" (abbreviated from Armadillo) made various caricatures, that of Sir Harry Keppel being of exceptional brilliance.

Max Beerbohm's Work.—One outstanding caricaturist of the age was Max Beerbohm, whose immature work was first published in *The Strand Magazine* and in *Pick-me-up*. He made a contribution to *Vanity Fair* with his amusingly delicate drawing of George Meredith and worked for *The Yellow Book* and *The Savoy*. For some years his drawings were exhibited biennially at the Leicester Galleries, London, and reproduced

FIG. 1.—" H. M. Hyndman " by Kapp.

in book form. The merit of his work, which was for many years quite independent of draughtsmanship or pictorial beauty, lies in his subtle appreciation of character, which he demonstrated as a rule without the grosser physicial exaggerations which found favour in the days of Gillray. Descriptive passages, often in the form of highly skilled parodies of his victims' speech and writings, form an ironic accompaniment to the drawings, and indeed, in a wider sense, Max Beerbohm's two vehicles of expression complement each other. Long practice in the use of pencil and wash gave his unconventional work, in which the representation of idea always supplanted the representation of fact, a definite beauty which challenges the work of serious and normal artists on its own ground.

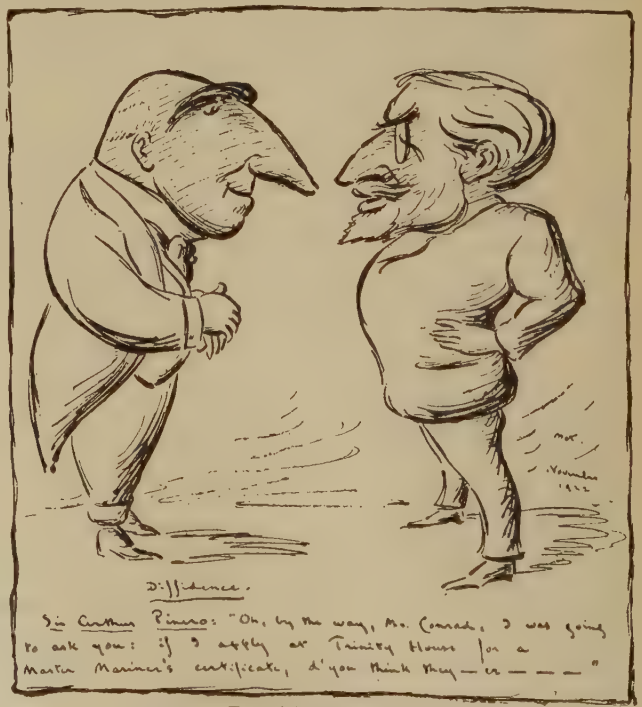
The very earliest of Beerbohm's drawings undoubtedly show the influence of Carlo Pellegrini (" Ape " of *Vanity Fair*), but he soon developed a style of his own based upon very accurate observation, although without academic knowledge of drawing. He was, so to speak, a caricaturist by nature, whilst other men such as Kapp and " Quiz " were artists first and caricaturists by chance. Beerbohm's best work was invariably done from memory, with an unfaltering line and comeliness of grouping which fills the observer with delight. His aim was to expose the weaknesses of the strong and his outlook was far too straightforward for him to avoid the charge of occasional malice. Beginning, as he himself said, a " petit maître " who would take nothing seriously, in his maturer work, still enlivened by a sense of the ridiculous, he ripened and ascended from cleverness to wisdom, from a rare spitefulness to an almost exuberant scorn.

His series of nine drawings exhibited in 1921 entitled *Tales of Three Nations*, dealing with the relative positions of Great Britain, France and Germany during the preceding hundred years, is a solid contribution to historical commentary. His lighter vein is admirably exemplified by *Rossetti and his Circle* and the series of *The Old and the Young Self*, exhibited in 1921 and 1925 respectively. In the latter notables are found in characteristic conversations with themselves in their own youth. These drawings show at its best Max Beerbohm's profound insight into other men's personalities. His work ably illustrates the impact of events upon a scholarly and cultivated mind, more prone to perceive the absurdity of wrongdoing than the evil, and of some forms of righteousness, the beauty equally with the absurdity. His expression is never heavy or pompous, he has no truck with the surface emotions, and his work, therefore, never has and never will be, in a wide sense, popular.

Claud Lovat Fraser (d.1921) made a few caricatures from time to time of considerable distinction, his method being to " catch " a likeness in remarkably few lines. Henry Ospovat (d. 1910) combined keen perception in true caricature with accomplished portraiture.

Edmond X. Kapp was an excellent draughtsman and his " straight " portraiture, usually in pencil or chalk, commands admiration. His caricatures are diverting and original, showing considerable observation not merely of a physical kind. His work appeared from time to time in the periodical press, and exhibitions of it were held at the Leicester Galleries, London. His most memorable caricatures were a series of judges which appeared in *The Law Journal* (1924), and a number of musical notabilities. Kapp's manner of drawing was extremely diverse, ranging from elaborate effects of light and shade made with broad-pointed chalk to a fine clean pen line. He was the first artist in Great Britain to make intelligible use of " abstract " drawing in conjunction with true caricature, and he shared with Max Beerbohm the distinction of making his drawings, apart from their ostensible purpose, of definite aesthetic interest.

" Quiz " (Powys Evans) contributed weekly to *The Saturday Review* (London) from 1922 onwards. His caricatures, drawn in pen and ink, were variously successful, and occasionally brilliant. His comment is mainly physical. Portraits from his hand appeared in *The London Mercury*. Among other artists who made


Diffidence.
Sir Arthur Pinero: "Oh, by the way, Mr. Conrad, I was going to ask you: if I apply at Trinity House for a Master Mariner's certificate, d'you think they—er——"

From *Things New and Old* (Heinemann, London)

FIG. 2.—" Diffidence " (Sir A. Pinero and Mr. J. Conrad) by Max Beerbohm.

successful caricatures from time to time were Edmund Dulac and W. K. Haselden, whose weekly illustrations to the dramatic criticisms in *Punch* were really of remarkable excellence. With

extreme economy of line he contrived to unite likeness to his victims with judgment on their performance or personality. Will Dyson, an Australian who first became known as a contributor to *The Bulletin* (Sydney), made powerful caricatures in black and white, though his work came as a rule rather under the head of cartooning. Other personal caricatures which appeared from time to time in the daily or periodical press consisted usually of large heads on little bodies—a convention which has the merit only of enabling the artist to draw especial attention to facial peculiarities, but which has the disadvantage of frequently inverting the figurative as well as the physical truth. It remained for Max Beerbohm to put very small heads on very large bodies when that reversal of the usual procedure seemed warranted.

German Caricature.—On the continent of Europe the best personal caricature was undoubtedly produced in Germany, where the satirical weekly paper *Simplicissimus*, formerly published from Munich, and later from Stuttgart, continued to lead the way in manner and content, followed by *Kladderadatsch* (Berlin). *Jugend* (Munich) devoted less space and talent to caricature than formerly. The World War gave the German caricaturists daily opportunities of malicious exposition of current events, and it was on the whole remarkable how they restrained themselves; their satire during those years was frequently tinged with manifest respect. Caricature in *Simplicissimus* was outstanding, not only for the excellent likeness to individual victims, but for the wealth of original and daring conventions by which such likenesses were built up. The best work in *Simplicissimus* was done latterly by two Scandinavians, Olaf Gulbransson, and " Blix," who treated the affairs of the world at large week by week in a spirit of bitterness, sometimes entertaining, sometimes revolting in its harsh realism, but always skilful. The caricatures of E. Thöny, an old contributor, were remarkable for their fertility of invention and variety of treatment.

In Great Britain, the name that most conspicuously emerged from the War in this respect was that of the Dutch artist, Louis Raemaekers, who, though not to be highly regarded as a caricaturist, contrived to adapt the skilled inventions of a continental technique to a bitter commentary on the conduct of the German Army. In Italy, Musacchio contributed brilliant caricatures to the *Giornale d'Italia*.

French and American Work.—In France, the personal caricatures of " Cabrol " in *L' Humanité* were noteworthy for physical likeness skilfully caught by unusual means; but it is to be observed that the continental draughtsmen in this *genre* seldom, in their estimate of individuals, went beneath the surface of reported utterances, and no particular insight into character was demonstrable, either in the drawings themselves or the words written beneath them. Very little true caricature worth mention appeared in other European countries during the period 1910–25, and in the United States, too, irony generally found expression in cartoons which typified rather than identified. Exceptions are found in the drawings of Ralph Barton, whose caricatures appeared in the New York *Life*, and, occasionally, in the work of Boardman Robinson, who became known also in Great Britain for his political cartoons in *The Outlook* during 1922 and 1923. The best true caricature seen in the United States after 1910 was the work of a Mexican, Miguel Covarrubias. (*See* CARTOON.)

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CARNARVON, GEORGE EDWARD STANHOPE MOLYNEUX HERBERT, 5TH EARL OF (1866–1923), English egyptologist, was born at Highclere, Berkshire, June 26 1866 and educated at Eton and Trinity College, Cambridge. In the course of extensive travels he acquired a knowledge of the Near East, but, though much interested in foreign politics, was prevented from taking part in public life owing to a motoring accident. Always interested in Egyptian archaeology and politics, he began excavations near Thebes with Mr. Howard Carter in 1906 and discovered tombs of the XII. and XVIII. Egyptian Dynasties in the Valley of the Kings. A further concession having been obtained in 1914, operations in another part of the Valley were conducted after the War, resulting in the discovery by Mr. Carter in Nov. 1922 of the antechamber of the tomb of Tutankhamun (*q.v.*) of the XVIII. Dynasty. On Feb. 16 1923 the sepulchral chamber was opened, the actual sarcophagus being discovered on Jan. 3 1924. Meanwhile Lord Carnarvon had died in Egypt on April 5 1923, from the results of a mosquito bite and pneumonia. See *The Tomb of Tut-ankh-Amen* by Howard Carter and A. C. Mace (1923).

CARNEGIE, ANDREW (1835–1919), American capitalist and philanthropist (*see* 5.364), died at Lenox, Mass., Aug. 11 1919. His ideals are shown by his benefactions (*see* CARNEGIE TRUSTS). In 1910 the Pan-American Union building erected in Washington by Carnegie at a cost of $850,000 was dedicated. In 1911 he established his last and greatest endowment, the Carnegie Corporation of New York, and before his death placed in its charge $125,000,000 to be used for promoting civilisation in whatever way should seem best to the trustees.

In 1913 the Hague Peace Palace, given by Carnegie and costing $1,500,000, was dedicated. By the close of 1918 he had erected 2,505 library buildings (1,679 U.S.A.; 660 Great Britain and Ireland; 125 Canada; 41 elsewhere) at a cost of more than $56,000,000. He had provided 7,624 church organs throughout the world, costing about $6,220,000. In his will he provided that after certain enumerated bequests the residue of his estate (his family having already been provided for) should pass to the Carnegie Corporation. Appraisal of the estate, smaller than had been estimated, was made in 1921 and showed a net value of $22,880,000. Since according to the law of New York only half of an estate can be assigned as public bequests in case husband, wife, parent or child survive, the residue passing to the Carnegie Corporation was less than $11,000,000. Before his death Carnegie had made public gifts, including those mentioned above amounting to $350,000,000. If he did not die poor, as he claimed every man should, he at least gave away all but a relatively small portion of his wealth. His *Autobiography* appeared in 1920.

CARNEGIE TRUSTS, the second largest, and in some respects the most remarkable, group of charitable foundations in the world. Andrew Carnegie's theory of wealth is summed up in the following sentence: " This, then, is held to be the duty of the man of wealth: to set an example of modest, unostentatious living, shunning display or extravagance; to provide moderately for the wants of those dependent upon him; and, after doing so, to consider all surplus revenues which come to him simply as trust funds, which he is called upon to administer . . . the man of wealth thus becoming the mere trustee and agent for his poorer brethren." In this spirit, he founded the following trusts in the United Kingdom and in America.

I. TRUSTS IN THE UNITED KINGDOM

Carnegie Trust for the Universities of Scotland (*Edinburgh*).—Founded in 1901 this has a capital of £2,000,000. One half of the income is to be applied to the improvement and expansion of the four Scottish universities, chiefly in the field of research; one half to the payment of the whole or part of the fees of university students of Scottish birth or extraction.

Carnegie Dunfermline Trust.—Founded in 1903 with £750,000, this is the counterpart of the Pittsburgh Institute (*see* below). This trust is limited to the founder's native city of Dunfermline, but the income may be spent on anything which tends to bring " sweetness and light " to the community. The trustees are, however, charged to maintain the beautiful park known as Pittencrieff Glen, which was presented by the founder separately. They have established a number of institutes, a clinic, a craft school, a school of music and a physical training college, and have substantially assisted the public library, the baths and a large number of local societies, educational, literary and artistic.

Carnegie Hero Fund Trust.—This fund is administered from Dunfermline by the trustees who are in charge of the Carnegie Dunfermline Trust.

Carnegie United Kingdom Trust (*Dunfermline*).—Founded in 1913 with a capital of £2,000,000 this is the analogue of the

Carnegie Corp. of New York " for the improvement of the well-being of the masses of the people of Great Britain and Ireland by such means as are comprehended within the meaning of the word charitable." This trust has carried on the founder's library policy, having erected a number of public libraries, established more than 100 county libraries and assisted many special libraries. It has published an edition of Elizabethan music and a number of modern compositions. Grants have been made for the erection of six child welfare model centres, to the Old Vic and Sadler's Wells theatres, London, as the nucleus of a national theatre for England, and to many musical and dramatic enterprises. The trust has also taken a prominent part in rural development by founding county community councils.

II. TRUSTS IN THE UNITED STATES

Carnegie Institute of Pittsburgh.—This consists of a group of cultural and educational departments of the municipal type, library, concert hall, technical college, museum and art gallery. The foundation really dates from 1881 when Carnegie offered to provide a public library; this offer was accepted in 1886. The idea expanded until the institute was finally constituted as such in 1896. It has a capital of $28,000,000.

Carnegie Institution of Washington.—Founded in 1902 with a capital of $22,300,000, this is a great combination of research departments, working in collaboration and including: Experimental Evolution (1903); Marine Biology (1903); Historical Research (1902); Economics and Sociology (1904, discontinued 1917); Terrestrial Magnetism (1904); Mount Wilson Observatory (1904); Geophysical Laboratory (1905); Botanical Research, including a laboratory in Monterey, Cal. (1905); Nutrition (1906); Meridian Astrometry (1907); Embryology (1914); Eugenics Record Office (1917). The published reports of the Institution constitute a highly valuable library of research and are presented in a liberal spirit to all well-established libraries. The numerous voyages of the non-magnetic ship " Carnegie," designed to test the variations of the magnetic compass, may be specially mentioned.

Carnegie Hero Fund Commission (Pittsburgh).—This is a group of foundations, dating from 1904, designed for the purpose of giving suitable recognition to persons engaged in peaceful occupations who risk their lives in heroic efforts to save others. Recognition takes the form of medals, pecuniary grants, pensions, educational help for children, etc. The funds are: U.S.A., Canada and Newfoundland $5,000,000 (1914); British Isles $1,250,000 (1908); France $1,000,000 (1909); Germany $1,500,000 (1910); Norway $125,000 (1911); Switzerland $130,000 (1911); Netherlands $200,000 (1911); Sweden $230,000 (1911); Denmark $125,000 (1911); Belgium $230,000 (1911); Italy $750,000 (1911); Total $10,540,000.

Carnegie Foundation for the Advancement of Teaching (New York).—This was founded originally in 1905 to provide pensions for teachers in the form of free gifts. The system was at first non-contributory, but after elaborate investigation, a new system was adopted by which colleges and teachers both contribute on a properly calculated actuarial basis. The Foundation has also undertaken many inquiries in the field of education, and issued numerous reports. Its capital is nearly $30,000,000.

Carnegie Endowment for International Peace.—Founded in 1910 with a view to " the speedy abolition of international war between the so-called civilised nations," this has a capital of $10,000,000. It is divided into three sections concerned respectively with " Intercourse and Education," " Economics and History" and " International Law." The endowment is very broad in its scope, being free to work in any way for the promotion of good feeling and understanding between the nations. Since the World War one important project has been a series of volumes on European economics in connection with the War and its aftermath.

Carnegie Corporation of New York.—Founded in 1911 this is the largest in size and scope of all the Carnegie Foundations, its capital being $125,000,000. It exists for " the advancement and diffusion of knowledge and understanding among the people of the United States." In 1917 its scope was extended to include Canada and the British Colonies. It may spend its large revenue through the other five American Trusts or through any other suitable channels. Its policy is in fact fluid, the founder having said in the deed, " Conditions upon the earth inevitably change. . . . . I give my trustees full authority to change policy or causes hitherto aided when this, in their opinion, has become necessary or desirable." The corporation has done a great deal for the American Library Service, and for adult education generally, *e.g.*, fine arts, the study of modern languages, law, engineering.

All the above foundations, except the Carnegie Corporation of New York and the United Kingdom Trust, have functional or local limitations. The two general trusts work largely on the same lines, seeking to promote adult education in the widest sense of the term, to make accessible to the public at large the cultural resources of the community and especially to finance carefully devised pioneer experiments for which, without practical demonstration, state subsidies and private liberality cannot be expected.

See the *Annual Reports* issued by the various Trusts; *Manual of the Public Benefactions of A. Carnegie* (Washington, 1920). *See* also LIBRARIES. (J. M. M.)

CARO, NIKODEM (1871–), German chemist, was born May 23 1871 at Łódź. He studied at Berlin University and at the technical high school, Charlottenburg, and founded a public chemical laboratory. He was engaged in agricultural research work, and experimented on peat as a source of power. He interested himself in the problems of calcium carbide and acetylene, and in the liquefaction of water gas for the production of hydrogen, also in ammonia oxidation. In conjunction with Frank, he devoted himself to the development of a process for the fixation of nitrogen (cyanamide) and organised the cyanamide industry founded theron. Large works for this industry were also erected at Piesteritz and Chovzow. Dr. Caro made a special study of the question of Bavarian sources of water-power with a view to utilising them in the chemical industry.

CAROLUS-DURAN (1837–1917), French painter (*see* 5.381), died in Paris Feb. 18 1917.

CARPATHIANS, BATTLES OF THE.—Under this heading is recorded the fighting of the first four months of 1915 in the wooded Carpathians, from the Dukla pass, south of Jaslo, to the Rumanian border. The average height of the crest of the main ridge in this section of the range is between 2,500 and 3,000 feet. The slopes are steep on the Galician side, gentler on the Hungarian side. The winter climate is extremely severe, the temperature being often many degrees below zero; snowstorms and blizzards are frequent. Why both sides chose these inhospitable highlands for a winter battle—for each side in turn attacked in great strength—invites some examination.

Object of the Operations.—For Austro-Hungary the main motives were the relief of the fortress of Przemysl and the security of the threatened plains of Hungary. But Conrad von Hotzendorf, Chief of the Austrian General Staff, hoped for more; the attacks, if successful, would develop into a large scale offensive against the southern flank of the whole Russian battle line. On the Russian side, the Grand Duke Nicholas sought during this winter to secure his flanks as the necessary preliminary to a direct advance from the Polish salient aimed at the heart of Germany. The undisputed possession of the Carpathian passes, with freedom to debouch at will into the Hungarian plains below, would go far towards breaking the resistance of Austro-Hungary and so safeguarding the Russian southern flank. The Grand Duke trusted to the greater endurance of his men under winter conditions to give them the advantage over enemies bred in less rigorous climates. He forgot that the Russian is a plainsman, and that hill fighting requires a special aptitude and training.

By the end of 1914 a continuous front had been established in the Carpathians only as far east as Baligrod. Thence to the Rumanian frontier, the conditions were those of open warfare; detachments on either side attacked and defended points of strategic importance, but no solid battle line had been formed.

Disposition of Troops.—The disposition of the opposing forces

when the campaign opened in mid-January were approximately as follows. The Russian III. Army (Radko Dimitriev) extended from the Vistula, northeast of Cracow, by Tarnów to about Gorlice; on its left came Brusilov's VIII. Army, which stretched from Gorlice to Baligrod and held the important Dukla pass. Further east, Webel's Dniester group (second-line infantry divisions and Cossacks) had pushed up the slopes of the Eastern Carpathians, capturing the Uzsok and Wyszkow passes and overrunning the Bukovina. The XI. Army was besieging Przemysl. On the Austrian side, the IV. Army (Grand duke Joseph Ferdinand) faced Radko-Dimitriev, and Boroevich's III. Army was opposed to Brusilov. Further east, Linsingen's newly formed Southern German Army (four German and two Austrian divisions and two cavalry divisions) had assembled at Munkacs and was moving forward. Further east still, beyond the Wyszkow pass, the group of Pflanzer-Baltin extended up to Dorna-Vatra on the Rumanian border.

Austrian Offensive.—The Austrian offensive, which opened the campaign, was made by the right of Boroevich's III. Army, by Linsingen's Southern Army and by Pflanzer-Baltin's group. The offensive began on Jan. 23 1915. The attack of the III. Army, after an initial success which carried it to the line of the Upper San, soon lost its impetus. The Russians retaliated with a counter-offensive which began on Jan. 26 against the left of Boroevich's Army astride the Mezö Laborcz railway; from now to the end of the battle the Russians maintained the initiative in this part of the field, to which both sides began to transfer forces from other sectors of the front. Linsingen's Southern Army recaptured the Uzsok and Wyszkow Passes and pushed slowly forward on Tuchla, but with the III. Army on its left falling back before the Russian counter attacks could accomplish little. Meanwhile, Pflanzer-Baltin, whose group had been reinforced in the last week of Jan. by a fresh corps, drove the Russians out of the Bukovina with his right wing, while his left wing reached in succession Kolomea, Nadworna, and finally, on Feb. 20, Stanislau. He now purposed to wheel to the left, to come in on the flank and rear of the Russian forces facing Lingsingen. This move was checked by the assembly to the north and west of Stanislau of Lechitski's IX. Army, which had been transferred from the Russian-front in Poland.

Attempt to Relieve Przemysl.—During the first half of Feb. the Austrians transferred the II. Army (Bohm-Ermolli) from the Polish to the Carpathian front, with the intention of making a last attempt to relieve Przemysl. By the end of February, when this II. Army was ready to advance, the situation of the Austrian forces in the Carpathians seemed critical, in spite of their numerical superiority. The left of Boroevich's III. Army had almost reached breaking point under the continual pressure of Brusilov's forces, which had captured Mezö Laborcz and the Lupkow pass; Linsingen's Army held its ground, but could make no headway; Pflanzer-Baltin's Army was threatened by Lechitski's concentration; and Przemysl was in sore straits. The offensive of the II. Army, if it was to restore the situation, required a rapid and striking success. The principal offensive was made in the direction of Baligrod, astride the shortest road to Przemysl. At no time did the attack meet with any great measure of success; and by the middle of March it was stopped as hopeless, the Austrians being completely exhausted by the weather and their heavy

losses. The formations which had borne the brunt of the assaults had lost over 50% of their strength. Przemysl was now abandoned to its fate.

Meanwhile, during the first fortnight in March, Lechitski's forces had driven Pflanzer-Baltin some 20 m. back from Stanislau and had reached the line of the Prut in northern Bukovina. An opportune reinforcement enabled Pflanzer-Baltin to check the Russian advance. There was some further fighting; but little material change took place in this eastern portion of the battlefield up to the end of April.

Russian Offensive.—On March 20 the Russians, now sure of the fortress of Przemysl (it actually fell on March 22) launched a final great offensive against the Austrian III. and II. Armies. The attack was made by the left wing of Radko-Dimitriev's III. Army, which had been extended eastwards, and by Brusilov's VIII. Army. For a month their effort lasted. Both the Austrian Armies were driven over the crest of the main ridge. But both managed to maintain their positions on the other side of it, though it was only the arrival of fresh German divisions (the Beskiden corps) which saved the III. Army from breaking. Linsingen's Southern Army obstinately withstood all shocks and indeed made some ground forward. It held fast to the important Uzsok Pass. By April 20 the Russians paused, breathless. They had appreciably enlarged their gains south of the Dukla Pass, but their effort to break through the Austrian front had failed.

Conclusions.—It is a little difficult to arrive at a just balance of profit and loss between the two antagonists in this long drawn-out struggle. The Austrians seem to have attached undue importance to their fortress of Przemysl; their obstinate efforts to relieve it brought them to the verge of collapse and cost them heavier losses in men than did the eventual surrender of the garrison. The Russians, though they secured a "bridge-head" over the barrier of the Carpathians, did not succeed in forcing the obstacle, and squandered valuable resources in men and munitions by their persistence.

The result showed in fact that both commanders had been ill-advised to embark on this winter battle. On the whole the consequences were more disastrous for the Russians, whose obsession with this Carpathian struggle induced them to withdraw two corps from the right wing of their III. Army, and was thus a direct cause of its crushing defeat by Mackensen at the beginning of May (*see* DUNAJEC-SAN). No special lessons of tactics can be drawn from the fighting. The conditions of weather and ground were against elaboration of manoeuvre. Hill fighting requires a degree of individual skill and of tactical leadership which neither side possessed.

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CARPENTER, JOHN ALDEN (1876–), American composer, was born at Park Ridge, Ill., Feb. 28 1876. He was educated at Harvard University, graduating in 1897, and joined his father in business in Chicago. Subsequently he studied music in Europe under Elgar, and in Chicago under Ziehn. His compositions include *Gitanjali*, a song-cycle with words by Tagore (1914); *Adventures in a Perambulator* (1915); a symphony (1917); *The Birthday of the Infanta*, a ballet pantomime, produced by the Chicago Opera Co., Dec. 23 1919; and *Krazy-Kat*, a ballet, produced Dec. 23 1921. His published works also include a sonata for violin and piano and a number of songs. As a composer he became distinguished by his adherence to modern tendencies, and displayed great skill and variety in his handling of the orchestra.

CARREL, ALEXIS (1873–), Franco-American surgeon, was born at Sainte-Foy-les-Lyon, France, June 28 1873. He graduated at the university of Lyons in 1890, and for two years was *Prosecteur à la Faculté de Médecine*. He went to the United States in 1905, and worked at the University of Chicago. In 1906 he was appointed to the staff of the Rockefeller Institute for Medical Research in New York, becoming a member in 1912. He developed a new method for suturing blood-vessels, which made it possible to perform blood transfusion safely, and to transplant arteries, veins and organs. He also studied the preservation of tissues outside the body and its application to surgery. This work led him in 1911 to investigate the conditions of tissues when they are living actively outside the organism. He was awarded the Nobel Prize in physiology and medicine in 1912 for his contributions to the surgery of blood-vessels. On the outbreak of the World War he returned to France and devised the Carrel-Dakin treatment for wounds, by means of which many lives were saved and countless amputations were avoided. At the same time, with Dr. du Noüy and other collaborators he studied the laws of the cicatrisation of wounds. In 1919 he resumed his work at the Rockefeller Institute for Medical Research.

CARSON, EDWARD HENRY CARSON, BARON (1854–), British politician and lawyer, son of Edward Henry Carson, a civil engineer of Dublin, was born Feb. 9 1854 and educated at Portarlington School and Trinity College, Dublin. He became an Irish barrister and made his reputation as crown prosecutor in the difficult years when Mr. A. J. Balfour was Chief Secretary for Ireland. His pluck, readiness, wit and skill in cross-examination soon brought him to the front, both in legal and in political circles. He became a Q.C. at the Irish bar in 1889; but his ambitions could not be satisfied with legal eminence in Dublin. He was called to the English bar, and took silk there in 1894.

Meanwhile he had been returned to Parliament in 1892 in the Unionist interest as member for his own University of Dublin and was for a few months Solicitor-General for Ireland. He entered Parliament just when Gladstone was about to make a second effort to pass a Home Rule bill, and he helped to defeat the measure. But during the next 20 years he was mainly occupied with his professional work. Having risen to a leading place at the bar in Ireland, he achieved an even more striking success at the English bar and in 1900 became Solicitor-General, a post which he held till the fall of Mr. Balfour's Government in Dec. 1905.

It was not until 1911, when another Home Rule bill was imminent, that Sir Edward Carson, who had gradually become the spokesman of the Irish Unionists in Parliament, emerged as a political figure of importance. He strenuously resisted the Parliament bill, which was to curtail the power of the Lords and enable a measure of Home Rule to be passed without a direct appeal to the people. He was one of the "Die-hards" who urged the peers to take the responsibility of throwing out the bill in spite of the ministerial threat to swamp their House with sufficient new creations to make its passage secure. He told the House of Commons that Home Rule, if carried by force, would be resisted by force and that the resisters would be constitutionally right.

Feeling against the Home Rule policy was most bitter in Ulster, which, Protestant and loyal, would be placed thereby at the mercy of the Roman Catholic, and largely disloyal, majority of the other three Irish provinces. He went to Ulster in the autumn, and at an enormous Unionist demonstration at Craigavon, near Belfast, endorsed the threats of rebellion against Home Rule which previous speakers had made. Belfast, he said was the key of the situation; Ulster would never submit to a Parliament in Dublin. They must be prepared, if necessary, to take over the administration of those districts which they were entitled to control. Practical measures were immediately taken in this direction, though Liberals and Nationalists scoffed. His position was that he and his Ulster friends were loyal to the constitution as it existed; they were only rebels, he said, in the sense that they desired to remain under the King and the Imperial Parliament.

In anticipation of the introduction of the Home Rule bill in the spring of 1912, he presided over a gigantic gathering in Belfast in Easter week, which Mr. Bonar Law, the newly appointed Unionist leader, came to address; and he made those present repeat after him, "we will never, in any circumstances, submit to Home Rule." He himself, in a speech instinct with passion, moved the rejection of the bill on its introduction, and took a leading part in opposition during its subsequent stages. But his activity was mainly outside Parliament. He made frequent

speeches in the next two years in different parts of England and Scotland, particularly at a great demonstration at Blenheim in July 1912, at which Mr. Bonar Law pledged the support of the Unionist party to Ulster.

His principal work, however, was in the organisation of resistance in Ulster itself, including the formation of a local volunteer force, which speedily assumed large proportions. In Sept. 1912 he was the chief figure at a series of demonstrations in all parts of the province, culminating in an enormous assemblage at Belfast on Sept. 28. There he took the lead in signing a solemn covenant, by which the men of Ulster bound themselves to stand by one another in defending their position of equal citizenship in the United Kingdom, and in using all necessary means to defeat the proposal to set up Home Rule, and further pledged themselves to refuse to recognise a Home Rule Parliament. He followed this up by moving (unsuccessfully) in Parliament on New Year's Day 1913 the exclusion of Ulster from the bill.

In the autumn of 1913 the Ulster Unionist Council organised itself, under his supervision, into a provisional government, of which he was the leading member, and a guarantee fund of £1,000,000 was initiated to which he himself contributed £10,000. He reviewed the Volunteers, who were rapidly becoming a formidable military force, approaching in number 100,000 men. But when ministers who had refused to prosecute him or to interfere with his activities began to realise the determination of the six northeastern Protestant counties he did not repulse their overtures for a settlement by consent, but said that it must not establish a basis for separation. His advice during the following winter to his Ulster friends was "peace but preparation." He entirely declined to accept Mr. Asquith's offer, in the early spring of 1914, of a county option of exclusion for six years. That was "sentence of death with a stay of execution." There was only one policy possible, he told the House of Commons: "Leave Ulster out until you have won her consent to come in." He became a member of the abortive Buckingham Palace Conference convened by the King, and when that broke down, at the end of July, it looked as if he and his Ulster friends would have to make good in action their policy of force.

The World War intervened and switched off his activity into another direction. Though he resented, as a breach of the political truce between parties, Mr. Asquith's determination to pass the Home Rule bill into law, while suspending its operation and promising some form of special treatment for Ulster, he went to Belfast in order to stimulate Ulstermen and especially Ulster volunteers to join the British Army, and had a considerable success. He was eager for a thorough prosecution of the War, and accordingly joined Mr. Asquith's Coalition Ministry of 1915 as attorney-general, resigning however in October because he thought that the policy of the Cabinet, after the defection of Greece, involved the desertion of Serbia, a small country in whose fate he took a profound interest. He was strongly in favour of the Compulsory Service bill in 1916, and regretted that Mr. Redmond should insist on exempting Ireland from its provisions.

He looked favourably upon Mr. Lloyd George's efforts that summer to arrange an agreed settlement of the Irish question; and when that statesman formed a new Government in December for the more efficient conduct of the War, he accepted office as First Lord of the Admiralty. At this period the Board of Admiralty were mainly engaged in devising means to counter the German submarine attack, which was steadily increasing in intensity; and he devoted all his energies to the pursuit of this vitally important aim. Outside his departmental duties he warmly promoted the Irish Convention which the Govt. assembled in 1917. In July he quitted the Admiralty to become a member of the War Cabinet without portfolio, a position which he resigned at the beginning of 1918. But, in or out of office, his activity was directed wholeheartedly to the vigorous prosecution of hostilities.

After the War was over Ulster and Ireland regained the first place in his thoughts. At the General Election of 1918 he left Dublin University in order to represent one of the divisions of Ulster's capital, Belfast. On the anniversary in July 1919, of the battle of the Boyne, he restated, speaking near Belfast, Ulster's position and claims, and threatened to call out the Volunteers if any attempt were made to change her status. When, however, Mr. Lloyd George proposed in the winter his bill for the reform of the government of Ireland, establishing parliaments and executives both in Dublin and in Belfast, and a Federal council for all Ireland, he modified his attitude. Though he would have preferred no change, yet, as this bill gave the six Protestant counties of Ulster a Parliament of their own, besides representation in the Imperial Parliament, he would not oppose it.

After it had passed, he exerted himself with success to secure a strong Unionist majority in the elections in May 1921 for the first Parliament of Northern Ireland. He had thus achieved his main political object of saving Protestant Ulster from domination by the Roman Catholic majority of the south and west. Throughout the past ten exhausting years he had, save while in office, combined with his political work an immense practice in the law courts; and after the Ulster elections he accepted a lordship of appeal and a life peerage as Baron Carson of Duncairn. But, though he had become a judge, he did not hesitate to avail himself of his opportunities as a member of the House of Lords to continue to give his countrymen the benefit of his counsel at critical moments of the Irish question. Thus, he bitterly denounced the treaty which constituted the Free State, both at the time of its conclusion and when the bill to carry it into effect was before his House. He also protested in 1924 against the bill which empowered the British Govt. to appoint, owing to Ulster's default, a third commissioner on the Irish Boundary Commission. But he cordially welcomed the agreement made at the close of 1925, between the British Govt., the Govt. of the Irish Free State, and that of Northern Ireland, which finally settled this question. He was twice married—in 1879 to Sarah A. F. Kirwan, who died in 1913, and in 1914 to Ruby Frewen. (G. E. B.)

CARTEL (*see* TRUSTS, 27.334).—During the last decade before the World War, in Germany and in other countries cartels were gaining greater importance. They were by no means confined to the so-called heavy industries, which are most suited for the formation of cartels owing to their large scale; industries with smaller units, especially the textile industries, were also increasingly organised in such groups. The increasing formation of cartels in merchanting, partly under the influence of the great industrial cartels, may also be mentioned.

During the War the Govt. of the German Reich made use of cartels for supplying the enormous requirements of the army. As the output capacity of the individual undertakings was known, it was possible to allocate orders amongst them in a satisfactory way. It is true that the sudden demand, even apart from the scarcity of raw materials which soon set in, necessitated the grant of higher profits, but the price increases were often much higher where application had to be made to individual firms.

Many cartels, especially the so-called contracts cartels, were formed during the War for the exploitation of urgent army requirements, and, later, associations of traders were formed to exploit the increasing scarcity of goods; but the great and well known cartels were moderate in their price-fixing. The fixing by the state of maximum prices was not so often necessary in their case, and was, in any case, more easily effected. Nevertheless the Govt. soon found themselves compelled to intervene in the cartel system, because many cartels failed to show proper consideration to consumers. The textile cartels in particular were compelled to reduce prices to the consumer.

State Interference.—But state interference with the cartels went further, as a rule in the form of maintaining existing cartels or of compulsory amalgamation. It was recognised that dissolution of the cartels and return to unregulated competition was economically undesirable, and would render impossible the economic utilisation of raw material and labour. Following the precedent created in the case of the Potash Syndicate, which in 1910 was compulsorily reconstituted in order to prevent its collapse, the German Govt. have created compulsory syndicates, especially in mining. Under the threat of such action the Rhenish-Westphalian coal syndicate was reconstituted just before the contracts expired. The state justly feared that if this great

organisation fell to pieces, the maintenance of a regular supply to the consumers and a uniform control, both of export and of internal consumption, would not be possible.

The industrialists have for the most part not been opposed to such compulsory cartels, because the accompanying rationing of production, raw materials and marketing also facilitated future monopolistic combination. Herein, however, lies the danger of these methods, which the state endeavours to counter by granting the consumer and also the workers certain rights in these organisations and by consulting with their representatives.

The power of the State in relation to industry, which had grown extraordinarily during the War, was still further strengthened in Germany when the Socialists came into power after the collapse in 1918, and demanded the socialisation of these industries. In practice, however, the existing compulsory syndicates for potash, coal, and iron were merely further extended, and far-reaching powers for the regulation of prices were given to the Federal Coal Council and the Federal Potash Council, on which workers and consumers were represented. In the iron and steel federation (Eisenwirtschaftsbund) state intervention was not carried so far. On the other hand, in the electrical industry, where the so-called "mixed undertakings" (whose capital was raised jointly by public and private bodies) had played a great rôle in the production and delivery of power over large areas before the War, the attempt was made to increase the influence of the Reich and of its constituent states.

Trusts in Germany.—Even before the War cartels were by no means the only form of combination of several undertakings. After the strong cartels in coal-mining had come into being, it was more advantageous for the large iron and steel works to possess their own coal mines. The so-called "pure" rolling-mills, which had to buy their raw material from the combined steel works, which were also their competitors in the sale of the manufactured products, were likewise at a disadvantage. Thus the association of raw material producing and manufacturing concerns in a single undertaking became increasingly common. Great combined undertakings arose, above all in the mining industry and in the electrical and other metal industries, which extended far into the finishing industries. The term "trust" made its appearance; but real trusts—the amalgamation of a whole industry into a single monopolistic undertaking—these were not. Such trusts only arose in a few specialised industries, thus in the Dynamite Trust in association with English undertakings, in the amalgamation of all German rice-mills in a holding company, and also in the accumulator industry.

With the increase in the number of joint-stock companies in many industries, the tendency to fusion and still more to the acquisition of participations in other industries was very active. In banking, the linking of provincial banks to the great Berlin banks had been going on for a long time. Participation and the formation of subsidiary companies was most extensive in the electro-technical industry and in large constructional undertakings. A substitute for cartels is provided in a smaller category of undertakings by the *Interessengemeinschaften*. These consist chiefly in a pooling of profits to secure an equalisation and distribution of risk; they are mostly formed for long periods, and practically exclude competition between those concerned. As a rule there is also an interchange of directors and members of control boards (*Aufsichtsräte*), and often participation by the acquisition of shares. After the crisis of 1900 the first important *Interessengemeinschaft* was the agreement concluded in 1902 for 20 years between the two largest German shipping companies and the International Mercantile Marine Co., which ended at the outbreak of the War.

The Chemical Industry.—Of still greater importance were the two great *Interessengemeinschaften* formed in 1904 in the chemical industry. The first, between the Höchster Farbwerke and the firm of Cassella & Co., took the form of an exchange of shares, the second, between the Badische Anilin und Soda Fabrik, the Elberfelder Farbenfabrike and the Berliner A.G. für Anilin Fabrikation, took the form of pooling profits in the proportion of 43: 43: 14. In 1916 these groups combined to make common cause against the fierce foreign competition expected after the War, and two other large factories also came into the combine.

Cartels after the War.—In the post-War period, with its economic insecurity and its colossal inflation, financial forms of organisation became more prominent, while the cartels lost for the time being in importance. With the shortage of goods and the apparent prosperity due to inflation, high prices could be obtained without cartels. These played a larger rôle in local industry and trade, where it was important to make prompt adjustments to the daily price increases. In large scale industries, however, certain traders and speculators took advantage of the opportunity of buying up whole groups of undertakings with cheap credits. There arose the great vertical combines (*Konzerne*), such as had already existed in the electrical and mining industries, whose scope was now greatly extended.

By the dissociation of the Lorraine and Luxembourg works many of the greatest undertakings had lost their economic basis and had to be completely reconstructed. Thus Hugo Stinnes created in the Siemens-Rhine-Elbe-Schückert Union a close *Interessengemeinschaft* of three great mining undertakings with the electro-technical Siemens-Schückert-Konzern. At the same time he built up a great private combine with a number of very distinct undertakings. Other mining combines also, such as the Phönix, Klöckner, Lothringen, etc., were further extended. In the potash, cotton and cement industries great vertical combines were also created. The penetration of wholesale trade, which had made very large profits during the War, into industry is worthy of note; often even very large undertakings suddenly came into the hands of a large trader or speculator. In many cases undertakings were thus grouped together which stood in no organic relation to one another and which were only kept united by the financial transactions of the founders. In 1926 about 75% of the German coal output, 75% of the coke output, and about 79% of the steel output was produced in the great vertical combines of the mining industry.

With the stabilisation of the mark in 1924 and the great scarcity of capital consequent on the destruction of all liquid capital, many of these artificial combines broke down with great losses for those concerned. On the other hand the shortage of capital and the unfavourable economic outlook demanded a great reduction of costs and the most efficient technical and commercial organisation. Thus many new amalgamations came into being, mostly in the more rational form of a complete fusion. These would have attained even greater importance but for the quite indefensible tax on fusions, although its burden was eventually reduced. The complete fusion of the seven chemical firms already mentioned as being associated in an *Interessengemeinschaft* is noteworthy. They were absorbed by the oldest and largest of them, the Badische Anilin und Soda Fabrik, which increased its capital for this purpose from 176,000,000 marks to 646,000,000 marks, and took the name of Interessengemeinschaft Farben-Industrie A.G. This group had already a monopoly position in many products, so that here we may speak of a real trust.

An equally great concentration of capital is found in the projected union of several of the greatest vertical combines of the Rhine-Westphalian iron and steel industry, namely, the Phöenix A.G., the Thyssen undertakings, the combine of the Gelsenkirchen and German-Luxembourg Mining Co., to which the Bochum Cast Steel Union also belongs, and of the Rheinische Stahlwerke. This gigantic combine, whose capital and type of fusion remained to be determined, had not a monopoly position; it maintained its participation in the various cartels of the coal and iron industry. The continuance of the union of the Gelsenkirchen with the Siemens-Schückert group was not certain.

In spite of these great amalgamations, the number of cartels has not become less; the desire of employers to restrict competition is further increased by the severe economic crisis. The saying that cartels are children of necessity holds good.

The Cartel Court.—For a long time a cartel Act was demanded in Germany. In July 1922, a Cartel Advisory Committee was formed, including members of the Reichstag, the Reichsrat and the Federal Economic Council. On Nov. 2 1923 the Govt.

issued an "order against the misuse of monopoly power." A cartel court was erected which can be set in motion by the Govt. as well as by the contracting parties. The chief provisions are as follows:—

Section 1. "Contracts and regulations which lay down obligations in regard to production and marketing, conditions of business, the nature of price fixing or price lists (syndicates, cartels, conventions and similar agreements) must be made in writing." Verbal contracts and the like are invalid.

Section 4 is the most important: "If a contract or regulation of the type described in Section 1. . . endangers the economic system as a whole or the well-being of the community, the Federal Minister of Economics can (1) appeal to the Cartel Court to declare the contract or regulation to be invalid . . . (2) decree that all parties to the contract or regulation can at any time cancel the contract or withdraw from the regulations, (3) demand the submission of copies of all agreements. The welfare of the community is to be regarded as endangered when production or marketing are restricted in an economically unjustified manner, when prices are raised or kept high, or when price increases are made to cover the risk of currency depreciation, or when economic freedom is inequitably restricted by embargoes on purchase or sale or by discriminating prices or conditions."

These provisions are only permissive, since power is merely given to the Federal Minister of Economics under certain circumstances to apply for a declaration rendering the contract null and void. Section 8 goes much further. It runs:—

"Contracts or regulations of the type described in Section 1 can be cancelled without notice where an important reason exists." An important reason is always to be held to exist if the economic freedom of the cancelling party is inequitably restricted in regard to production, marketing or the determination of prices.

Section 9 runs: "Guarantees may not be demanded, nor embargoes or similar prejudicial measures be imposed, in virtue of contracts and regulations of the type described in Section 1, without the consent of the chairman of the Cartel Court. Those concerned can appeal within a week of the decision to the Cartel Court."

Hitherto sections 8 and 9, which are directed against the so-called exclusive contracts (obligations to trade exclusively with members of the cartel, boycotts, embargoes on delivery and the like) have been mainly enforced. But in the summer of 1925 the Govt. resolved, in connection with its endeavours to bring about a fall in prices, to proceed more energetically against the cartels, and a number of them have been dissolved, while others have been compelled to alter their trading conditions.

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CARTOON.—The word cartoon is now used so diversely that it is necessary to be more precise in definition in order to get an appreciation of the art of cartooning in the best sense. The highest order of cartoon is educational or propagandist, but unrecognisable as such. It is not a mere drawing of some episode, condition or situation of life, but conveys a message, by reason of the purpose, thought and spirit underlying the drawing, for which the situation as depicted is merely a cloak. Cartoons of this class, however, need not be only what are known as "political cartoons," which are obviously propagandist in structure. They can be so subtle in form as to convey propaganda and sway moods or opinions without the cause being detected. This is the highest form of cartoon and is an immense weapon in whatever direction it is used. Cartoons have a larger scope of appeal in a shorter space of time than equivalent education coming by a literary route. They can reach all classes and be either serious or jocular, provided the necessary hidden quality is present.

The technique of the drawing—though of course the better, the more pleasing—is of secondary importance. The psychological strength emanating from the cartoon is the most important feature. The best artists are not necessarily the best cartoonists.

The usual political cartoon is of a positive nature. A situation, apt and symbolic in form, parodied by the artist, deliberately states a point of view; the cartoonist endeavours to educate observers thereby or to satisfy the ideals of observers whose judgment is already formed. Far deeper and more potent is the cartoon which by means of its own peculiar and subtle statement of life causes the observer to find unconsciously a point of view, this process being the education intended. It is easier to portray the wishes and policy of a party or a nation by cartoons than to express the culture and civilisation of a nation or an age in such a way as to help in the bringing about of a change—an achievement wrought by Hogarth, amongst others, who was quite possibly unaware of the education that a study of his piercing cartoons afford. There are some who can, by placing their personal outlook on paper, be great and unconscious cartoonists. They can achieve the highest form of the art of cartooning—the distribution of acceptable propaganda in arresting form. (*See* also CARICATURE.) (B.B.)

CARTRIDGE: *see* AMMUNITION.

CARTWRIGHT, SIR RICHARD JOHN (1835–1912), Canadian statesman (*see* 5.435), died at Kingston, Ont., Sept. 24 1912.

CARUSO, ENRICO (1873–1921), Italian singer, was born in Naples Feb. 25 1873. He was early apprenticed to a mechanical engineer. He began to sing in the choirs at Naples when he was eleven years old and later studied under Guglielmo Vergine. He made his début in 1894 in *L'Amico Francesco* at the Teatro Nuovo, Naples, and first won marked success as Marcello in *La Bohème*, at Milan, in 1898. From 1899 to 1903 he was at St. Petersburg (Leningrad) in the winter, and in the summer at Buenos Aires. He appeared also in many cities, including Moscow, Warsaw, Rome, Paris and London (Covent Garden, 1902). In America he first appeared in 1903 at the Metropolitan Opera House, New York, where for 18 years he was the leading tenor. Caruso had a very extensive Italian and French repertory, but never appeared in Wagner's operas. He won special success in *Aïda*, *Carmen*, *Huguenots*, *L'Elisir d'Amore*, *Pagliacci*, *Rigoletto* and *Samson and Delilah*. He died Aug. 2 1921 at Naples.

CARY, ANNIE LOUISE (1842–1921), American singer (*see* 5.438), died April 3 1921 at Norwalk, Connecticut.

CASABLANCA, Morocco (*see* 5.440), had a population in 1921 of 101,790, including 48,890 Moslems, 15,136 Jews, 21,579 French, 16,185 other Europeans. The two chief thoroughfares in the city are the Boulevard de la Gare, from the Place de France to the station and industrial quarter near the port, and the Grand Traverse running east and west. A new native quarter lies southeast of the city, near the Sultan's palace. Health conditions have been improved, and extensions of the water supply undertaken. Large electric power works, to be utilised for the railways in the flatter parts of the country, were finished in 1924. There are railways to the phosphate fields of El Boruj district (near which a valuable iron-field has been found), to Fez and Rabat, and to Marrakesh (171 m.). Metalled roads link Casablanca with the principal centres. A daily air-service connects Casablanca and Toulouse, and a bi-weekly service, Casablanca and Oran. An outer harbour, consisting of a jetty 2,050 metres long, with a transverse pier of 1,600 metres, was completed in 1925. Further extensions of the harbour works were taken in hand in 1925. A superphosphates factory has been built outside the town. Other industrial establishments include brick, cement, lime, biscuit and printing works and foundries.

CASEIN.—An albumin occurring in milk, as a lime salt in a very finely divided state, giving the milk an opaque appearance. It is manufactured from cow's milk, which contains about 3% of casein.

Pure casein is a white, amorphous substance without taste or smell. It is a weak acid, readily soluble in solutions of caustic alkalis and of the carbonates, borates and other salts of the alkali metals. Water dissolves casein only to a very small extent, but causes it to swell. Casein is converted by the action of formaldehyde, or formalin, into a hard material quite insoluble in water. This result, of great importance in connection with

the use of casein in the arts, was first obtained by *Chemische Fabrik auf Aktien* (formerly E. Schering) of Berlin and is described in British Specification No. 23,585 of 1894. Casein is non-inflammable. Its specific gravity is about 1·25. Commercial casein of good quality is a dry, friable, white, or slightly brown powder; casein of inferior quality has an unpleasant smell and is usually moist and dark coloured.

Processes of Manufacture.—Three of the commercial processes for making casein depend mainly on the precipitation of the casein from previously heated skim or separated milk by means of an acid. These processes are: (1) the rennet process; (2) the process in which an acid, *e.g.*, dilute sulphuric or hydrochloric acid, is added to the milk; and (3) the self-curdling process, in which the milk is allowed to rest until it is curdled by the action of lactic acid formed from the lactose or milk-sugar of the milk by the activities of a bacillus (*B. acidi lactici*). In the United States, the substance precipitated by the action of rennet is commonly called paracasein, the term casein being reserved for that precipitated by acids. Two other processes of exceptional interest have been used in France. In one of them the milk is run into a closed vessel provided with agitators and is subjected to the action of great pressure; the precipitation of the curd may be hastened by introducing carbonic acid gas. The second process is electrolytic and has been carried on at the casein factory of Aigrefeuille, Charente Inférieure. The details of the process are secret, but it is said that a very high quality casein is obtained. In all these processes, the precipitated curd is separated from the whey, washed with cold water, passed through a press or a centrifugal separator, broken up, and dried by currents of dry air or other means. The dry casein is ground and packed for sale.

Uses of Casein.—In many countries casein is produced on a commercial scale and a large amount is used in the making of confectionery and special foods of which Sanatogen, Lactorin and Plasmon are examples. Casein preparations are also used as media for administering quinine, lithium salts, iodides and other drugs and medicines. Casein preparations are used for printing on calico, sizing yarns and sizing waterproofing, and coating in the paper industry. Formalin-hardened casein has been employed in making photographic films, and it has been proposed to make from such casein fibres to be spun like artificial silk. Casein is used largely in the production of cold water paints and distempers, of cements for porcelain and glass, and of glues for use in bookbinding, wood-working and aircraft construction.

The production of casein plastics intended to imitate ivory, tortoiseshell, amber, horn, ebony, agate, malachite, celluloid and other substances is important. The casein is made plastic by being thoroughly mixed with colouring and filling materials, according to the nature of the substance to be imitated, and moulded into blocks or other forms which are hardened by exposure to the air or by means of formalin. Casein plastics can be turned, carved, or otherwise worked. They are good electrical insulators, hard and insoluble in water, but can be softened to some extent in hot water.

See Robert Scherer, *Casein, its Preparation and Technical Utilisation* (1921) and E. L. Tague, "Casein," in A. Rogers' *Handbook of Industrial Chemistry* (4th ed., 1925). (T. E. L.)

CASEMENT, ROGER DAVID (1864–1916), British consular agent, was born near Dublin Sept. 1 1864. After serving in the Niger Coast Protectorate he entered the British consular service. In 1910 the British Govt. commissioned Casement to investigate certain charges brought against the Anglo-Peruvian Amazon Co., and for the adequate performance of this service he was knighted (1911). From about 1912 Casement seemed to develop an intense hatred of England. On the outbreak of the World War he went to the United States and thence, in Nov. 1914 to Berlin. During 1915 he published various anti-British pamphlets, and attempted to form a brigade, for service against England, of Irish soldiers who were prisoners of war. He planned to aid a rising in Ireland for Easter week, 1916, and on April 12 sailed for Ireland in a German submarine, which was accompanied by a vessel laden with arms and ammunition. The latter was captured by a patrol boat. Casement landed in a collapsible boat, but was captured on April 24 and brought to London. Tried for treason before the Lord Chief Justice, he was convicted and sentenced to death on June 29, being deprived of his knighthood on the following day. His appeal against conviction was dismissed on July 18, and on Aug. 3 he was executed at Pentonville, London.

CASSATT, MARY (1855–1926), American artist, was born at Pittsburgh, Pennsylvania, a sister of A. J. Cassatt, president of the Pennsylvania Railroad. In 1875 she went to Europe to study art, spending some time in Spain, afterwards proceeding to Paris, where she was greatly influenced by Manet, Renoir, Degas and the Impressionist school. Her first exhibition of paintings in Paris was in 1893 at the gallery of M. Durand-Ruel, where in later years her works were frequently exhibited. She also contributed to the various exhibitions of the Impressionist school, but never to the salons. Her work was warmly appreciated in French artistic circles. Mothers and babies or children were to her the chief subjects of inspiration, and her pictures are distinguished by great firmness in drawing and boldness of tone and colour. As a pastellist she attained high rank. Exhibitions of her works have been held in New York and Pittsburgh, and she is represented in the public art galleries of the United States and in private collections. She died in June 1926.

See Achille Legard, *Un Peintre des Enfants et les Mères: Mary Cassatt*, illustrated (Paris, 1913).

CASSEL, SIR ERNEST JOSEPH (1852–1921), Anglo-German financier, was born at Cologne March 3 1852, the son of a small banker in that city, and at the age of 16 became a clerk in the banking firm of Elspacher. In 1870 he went to London and entered the foreign banking house of Bischoffscheim and Goldsmid. There he attracted notice by his skillful disentanglement of the accounts of the Khedival loans. In 1884 he set up for himself and became interested in South-American finance. He reorganised the finances of Uruguay, and issued three Mexican loans, as well as acquiring the Royal Swedish railway and financing enterprises such as Vickers' absorption of the Maxim-Nordenfelt Co. and the building of the Central London railway. He also raised a Chinese loan after the war with Japan. His principal achievement was, however, the financing of the Nile irrigation work, and in connection with that the founding of the National Bank of Egypt. During the War, though he had long been a naturalised British subject, an unsuccessful attempt was made to have his name removed from the Privy Council. Sir Ernest retired in 1910 and died in London Sept. 21 1921. His daughter married Mr. W. W. Ashley, M.P., Minister of Transport, and their daughter, who inherited much of her grandfather's great wealth, married Lord Louis Mountbatten.

CASSEL, GUSTAV (1866–), Swedish economist, was born at Stockholm Oct. 20 1866. He began his career as a mathematician but became in 1904 professor of economics in the *Högskola* at Stockholm. He was consulted by the Govt. as an expert on taxation and budget matters and his memorandum on "The World's Monetary Problem" at the Brussels Conference in 1920 attracted great attention. In another memorandum to the League of Nations Finance Committee in Sept. 1921 (printed together with the first under the title of *The World's Monetary Problems. Two Memoranda*, 1921), he discussed the questions connected with the financial crisis of 1920. Cassel was attached to the Swedish delegation as a financial expert at the 1922 Genoa Conference and was a delegate at the meeting of International Chambers of Commerce in London in 1921 and 1922.

Among Cassel's published works are *The Nature and Necessity of Interest* (1903); *Theoretische Sozialökonomie* (1918); *Money and Foreign Exchanges After 1914* (1922); *Weltwirthschaft und Geldverkehr unter besonderer Berücksichtigung des Valutaproblems* (1920); *Fundamental Thoughts on Economics* (1925). He also wrote articles in *The Economic Journal* (London). (*See* EXCHANGES FOREIGN).

CASTELLORIZO, the ancient Megiste, an island of the Dodecanese. It was included by the Turks in the privileged group known as "the Dodecanese" (*q.v.*), but did not form part of the Italian "Dodecanese," occupied during the Libyan War of 1912. The outbreak of hostilities against Turkey during the World War gave the Italians an opportunity of adding Castellorizo to their Dodecanesian possessions, after the French had

occupied it on Dec. 27 1915, and articles 122 of the Treaty of Sèvres in 1920 and 15 of the second Treaty of Lausanne in 1923 provided that "Turkey renounces in favour of Italy all rights and title . . . over the island of Castellorizo." Thenceforth the chief Italian authority in the Southern Sporades styled himself first "governor of Rhodes and Castellorizo" and then "Governor-general of the Dodecanese and Castellorizo." Disputes arose with the Turks over the ownership of some islets between the island and the coast, used by the islanders for purposes of fishing. Castellorizo has a small harbour but no exports, and the inhabitants engage in the sponge-fishery. Its liability to a sudden attack from the adjacent coast (actually said to have once occurred since the Italian occupation) may be set off against its utility as a base for the Italian penetration of the mainland. Its population is entirely Greek, and the Neapolitan domination (1450–1522) is the only precedent for its present ownership.

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CASTELNAU, EDOUARD DE CURIERES DE (1851–), French soldier, was born at Saint-Affrique, Aveyron, Dec. 24 1851, third son of the Marquis de Curières de Castelnau. He entered the military school of St. Cyr, near Versailles, in 1869; and during the Franco-German war took part in the Loire campaign. Captain in 1876 and commandant in 1889, he was appointed by General de Miribel in 1893 to a post in the chief department of the general staff; later as head of the department he built up the vast system of French mobilisation. In 1910 he became general of division, and in June 1911 assistant to the chief of the general staff. On the outbreak of war he commanded the II. Army in Lorraine. After the French offensive was driven back at Morhange in Aug. 1914, General Castelnau in turn successfully repulsed the Germans at the Trouée de Charmes and the heights of the Grand Couronné. On Sept. 18 the II. Army was moved to the west between the Somme and the Oise in the abortive attempt to outflank the German armies—known as the "race to the sea."

On June 13 1915 General Castelnau took command of the group of four armies which constituted the French centre, and directed the Sept. offensive in Champagne. In the following Dec. he became chief of the general staff under General Joffre. He was next sent to Salonika on a tour of inspection, returning by way of Athens and Rome. Three days after the opening of the German attack at Verdun on Feb. 21 1916 Castelnau was sent there on an emergency mission, with full powers, and appreciating the danger gave orders that the right bank of the Meuse should be held at all cost; he returned to Chantilly only when the position was secure. On the appointment of Nivelle in place of Joffre, Castelnau was sent on a mission to Leningrad in Jan. 1917. On his return he was given the command of the group of armies in the east with a view to directing the large-scale operations which were anticipated in Nov. 1918, and which the Armistice happily forestalled. After the War General Castelnau entered the Chamber as deputy for Averyron; he acted as president of the army committee, and allied himself to the group known as the *Entente démocratique et sociale*. See Victor Giraud, *Castelnau* (1921).

CATALYSTS (*see* CATALYSIS, 5.501).—The term catalytic agent (Gr. to break up) was introduced by Berzelius (Jahresbericht, Tübingen, 15,1836) to include those substances which by their presence accelerate the rate of reactions proceeding with a decrease in free energy towards equilibrium without undergoing any change in themselves. In reversible systems catalysts thus necessarily accelerate the rates both of the forward and reverse reactions.

Many cases of supposed alteration in the conditions of equilibrium for the catalysed and noncatalysed reaction have been noted, but closer examination has shown in many cases, either that true equilibrium was not attained or that the catalyst was added in quantity sufficient to affect the active mass of one or more of the reactants. Although taking part in the reaction a catalyst, being constantly reformed, should be able to effect the conversion of an unlimited amount of reactant. In practice, this is not realised, as loss of the active catalyst occurs. This loss may occur (*a*) through side reactions, unconnected with the main reaction, as in the gradual reduction of sulphuric acid in etherification processes; (*b*) through the formation of inactive compounds with impurities present in the reactants, as in the formation of nickel sulphide from sulphur compounds present as impurity in hydrogen employed in hydrogenation processes; (*c*) through removal from the reacting system, either by vaporisation as in the case of platinum catalysis for the formation of sulphur trioxide, or by coagulation as occurs in colloidal metal catalysts employed for hydrogenation; (*d*) through sintering and fusion due to overheating of the active surfaces.

Causes of Acceleration.—Acceleration of reaction rates by catalysts is due to the opening of a fresh avenue for molecular reaction in which the catalyst plays a part. If two substances A and B react and form a product C a reaction accelerated by a catalyst X two simultaneous reactions take place

$$(1)\ A+B\rightarrow C,\quad (2)\ A+B+X\rightarrow C+X$$

Catalytically accelerated reactions may be homogeneous or heterogeneous in character, the former taking place in gases and liquids, the latter at interfaces more especially at gas solid and liquid solid interfaces. In all cases it is now generally assumed that reaction proceeds through the formation of temporary complexes; thus the above reactions can be expressed as a sequence of changes

$$(1)\ A+B\rightarrow(AB)\rightarrow C,\ (2)\ A+B+X\rightarrow(ABX)\rightarrow CX\rightarrow C+X.$$

Whilst in many cases unstable intermediary complexes of the type AB, *e.g.*, benzoyl peroxide, ester-acid compounds can be isolated at low temperatures, the ternary complex reactants-catalyst ABX is usually present in subanalytical quantities and its existence frequently postulated from identification of the more stable binary compounds AX, BX, AB. All binary collisions between reacting molecules are not effective in producing combination, a large fraction generally undergoing collision and elastic reflection. Two types of such reactions may be readily identified. In the union between gaseous atoms such as the reaction $2H\rightarrow H_2$ before the hydrogen molecule can exist as a stable system, the energy liberated during combination has to be dissipated. In some cases such energy is liberated as radiation but frequently a third atom strikes the system within the life period of the unstable molecule, ca. 10·7 seconds, and effects the removal of the energy thus catalytically accelerating the union of the atoms. In this way surfaces catalyse the union of hydrogen atoms and sodium vapour the union of sodium and iodine atoms.

Effect of Temperature.—More frequent are those reactions which are markedly temperature sensitive, the reaction velocity increasing exponentially with elevation of the temperature. Sv. Arrhenius (*Zeit. Physikal. Chem.*, July 1889) inferred that there existed in the reacting system, active or excited, and inactive or normal molecules in mass equilibrium with each other.

$$A\rightleftarrows A^1$$
$$B\rightleftarrows B^1$$

Only excited molecules underwent reaction on collision, their number increasing exponentially with the temperature. In simple cases the energy required for excitation or the critical energy increment E may be calculated from the velocity temperature coefficient with the aid of the equation $\frac{dby}{dt}\ K=\frac{E}{RT^2}$.

Trautz in 1906 and, independently, Perrin and McLewis in 1913 advanced arguments in favour of the view that the energy of activation required for the conversion of normal into excited molecules was supplied by radiation flowing into the reacting system. In a number of cases this hypothesis is not necessary, for if it be assumed that there are no active molecules in the system but only those molecules react which impinge on one

another with such initial speeds that the available kinetic energy exceeds the critical energy increment, the agreement between the observed and calculated rates of reaction is excellent. Confirmation is seen in the decomposition rates of Cl_2O, N_2O and H_1 (C. N. Hinshelwood, *Jour. Chem. Soc.*, vol. 123, 1923; *Proc. Roy. Soc.*, vol. 106, series A, 1924; and M. Bodenstein, *Zeit. Physikal. Chem.*, vol. 110, 1924).

Gas Reactions.—These bimolecular gas reactions are catalysed by hot metal surfaces and the reactions there appear unimolecular in respect to the gas. Catalytic acceleration is thus produced by converting a bimolecular reaction, with a large critical energy increment, necessary for two molecules, and thus a small velocity at low temperatures, into what is virtually a series of reactions, each with a lower critical energy increment and a greater velocity, although the critical energy increment per molecule may be very similar in the two cases.

Whilst homogeneous gas reactions are more simple in character than reactions in liquids, or at interfaces, very few cases of true catalytic action in such systems are known. In addition to the cases of atom combination referred to above, two other reactions appear to be chiefly, if not completely, homogeneous in character. The decomposition rate of ozone is accelerated by gases such as helium, nitrogen and oxygen (Griffith and McKeown), whilst the numerous experiments of Dixon and Baker on the influence of traces of moisture on chemical actions lead to the conclusion that some of these reactions are undoubtedly homogeneous catalytic gas reactions, although surface phenomena on the walls of the containing vessel are frequently of predominating importance. To explain such reactions on the hypothesis of activation by collision it is necessary to assume that a molecular complex, *e.g.*, Br_2H_2O is more readily activated on collision than a simple molecule Br_2. Evidence from a study of absorption spectra of wet and dry vapours and liquids is beginning to support the view that the energy of excitation for such complexes formed with polar molecules is less than that necessary for simple molecules.

Liquids.—In liquids, cases of catalytic acceleration of reactions are common, the classical examples being the catalytic activity of hydrogen and hydroxyl ions on hydrolytic changes. Other ions exert marked specific effects in many cases, such as the iodide in the decomposition of hydrogen peroxide, the chloride ion in the decomposition of chloramine, organic anions in the decomposition of nitramide and the ions of polyvalent elements such as cerium, vanadium and chromium in oxidation processes. In the cases of hydrogen ion catalysis in the hydrolysis of an ester, the reaction velocity in dilute solutions may be considered as proportional to the concentrations of the three reactants or $$\frac{dx}{dt} = KC_HC_{ester}(C_{H_2O}).$$

When more concentrated solutions are employed, or neutral salts are added to the solution, the reaction velocity rises more rapidly than would be anticipated from a consideration of the above equation. For other reasons we have cause to believe that electrostriction occurs in solutions and the reactants are solvated thus removing free water from the system, consequently the "thermodynamic concentration" or "activity" is actually greater than the apparent concentration.

If the reaction velocity be assumed proportional to the concentration of the complex ABX, or $\frac{dx}{dt} = R(ABX)$ we obtain, according to the law of mass action

$$K = \frac{(A)\ (B)\ (X)}{(ABX)} \cdot \frac{fA\ fB\ fX}{f(ABX)},$$

where fA fB fX are the activity coefficients of the reactants and K the mass action equilibrium constant. Hence we obtain

$$\frac{dx}{dt} = \frac{R}{K} \cdot \frac{(A)\ (B)\ (X)}{f(ABX)} f(A)\ f(B)\ f(X).$$

The dependence of the reaction velocity on the activities of the reactants and catalytic agent has been demonstrated in the inversion of sucrose, the decomposition of acetylchloramino benzene and the decomposition of hydrogen peroxide in the presence of hydrobromic acid. The energies of activation of catalysed reactions in aqueous media lie between 26,000 and 10,000 calories per given molecule, values sufficiently low to permit of relatively rapid reaction at ordinary temperatures. If no catalyst be present the energies of activation for the binary complexes (A B) are proportionately higher; thus if the ester water hydrolysis in the absence of a catalytic agent required an energy of activation of some 60,000 calories, reaction would only occur at a perceptible rate at temperatures in the neighbourhood of 700° C. The velocity of catalysed reactions in homogeneous solutions depends on the magnitudes both of the energy of activation and of the equilibrium constant for the system reactants complex: thus it does not necessarily follow that a reaction with a low energy of activation will proceed at a great speed. The following data from H. E. Cox, *Jour. Chem. Soc.*, vol. 119 (1921), on the rate of addition of aniline to bromacetophenine in various solvents may be cited in this connection.

Solvent	Energy of activation	Velocity constant
Benzene	8,088	·000985
Chloroform	10,700	·00186
Methyl alcohol	12,440	·0748
Ethyl alcohol	13,910	·0626

Technical Applications.—The most important technical applications of catalytic methods are to be found in heterogeneous systems where reactions between gases such as nitrogen and hydrogen to form ammonia (*see* AMMONIA) at the surface of iron, carbon monoxide and hydrogen to form methyl alcohol and the higher alcohols at the surface of zinc oxide and sulphur dioxide and oxygen to form sulphuric anhydride at the surface of platinum have been developed industrially on a large scale. Other large industries falling under this category include the hydrogenation of oils and fats, the oxidation of ammonia to nitric acid and the manufacture of acetic acid.

Heterogeneous gas reactions operate through the formation of adsorption complexes between catalyst and reactants and thus the catalytic layer at the surface of a catalytic solid is but one molecule thick. At high temperatures a reaction zone is formed on the solid surface which may be relatively thick. It is probable however that in these cases the catalyst serves to start a series of reaction chains which spreads out into the surrounding gas, at the same time thermionic emission of electrons from the hot surface occurs and it would appear that these in turn serve as exciting agents.

Adsorption.—At surfaces both the reactants are generally adsorbed and the reaction velocity attains a maximum when the partial pressures of the reacting gases or the concentration of reactants in solution are so adjusted as to preserve an optimum surface concentration. Such maxima have been experimentally observed in the following systems: sulphur dioxide, oxygen on the surface of platinum; ethylene, hydrogen on a nickel surface; oxalic acid, oxygen on a carbon surface. Such surface reactions proceed generally at a rate which is slow compared with gaseous diffusion but in liquid systems we frequently find a limitation of the speed of reaction imposed by the slowness of diffusion. A catalytic metal is not uniformly active over the whole of its surface, but the surfaces of the microcrystals, the edges, corners and the amorphous portions of distended crystal lattices all possess different surface energies. The fraction of the area which is capable of functioning as a catalyst is frequently minute. A good nickel catalyst has a surface efficiency of the order of 1:1000. The existence of patches of varying activity on a catalyst surface has been demonstrated not only from consideration of surface energies and adsorption of various gases but also from the effect of substances which are strongly adsorbed, *i.e.*, poisons on the catalytic activity. It is, as shown by the experiments of Vavin and Husson, possible to poison a catalyst progressively, eliminating in stages the catalytic power of the surface for various reactions. The molecules adsorbed on the surface are

attached by particular groups and may be considered as forming definite surface compounds similar in properties to co-ordinated compounds, although a distinction must be drawn between the properties of such substances as CuO or Ni $(CO)_4$ and oxygen or carbon monoxide adsorbed on copper and nickel respectively. By kinetic transfer of energy and also, in certain cases, by absorption of radiation these surface compounds may be excited or brought to a reactive level, thus on the adsorption of hydrogen by nickel it is found that hydrogen atoms, formed on the surface by excitation of the adsorbed molecules, may be recovered by evacuation at low pressures.

Promoters.—The activity of a catalytic surface may be modified by promotion, *i.e.*, the addition of small traces of other substances termed promoters. Thus palladium will promote copper, ceria iron oxide, molybdenum iron and iron will promote carbon. Three distinct effects may be produced by the addition of a promoter: the total catalysed area may be increased by dispersion, the fraction catalytically active may be increased, or again specific atoms or atom groups may be augmented in activity by the juxtaposition of the foreign material. This latter appears to be similar to, if not identical with, the instability of molecules at phase boundaries first noted by Faraday in the case of the efflorescence of hydrated salts. Promoters are now extensively employed in industrial catalytic processes: thus zinc oxide is promoted with chromium oxide in the synthesis of alcohols from water gas, iron is promoted with alkali in the synthesis of ammonia from nitrogen and hydrogen, two typical high-pressure reactions.

Specific Action.—Inorganic catalysts are far less specific in character than the ferments and enzymes; nevertheless certain reactions present interesting peculiarities indicating a specific action. In homogeneous reactions Abel noted that the following oxidations by hydrogen peroxide catalytically accelerated by iodine ions and sodium molybdate were almost specific

$$2S_2O_3'' + H_2O_2 \xrightarrow{I'} S_4O_6'' + 2OH'$$

$$S_2O_3'' + 4H_2O_2 \xrightarrow{Na_2MoO_4} 2SO_4'' + 2H + 3H_2O.$$

In heterogeneous reactions we find that the alcohols can undergo catalytic decomposition in two ways, *e.g.*,

$$C_2H_5O_4 \begin{cases} \rightarrow C_2H_4 + H_2O \\ \rightarrow CH_3CHO + H_2 \end{cases}$$

The dehydrogenating reaction is more marked on metals; the dehydrating reaction on metallic oxides. It is as yet uncertain whether the difference is due to differences in structure of the adsorption compounds formed or whether the same adsorption compound can undergo different modes of decomposition when raised to different energy levels. The energies of activation of the adsorption products are, as determined from the temperature coefficients of the two reactions, at least very different.

Efficiency.—Catalyst efficiencies are usually compared by observation of the space time yields (S.T.Y.) in which the yields per litre of catalyst space per hour is determined. Since in general the systems are strictly reversible, complete conversion of reactants into products is not obtained when the conditions of equilibrium are attained. It follows that for slow velocities of gas flow, equilibrium is attained and the S.T.Y. increases in a linear manner with the gas velocity. Above a certain critical velocity equilibrium conditions are not obtained, but the S.T.Y. still increases, although less rapidly, with the gas velocity. Finally the S.T.Y. succeeds in attaining a maximum value.

For industrial gas reactions it is necessary to prepare the catalyst in a form which will withstand considerable loads without crushing and present a minimum resistance to gas flow without undue diminution in catalytic efficiency, inert support materials or binders being frequently incorporated to achieve this end. Limits to attainment of the maximum S.T.Y. of a catalyst may be set by the excessive cost of pumping gases or fluids at high speeds or by the difficulties associated with the maintenance of uniform temperatures in the case of strongly exothermic reactions.

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CATHER, WILLA SIBERT (1876–), American author, was born at Winchester, Va., Dec. 7 1876. After graduating at the University of Nebraska in 1895, she took up newspaper work, contributing also to magazines. From 1906 to 1912 she was associate editor of *McClure's Magazine*. Her novel, *One of Ours*, was awarded the Pulitzer Prize in 1923, and her delicate and individual work was warmly welcomed by English critics as well as by those of her own country. Among her other novels are *O Pioneers!* (1913), *My Antonia* (1918), *A Lost Lady* (1923) and *The Professor's House* (1925). In 1917 she became Litt.D. of Nebraska University.

CATT, CARRIE CHAPMAN (1859–), American suffragist leader, was born at Ripon, Wis., Jan. 9 1859. She was educated at the State College of Iowa and took a special course in law, subsequently becoming high school and general superintendent of schools at Mason City, Iowa. She devoted her subsequent career to the cause of woman suffrage, in furtherance of which she lectured throughout the United States and in Europe. She held the office of president of the National American Woman Suffrage Assn. from 1900 to 1904 and from 1915 until the close of the campaign which resulted in the passing of the woman-suffrage amendment to the United States Constitution. She organised and was president of the International Woman Suffrage Alliance from 1904 to 1923.

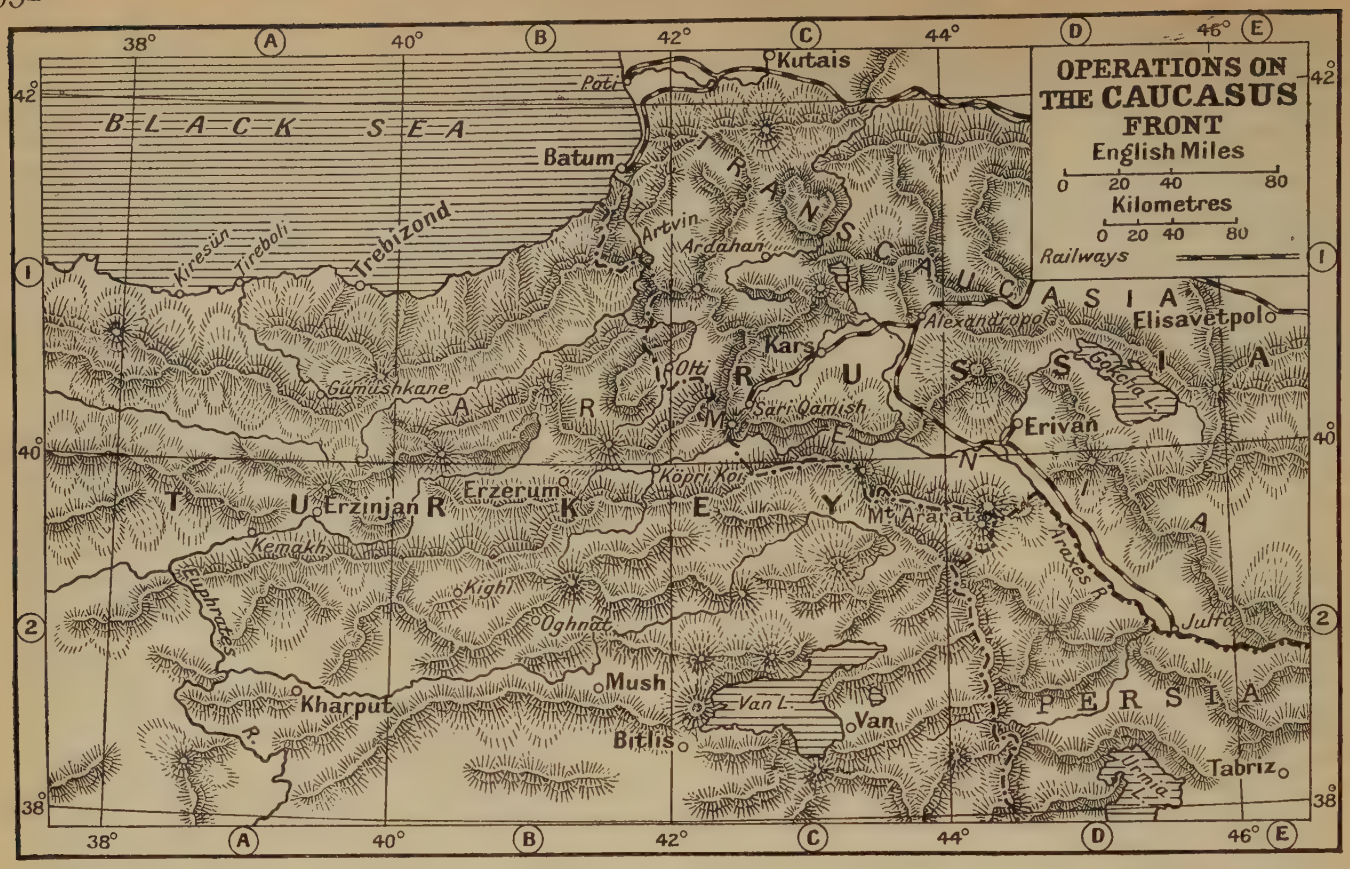
CAUCASUS, CAMPAIGN IN THE.—Though both Russian and Turk spoke of a "Caucasus front" and gave to their armies engaged on this front the designation "Caucasian," the operations actually took place at a considerable distance from the Caucasus.

The Terrain Described.—The main theatre of these operations may be defined as lying within the following limits: on the east, Batum (on the Black Sea)-Kars-Mount Ararat; on the south, Lake Van-Mush-Kharput; on the west, Kemath-Erzinjan-Kiresün; and on the north, the south coast of the Black Sea. The whole of this region is covered by the historical term Armenia—not merely the present republic of that name, but, in the wider sense of the term, the country which was inhabited in 1914 largely by the ill-starred Armenian nation. Outside this main theatre of operations, a somewhat desultory warfare was carried on by detachments from the main forces up and down the western parts of Persia. Though some of the valleys are fertile, the area as a whole is bleak, sparsely populated and almost undeveloped.

The poverty of the communications and the severity of the climate render military operations on a large scale difficult and arduous. In 1914, on the Russian side, railway communication ended at Sari Qamish, some 40 m. southwest of Kars and 15 from the frontier; on the Turkish side, 600 m. of indifferent roads and tracks separated their armies operating in the Erzerum area from the nearest railhead at Angora or Ulu Qishla, on the Baghdad railway northwest of Adana. Thus the advantage in land communications lay, at the outset, very decidedly with the Russians, who had also, except for a short period after the outbreak of War, command of the Black Sea. On neither side, however, could the communications be considered in any way adequate for operations on the grand scale.

Few commanders would welcome a campaign in such extreme conditions of climate and difficulties of movement and supply. Neither army was up-to-date in its technical organisation. The higher leading and staff work in both armies was rough and ready rather than scientific, though there were a number of German staff officers with the Turk and many highly educated and intelligent men in the Russian General Staff. Given the characteristics of the two armies and the restrictions to manoeuvre which the terrain imposed, it was sufficiently obvious that the campaigns were likely to be marked by hard, straightforward fighting rather than any striking display of military art. Only the hardiest of soldiers could have come to grips with each other at all in that waste of snow-clad hills, in the depths of winter when the campaign opened. It was at the end of October 1914, that Turkey definitely entered the World War on the side of the Central Powers, and opened hostilities by naval-bombardment of Russian ports in the Black Sea.

The strategy of the Central Powers would have naturally



dictated as the most useful contribution of her new ally to the common effort a diversion likely to withdraw most Russian troops from the hard-pressed Austrians; and Liman von Sanders, the chief of the German Military Mission in Turkey, is known to have proposed a scheme for the landing of a Turkish force at Odessa with this object. But this scheme, even apart from doubts whether command of the Black Sea could be effectively secured, was, perhaps not unnaturally, viewed with disfavour by the Turks, who preferred the hope of reconquest of some of the territory, notably the fortress of Kars, lost to Russia in previous wars. The III. Turkish Army had been assembling during Sept. and Oct. in the neighbourhood of Erzerum. It consisted of the IX. and XI. Corps, the 2nd Cav. Div. and some mounted irregulars. During Nov. the X. Corps was added, bringing the fighting strength of the army up to approximately 100,000 men. All three corps were composed mainly of Anatolians, the best fighting material in Turkey.

The Turkish Plan of Campaign.—The plan evolved by Enver, whose megalomaniac mind seems to have dreamed of campaigns rivalling those of Alexander and extending even up to India, was a wide enveloping movement with Kars as the objective. The XI. Corps was to attack frontally toward the Russian railhead at Sari Qamish, while the IX. and X. Corps moved north from Erzerum, swept by difficult hill passes through Olti, on toward Kars and Sari Qamish. Still further north, a detachment which had landed at Trebizond was to advance on Ardahan. This grandiose plan wholly ignored the absence of communications and the climatic conditions. The Russian attitude was, at the outset, purely defensive; their main preoccupation was on their Western Front, which had absorbed nearly all the available forces; two of the three regular corps, stationed in the Caucasus in peace, had been sent on mobilisation to defend the Western Front against Austria and Germany. Only two complete corps, the I. Caucasian and II. Turkestan, were at first available for the defence of the Caucasus. Yet the Russians made the first advance, moving a force across the frontier to Köpri Köi on the road to Erzerum. This advance was made to secure room for manoeuvre in front of the important base at Sari Qamish. The Turks promptly attacked, and some fierce fighting took place between Nov. 8 and 20, which ended in the withdrawal of the Turks.

Enver now arrived from Constantinople and assumed personal command of the III. Army. He insisted, against the views of his German advisers, on putting into execution the ambitious plan he had conceived. The routes by which the turning movement was made were mere mountain tracks deep in snow; the greater part of the artillery and transport had to be left behind, and the attempt seemed madness. Yet such fortitude and endurance did the poorly equipped and ill-fed Turkish troops display that they almost achieved the impossible. While the main Russian body was engaged with the XI. Corps, the IX. Corps appeared, in the last days of Dec., on the heights above Sari Qamish, and the X. Corps on its left approached the railway between Kars and Sari Qamish; the detachment from Trebizond had already driven the Russians out of Ardahan.

The Russian commander's nerve failed him at the crisis; and the situation was saved only by his chief of the staff, Gen. Yudenich, a man of considerable ability and imperturbable resolution. He collected forces for a counter attack, which resulted in the complete defeat and practical annihilation of the two Turkish turning corps, worn out and disorganised by their formidable approach march; the XI. Corps was then in its turn driven back. The total losses of the Turkish III. Army are said to have approximated to 85%. Enver at once handed over the command to Hawis Hakki Pasha and returned to Constantinople. Hawis Hakki died shortly after, and the command was given to Mahmoud Kiamil. The alarm caused in Russia by the Turkish incursion was such that an appeal was made to Great Britain for a diversion against the Turks. This led to the first suggestion for the Gallipoli expedition.

During the whole of 1915 the fighting on the Caucasus front was of minor importance only. The main preoccupation of the Russians lay on their Western Front, of the Turks in Gallipoli. The shattered III. Army was gradually reconstituted, and the Russians raised fresh units to increase their strength. But neither side was yet in shape for a serious offensive. The detach-

ment of Turks which had in the previous winter advanced to Ardahan and then been driven back to Artvin attempted in April a *coup de main* against Batum, but without success. On the other flank the Russians advanced their left wing into Armenia during May and June, occupied Van and threatened Bitlis. The Armenian rising which assisted the Russians led to bloody reprisals on their compatriots still in Turkish power. In Sept. 1915 the Grand Duke Nicholas took over command of the Caucasus front, an event which was to produce a marked enlargement of the Russian effort in this theatre. Grand Dukes in Imperial Russia could still obtain reinforcements in men and material denied to ordinary commanders. Nor did the character of the Grand Duke make it likely that he would adopt a passive rôle. Though not a great strategist, he was shrewd and energetic, and, as he had already shown while in command on the Western Front, a most loyal and unselfish supporter of the Allied cause. He found an able executive commander in Gen. Yudenich, already mentioned.

The Taking of Erzerum.—Once again an offensive on a large scale was made in the depth of winter. The Grand Duke wished to anticipate the arrival of Turkish reinforcements released by the British evacuation of Gallipoli. This enterprise was completely successful. The Russian capture of Erzerum was one of the finest feats of arms of the whole War. Its assault did not form part of the original plan, but the attacks up the Araxes valley, begun on Jan. 11 1916, so completely surprised the Turk that it was decided to attempt it. The famous fortress, though many of the works and much of the armament were not modern, occupies a position of great natural strength, which the Turks under German supervision had improved with field works in addition to the existing forts. Its capture on Feb. 16 was mainly the result of a turning movement from the north, made by the II. Turkestan Corps under Przjevalski, the ablest of the Russian Corps commanders on the Caucasus front, who had an intimate knowledge of Erzerum, where he had spent 15 years as military attaché. The Turks retired in considerable disorder with heavy losses in men and material.

The next Russian objective was Trebizond; its capture in April considerably simplified the supply problem. Meanwhile, the Turkish Higher Command, alarmed at the fall of Erzerum and continued advance of the Russians, had decided on a counterstroke. They ordered the assembly of a new army, the II., under Izzet Pasha, in the Mush-Kharput region, to attack the Russian flank and rear and recapture Erzerum. The plan was sound enough, had the communications allowed of a speedy concentration and swift advance. But the assembly of the II. Army, begun in April, was not complete in July. The Grand Duke became aware of the Turkish intentions and anticipated their attack by a heavy blow at the III. Army, which eventually broke in complete rout. The Russians occupied Erzinjan in July. So heavy were the losses of the III. Army that it had subsequently to be completely reorganised. To do this divisions were formed out of army corps, regiments out of divisions, battalions out of regiments.

The defeat of the III. Army delayed and weakened the counterstroke of the II. Army, which did not take place till August, giving the Russians time to transfer troops from their right wing to meet it. After some heavy fighting on the Oghnat-Kighi front the II. Army's effort was definitely held. It had gained little ground at a considerable sacrifice in men. Both armies then took up defensive positions for the winter. The line now ran approximately from Tireboli on the Black Sea, west of Gumushkane to Kemakh, then southeast by Kighi, Oghnat, Mush, and Bitlis to Lake Van. Further east, on the Turko-Persian border and in Persia, both armies had detachments to protect their flank, and fighting took place with varying fortune during 1915–6.

During the winter of 1916–7 no movements took place. The Turkish II. and III. Armies (Mustapha Kemal and Wahib Pasha respectively), now combined under Izzet Pasha, suffered terrible privations from lack of supplies and the weather. Nor were the Russians in very much better case. A light line was being built from Sari Qamish to Erzerum, but progress was very slow and railhead was still some miles short of Erzerum in March 1917. Their command of the sea enabled them to feed their right wing from Trebizond; but from Erzerum and Trebizond to the front, supply was dependent on horse transport over indifferent tracks, sometimes closed for days by blizzards of snow. The Russians, too, suffered severely from poor rations and typhus.

Attempted Russo-British Co-operation.—In Dec. 1916 the British Army in Mesopotamia, under Gen. Maude, commenced the attacks on the Turks at Kut, which were eventually to lead to the capture of Baghdad in March. Unsuccessful efforts had previously been made to concert the operations of the British in Mesopotamia and the Russians in the Caucasus; and now, with the approach of Maude's forces to Baghdad, an opportunity for effective combination seemed to have arrived. It was agreed that the Cavalry Corps of Baratov from Persia and of Chernozubov from between lakes Urmia and Van (both these corps, though composed mainly of cavalry, had a strong backing of infantry and artillery) should advance on Mosul; and thus, it was hoped, in co-operation with Maude, finally liquidate the Mesopotamian campaign. However, it was not to be. The Grand Duke adopted the plan whole-heartedly, and the Turk would not have been in a position to offer effective resistance. But, first of all, the weather conditions and the difficulty of organising a line of supply through the mountains of the Persian border caused delay; then, before the movement had well begun, the Russian revolution broke out. With the recall of the Grand Duke toward the end of March—only to be described as an incredible blunder on the part of Kerenski—the best hope of energetic action had gone.

Collapse of the Russian Army.—Throughout the summer the Russian Army lay inactive, gradually disintegrating; by the early autumn it was sufficiently obvious that the troops would make no further forward movement, and could only be relied on to hold their positions so long as they were not attacked. Yudenich, who had succeeded the Grand Duke, gave up the command in August and was succeeded by Przjevalski. But the end was near. In December an armistice was concluded on the Caucasus front, and in Jan. 1918, after the peace of Brest-Litovsk, the Russian troops still remaining retired. The condition of the Turkish armies had been too wretched to allow them up till now to take advantage of the Russian collapse; but when the Russians finally retired, the Turks were once more fired with hopes of territorial gains; and advanced on the Caucasus with troops which from the military point of view would have been more profitably employed in strengthening their front in Palestine. They occupied Batum on April 14 and Kars on the 26th. All Russian regular troops had disappeared, and their only opponents were Georgian and Armenian bands defending their homes.

The British Expedition to Baku.—The British General Staff, alarmed at the prospect of a Caucasus under Turkish control being used as a base of propaganda and even operations against India, had meanwhile organised a group of British officers and non-commissioned officers under Gen. Dunsterville to be sent to the Caucasus to rally the local Armenian and Georgian populations against the Turk. But this force, dispatched through Persia from Mesopotamia, was delayed by the anarchic conditions which followed the collapse of the Russian forces in Persia, and arrived too late. When it reached Baku in August, things had gone too far; and after a short but gallant defence it was compelled to withdraw. But the Turkish control of Trans-Caucasia was shortlived, for Allenby's crushing victory in Palestine a month later spelt the loss of the War for the Turks.

Criticisms of the Campaign.—The operations of the so-called "Caucasus Front" described above thus led to no decisive results on either side. In view of the poor means of communication in the theatre of operations it is difficult to see how decisive results could have been expected. The lure of territorial conquest and false strategical conceptions led the Turks to attach an undue importance to this front, which had disastrous consequences for them from a military point of view. The unnecessarily heavy losses in their best troops caused by the offensives of the III. Army at the end of 1914 and of the II. Army in 1916 caused the weakness which proved their undoing on the Palestine and

Mesopotamian fronts. Had the Turks been content with a defensive attitude on the Caucasus Front, British difficulties in these theatres might have been greatly increased.

The purely defensive attitude which the Russians took up at the outset was strategically correct; they had no other objective than the protection of their Transcaucasian provinces from invasion; the state of the communications would obviously never allow them to penetrate far enough into Asia Minor to produce any decisive effect on Turkey. That they advanced as far as they did—farther, perhaps, than was strategically wise—was due to the influence and energy of the Grand Duke. From the military point of view these campaigns are likely to be remembered only for one great feat of arms—the boldness and endurance displayed in the capture of Erzerum—and as affording to soldiers one more example of the dependence of strategy on communications.

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CAVALRY (*see* 5.563).—In the years immediately preceding the World War ideas on the employment of cavalry were distinctly confused. The leading military nations were agreed that its chief uses would be as an arm of reconnaissance and pursuit, but only the British realised that the mobile fire power now given it by the possession of an efficient breechloading rifle had made it an effective arm of protection as well. No nation had realised the amount of auxiliary fire power cavalry formations would require if they were to act independently and carry out a dismounted assault when necessary.

Theories Compared.—The Germans, with the exception of divisional cavalry, intended to employ the whole of their cavalry, independently to seek out and destroy the opposing cavalry and so from the outset gain superiority in the area to be reconnoitred. They put intelligence first, did not consider security and had no protective cavalry whatever. The French had a small amount of protective cavalry as well as the divisional, but, like the Germans, intended to employ the bulk of their cavalry independently against the opposing cavalry. The British considered that it would often be more important to screen one's own movements than to fight for intelligence, which might arrive too late to be of use, and intended, after allotting a small proportion as divisional cavalry, to employ the bulk of their cavalry protectively and send forward only small detachments for independent reconnaissance.

French and German cavalry training was, therefore, devoted mainly to reconnaissance duties and the mounted action, which they considered would be the decisive factor in the inter-cavalry struggle they so confidently expected. They neglected musketry and dismounted action and overlooked the possibility that they might never meet the opposing cavalry owing to the wide front over which the enormous armies of this period would be operating, or that their opponent might decline a mounted combat and use his rifles and machine-guns instead. Neither nation had fully realised the limitations which the introduction of the breechloading rifle and machine-gun and the difficulties of the terrain in western Europe had imposed upon the possibility of employing a mounted assault against a dismounted enemy, nor recognised that, unless surprise and a short distance to cover were obtainable, he had first to be disorganised and demoralised by fire if such an attack was to succeed. British cavalry, recognising both the advantages and limitations of the mounted assault, and trained to fight either mounted or dismounted, as well as to reconnoitre, was distinctly superior to that of any other nation when war broke out in 1914.

Cavalry in the World War.—Both France and Germany employed 10 cavalry divisions in the west and the failure of these large bodies of cavalry to effect any decisive results is attributable to faulty employment and tactics. The Germans put five divisions in their centre and left, where there were no flanks and the country unfavourable, and these divisions, which received very poor instructions, never got ahead of the leading infantry. The remaining five were employed with their right, the offensive wing, where there was an open flank, favourable terrain and ample scope for exploiting the mobility of cavalry—its chief asset—to the full. Here all 10 divisions, skilfully employed, might have altered the result of the whole campaign.

But these five divisions were given such misleading original directions, and were so misdirected subsequently, that golden opportunities were missed and their action was ineffective. Their tactics were poor. The expected inter-cavalry struggle never took place, and after two divisions had failed disastrously to gallop down a weak rearguard of Belgian cavalry and cyclists at Haelen, Aug. 12 1914, over unsuitable ground with no covering fire, they rarely attempted a mounted assault again, nor did they make full use of their mobility. At Le Cateau three cavalry divisions were employed in dismounted frontal attacks against the British II. Corps and the latter's exposed flanks and isolated condition were never discovered.

The original French dispositions were equally faulty. They placed only three divisions on their exposed left flank, where there was ample scope for effective cavalry action, and speedily exhausted these by orders and counter-orders without obtaining any effective results. The remaining seven were distributed along the front where there were no flanks and the country was unfavourable, and, not having been trained in dismounted action, they effected very little. Their tactics showed immense gallantry but little skill, mounted attacks being attempted regardless of circumstances.

The British Cavalry.—The British cavalry, consisting of one division of four brigades and an independent brigade, played a most effective rôle in these opening stages. It successfully covered the advance to and withdrawal from the Mons position and the subsequent advances to the Aisne and into Flanders. The soundness of its pre-War training was demonstrated and the action of Cerizay, fought in the early days of the World War, is a model of the combination of fire and shock action. All three combatants found divisional cavalry invaluable during this period of open warfare, though here again the British cavalry with better training and tactics proved itself superior. Once trench warfare set in, all the cavalry were employed most effectively as a mobile reserve to occupy or reinforce rapidly a sector of the line or fill a gap, and here the training in dismounted action and high standard of musketry of the British cavalry proved invaluable.

In 1915 the Germans transferred most of their cavalry to the east, where conditions were favourable and they did most effective work, but in 1917, owing to shortage of horseflesh and manpower, three divisions had to be dismounted. They never sent the remaining seven back to the west for their great offensive in the spring of 1918, an error to which Ludendorff attributes its failure, for they had no cavalry with which to exploit the extremely favourable situation created in its opening stages and, in his own words, "without cavalry it is impossible to reap the fruits of victory." The British commander-in-chief never lost sight of this necessity for mounted troops and, despite considerable criticism, retained all his five cavalry divisions throughout the long period of trench warfare, though two were sent to Palestine early in 1918.

By this period cavalry had been considerably strengthened in fire power by the addition of extra machine-guns and automatic rifles, and was to be reinforced by armoured cars, light tanks, extra artillery and infantry in lorries directly mobile warfare reappeared. The battle of Amiens in Aug. 1918, where the advance of the cavalry was limited only by the extreme difficulties of crossing an old trench warfare battle-field, showed to a great extent what possibilities lay open in European warfare to fast moving, hard hitting formations of cavalry, reinforced by other mobile troops, and capable of independent action in almost any nature of country, but the Armistice a few months later, which came just as the German resistance was completely collapsing and an opportunity for effective cavalry action was imminent, prevented this wise retention of his cavalry by Haig from being justified as it deserved.

Allenby's Use of Cavalry.—The value of cavalry in suitable

country and against an inferior opponent was well demonstrated in the later stages of the campaigns in Palestine and Mesopotamia, and Gen. Allenby's employment of his cavalry in his offensive in Sept. 1918 will always remain a historic example of how this arm should be employed in pursuit. The enemy's right flank was broken down by an infantry assault and three divisions of cavalry were pushed through and directed, first well in rear, to destroy vital nerve centres, such as headquarters and railway junctions, and then to place themselves astride the enemy's line of retirement. With complete air superiority they were not hampered by air attack, and covering 70 m. within the first 36 hours, within 14 days completely destroyed the whole of the Turkish forces in this theatre of war, over 100,000 prisoners and 500 guns being captured.

In Mesopotamia, with small forces engaged, cavalry, besides proving invaluable for reconnaissance, were again employed most effectively in pursuit, notably at Ramadi, 1917, and Sharqat, 1918, where in each case cavalry were pushed round the flank of a retreating enemy, and, occupying positions well in rear across his line of retirement, compelled his complete surrender. In both these eastern theatres of war, mounted action was successfully employed on many occasions, such as at El Mughar in Palestine, Nov. 1917, where a yeomanry brigade successfully charged the flank of a position which had been holding up an infantry division for some hours, and demonstrated once again the superiority of this form of attack to any other, given suitable ground, bold and skilful leading and adequate covering fire.

Some Conclusions.—The peculiar conditions of trench warfare, which prevailed for so long in the main theatre of war and gave such little opportunity for the effective employment of cavalry, have caused its successes in open warfare to be overlooked, and a great deal of ill-informed criticism to be directed upon it. A new, and at present most effective, arm of assault has been introduced in the tank, and because cavalry, unless reinforced by other arms, has now such distinct limitations in this rôle, it has been suggested that it should either disappear or replace its horses with mechanical vehicles. Its capabilities as an arm of reconnaissance, of protection and of pursuit have been forgotten. For reconnaissance it is essential. Aircraft can go further and bring back information quicker, but cavalry is the only mobile arm which can operate in almost any nature of country, take prisoners, examine documents, search ground closely and work by night or in rough weather. For protection and pursuit a mobile arm is again required which can operate in all natures of country including unsuitable tank country, such as covers a great portion of Western Europe, and which cannot only reconnoitre, but seize and hold positions, protect a flank or cover a retirement; so that even if a nation had sufficient light tanks available at the commencement of a future war to employ any large number as covering troops, a force of cavalry would be essential as well.

For close co-operation with infantry as scouts and messengers, divisional or corps cavalry are invaluable, the trained mounted man being one of the most efficient means of inter-communication once battle is joined. For warfare against a civilised opponent, cavalry will, in future, require reinforcing by armoured cars or light tanks, extra artillery, cyclists or some form of mobile infantry and aeroplanes, and will possibly be most efficiently employed in brigades, any larger formation being difficult to control effectively when dispersed, and too vulnerable a target to artillery and aircraft when concentrated, unless only moved at night, which would seriously diminish its efficiency. Against an uncivilised opponent, in country that is suitable for cavalry, larger formations such as divisions or corps should prove most useful.

With regard to the "arme blanche," the French doctrine that "cavalry manoeuvres on horseback and fights on foot" has been forced upon them by the impossibility of turning a short service conscript into anything more than a mounted infantryman in the one year's training available. To sacrifice the value of a well-trained cavalryman who can fight equally well, either mounted or dismounted, by not teaching our long-service volunteers to ride home with a steel weapon as well as to scout and shoot, would be a serious mistake.

Mounted action, as exemplified in the World War, will still be possible by individuals or small bodies, given surprise and a short distance to cover and by larger bodies against an inferior enemy, or one already disorganised and demoralised by fire. The leading patrols must not gallop blindly into ambushes, as the French cavalry so often did in 1914, but rather go straight for their enemy mounted whenever they have a reasonable chance of doing so, and thus establish a moral superiority over him such as the British had over the German cavalry in 1914.

The results of the opening stages of a campaign are of far-reaching importance, and it is in the preliminary skirmishes between the opposing covering troops that a cavalry trained to use the "arme blanche" will have an immense advantage, while for pursuit or for operations against an uncivilised enemy, the mere possession of a steel weapon has the greatest moral effect. *See* STRATEGY; TACTICS; WAR.

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CAVAN, FREDERICK RUDOLPH LAMBERT, 10TH EARL OF (1865–), British general, was born Oct. 16 1865, and succeeded to the title in 1900. Commissioned in the Grenadier Guards 1885, he was A.D.C. to the governor-general of Canada 1891–3, and served in the South African War 1901. Retiring from the army in 1913, he was recalled in Aug. 1914 and in Sept. went out to France to take command of the 4th (Guards) Brigade. In June 1915 he was promoted to command of the 50th Division, and in Aug. to the Guards Division. Winning a reputation as a trusted and admired fighting commander, his next step was the command of the IV. Army Corps at Ypres, which he held from Jan. 1916 to March 1918, when he was appointed to succeed Gen. Plumer as commander-in-chief of the British Forces on the Italian front. A notable mark of trust was that the Italian command put him in charge of the X. Italian Army for the final offensive. It was through the initial forcing of the passages of the Piave by the mixed British and Italian troops under his command that the way was paved for the decisive successes which followed. Remaining on the active list after the War, Lord Cavan was appointed to the Aldershot command in 1920 and in 1922 was advanced to be chief of the Imperial General Staff, a unique distinction in that a retired officer was not only brought back to the active list but became the chief of the army. Cautious, perhaps, in his attitude to military progress and new weapons of warfare, he was a tranquilising influence rather than a driving force. But in view of the political war weariness and military soreness which prevailed during the first stages of rebuilding the regular army, the former quality was an unquestionable aid in paving the way for subsequent reforms.

CAVE, GEORGE CAVE, 1ST VISCOUNT (1856–), British lawyer and politician, was born in London Feb. 23 1856 and educated at Merchant Taylors' School, London, and St. John's College, Oxford. Called to the bar in 1880, he became K.C. in 1904. In 1906 he entered Parliament as Conservative member for Kingston. The House of Commons soon recognised that the new member was a man of sincerity and judgment with a wide knowledge of affairs, and Mr. Cave came to be regarded as a leading member of the Conservative party. In 1915 he became solicitor-general and was knighted. On the formation of the first Coalition Govt., in 1916, he was appointed Home Secretary. In 1918 he was raised to the peerage. When, in 1919, he became a lord of appeal, it appeared that Lord Cave's political career had come to an end; but on the break-up of the Coalition, Mr. Bonar Law appointed him Lord Chancellor (1922). The election of 1923 brought about a Conservative defeat, but when Mr. Baldwin returned to power in 1924 Viscount Cave was reappointed to his former office. He was elected chancellor of the University of Oxford in 1925.

CAVELL, EDITH LOUISA (1865–1915), British nurse, was born Dec. 4 1865 at Swardeston, Norfolk. She entered the London Hospital as a probationer in 1895. In 1907 she was appointed the first matron of the Berkendael Medical Institute, Brussels, which became a Red Cross hospital on the outbreak of the World War. From Nov. 1914 to July 1915 wounded and derelict English and French soldiers were hidden from the Germans by Prince Reginald de Croy at his château near Mons, thence conveyed to the houses of Edith Cavell and others in Brussels, and furnished by them with money to reach the Dutch frontier with the aid of guides obtained through Philippe Baucq. On Aug. 5 Edith Cavell was arrested and imprisoned. She admitted having sheltered and helped to convey to the frontier some 200 English, French and Belgians. A court-martial was held Oct. 7 and 8 and a Belgian lawyer, M. Sadi Kirschen, defended Edith Cavell. On Oct. 9 Edith Cavell and Philippe Baucq were sentenced to death with three others who were afterwards reprieved. Despite efforts to obtain a reprieve in which Mr. Brand Whitlock, the U.S. Minister at Brussels, was active, Edith Cavell and Philippe Baucq were shot on Oct. 12. Miss Cavell, who had tended many wounded German soldiers with devoted care, faced the firing squad with a dignity which moved the world. To the British chaplain who administered a final sacrament, she made the remark "patriotism is not enough" which at once became as historic as Nelson's utterances at Trafalgar. On May 15 1919 her body was removed to Norwich Cathedral after a memorial service in Westminster Abbey. A memorial statue stands opposite the National Portrait Gallery, London.

See *The Case of Miss Cavell from the Unpublished Documents of the Trial*, interpreted by Ambroise Got (1920); Sadi Kirschen, *Devant les Conseils de Guerre allemands* (1919); *Correspondence with the United States Ambassador respecting the Execution of Miss Cavell at Brussels*, Cd. 8013, Stationery Office (1915).

CAVIGLIA, ENRICO (1862–), Italian soldier, was born at Finale Marina (Genoa) May 4 1862. After Italy's entry into the World War, he was promoted to major-general and commanded the Bari Brigade. In June 1916 he took over the 29th Div. and later was promoted lieutenant-general. In July 1917 he was given command of the XXIV. Corps, which broke through the Austrian lines on the Bainsizza plateau. In June 1918 he was chosen to command the VIII. Army which played an important part in the final victory of Vittorio Veneto. From Jan. to June 1919 Caviglia was Minister of War, and as such became a senator, and in Nov. of the same year he was promoted army general. In Jan. 1920 he took over the command in Venezia Giulia. His task was difficult, since the discipline of the troops had been severely shaken by the example of D'Annunzio's Fiume raid. He restored discipline, and when it became evident that only force would drive D'Annunzio from Fiume, he did not hesitate to carry out his task (Dec. 1920).

CECIL, LORD HUGH RICHARD HEATHCOTE (1869–), English politician (*see* 24.76), youngest son of the 3rd Marquess of Salisbury, the Prime Minister, was born Oct. 14 1869 and was educated at Eton and University College, Oxford, where he obtained a first class in Modern History in 1891, and was elected a fellow of Hertford College. He gained his first insight into politics as one of his father's secretaries, and was returned to Parliament as a Conservative in 1895. He took a particularly keen interest in ecclesiastical matters and was remarkable in debate for his oratorical powers and the loftiness of his ideals, thus establishing a reputation which was confirmed and heightened during the progress through Parliament of Mr. Balfour's Education bill of 1902. In regard to the religious difficulty, he maintained that the only possible basis of general agreement was that every child should be brought up in the belief of its parents. He and Mr. Winston Churchill gathered round them, in the early years of the 20th century, a small group of young and able Conservative members, whose independent proceedings attracted some attention. He took a decided part in resisting tariff reform, and consequently lost his seat in 1906.

Lord Hugh did not return to Parliament until 1910, when his high character and his academic outlook recommended him, in spite of his hostility to tariff reform, as a fitting member for Oxford, his own university. He threw himself immediately and with passion into the struggle over the proposed curtailment of the powers of the House of Lords, and was active in resistance to the Parliament bill. But he never quite regained the authority which he had possessed in the House in his earlier years. During the World War he joined the Flying Corps, becoming a lieutenant in 1915, and he also served as a member of the commission that enquired into the Mesopotamia expedition. After the War he took a less active part in politics, but generally found himself in agreement with his brother, Lord Robert (later Lord Cecil of Chelwood), in adopting a more independent attitude toward the Coalition Government. With him, too, he supported the Enabling bill, and he became a prominent member of the Church Assembly set up in accordance with its provisions.

CECIL OF CHELWOOD, EDGAR ALGERNON ROBERT CECIL, 1ST VISCOUNT (1864–), British politician (*see* 24.76), known before his elevation to the peerage as Lord Robert Cecil, was the third son of the 3rd Marquess of Salisbury, the Prime Minister. Born Sept. 14 1864, he was educated at Eton and University College, Oxford, and obtained a second class in law in 1886. He was a prominent speaker at the Oxford Union, and obtained political experience as one of his father's private secretaries from 1886 to 1888; but he determined to approach an active political career by way of the bar, and was called in 1887. Making good progress in his profession he took silk in 1899, and soon established his position as a capable lawyer and advocate.

It was not until 1906 that he entered Parliament as Conservative member for East Marylebone, and he was one of the principal critics of Mr. Birrell's abortive Education bill of that year. Though in this respect he showed himself in sympathy with the position of his younger brother, Lord Hugh Cecil, he made his reputation mainly by assuming, in conjunction with Mr. Harold Cox on the Liberal side, an attitude of individualist opposition to measures such as those for eight hours for miners, and old-age pensions. He also dissociated himself from the tariff reform policy of his party, and was consequently out of Parliament from 1910 to 1912, when he was returned at a by-election for Hitchin. He immediately resumed his prominent position in the House, and was active in his opposition to schemes of socialism and disestablishment. He was a leading advocate of woman suffrage, and, though not palliating militancy, was a strong critic of forcible feeding. Ultimately, after women had been granted the suffrage, he had the satisfaction of carrying a resolution permitting them to sit in the House of Commons.

Lord Robert was in office throughout the World War from the time that the Unionists associated themselves with the Govt. in May 1915 till the Armistice. His functions, at first as Under-Secretary for Foreign Affairs, then as Minister of Blockade and lastly as Assistant Secretary of State for Foreign Affairs were mainly concerned with the vital question of blockade, and it fell to him to announce in June 1916 to the general satisfaction, that the Allies had decided to abandon altogether the Declaration of London. Lord Robert resigned at the general election of 1918 on the ground that he could not support the decision of the Coalition Ministry to treat Welsh Disestablishment as a *fait accompli*. Though out of office, he nevertheless went over to Paris in 1919 to assist in the formation of the League of Nations, of which from the first he was an enthusiastic advocate. He was subsequently indefatigable in pressing its claims upon both Parliament and people; and in 1920 he attended the first Assembly of the League in Geneva as a representative of South Africa. In Parliament he steadily drifted into opposition to the Coalition Ministry, and, though he did not form part of Mr. Bonar Law's Unionist Ministry in 1922, he joined Mr. Baldwin's first Cabinet in May 1923 as Lord Privy Seal. Before that Cabinet resigned, he had been raised to the peerage in Dec. 1923. His close association with the League of Nations was fitly recognised in Dec. 1924, when he received the first annual award of the Woodrow Wilson Peace Prize of $25,000. He returned to office in Mr. Baldwin's second Cabinet, in Nov. 1924, as Chancellor of the Duchy of Lancaster, and on several occasions acted as deputy

for the Foreign Secretary, Sir Austen Chamberlain, on the Council of the League of Nations.

CELL: *see* CYTOLOGY.

CELLULOID.—This artificial substance, known also as artificial ivory and xylonite, is a compressed, solid solution of nitrated cellulose in camphor or a camphor substitute. It is colourless or slightly yellow, transparent in thin sheets, and capable of being stained with the most delicate colours, which permeate its entire mass. Celluloid is of uniform composition and its specific gravity is about 1·35; it is insoluble in water or dilute acid, usually emits a faint smell of camphor and is inflammable.

Celluloid becomes plastic when immersed in water at or near boiling-point and can then be moulded into any desired form. At ordinary temperatures it can be cut, turned, sawn, drilled and otherwise worked to form numerous useful and ornamental articles. Having a tensile strength of 10,000–12,000 lb. per sq. in., it is one of the strongest of artificial materials. Celluloid is elastic, and can be produced in very thin sheets and films; celluloid films 0·0000039 ($\frac{1}{256,000}$) in. thick were made in 1924 by the U.S. Bureau of Standards, for use in X-ray researches.

The solubility of nitrated cellulose in camphor is the important property on which the success of making ordinary celluloid depends. Tissue paper, cotton, wool or other cellulose material is nitrated by means of a mixture of strong nitric and sulphuric acids. The product, which is of the nature of, but less highly nitrated than, gun-cotton, is bleached, washed and dried; it is then incorporated in a mixing-machine, with natural or synthetic camphor and alcohol. At this stage colouring matter and filling material, selected according to the kind of celluloid required, may be added. The gelatinous mass obtained is transferred to heated adjustable rollers by which it is kneaded and rolled into sheets of any desired thickness. After removal from the rollers, the sheets are pressed and dried or seasoned, most of the volatile solvents being thus eliminated from the celluloid.

Numerous modifications of the process thus briefly described have been proposed, the most important having for their objects the production of so-called "non-flammable celluloid" and the use of a substitute for camphor, the price of which is usually high and subject to great fluctuations.

The attempts to make a celluloid which is less inflammable then ordinary celluloid have been to some extent successful. To achieve this result, a chloride, *e.g.*, stannous chloride, is added to the celluloid-making materials, or acetyl cellulose is used, or a bromate or other substance capable of liberating flame-extinguishing gases. In some processes, the pasty mass is pressed into a block by hydraulic pressure, cooled and then planed to any desired thickness.

If supplies of cheap camphor were always available, the search for a substitute for it would lose much of its importance. There have been, however, very many attempts, mostly unsuccessful, to obtain a suitable camphor substitute. In 1914 the Badische Anilin und Soda Co. claimed that the acyl compounds of completely hydrogenised aromatic amines were very efficient in dissolving nitrated cellulose and were obtainable in large quantities.

The term celluloid was first applied by J. W. and I. S. Hyatt, who began the manufacture of the material in the United States in 1869. Their work was based on that of A. Parkes and D. Spill, who, in 1855 and 1868 respectively, succeeded in England in making plastic materials with pyroxylin as a base. The advance of J. W. and I. S. Hyatt was due to their investigations into the action of camphor upon cellulose and to their improved mechanical methods. The industry has become established in the United States, Great Britain, France, Germany, Austria, Switzerland and Japan, the total output being in excess of 200,000 lb. per day.

Not only ivory but also horn, tortoise-shell, amber, agate, ebony and many other natural substances may be imitated by means of celluloid, and it is used in making numerous useful and ornamental articles. These include cutlery handles, billiard balls, collars, automobile windows, piano keys, buttons, combs, brush and mirror backs, fancy boxes, dolls, hollow balls and other toys, cinematograph films, dental plates, accumulator cases, telephone mouthpieces, transparent screens and parts of drawing and optical instruments. During the War the demand for celluloid articles such as, for instance, accumulator cases and transparent screens, was very great.

See F. Boeckmann, *Celluloid* (1921); H. H. Hodgson, *Celluloid* (1925). (T. E. L.)

CELLULOSE (*see* 5.606).—The term cellulose is used broadly and comprehensively as equivalent to "the component elements of plant structures." Cellulose as a substance, however, is a chemical individual. In the working and fashioning of cellulose structures as such, the most important industries engaged are the textile, twine and rope making, and paper making (*q.v.*).

The stress of War conditions incident upon Germany in regard to supplies of textile and raw materials led to an extraordinary development in that country of the manufacture and use of twisted paper yarns. A paper web, cut to plane strips, twisted to cylindrical form in continuous length, formed a yarn serviceable as a substitute for the staple textile yarns in many and unexpected directions.

The manufacture was rapidly developed to an extensive industry, the yarns being woven into clothing, dress fabrics and wrapping cloths, or worked by plaiting into belting.

Certain of these uses survive on the merits of the goods produced; but in the main a "felt" of short fibre lengths put together necessarily by wet process is inferior in structural quality to the lowest grades of whole-length-fibre felts produced by the dry process of carding preparation, and the twisting of the felts to yarns only intensifies the fundamental contrast.

This development involves a fundamental principle implicitly stated in the foregoing paragraph, and there remains open the problem of putting together long fibre by wet process to a continuous web, to be slit to strips which are then twisted to yarns as in the process applied to plane paper strips.

Kapok.—The use of kapok fibre under naval War exigency was specially developed in the confection of life-saving appliances.

The kapok seed hair is a thin-walled tubular cylinder with a smooth surface and therefore lustrous. When tightly packed in a container it still occupies a very large volume—in specific terms 12 to 13 c.c. per 1 gramme. The container being a bag of textile material and suitably waterproofed, the kapok filling confers a floating capacity 2–3 times that of cork, such that a belt made up with special attention to life-saving conditions, has proved greatly superior in all respects to the cork jackets and other appliances of pre-War times. Under the stress of the naval and marine conditions of the World War, these life-saving appliances came in under enormous demand, and kapok floss was elevated to a position of unique value. This is a conspicuous illustration of the adaptation of plant structures as such to man's necessities.

Use in Aeroplane Construction.—Another development due to the War is the application of cellulose material to the aeroplane, furnishing the air-resistant surface of the wings. To complete the structure as a taut, and, at the same time, water-resistant membrane, a "dope" or varnish was required. Of the many possible colloidal preparations, the only one filling the specification of qualities was the cellulose acetate or acetic ester; a special form of the product, acetone-soluble, was dissolved in the liquid dope in association with "plastifiers," which, after evaporation of the solvent, remained in permanent union with the acetate, modifying its properties to increased plasticity and resistance to strain (*see* ARTIFICIAL SILK).

Cellulose in Industry.—There are three groups of industries based on derivatives of cellulose synthesised by chemical process and retaining the exceptional colloidal characteristics of the mother substance.

(*a*) *Anhydro esters:* mainly nitric and acetic esters formed by combination with the respective acid radicals and with consequent large increase of weight (60–80%)—soluble only in special solvents.

(*b*) *Hydrate esters:* the sodium cellulose-xanthogenic derivatives dissolved by water to "viscose."

(*c*) *Colloidal disperse systems* or solutions formed by interaction in aqueous solution with cuprammonium, zinc chloride, sulphocyanides, etc.

Nitrates and Viscose Derivatives: Explosives and Artificial Silk.—In order of technical and industrial importance, the nitrates and the viscose derivatives are of outstanding prominence. The former, as the basis of modern military explosives, were produced in almost incredible quantities throughout the War period

1914–8. The latter as the main raw material of the artificial silk industry has been produced and worked in rapidly increasing proportions, even during the World War. The growth of the industry from 8,000 tons in 1910 to 62,000 tons in 1924 is mainly that of the viscose products, and, in the main, attributable to British enterprise and capital.

In respect of the War-production of the nitro-cellulose explosives in Great Britain, the mere dimensions of the manufacture, reaching a weekly production of 2,000 tons of cordite (from 1,000 tons cellulose raw material), represent great achievement. But outside the industrial, there were technical scientific problems to be solved in standardising the products, for controlling manufacture, securing uniformity under storage and developing ballistic efficiency.

A main problem is that of chemical purification of the raw material and it is known that the cellulose is modified by the processes, necessarily severe, to which it is subjected. Changes in the cellulose are measured by change—the viscosity of its solutions (Group 3). For a standard of normal condition of the colloid a special method of preparation and a viscosity test based on cuprammonium solution was devised and adopted.[1]

The stability of the nitrate explosive is prejudiced by minute residues of non-cellulose matters. For special types of cordite ammunition, it was found necessary to employ an original "long cotton" prepared by the spinner to the stage of "sliver." This preparation imports a considerable removal of non-cellulose foreign matters, and chemical treatment following this mechanical purification was found to realise the optimum; and the result justified the obviously large increase of cost.[2]

Under the exigency of shortage of supplies of cotton cellulose the wood pulps (cellulose) were adapted in Germany to this manufacture by processes of controlled hydrolysis, removing β and γ cellulose components and incidentally residues of resinoid and other non-cellulose impurities. (*See* EXPLOSIVES.)

Paper-making.—The production of the nitrate from this form of cellulose certainly reached relatively enormous figures. But in point of tonnage the figures in either case are only a fraction of the world's consumption of wood cellulose in the paper-making (*q.v.*) industry, for which the production of wood pulp (cellulose) by chemical process has progressively increased in 1925 to the figure of 6–7,000,000 tons per annum. In point of cost and money value of the product, the figures, ton for ton, *i.e.*, for cellulose as nitrate, and in the form of paper, represent a large multiple ratio.

The extension of artificial silk, the second of the industrial developments of the cellulose industries, from its position in 1910 to an estimated production of 100,000 tons per annum, is one of the most conspicuous features of the age. The basis of the artificial silk industry in 1925 is very much as in 1910.

Properties of Cellulose.—Having fulfilled its predominant functions in the plant world, of which it is the structural basis, it becomes, as nitric ester, a high explosive, but with associated properties by which it can be controlled as the most powerful of agents for calculated destruction and in effect the primary material basis of modern warfare. On the other hand, by chemical process it is restored to the plastic condition of a water-soluble hydrated colloid, analogous in essential properties to the form in which it subserves its constructive functions in the plant, to be then transformed at will into thread, film or massive solid, to subserve, in continued service, the needs of the complex civilisation of our age.

Research.—There has been a remarkable extension and concentration of research on the fundamental problem of the subject-matter: what is cellulose in the language and terms of pure science? In America the Chemical Society has created a special section for the subject—in Germany an important technical society has founded a special publication, *Cellulose Chemie*, also in the *Kolloid Zeitschrift* investigations of cellulose and derivatives are prominent. In Great Britain there are several centres of specialised research: *e.g.*, at Woolwich, Ardeer (Nobel's Explosives) and the Naval Cordite Factory. The Shirley Institute has been founded for research in connection with the cotton industries and its published records (Shirley Inst. Memoirs) have already taken a prominent position in science literature. Important developments in respect of the root problem of constitution as a chemical individual have resulted from the investigations of Sir J. C. Irvine and his collaborators at St. Andrews University. It has long been known that cellulose is hydrolysed by acid to the simple "sugar" dextrose, and that no other product of such resolution could be identified. Later investigations (Flechsig, Ost, Monier-Williams) claim to establish the quantitative realisation of the effect:—

$$N(C_6H_{10}O_5+H_2O)=N\cdot C_6H_{12}O_6$$

In a comprehensive critical survey and investigation Irvine avails himself of the newer experimental methods. The cellulose is fully acetylated and the acetate hydrolised to the simpler sugars, chiefly a biose (C_{12}) (H. Ost). In etherification and hydrolysis, the replacement of the OH groups by $O\cdot CH_3$ and $O\cdot C_2H_5$ is a preliminary to hydrolysis (W. S. Denham: Lilienfeld).

Obtaining the products of resolution in corresponding derivative forms, and avoiding complications otherwise attending the breakdown of the cellulose complex, Irvine establishes the quantitative relationship above formulated and is able to draw definite inferences in respect of constitution and configuration of the products, which may apply to the original complex.

One other contribution must be mentioned as of critical importance in relation to the mode of aggregation of the nexose (dextrose) units to the complex of indeterminate dimensions. A. Pictet has shown that cellulose (and starch) when heated at 210°–250° under reduced pressure (10–15 mm.) gives a distillate with a high yield (45%) of a glucosan.

This definitely raises the critical question whether the hexose anhydride as such is the unit constituent, or main component group of the cellulose complex, and therefore whether the polymerisation of the unit is not of a different order from that which has been generally assumed, *i.e.*, a definite alternative to the C_6–O–C_6 linking upon which hypothesis units of $2.C_6$, $3.C_6$, $4.C_6$ dimensions have been put forward as established by different investigations. This aspect of the constitutional problem is still the subject of active controversy that is sustained by distinguished German chemists and others, as Willstaetter, Hess and Wittelsbach, Karrer, Wislicenus, Herzberg, Hibbert and Haworth. The researches of Irvine are specially mentioned as comprehensive—covering the whole field of the sugar carbohydrates, and rigorously and exhaustively methodical, in continuation in fact of the classical researches of Emil Fischer.[3]

Bisulphite Process.—The chemical mechanism of the bisulphite process of treating wood for the isolation of cellulose, *i.e.*, the industrial production of "chemical wood pulp" has been variously interpreted by technologists over the long period of its industrial evolution (1880–1925). It is now shown[4] that the attack on the lignone components of the wood is that of direct sulphonation by the sulphurous acid SO_3H_2, the sulphonic group SO_3H combining at relatively low temperatures (90°–100°), the reaction taking place with the aqueous acid at 4–6% SO_2 and not being in any sense determined by the basic component of the bisulphite (CaO,MgO,Na_2O).

As an industrial process it is facilitated and controlled by the addition of ammonia in small proportions. The soluble by-products from these sulphurous acid processes have many advantages over those from the bisulphite process, in which the proportion of associated salts is a large percentage of the total solids, and excludes them from a number of industrial applications for which they are otherwise available. (C. F. C.)

[1] *Jour. Chem. Soc.*, 117, pp. 472, 484, 819 (1920)—Robertson, Gibson, McCall, Spencer and Marson; also *Jour. Soc. Chem. Ind.*, 39, p. 172 (1920).

[2] This interesting chapter in the history of "cellulose" development is fully treated by Sir R. Robertson in *Trans. Faraday Soc.*, 16, 66; R. Susti, Lecture, 1921, "War Development of Explosives"; "Chemistry in the 20th Century" 1924.

[3] The records of these researches will be found in *Jour. Chem. Soc.*, 1911–25; the constitutional problem is generally dealt with in *Researches on Cellulose*, vol. 4, C. F. Cross and C. Dorée (London, 1924).

[4] *Jour. Soc. Chem. Ind.*, 1924–5, C. F. Cross and H. Engelstad, C. Dorée and L. Hall.

CENSORSHIP (*see* PRESS LAWS, 22.299).—In practice the censorship may be generally defined as action taken by any governing authority to prevent the dissemination of false statements, inconvenient facts or displeasing opinions among the governed.

I. GENERAL

The outbreak of the World War in 1914 made censorships necessary in all belligerent countries from a purely military point of view. Broadly speaking, they were then established with the following objects: (1) to prevent information of military value from reaching the enemy; (2) to obtain information as to the enemy's strength, disposition, morale and intentions from the indiscretions of his Press or his people; (3) to control the enemy's channels of communication; (4) to prevent false statements, inconvenient facts or enemy-inspired propaganda from reaching the public. The methods of communication which lend themselves to censorship from such points of view are (1) postal communications; (2) telegrams and wireless communications; (3) printed publications.

Postal Censorships.—The communications dealt with by such censorships were divided broadly into (*a*) correspondence with the combatant forces, (*b*) private correspondence, (*c*) commercial correspondence, (*d*) printed publications arriving from abroad. In practically all the armies field censorships were established to deal with the correspondence of the combatant forces. The censoring was performed in the area of military operations by regimental officers, or if necessary at the base by staff officers specially appointed for the purpose. In Great Britain only such letters arriving from the area of military operations as appeared to have escaped the eyes of the field censors were submitted by the post office for scrutiny to the censors in London. With regard to the other categories of communications, it will be convenient to describe the history and methods of the English censorship, which (partly owing to geographical circumstances and partly owing to able organisation) became during the War more efficient and comprehensive than those of most other countries.

In Great Britain the censorship of postal communications, like that of cables, was placed at the beginning of the War on a military basis. The competent military authority for these purposes was a general officer responsible to the Army Council, and the officers of the censorship acted under his directions. Non-postal communications to and from the United Kingdom were prohibited by a regulation under the Defence of the Realm Act, and a similar regulation allowed a search at the ports of persons embarking and disembarking in order that written communications which were intended to escape or might escape the censorship might be discovered. The postal censorship officers were established in London, and in May 1915, nine months after the beginning of the War, the number of censors of all grades was 800. They then examined each week a ton of private correspondence and five tons of commercial correspondence. By the end of the War the Censor's staff numbered 4,608, and an average of 375,517 letters were being scrutinised per day. The procedure throughout the War was as follows: Outgoing mails were examined, so far as legitimate correspondence was concerned, for any information (or misinformation) which might, if conveyed to the enemy through neutral channels, supply useful information or useful propaganda. All such passages were deleted and the correspondence was then allowed to go forward. Correspondence, which from its origin or destination there was any reason to suspect as a channel of enemy communication, was specially examined, along with any suspicious correspondence, the derivation of which was not obvious.

This part of the censorship's activities was really a part of the *contre-espionage*, a service designed to defeat the enemy's attempts to extract useful information from behind the lines. Such services were general in all belligerent countries, and involved, so far as the censorship was concerned, a strict examination of any suspect or suspicious documents which might possibly convey, by the use of cipher, code, sympathetic ink or any other device, a message to the enemy. In the British, French and German postal censorships special branches were organised to deal with these problems, and as a result messages were discovered through which enemy agents were apprehended and enemy channels of communication were closed. In Great Britain arrangements were made by which communications intended for enemy persons might be placed in open envelopes and enclosed in covers addressed to a neutral country. All such letters were of course submitted to careful examination. Mails for neutral countries contiguous to the enemy were censored from the first, and as the area involved by the War extended to extra-European territory it became necessary to examine practically all outgoing mails, for information which might be of military value to the enemy and for statements which might damage Great Britain in the eyes of neutrals or raise the enemy's morale.

Communications obtained from known enemy agents were in many cases altered in such a way as to convey false information and then allowed to proceed. Incoming mails were examined for any information regarding the enemy's strength, dispositions, plans and morale, and for any statements which could be used to discredit the enemy in the eyes of neutrals or to raise the morale at home. Printed publications emanating from enemy sources and found in postal packets were difficult to deal with. Many of them were of a highly propagandist nature, and were therefore seized and condemned. Others, less objectionable, were condemned because of the extreme ease with which secret communications can be made (by code and derivation) through printed matter and the extreme difficulty of detecting such messages. Certain neutral publications were placed on a "black list" and destroyed whenever found, either as being enemy-inspired or as being calculated to lower morale at home. Protests at the destruction or detention of printed books and periodicals were constantly made in Parliament, but for the reasons enumerated they were disregarded.

Neutral Protests.—During the early days of the War the censorship brought many protests from neutral countries, and early in 1915 it was actually suggested by a harassed Government that the censorship of neutral mails should be abolished. The military authorities, however, were able to prove conclusively that such a step would have been fatal. When the blockade was declared and enforced neutral protests redoubled, it then became necessary to examine all mails entering the area of the blockade for contraband of war which, though addressed in postal packets to neutral countries, was suspected of enemy destination. Mail-boats sailing to neutral ports within the blockade area were stopped by naval patrols. The so-called transit mails were landed in the north of Scotland, sent to London, examined and then returned. This caused much unavoidable delay and consequently much neutral protest. It was quickly justified, however, by the finding of large quantities of contraband, rubber, cotton and even contraband metals concealed in these transit mails. America in particular protested vigorously against the censorship delays. In the autumn of 1915 a test examination was made of the direct outgoing mails to the United States, and the results yielded were of such importance from the censorship point of view that it was decided to establish a special branch of the censorship at Liverpool to deal with the American mails. This branch was established on Jan. 1 1916 and disbanded exactly two years later. It was of great advantage in minimising delays. Censorship was practically confined to trade letters and letters to suspect addresses. Trade letters of enemy origin or destination had been examined from the first in London and action taken to close down all enemy transactions abroad. It was early discovered that such letters were of the utmost importance, as they often contained messages in code or sympathetic ink.

There is not much of importance to be said of postal censorships in the other belligerent countries. The problems were the same as in the British censorship, though the methods adopted to meet them were sometimes more radical and based on the principle that no correspondence can be dangerous which the addressee never receives. When America came into the War an officer of the British censorship was sent to New York to assist in conducting a censorship on the London model.

Inefficiency of Russian Censorship.—It was, from the Allied point of view, important that there should be a strong censorship in Russia, for it was early discovered that the enemy were communicating freely by this route with Asia and America. But the Russian censorship was inefficient, and remained inefficient throughout the War. There was no attempt at field censorship, and the small staff in Petrograd were entirely inadequate for any proper postal censorship duties. Early in 1916 an officer of the British censorship was sent to Russia to reorganise the censorship, but found it impossible to put it on a sound basis. All that could be done of value was to stop enemy commercial communications. No staff was available to deal with code or secret writing, and the censorship yielded very little information of value to the Allies.

Of the enemy postal censorships it will be enough to say that the German organisation, like the British under military control, was efficient, though a good deal escaped the eye of the German—as indeed that of every other—censor.

Cable Censorship.—The position of Great Britain gave her a most valuable control over enemy communications by cable. A cable censorship was established at the beginning of the War, and was placed on the same footing as the postal censorship, being conducted under a military chief responsible to the Army Council. The action taken by the cable censors, however, was based on the International Telegraph Convention of 1875. Scrutiny of private messages was conducted on the same general principles as those adopted in the postal censorship, *i.e.*, to prevent information reaching the enemy and to prevent him from communicating with persons outside his lines. Between 30,000 and 50,000 telegrams passed through the hands of the cable censors in the United Kingdom every 24 hours. British cable stations elsewhere in the Empire were also under central control so far as censorship was concerned.

Great importance was attached to the censorship of commercial cables. All cables were stopped which showed evidence either by the text of the telegram or by the known facts as to the sender or addressee that they related to a transaction whether in contraband or non-contraband to which a resident in an enemy country was one of the parties. The principle adopted was purely to withhold, as far as British cables were concerned, all facilities for carrying on trade with an enemy country. At various times there was much neutral protest against the actions of the cable censors, but the British policy was upheld and shown to be in accordance with the International Convention. Trade cables were often found to contain military, and especially naval, information.

Censorship of Printed Publications.—The censorship of the Press in Great Britain is dealt with at length in the next section of the present article. Here we need only refer to the German censorship of printed publications.

In Germany, as in other European countries, a political censorship of the Press existed in peace time. When war was declared all executive powers, including the control of the censorship, were transferred to the military command under the fundamental law governing the state of siege. The censorship was administered from the headquarters of the army corps districts into which Germany like most continental countries was divided. Every two or three days instructions were issued to the Press in every district as to (1) what they were definitely forbidden to publish, (2) the attitude they were to take up with regard to certain questions, (3) inspired articles—often taken from other newspapers—which they were requested and given permission to reproduce. At the beginning of the War there was much inequality in the working of the censorship in the various districts. Statements, for instance, would appear in the Saxon Press regarding the food supply which would have been forbidden in the Brandenburg command. In Oct. 1915 a war press bureau was established in Berlin, one section of which was devoted to securing uniformity of censorship throughout the Reich. It had, however, only advisory powers. It acted as a liaison between the Press censorship authorities (*i.e.*, the military authorities) and the various Government departments.

In practice the political and economic censorship was exercised by the Ministries of the Interior and of Foreign Affairs through the military. The Government was thus always sheltered in its political censorship by the higher command. There were two methods of exercising the Press censorship: (1) Editors were allowed to produce their papers without preliminary examination of proofs. If they transgressed any regulations they could be prosecuted and their paper suspended or placed under "preventive censorship." Except where purely military subjects were involved, it was impossible for an editor to escape responsibility by submitting his copy to the censor by way of precaution. (2) "Preventive censorship" involved the submission of all proofs before they are passed for press. The censor was thus in a position to strike out all matter to which he objected, whether it was actionable or not.

The German censorship as a whole was undoubtedly severe. It was conducted on the general lines of allowing practically no discussion of doubtful topics, such as war news or the economic situation, no criticism of the Government and above all no criticism of the higher command. All information which might be of military value to the enemy was excluded, though, in spite of the efforts of the censors, much military information was obtained by the British War Office from the German Press. An organisation was created in London to scrutinise all enemy periodicals, and a similar institution existed at Berlin. Both organisations were able to obtain much information from the indiscretions of the enemy Press.

A peculiar feature of the German censorship was the censors' insistence that the published periodical should bear no obvious traces of censorship. This was not so in the Allied countries, where most papers appeared daily either heavily *caviarê*, as it was called in Russia (*i.e.*, with paragraphs blacked out), or with large numbers of blank spaces. In Germany it was considered bad for morale that censorship should be so obvious. (W. E. B.*)

II. THE BRITISH PRESS CENSORSHIP

The following note to newspaper editors, dated July 27 1914, was the first official intimation to the British Press of the approach of war:—

> At a meeting of the Admiralty, War Office and Press Committee, it was resolved that as, in view of the present situation, the authorities may have to take exceptional measures, the Press should be asked to refrain from publishing any information relative to movements of British warships, troops and aircraft, or to war material, fortifications, and naval and military defences, without first communicating with the Admiralty and War Office respectively in accordance with the arrangement which was notified to you by me in January of last year.
>
> Having regard to the nature of the case it is found impossible further to indicate the character of the information the publication of which is undesirable in the national interests. The request does not affect the dissemination of news concerning ordinary routine movements or training on the part of the navy or the army; its object is to prevent the appearance of anything concerning steps of an exceptional kind which may be rendered necessary by the existing state of affairs.
>
> I may add that the authorities from time to time will continue to issue such information as may be made public.

Apart from the Official Secrets Act, no legislation existed which enabled the authorities to suppress naval and military information. Notwithstanding this, the newspapers loyally observed the request, followed by others of a more detailed character. The result was that British preparations were made with such secrecy that the Germans subsequently admitted that on Aug. 20 they knew neither when nor where the British troops were landed, nor their strength.

The Press Bureau.—On Aug. 11 the Press Bureau (the outward and visible sign of the censorship) was established. Its objects were the censoring of (1) incoming and outgoing press cablegrams, (2) certain inland press messages, chiefly those passing through the General Post Office and (3) matter voluntarily submitted by the Press. The Bureau was also intended as the medium for the issue of official information. The censorship was, for the most part, carried out in accordance with the wishes of the government departments concerned. It was an open

secret that in some instances the directors of the bureau disagreed with the policy they were called upon to enforce.

On Aug. 8 1914 the Defence of the Realm Act was passed, followed by a series of censorship regulations.

They were amended from time to time and in their final form stood as follows:—

Reg. 18. No person shall, without lawful authority, collect, record, publish or communicate, or attempt to elicit, any information with respect to the movement, numbers, description, condition or disposition of any of the forces, ships, or aircraft of His Majesty or any of His Majesty's allies, or with respect to the plans or conduct, or supposed plans or conduct, of any operations by any such forces, ships, or aircraft, or with respect to the supply, description, condition, transport or manufacture, or storage, or place or intended place of manufacture or storage of war material, or with respect to any works or measures undertaken for or connected with, or intended for the fortification or defence of any place, or any information of such nature as is calculated to be or might be directly or indirectly useful to the enemy, and if any person contravenes the provisions of this regulation, or without lawful authority or excuse has in his possession any document containing any such information as aforesaid, he shall be guilty of an offence against these regulations. . . .

No person shall, without lawful authority, publish or communicate any information relating to the passage of any ship along any part of the coast of the United Kingdom. . . .

Reg. 27. No person shall by word of mouth or in writing or in any newspaper, periodical, book, circular, or other printed publication—

(*a*) spread false reports or make false statements; or

(*b*) spread reports or make statements intended or likely to cause disaffection to His Majesty, or to interfere with the success of His Majesty's forces or of the forces of any of His Majesty's allies by land or sea, or to prejudice His Majesty's relations with foreign powers; or

(*c*) spread reports or make statements intended or likely to prejudice the recruiting of persons to serve in any of His Majesty's forces, or in any body of persons enrolled for employment under the Army Council or Air Council or entered for service under the direction of the Admiralty, or in any police force or fire brigade, or to prejudice the training, discipline or administration of any such force, body, or brigade; or

(*d*) spread reports or make statements intended or likely to undermine public confidence in any bank or currency notes which are legal tender in the United Kingdom or any part thereof, or to prejudice the success of any financial measures taken or arrangements made by His Majesty's Government with a view to the prosecution of the war; . . .

The maximum penalty was imprisonment with or without hard labour for six months or a fine not exceeding £100, or both.

The regulations gave the Government power in certain cases to seize the plant of a newspaper which had offended, or in others to seize the type on suspicion that an offence was about to be committed. These regulations placed heavy shackles upon the Press, but in the main were accepted with patriotic equanimity. Prosecutions were few.

It will be seen that the bureau had no power to insist upon submission of matter for censorship. Responsibility rested with the editor, who could publish what he thought fit, subject to complying with the regulations. If he erred he was liable to prosecution, and even if the matter were passed by the bureau he would not be relieved, although the fact might be pleaded in mitigation. From time to time secret instructions were issued for the information and guidance of editors. At the end of the War these numbered several hundred.

Regulations at the Front.—Messages from authorised British correspondents on the several fronts were primarily, and compulsorily, censored by military censors on the field, but were transmitted through the bureau, which occasionally exercised a further censorship. The methods adopted caused constant grumbling and discontent. In France almost from the first newspaper correspondents were not allowed to proceed beyond the fringe of the area of operations, and their movements were strictly controlled. In Sept. 1914, owing to demands for more information, an official "Eye-witness" was appointed. He wrote according to order, and no question of censorship arose. The news supplied was meagre and inappropriate, and it did not take long for mischievous results to accrue. On March 12 1915 the following notice was issued by the bureau:—

The magnitude of the British task in this great war runs serious risk of being overlooked by reason of exaggerated accounts of successes printed daily in the Press and especially by exhibiting posters framed to catch the eye and magnify comparatively unimportant actions into great victories. Reported reverses to the enemy are proclaimed as crushing defeats, Germany is represented as within measurable distance of starvation, bankruptcy and revolution, and only yesterday a poster was issued in London, declaring that half the Hungarian Army had been annihilated.

All sense of just proportion is thus lost, and, with these daily, and often hourly, statements of great Allied gains and immense enemy losses, the public can have no true appreciation of the facts or of the gigantic task and heavy sacrifices before them.

The Director appeals to all those who are responsible for the Press to use their influence to bring about a better knowledge of the real situation, and rather to emphasise the efforts that will be necessary before the country can afford to regard the end for which we are striving as anything like assured. The posters, more especially those of the evening papers, are very often preposterous as well as misleading, and, at such a time, those responsible may fairly be asked to exercise a reasonable restraint and help the nation to a just appreciation of the task it has undertaken and the necessity for unremitting effort to secure the only end that can be accepted.

The newspapers did not receive this without protest. On March 26, through Lord Riddell, they sent the following letter to Mr. Asquith, the Prime Minister:—

My Council have had under consideration your Memorandum of 12th March 1915, Serial No. D 183, for which, in their opinion, there is no adequate justification. The Press has dealt faithfully with the news furnished by the naval and military authorities, but it may well be that the public misunderstand the situation and that this misconception is producing serious results. If, however, the people are being unduly soothed and elated the responsibility lies with the Government and not with the Press. In this connection my Council desire to direct your attention to the optimistic statements of the Prime Minister, Sir John French, "Eye-Witness," and other persons possessing official information. The Press acts upon the news supplied. If this is inaccurate or incomplete, the Government cannot blame the newspapers. My Council desire to represent that the methods now being adopted are fraught with grave public danger. Ministers are continually referring to the importance of energy and self-sacrifice on the part of the industrial population, who cannot be expected to display these qualities unless, generally speaking, they are acquainted with the facts. In dealing with the news, the naval and military authorities should consider not only our enemies and the army in the field, but the commercial and industrial classes at home, upon whom so much depends. It is futile to endeavour to disregard the long-established habits and customs of the people.

As you know, I am writing on behalf of the London Press only, but my Council are confident that their views are shared by the provincial newspapers.

The result of this letter was that Mr. Asquith invited the Press to appoint a representative who would interview Lord Kitchener and Mr. Churchill, then First Lord of the Admiralty, each week with the object of receiving private information for circulation to editors. As a result of further urgent representations by the Association, correspondents on the French front were authorised in May 1915. At the beginning, regulations for their guidance were prescribed, but for the most part they were allowed to write as they wished. Before long, however, the regulations were rigidly enforced, and an attempt was subsequently made to strengthen them. The severe restrictions on the liberty of the correspondents led to continual complaints by the Association. Notwithstanding these, no marked improvement took place until July 1917. From that date onwards the stringency of the censorship was gradually relaxed, and the army eventually set up an organisation to supply correspondents with information. By the exercise of tact, discretion and good faith, the correspondents gradually won the confidence of the army, so that towards the end of the War officers of all ranks were keen to have the correspondents with their troops and to give every facility permitted by official regulations. Thus a great victory was achieved and a great service rendered by the correspondents to the country.

Until Nov. 1917 the censorship was controlled by the Intelligence Department at G.H.Q. At that date it was transferred to a department known as "staff duties." The difficulties were accentuated by the lack of association between the correspondents and the real head of the censorship at G.H.Q. The man

who gave the orders did not censor the "copy," and was not in continuous and direct touch with those who did. The censors worked under great pressure, and complaints were due chiefly not to their decisions, but to principles laid down by those in command at G.H.Q. At other military fronts the system adopted was similar.

The navy had its own censorship. Generally the policy was to suppress all information, and in particular to suppress information of unfavourable events. Little was published concerning mercantile tonnage sunk by the enemy. There was, however, much to be said for suppressing these figures, publication of which would have put fresh heart into the enemy and given valuable information as to the submarine campaign. In many instances German submarine crews were unaware of the effect of their operations.

Domestic News.—Within the British Isles a rigid censorship was exercised concerning publication of information as to production of munitions, measures of defence, bombardments, air raids, arrests, trials and executions of spies, etc. Books, magazines, etc., were subject to censorship on the same principles as newspapers. In many cases the authorities refused permission to reproduce matter which had already appeared in American and other publications, the contention being that publication in Great Britain would tend to confirm and increase belief in the statements made.

As a method of suppression the censorship may be regarded as a complete success. The vast task was efficiently done, but the authorities displayed little imagination, and during the first two and a half years failed to realise that the War was a conflict between nations, not armies. They did not appreciate that the united effort of all classes was essential to victory, and that such effort could be secured only by telling the people the facts and letting them know that the War was a matter of life or death to the nation. Experience showed that in dark days the country always rose to the occasion. The authorities also failed to appreciate the necessity for telling other peoples, and in particular the Overseas Dominions and America, what Great Britain was doing. The rule prohibiting correspondents, except in rare cases, from describing the achievements of the different units, who were thus robbed of the glory to which they were entitled, had most unfortunate results. The Australian, Canadian and New Zealand censorships adopted a different system, so that the exploits of these troops were well known throughout the world. This led to the circulation of malicious stories to the effect that Great Britain was not doing her share, and was preserving her soldiers at the expense of those from overseas. Reference to the weekly casualty lists would at once prove the falsity of this statement. The truth is that, so far as the British effort was concerned, the main burden was borne by troops furnished from Great Britain.

The policy of secrecy was not confined to naval and military operations. It was only after continued protests that publicity was given to the achievements of the Ministry of Munitions, and of the manufacturers and millions of workers associated with it. Nothing was published about the working of the railways, one of the most remarkable feats in history. The Admiralty was a great offender. It was stated officially that "the navy did not wish for publicity." The result was that the British seamen, including the mercantile marine, mine-sweepers and fishermen, did not receive adequate recognition of their services. After continued representations by the newspapers, more publicity was given to their doings in the later stages of the War. Censorship bristled with difficulties, therefore the authorities may be excused for their inability in the early days to grasp essential facts, but they laid themselves open to severe criticism for delay in realising the necessity for a change of policy.

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III. CENSORSHIP IN THE UNITED STATES

Censorship.—The theory of censorship implies a stratified society with the right of the uppermost stratum to control those below. The controlling power may be the Church, using it to suppress heresy. It may be the State, using it to check sedition. It may be the representatives of the nation, using it to enforce an artificial patriotism. But whatever the authority putting censorship into effect, there seems substantial agreement that censorship is necessary. The United States, however, prior to 1914, had not accepted this theory, and censorship was considered outworn in practice. Trials for heresy were rare, sedition was unknown, and universal patriotism was assumed.

The War brought a rude awakening. While technical censorship was not instituted, every form of censorship was virtually established, though under different names. Preventive censorship was known as "voluntary censorship." Punitive censorship was enforced against the foreign language Press and against the American Press suspected of radical or even liberal tendencies. Regulation of the Press appeared in the restrictions put on second-class mail matter. Direct control of the Press was established under a committee euphemistically called a "Committee on Public Information." The result was a censorship described as "a web which caught small flies but which big ones broke through." The effect was an excessive irritation on the part of the Press, but it must be said that this opposition did not always extend to protesting against the censorship of the foreign language Press and the radical Press.

Censorship and Patriotism.—The explanation is found in the rapid development during the War and subsequent to it of an intense, fierce and aggressive patriotism. With no clear conception of the meaning of the term, no appreciation of the protean forms it had assumed, and no knowledge of the history of the sentiment, many individuals and self-constituted committees harried the public into hounding weak and defenceless newspapers because they did not conform to the standards arbitrarily and suddenly erected. It seems probable that freedom of thought, speech and Press suffered quite as much from the superpatriots as from recognised legislative authority. Censorship had been begun to maintain the integrity of the Government but the result was a progressive indirect censorship that even since the War has looked askance at freedom of thought. In the state it has passed from a formal official repression to a positive unofficial insistence on a defiant patriotism that seeks to protect the public from the contamination of foreign thought. For this an ignorant public rather than the Government has been responsible.

The habit of censorship once formed, extension to other fields has naturally followed. Literature, the drama and the moving picture have all come under suspicion. But censorship in these fields has had a different basis from that of censorship of the Press. Great diversity in standards of taste and morals has led to efforts to protect the public from crude art, drama and literature. But since criticism of taste is specially offensive to those criticised, the censorship desired has been preferably referred to the effect of low standards on morals. Thus far legislative censorship in these fields seems to have been averted and to have been exercised by special unofficial committees.

Since the War, official censorship of the Press has rapidly declined, and discussion concerning it is now confined to the desirability of the Press itself voluntarily limiting the publication of news of crime and scandal. The occasion has been the crime wave and lowering standards of morality usually regarded as an aftermath of the War. The objection to censorship of the Press has been to the idea of censorship itself: that comparatively few newspapers have suffered from it seems apart from the question.

Censorship of thought is applied by one wing of the Church to insistence on a forced orthodoxy of belief. It is desired by one class in society to protect the weak and the ignorant from low mental and moral standards. These applications of censorship are not universally accepted, but they find a good deal of support in various quarters.

Note.—These necessarily general statements are subject to many exceptions. The conclusions reached are based on about 10,000 clippings collected by the writer during the War with the object of discovering how far it affected the Press and the general subject of censorship. The collection is now in Vassar College Library.

(L. M. S.)

CENSUS OF PRODUCTION: *see* PRODUCTION, CENSUS OF.

CENTRAL AMERICAN UNION.—The idea of a Central American Union dates back to 1821, when the old Spanish viceroyalty of Guatemala proclaimed its independence (*see* CENTRAL AMERICA, 5.676). The year 1840 saw the complete breakdown of the first federal system, and between that date and 1907 five important attempts were made to re-establish the federation:—

1. 1842: Delegates from Salvador, Honduras and Nicaragua made a treaty providing for a confederation.
2. 1849: A treaty was signed by the central republics providing for common action in foreign affairs and a union for defence.
3. 1852: Further efforts were made along the same lines.
4. 1885: Rufino Barrios, President of Guatemala, made a forceful attempt to restore the old federation and failed.
5. 1895: Representatives of the three central republics met at Amapala and drafted a treaty establishing a diet to elaborate a plan for closer permanent union. A weak federation, under the name of the Greater Republic of Central America, was formed, and a constitution drafted, but, owing to faction differences and activities, the whole scheme had to be abandoned.

In 1907 President Zelaya of Nicaragua overthrew the Govt. of Bonilla in Honduras and attacked Salvador. This war was brought to an end by the mediation of President Roosevelt of the United States and Porfirio Diaz of Mexico. A conference of the Central American countries followed at Washington, which resulted in recommendations for a unification of communications, fiscal systems, customs and coasting trade; provision was made for the formation of a court of compulsory arbitration and for the holding of conferences to discuss federation. A treaty embodying these recommendations was signed. The conferences held from time to time after the 1907 treaty came to a head in Dec. 1920, when the five republics made a further attempt at unification. Agreement was reached, Guatemala, Honduras and Salvador signed a Pact, Costa Rica assented and Nicaragua refused; but when President Herrera of Guatemala was overthrown by a *coup d'état* on Dec. 6 1921 the project was again abandoned.

Meeting at Washington.—On Dec. 4 1922 representatives of the five republics met at Washington, D. C. A conference, lasting until Feb. 7 1923 was held under the chairmanship of Mr. Charles E. Hughes, the United States Secretary of State, with the object of negotiating a treaty to make effective the provisions of the treaty of 1907. As a result of this conference a general treaty of peace and friendship, 11 conventions and three protocols were approved for signature. Of these the treaty was the most important: it contained those parts of the 1907 treaty which it was considered would be practicable in maintaining peace among the five nations. Provision was made for measures to help in checking revolutionary movements, civil war and violent alterations of constitutions; on each Government was imposed an obligation not to intervene in the internal political affairs of the other four countries, and no secret treaties were to be entered into by any of the five republics. The other documents signed provided for the diplomatic settlement of controversies, arbitration, limitation of armies and control of arms, commissions to simplify and unify financial systems of the five parties and the establishment of an international Central American tribunal, to which 15 United States citizens may be appointed if necessary.

The 1923 agreements are by far the most important step towards Central American union that has been taken since 1840. The republics themselves thoroughly recognise the necessity for a unified system, and the 1923 general treaty of peace and friendship should go a long way towards removing the faction differences that have always been the chief obstacle to union.

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(C. Du.)

CERAMICS (*see* 5.703).—The progress made in the study of Chinese ceramics since 1910 almost amounts to a revolution. It is revealed in a mass of fresh ceramic literature of which quite a large proportion is of serious interest, the outcome of scientific methods and industrious research; and it has resulted in a much more accurate classification of the known wares and in the identification of many new types, as well as in the correction of innumerable minor inaccuracies. In fact at least 30% of the labels in every ceramic collection must have needed revision. Fruitful excavations have been made on many ancient sites in Asia and the countries bordering on the Mediterranean; and much interesting, if fragmentary, pottery has been found; but this belongs rather to the domain of archaeology and can hardly be included in the present brief survey.

We may, however, allow ourselves reference to one type of primitive pottery which seems to have been common to the whole of western Asia and parts of eastern Europe in the late neolithic and bronze ages. It is a comparatively fine pottery of buff, red or grey colour with painted decoration, mostly geometrical designs, in black or red slips. The latest finds in northern China have included a ware of very similar appearance, though rather more advanced in technique and more elaborate in decoration, which belongs to the third, perhaps the fourth millennium B.C. These finds not only open up a new vista in Chinese ceramics, but also raise important questions as to the origin of Chinese civilisation.

Chinese Ceramics.—Passing from the primitive periods, it is in Chinese ceramic history again that the most remarkable developments have taken place in the last decade and a half. Not merely a few pages, but whole new chapters have been written, and a quantity of entirely fresh material has been found to illustrate them. Thus, much has been learnt about the glazed and unglazed tomb wares of the Han dynasty (206 B.C. to 220 A.D.) which were first studied by Dr. Laufer in 1909. The period of the Six Dynasties (220–589 A.D.), so long regarded as a no-man's land, has been peopled with the charming Wei figures, with artistically pigmented vases and with the so-called proto-porcelain. The T'ang dynasty (618–906 A.D.), barely mentioned by the older writers, has been proved as great in its pottery as in the other arts; and even the tomb wares show that the T'ang potter was little behind the mature craftsman of the 18th century in technical knowledge, and not a whit behind him in artistic perception.

A fresh study of the Chinese texts in the light of the new material which has reached us, has made it possible seriously to attempt the classification of the beautiful Sung wares (960–1279 A.D.). Before 1910 we had barely learnt to distinguish the sea-green celadon of Lung-ch'üan, the cream-white Ting Chou porcelain, the mottled black tea-bowls of Chien-an and the brilliant Chün Chou flower bowls. These are now quite familiar; and we have gone on to identify the rare Ju type in the *ying ch'ing* (misty blue) porcelain, a translucent white ware with thick soft-looking glaze of pale duck-green or blue, of which many beautiful specimens have recently arrived in Europe. The Chien-an tea-bowls have expanded into a large group of stoneware and semi-porcelain with "temmoku" glazes, black and brown, including the Kiangsi temmoku and the multifarious Honan temmoku which doubtless include the wares of other northern provinces besides Honan. Another and even larger group of stoneware, with black and brown painted designs on a cream glaze or with bold *graffiato* decoration (both capable of many variations in colour and technique), is almost entirely new to us. These wares are generally labelled Tz'ŭ Chou, though Tz'ŭ Chou was doubtless only one of many centres which produced them in northern China. Cream-glazed stoneware painted in enamels of the muffle-kiln—green, yellow and iron-red—has now been traced back to the Sung dynasty; and there is little doubt, though circumstantial proofs are still wanting, that

some blue and white porcelain should be assigned a similar date. As to the actual origin of porcelain, conjecture now dates it somewhere in the period of the Six Dynasties, and we have concrete proof in the excavations at Samarra on the Tigris that it was not only made in China in the 9th century but that it was already an article of export. The fragments found at Samarra include white and cream-white porcelain and two kinds of green celadon. Meanwhile the later Chinese porcelains have not been neglected, and some new light has been thrown on Korean ceramics.

Excavations to Near East.—After China the Near East has produced the most important additions to ceramic knowledge. Excavation has brought to light the earlier types of Persian pottery, the so-called Gabri ware with its bold *graffiato* designs covered with green and yellow glazes, the lead-glazed and tin-glazed pottery with lustre decoration or painting in blue, and the splashed and mottled wares which were obviously made in imitation of the T'ang pottery of the Chinese. Very early dates have been claimed for all these types, especially the *graffiato*, but without much justification. The excavations at Samarra are our only sure guide and from them we learn definitely that the splashed and mottled, the blue and white and the various kinds of lustred wares were made in the 9th century, as also a ware with incised designs under splashed glaze but differing widely from the bold *graffiato* of the Northern Gabri. The Mesopotamian ware is distinguished by a soft, close-grained body, usually pale buff, sometimes buff red and not unlike that of our European faience. Lustred ware resembling the Mesopotamian has been found at Fostat in Egypt and in the ruins of Medina Azzahra in Spain, linking up the lustre of the Near East with the Hispano-Moresque.

No major work has appeared on Italian majolica, though it and European faience as a whole have been skilfully treated in at least one large general work (Hannover). A detailed study has been made of the numerous German faience factories; and much has been learnt of the early history of Dutch faience and of the Antwerp ware, which preceded the celebrated Delft, and of its connections with Italy. In continental porcelains, some excellent studies have been made of the German figures; and the work of several individual modellers has been identified, notably that of Bustelli of Nymphenburg who was perhaps the most accomplished of the German porcelain sculptors.

English Ceramics.—The knowledge of English ceramics has been sensibly increased by research and excavation. The site of a pot works in Lord Street, Liverpool, yielded fragments of delft and saltglazé, besides an artificial porcelain decorated in blue in the Lowestoft style. The site of Whieldon's pottery at Little Fenton, Staffordshire, yielded a great variety of wares, including saltglaze and the Astbury types as well as the typical clouded Whieldon glazes. Excavations at Brislington, Bristol and Wincanton have shown that large quantities of Delft were made in the western counties from the middle of the 17th century and that Bristol produced the well-known " blue-dash " dishes among numerous other types. A large number of the moulds used at the Chelsea factory have been found, and identification of Chelsea figures has been made from them. A serious attempt has been made, with no little success, to segregate the early Derby figures, and analysis of the paste has led to the recognition of a few rare Worcester figures.

Similarly the porcelain made at Loudin's short-lived Bristol factory has been separated from the mass of early English blue and white and enamelled wares; and it has been clearly established that Loudin's plant was taken over by the men who founded the Worcester factory in 1751. Minor discoveries of this kind going on all over Europe, have helped to swell the volume of ceramic knowledge and, though there is no space to discuss them here, the attached bibliography will show where records of them are to be found.

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CEREALS: *see* FOOD SUPPLY; GRAIN.

CEYLON (*see* 5.778), a British crown colony in the Indian Ocean. Its area is 25,332 sq. m. and its population, according to the census of 1921, 4,504,549.

Constitution.—The elective principle of representation was first introduced in 1910 in the Legislative Council which was formerly on a nominated basis. In 1912 Sinhalese and Tamil representation was increased and the legislative council was composed of 11 official and 10 unofficial members, of whom four were elected. In 1920 the constitution was again altered, and for the first time provided for an unofficial majority, the council being composed of 14 official and 23 unofficial members, 16 of whom were elected; 11 of the elected members were for territorial constituencies.

In 1923 another change was made; the unofficial majority was further increased, while for the first time provision was made for an elected majority under the order in council of Dec. 19 1923. The legislative council was to consist of 12 official and 37 unofficial members, of whom 34 were to be elected; 23 of the elected members were to represent territorial divisions. The executive council is purely advisory to the governor, who may accept or reject its opinions. Until 1921 it consisted of a few of the highest officials only, but in that year its composition was changed so as to include four official and three unofficial nominated members —a European, a Sinhalese and a Tamil being appointed. The letters patent constituting the executive council do not limit its membership, and beyond three ex-officio members the governor may appoint as many persons as he likes, either official or unofficial.

Local Government.—The big towns—Colombo, Kandy, Galle—are administered by municipal councils, half the councillors being elected, and half nominated by the governor. Of lesser importance are local boards and boards of health, supplemented by provincial and district road committees and village tribunals and committees. The Local Government Ordinance, 1920, was intended to develop self-governing institutions which would be guided, assisted and controlled by a central local government board composed of official and unofficial members in equal numbers. Wherever there is a clear demand by the people of a district, the governor may order a district council to be constituted

ILLUSTRATIONS

PLATE I.

Lung-Ch'üan yao, or "Celadon," vase, probably made by the younger Chang, who lived during the Southern Sung dynasty (1127–1279), of white porcelain biscuit covered on exterior, interior and under foot with brilliant, unctuous green glaze, clouded slightly with olive green on two sides, running unevenly over surface, in places so thinly as to allow the biscuit to show through, and again inside of mouth forming thick blobs. The shape is that of the jade tubes, huang ts'ung, or symbols of earth, with the typical tsu or tooth decoration, set off in eight rectangles on the corners. Southern Sung dynasty (1127–1279). Height, 16½ inches. Warren E. Cox Collection.

PLATE II.

Pair of beaker-shaped Chün yao flower pots, marked with the Chinese numeral "1," probably indicating that they are of the largest size, from the Imperial Palace in Mukden. Of a greyish white porcelainous stoneware, covered with a thick plum-coloured and pale-blue glaze, in the depths of which are bubbles, streaks and mottlings, including the small "ch'un ying wen," or earthworm marks, which rarely appear except on the finer types. Sung dynasty (960–1279). Height, 10⅛ inches. Parish-Watson Collection.

PLATE III.

Figure of Bactrian horse, excavated at Kai Feng Fu, in Honan province, modelled in buff-coloured biscuit, the body of which is covered with a warm aubergine or brown-black lead glaze very rarely used for this purpose. This type of large horse was unknown in China until the Han dynasty (206 B.C.–220 A.D.), when it was introduced from the west and interested the artists of the country because of its size and noble proportions. T'ang dynasty (618–906). Height, 33½ inches. Yamanaka Collection.

PLATE III.

Incense burner of buff grey biscuit with wash of white slip and transparent cream white glaze with stops inside of mouth, decorated on each side, when originally made, with a free and beautiful painting, in the typical Sung feeling, of a lotus, in red (of copper, reduced with iron oxide), and outlined in the same colour, surrounded with foliage, in yellow and green enamels, outlined with black. It is impossible that these enamels could have been applied later, as undoubtedly was the case with most of the specimens of this character, as the crazing in several places extends clearly up through them and shows no trace under the glass of their having sunk into it. Tz'ŭ Chou (?) Sung dynasty (960–1279). Height, 7 inches. Warren E. Cox Collection.

PLATE III.

Figure of pony, of buff biscuit with wash of white slip and transparent cream white glaze, finely crackled, extending down to just below body, leaving base and part of the legs exposed in the biscuit. Decorated with green and muddy yellow enamel, dulled and frosted over by burial, on crudely drawn saddle, top of mane and two harness ornaments at head. Faint pinkish traces outlining the harness and decorating the mane would seem to indicate that a red, similar to that used on the incense burner, had been applied and had almost entirely worn off. A comparison of this modelling with that of the noble T'ang dynasty specimen on the same page shows the typical gentle humour of the artist of China. Tz'ŭ Chou (?) Sung dynasty (960–1279). Height, 5½ inches. Warren E. Cox Collection.

PLATE III.

Tz'ŭ Chou vase, excavated at Lo Yang, Honan province, of dark buff grey stoneware, covered with white slip and transparent, clouded brown glaze. On the body of the vase are the four characters: Hsueh (snow), Yueh (Moon), Feng (wind), and Hua (flower), incised in the slip, allowing the biscuit to show through the glaze. Around the shoulder is a superbly direct and vigorous painting, in thick, dark olive glaze, of lotus blossoms, each petal of which is executed with a single brush stroke. Sung dynasty (960–1279). Height, 15 inches. Yamanaka Collection.

made by the younger Chang, who lived

green glaze, clouded slightly with olive green
places so thinly as to allow the biscuit to show
s. The shape is that of the jade tubes,
tooth decoration, set off in eight rec-
79). Height, 16¼ inches. Warren E.

Pair of beaker-shaped C[illegible] flower pots, marked with the Chinese numeral "1," probably indicating that they are of the largest size, from the Imperial Palace in Mukden. Of a greyish white porcelainous stoneware, covered with a thick plum-coloured and pale-blue glaze, [illegible] or earthworm marks, which rarely appear except on the finer types. Sung dynasty (960–1279). Height, 10¾ inches. Parish-Watson Collection.

cavated at Kai Feng Fu, in Honan province, modelled in buff-

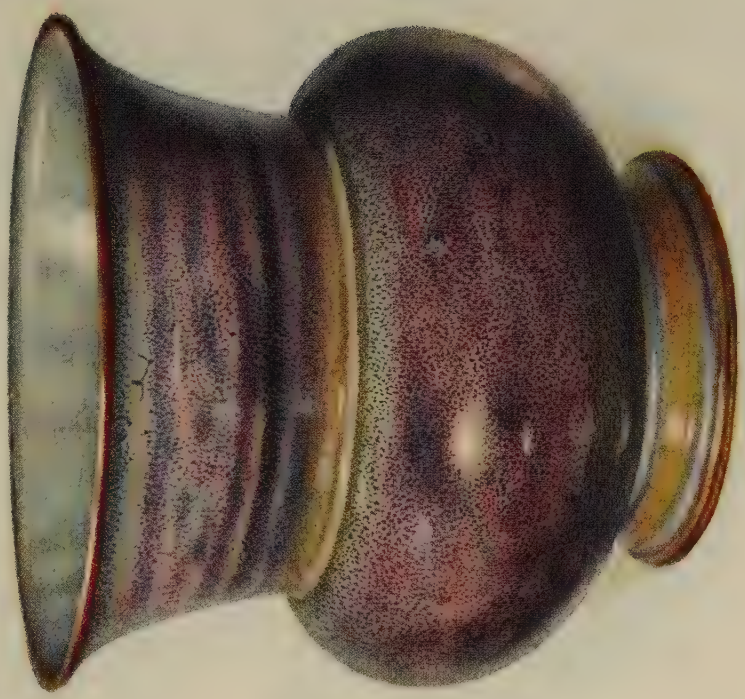
glaze with stops inside of mouth, decorated on each side, when originally made, with a free and beautiful painting, in the typical Sung feeling, of a lotus, in red (of copper, reduced with iron oxide), and outlined in the same colour, surrounded with foliage, in yellow and green enamels, outlined with black. It is impossible that these enamels could have been applied later, as undoubtedly was the case with most of the specimens of this character, as the crazing in several places extends clearly up through them and shows no trace under the glass of their having sunk into it. Tz'ŭ Chou (?) Sung dynasty (960–1279). Height, 7 inches. Warren E. Cox Collection.

PLATE III.

Figure of pony, of buff biscuit with wash of white slip and transparent cream white glaze, finely crackled, extending down to just below body, leaving base and part of the legs exposed in the biscuit. Decorated with green and muddy yellow enamel, dulled and frosted over by burial, on crudely drawn saddle, top of mane and two barness ornaments at head. Faint pinkish traces outlining the harness and decorating the mane would seem to indicate that a red, similar to that used on the incense burner, had been applied and had almost entirely worn off. A comparison of this modelling with that of the noble T'ang dynasty specimen on the same page shows the typical gentle humour of the artist of China. Tz'ŭ Chou (?) Sung dynasty (960–1279). Height, 5¾ inches. Warren E. Cox Collection.

PLATE III.

Tz'ŭ Chou vase, excavated at Lo Yang, Honan province, of dark buff grey stoneware, covered with white slip and transparent, clouded brown glaze. On the body of the vase are the four characters: Hsueh (snow), Yueh (Moon), Feng (wind), and Hua (flower), incised in the slip, allowing the biscuit to show through the glaze. Around the shoulder is a superbly direct and vigorous painting, in thick, dark olive glaze, of lotus blossoms, each petal of which is executed with a single brush stroke. Sung dynasty (960–1279). Height, 15 inches. Yamanaka Collection.



Under the Village Communities Ordinance the inhabitants of a village may hold a meeting, presided over by an official, and elect a committee to manage village affairs. This committee is a minor court of law, free from all formalities and where no lawyer may plead, deciding petty, civil and criminal cases, subject to appeal to the government agent. Guiding and assisting all these urban, rural and general district councils, village committees and tribunals, is the government officer, sometimes himself presiding, but often unseen, training and helping the people to be self reliant and self governing.

Justice.—The judicial system was established in 1833. Roman-Dutch law—a relic of the Dutch occupation—is the common law of the Maritime provinces, whilst in the Kandyan provinces the old Kandyan or Sinhalese laws prevail; but wherever possible the tendency is to apply the Roman-Dutch law. The administration of justice is complicated by the influence of Tesawalamai or Tamil custom in the north and the Mukkuvar law in the east, of Mohammedan or Buddhist (religious) laws, and of English commercial law. The Supreme Court has a full bench of five—a chief justice and four Puisne judges—and is the final criminal court of appeal, while appeal to the Privy Council is permitted in civil cases involving over Rs. 5,000. The island is divided into four circuits for holding assizes, and each circuit into several judicial districts where district courts have a limited criminal jurisdiction. Below the district courts are courts of requests and police courts, and below these are the village tribunals already referred to.

Population.—The census of 1921 showed the population as 4,504,549 composed of low country Sinhalese 43%, Kandyan Sinhalese 24%, Tamils 25%, Mohammedans 6%, Europeans 2%. The birth rate for all races is 38·9 per thousand (varying from 22 for Europeans to 40 for Sinhalese), while the death rate is 30 per thousand (varying from 10·9 for Europeans to 34·9 for Malays). Of the whole population 61·6% are Buddhists, including some 91% of the Low Country Sinhalese and Kandyans. Christianity was introduced by the Portuguese, and in consequence 368,499 out of the 443,000 Christians of all races in the island are Roman Catholics, only 44,730 belonging to the Church of England, while 31,000 are Christians of other denominations. Followers of the Hindu faith form 21·8% of the population, the bulk being Tamils. The country is divided into nine provinces. The largest of these is the North Central with an area of 4,008 sq. m., but the most populous is the western with a population of 1,246,847.

Apart from the university, medical and law colleges, education is controlled by the government director of education. In addition to over 1,000 government schools there were, in 1925, some 2,000 missionary and private schools receiving a government grant-in-aid. Pupils in attendance numbered nearly 10% of the entire population, and government expenditure on education equalled 7% of the entire revenue.

Finances.—Government revenue in 1910–1 was Rs. 4,70,00,000; by 1924–5 it had risen to Rs. 10,20,00,000 of which 40% was from import and export duties and port dues. Only 2% of revenue is expended on military forces. The financial position is very sound, for while the public debt is only about Rs. 16,00,00,000, less than two years' revenue, assets show an excess over liabilities of over Rs. 2,00,00,000 in cash, gilt edged securities and stores. In addition the government owns the railways, posts, telegraphs, telephones and many public works and buildings. A railway extension to Trincomalee was completed in 1925 and extensions to Batticaloa and Puttalam were under construction. There are over 4,000 m. of excellent metalled roads in the island. Government ownership of the port of Colombo brings in a revenue of about Rs. 50,00,000 annually, while railway gross revenue amounts to some Rs. 2,45,00,000.

Production.—Situated near the equator, with cultivation from sea level to 7,000 ft. (the highest peak in Ceylon is 8,200 ft. elevation), annual rainfall from 34 in. (in the north) to 319 in. (in the southwest centre), and shade temperatures varying from 27° F. (Nuwara Eliya) to 103° F. (Trincomalee), Ceylon offers scope for the production of a variety of products. Its prosperity rests upon agriculture, and the development of the plantation industry in the island makes a romantic story. The coffee crop, formerly the staple crop of the island, was destroyed by disease, and by 1924 exports had fallen to only 15 hundredweight. Faced with disaster the planter had sought to make good his losses by planting cinchona and tea, but the consequent falls in price, owing to the supply exceeding the demand, made cinchona production hardly a profitable business and restricted the extension of tea cultivation. Tea, however, was definitely established as the principal planting product of the island by 1900.

Yet again the planter sought for some other product for profitable enterprise, and the planting of rubber on a large scale was begun. In 1901 there were only 2,500 acres under rubber: by 1906 the area had grown to 100,000 acres, by 1912 to 217,000 acres, by 1919 to 385,000 acres and in 1925 it was roughly 435,000 acres. From 41,798 lb. in 1903, rubber exports rose to 45,000 tons in 1919. But yet again production outstripped consumption, and the industry in Ceylon and Malaya was therefore assisted by a temporary restriction scheme which, after two years operation, enabled the industry to rest again on a profitable basis (*see* RUBBER). Exports in 1924 were 37,351 tons.

Tea was still the principal product in 1925; its production employed more labour than any other industry, and the value of its exports exceeded that of any other product. The area under coconuts in 1925 was about 800,000 acres; the nut is used very extensively in the island as a necessary article of food, yet the exports of the fresh and desiccated nut, copra oil and fibre amounted to over Rs. 7,00,00,000 in value in 1924. In the same year the value of tea exported was Rs. 21,50,00,000, and of rubber Rs. 6,30,00,000. The production of cocoa, cinnamon, pepper, vanilla and cardamoms leaves a surplus for export, but, unfortunately, though there are 850,000 acres under paddy, the island is not self supporting in rice and annually imports 13,000,000 bu. worth £6,000,000. Plumbago is the chief mineral product; the export reached 703,666 cwt. in 1906, but in 1924 it was only 193,017 hundredweight. Rubies, sapphires and other precious stones are found.

Trade.—The development and prosperity of the island can be judged from the trade returns. Between 1910 and 1924 trade more than doubled in value. In the latter year the total value of imports (exclusive of bullion and specie) was Rs. 30,23,72,926 while domestic exports (exclusive of bullion and specie but including the value of stores supplied to vessels) were valued at Rs. 37,66,70,299. The principal imports are cotton, linen and silk piece goods, grain, coal, tobacco, hardware, sugar, tea and rubber chests, motor cars, manure, oil fuel, kerosene oil, cement and spirits. The chief exports are tea, rubber, coconut products, plumbago, cocoa, cardamom, cinnamon and citronella oil. Some 70% of the total trade is with the British Empire. In 1924 23·06% of imports came from the United Kingdom and 53·76% from other parts of the British Empire. Of exports 44·72% went to the United Kingdom and 18·20% to other parts of the British Empire. The number of vessels entering Ceylon ports in 1924 was 3,858 and their tonnage 10,649,557 tons: over 60% was British.

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CHAFFEE, ADNA ROMANZA (1842–1914), American soldier (*see* 5.800), died in Los Angeles, Cal., Nov. 1 1914.

CHALIAPIN, FEODOR IVANOVICH (1873–), also spelt Shalyapin, Russian singer, was born at Kazan on the Volga, Feb. 15 1873. His early career was a varied and adventurous one, and after being by turns porter, shoemaker, hunter and street sweeper, he became a singer and dancer and obtained engagements at the Tiflis Opera House in 1892 and in 1894 at the Summer Theatre, Leningrad (St. Petersburg), and later at the Imperial Opera House. After visiting Milan he took important

parts in the Mamantof opera company, and at a private opera house in Moscow in 1896. In 1913, during the brilliant Russian opera season organised by Sir Thomas Beecham at the Drury Lane Theatre, London, he appeared in *Boris*, *Ivan the Terrible* and *La Khovantchina*. His superb bass voice and remarkable dramatic powers took his audience by storm and he had a similar success in *Prince Igor*. His seasons in New York were brilliant and among his rôles were Ivan the Terrible in Rimsky-Korsakov's *Maid of Pskof;* Salieri in the same composer's *Mozart and Salieri;* Leporello in Mozart's *Don Giovanni* and Don Basilio in Rossini's *Barber of Seville*.

CHAMBERLAIN, ARTHUR NEVILLE (1869–), British politician, was born March 18 1869, the son of Joseph Chamberlain by his second wife. Educated at Rugby and Mason College, Birmingham, in 1911 he entered the Birmingham city council, became chairman of its town planning committee and was lord mayor in 1915–6. During the early part of the World War he was an active member of the Central Board of Control of the Liquor Traffic under the Munitions Act, and in Dec. 1916 was appointed by Mr. Lloyd George Director of National Service. His schemes for co-ordinating military and civil employment met with much opposition, and in 1917 he resigned. At the general election of the following year he entered Parliament as member for the Ladywood Division of Birmingham, and was Postmaster-General from Oct. 1922 to March 1923, and Minister of Health in 1923. In the latter capacity he was responsible for the Housing and Rent Restriction Acts of 1923. He was appointed Chancellor of the Exchequer by Mr. Baldwin in Aug. 1923, but the Government fell before he could present a Budget. Again he became Health Minister in Nov. 1924, when the Conservative Government returned to power.

CHAMBERLAIN, JOSEPH (1836–1914), British statesman (*see* 5.813), died at Highbury, Birmingham, July 2 1914, having taken little part in public life for some years. In 1916 Mr. Chamberlain's widow married Canon W. H. Carnegie, rector of St. Margaret's, Westminster, and chaplain to the House of Commons.

CHAMBERLAIN, SIR JOSEPH AUSTEN (1863–), the eldest son of Joseph Chamberlain (*see* 5.813) and of his first wife, Harriet Kenrick, was born at Birmingham Oct. 16 1863. He was educated at Rugby and Trinity College, Cambridge, and afterwards studied in Paris and Berlin. During the early stages of the Home Rule controversy he acted as his father's private secretary, and in 1892 entered the House of Commons unopposed as M.P. for East Worcestershire. This seat he retained until 1914 when, on his father's death he succeeded him as member for West Birmingham. "I was born in Birmingham," he said when he was given the freedom of that city in 1926. "I was bred in Birmingham; Birmingham is in my blood and in my bones, and wherever I go and whatever I am, I shall remain a Birmingham man."

His maiden speech drew from Mr. Gladstone the famous compliment, uttered in his father's presence, that it was one which must have been "dear and refreshing to a father's heart." After a short apprenticeship as a private member, he was a Civil Lord of the Admiralty (1895–1900), Financial Secretary to the Treasury (1900–2) and Postmaster-General (1902). This rapid promotion was due rather to the towering influence of his father, during the days of his great Colonial Secretaryship, than to his own abilities, which were of a solid rather than of a showy order, while as a speaker he lacked the paternal dash and fire. In 1903 he was promoted to the Chancellorship of the Exchequer. He ardently espoused his father's fiscal policy of Tariff Reform, nor did he slacken in its advocacy when Joseph Chamberlain left the Balfour Administration in order to prosecute, with less embarrassment to the Prime Minister, his unofficial campaign. Unfriendly critics suggested at the time that the son's promotion to the second post in the Government was made in the hope of continuing his father's activities within reasonable bounds and preventing the threatened rupture in the party. Austen Chamberlain remained at the Exchequer till the Conservative débâcle at the polls in 1906 and there acquired the reputation of being a departmentalist of the best Victorian type—safe, cautious, hard-working and loyal to his official advisers and subordinates.

During the long Liberal domination from 1906 to the World War Austen Chamberlain consolidated his position as a Conservative leader and gained the high esteem of all parties. He suffered, however, a great disappointment when Mr. Balfour, dispirited by failure in the two General Elections of 1910, and weary of the intrigues against his authority, resigned his leadership of the Conservative party in 1911. Austen Chamberlain aspired to the succession and had the support of a considerable section of the party. But a slightly stronger section favoured the claims of Walter Long, and as neither would yield to the other, both honourably agreed to the election of Mr. Bonar Law, who became joint leader with the Marquis of Lansdowne. Austen Chamberlain did not allow his natural disappointment to affect his relations either to the party or to its new leader, and steered a straight course as a resolute anti-Home-Ruler and a convinced Tariff-Reformer.

When the first Coalition Govt. was formed in 1915, Austen Chamberlain entered Mr. Asquith's Cabinet as Secretary of State for India, and held this post until 1917, when he resigned in consequence of the Government's decision to submit to a judicial investigation the charges and criticisms embodied in the report of the Mesopotamia commission. In his view the public interest and his personal honour alike required his resignation, though not one of the charges referred to him. The official responsibilities for the "horrible break-down" of the hospital arrangements during the first advance on Baghdad were incurred without his personal knowledge. But he did not long remain out of office. In April 1918 he became a member of the War Cabinet and after the Armistice returned to the Chancellorship of the Exchequer in succession to Mr. Bonar Law. His guiding principle during the next two years was to strengthen British credit and pay off debt, and to that end he called upon the taxpayer to make unprecedentedly heavy sacrifices, especially in respect of income tax, super-tax and Excess Profits Duty.

In 1921 Mr. Bonar Law's failing health caused his withdrawal from active politics. Austen Chamberlain stepped into the vacant leadership of the House of Commons amid general acclamation. The post carried with it the virtual promise of the leadership of the Conservative party and thus a laudable ambition, frustrated in 1911, seemed certain of fulfilment ten years later. But the restraints and compromises of coalition had already begun to be irksome to many Conservatives, who distrusted the direction in which the Liberal Prime Minister of the Coalition was leading them. Austen Chamberlain, as Lord Privy Seal and Leader of the House, soon found that his staunch loyalty to his chief was bringing him into disfavour with many of the Conservative rank and file. The complaint was that he did not stand up to Mr. Lloyd George with sufficient firmness and that he sacrificed too many Conservative principles to the expediency of keeping the Coalition together. This feeling was sharply intensified when it was found that Austen Chamberlain had taken a leading part in the "surrender to murder"—as the Die-Hards described it—in connection with the signing of the Irish Treaty Dec. 6 1921. He had been, indeed, the first to suggest to the Prime Minister that a choice had to be made between negotiations with the rebels and a thorough reconquest of Ireland.

The Conservative party accepted the treaty with reluctance and with forebodings, and party confidence in Austen Chamberlain was weakened still more by his steady refusal to listen to those who suggested that fidelity to Conservative principles required him to lead his party out of Coalition bondage into party independence and freedom. His view, and it was shared by his principal Conservative colleagues in the Lloyd George Administration, was that Coalition was still necessary to deal with the difficult problems of the post-War period and not less to obviate the dangers of a Socialist Govt., which, without co-operation between the two older parties, could not in their view long be averted. When, therefore, the discontented Conservatives carried their revolt to a successful issue and at the Carlton

Club meeting on Oct. 19 1922 offered the leadership to Mr. Bonar Law—who accepted it—Austen Chamberlain once more saw the ruin of his legitimate hopes. He and those of his colleagues who shared his views and quitted office with Mr. Lloyd George, naturally had no place in Mr. Bonar Law's Cabinet, though Austen Chamberlain gave the new Government loyal support and uttered no word of recrimination. He remained a private member during Mr. Baldwin's first Administration and during the short period of the succeeding Labour Government. The dissensions in the Conservative party were gradually healed and when Mr. Baldwin formed his second Administration, at the end of 1924, the post of Foreign Secretary was offered to and accepted by Austen Chamberlain.

He entered on his duties at a singularly favourable moment. The settlement of the intricate problem of Reparations by the acceptance of the Dawes Plan had prepared the way for the settlement of the other great European problem of security. The plan of the Geneva Protocol being unacceptable to the British and Dominion Govts., Austen Chamberlain revived the plan of a Guarantee Pact between certain Western Powers, which by dint of his skill in conciliation he succeeded in getting adopted by Germany, Belgium, France, Great Britain and Italy.

The conclusion of the Pact of Locarno and the spirit of general good-will in which the Conference had been conducted created great hopes that at last the post-War era had closed and the nations of Europe no longer regarded one another exclusively as Allied or ex-Enemy Powers. Austen Chamberlain's work was highly eulogised at home and abroad, and the Order of the Garter was bestowed upon him by the King. The sequel to the Locarno Pact, together with a detailed examination of the Pact itself, is dealt with under the article SECURITY. (J. B. F.)

CHAMBERLAIN, JOSHUA LAWRENCE (1828–1914), American soldier (*see* 5.819), died at Brunswick, Me., Feb. 24 1914.

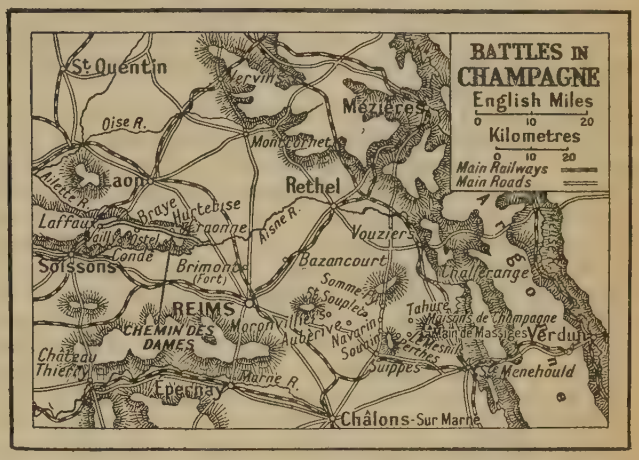
CHAMPAGNE, BATTLES IN.—Under this title appear critical accounts of the offensive that was launched by the French on the Champagne front in Sept. 1915, and of the one undertaken early in 1917. British forces co-operated in the latter; but although important results were obtained in 1917, neither operation can fairly be said to have fulfilled the hopes of the Allied commanders.

I. THE SEPTEMBER OFFENSIVE

All through the summer of 1915 local attacks had been proceeded with in the Vosges and Argonne area, while at the same time preparations were being made for operations in Champagne on a larger scale than the preceding ones and for a powerful diversion in Artois. The objective in Champagne was the rupture of the German front from Bazancourt to Challerange, so as to outflank their positions to the north of Rheims and in the Argonne. It was hoped thus to sweep up the Eastern Front. Attacks were to be made between the heights of Moronvilliers and the Aisne. At the beginning of Sept. the Germans had 70 battalions of the III. Army (Von Einem) in Champagne. During the artillery preparations which preceded the French attacks they reinforced these by 29 battalions and later by 93 others. Their strength in Champagne was thus raised to 192 battalions, but the mix-up of units was calculated to make their command difficult.

On the side of the Allies, the arrival in the Albert region of the British III. Army, and the extension northwards of the French VI. Army, had permitted the transfer of the II. Army (Pétain) from Artois to Champagne. Under the direction of Gen. de Castelnau, this II. Army with the right of the IV. (de Langle de Cary) and the left of the III. (Humbert) represented a total of 35 divisions or at least 420 battalions, more than double the enemy forces engaged. However, the secret of the future offensive was so badly kept that as early as Aug. 15 a German order had foreseen it. The artillery preparation commenced on the morning of Sept. 22 and continued with great effect for three days and nights. On Sept. 22 and 23 the weather was favourable, but the 24th was cloudy. Rain fell from 9 A.M. on the 25th and continued for several days—an important factor.

At 9:15 A.M. on Sept. 25 the assault took place along the whole front and generally speaking succeeded brilliantly. Nearly everywhere there was a gain of from 2,000 to 4,000 yd. in depth, reaching even the second position in one sector. A break through seemed certain, but the French front was very irregular, some parts were facing east, some west and the rest north. In the region of Perthes-Souain, Sept. 26 and 27 were devoted to reinforcing the line and pushing it as far as the second position. On



the 28th the reconquered territory between Aubérive and the western part of the Valley of Souain measured about 20,000 sq. yd. and 3,000 prisoners and 44 guns had been captured. Progress in the east had also been made on the 27th in the neighbourhood of Tahure; a counter-attack retook Maisons de Champagne on the 26th and the attack on La Main de Massiges only progressed with difficulty. On the 28th, contact had been made with the second position on a front of about 9 m. to the south of St. Souplet and of Somme-Py, but Aubérive remained in the hands of the Germans as well as the hill of Le Mesnil and the woods to the east. These positions, however, were menaced on their flanks.

On Sept. 28 and 29 a part of the second position was carried to the west of Le Mesnil and Navarin farm and a break through was made in a narrow section, but the enemy was able to re-establish his front. The French Cavalry Corps had to retire on the 28th to the rear lines without having been engaged. On the 30th a general order announced the end of the operations with the capture of 25,000 prisoners and 150 guns. Nevertheless, abortive attacks continued until Oct. 8. The Champagne offensive cost the French 80,000 killed and missing and 100,000 sick and wounded. The results were not in due proportion to this sacrifice, mainly because the attacks had lacked the characteristics of surprise, rapidity and continuity, and had been continued over a longer period than was necessary. (B. E. P.)

II. FRENCH OFFENSIVE ON THE AISNE

The plan of campaign of the Allies for 1917 was made out in a conference at Chantilly, Nov. 18 1916, between the commander-in-chief, Joffre, and Haig, together with the British, Italian, Russian, Belgian, Serbian and Rumanian military representatives. The formation of new German divisions argued a second offensive in the spring, probably on the Western Front. It was decided to forestall this. The Allies held themselves ready to make a general offensive move with all their available strength about the first fortnight in Feb. 1917. On the Aisne, the French offensive was to extend from Vailly to Rheims. Gen. Pétain, consulted by Nivelle on the proposed action, criticised it freely and refused the leadership, which was entrusted to Gen. Michelet. The V. Army (Masel) which had held this front since 1914, closed on its right to make room for the VI. (Mangin), while the X. Army (Duchesne) was in reserve.

Nivelle's Plan of Attack.—Nivelle had decided on a sharp attack, aiming at carrying the positions and all the artillery zone at the first assault. This was in accordance with Joffre's scheme of Dec. and resembled the method twice employed at

Verdun. No one raised any serious objection, but Nivelle foretold an immediate exploitation of the success by the X. Army, which should carry it as far to the north as possible. Michelet estimated that the whole operation might be accomplished the first day, or at latest on the morning of the second. He indicated as objectives the foot of the heights to the north of the Ailette, the plain of Laon, and the east of Brimont Fort. The only objection was raised by Mangin, who called attention particularly to the importance of good atmospheric conditions. This did not modify Nivelle's wishes, and Michelet exaggerated them by giving such detailed orders that no initiative was left to the army commanders.

The preparation for the offensive was in full swing when, on March 14, the German retreat to the Hindenburg line commenced, and on the 19th it extended to the front between the Oise and the Aisne. These well prepared movements, cleverly carried out, were very successful. The spoils captured by the Allies were relatively unimportant and the evacuated country had been systematically devastated. Nivelle's plan had to be modified by this retreat, the Oise-Somme attack lost all interest and that upon the Aisne alone remained. Mangin called attention to the fact that the retirement had left a right-angled salient about the Laffaux mill and that an attack to the north would be able to take the Chemin des Dames in reverse. The commander-in-chief admitted this and two divisions were devoted to this local operation. In addition it was decided that the IV. Army (Anthoine) should attack the Massif de Moronvilliers, east of Rheims.

Two other events entirely modified the general situation—the entry of the United States into the War and the Russian revolution. On top of this a political incident led to the retirement of Gen. Lyautey, Minister of War. He was replaced by M. Painlevé, who was hostile to Nivelle's plans. This weakened the confidence of the commander-in-chief's subordinates, and Nivelle went so far as to offer his resignation, which was refused.

The Anglo-French Advance.—The offensive commenced on April 9 before Arras, and continued up to the 14th with considerable success. There was no break through, but 14,000 prisoners and 104 guns were taken by the British. On April 14, Franchet d' Esperey's group of armies came up to the Hindenburg line in the neighbourhood of St. Quentin, but Franchet d'Esperey decided that with the means at hand a successful attack was impossible. The operations on the Aisne should have commenced on April 12, but were put off, first to the 14th, then to the 16th on account of the bad weather. The front of attack measured 25 miles. The VI. Army (Mangin) operated on nearly 10 m. with 17 divisions plus a cavalry division and a territorial division, 1,669 guns, of which 823 were heavy or large; the V. Army (Masel) had a nearly similar strength but with 1,967 guns (1,107 heavy or large). The artillery preparation commenced on April 5 and continued until the 15th on account of the postponement of the attack. It sufficed, but its duration permitted the Germans to make suitable dispositions and there was no surprise. On the morning of April 16 the Allies carried the first German line on the whole front. The right and centre of the V. Army gained a depth of 1½ to 2 m., but on the left a tank attack, badly conducted, failed with heavy losses and the infantry rapidly came to a standstill on the plateau of Craonne. The right of the VI. Army took the position of Hurtebise and pushed as far as the Ailette, but further east the fighting was desperate and the gain insignificant. In the centre progress was more satisfactory, though difficult. On the left, the commencement was good, but the advance quickly became wild, and at certain points it was practically negligible.

Results Obtained.—To sum up, although some good results had been obtained the hoped for success had not been won. Badly informed, Nivelle imagined that on the 17th he ought to stop the northern advance of the VI. Army and push the V. Army towards the northeast. This order became delayed, so on the 17th Mangin continued his attacks, notably in the centre, where he made a marked advance on the front Braye en Laonnois-Ostel. The situation having changed, Mangin ordered a vigorous pursuit, in spite of the stopping order. The fort of Condé was occupied and a slow push was made towards the Chemin des Dames. On the same date (17th), the IV. Army (Anthoine) had made good progress in the Massif de Moronvilliers. Between the 16th and 20th, they had captured 21,000 prisoners and 183 guns, progressed some 5 m. on the Aisne front of 7½ m., seized a dozen villages, the fort of Condé, and all the observation posts which overlooked the Aisne; in the front line the morale was good, particularly in the VI. Army. Of the 52 German divisions in reserve available on April 1, only 16 remained unengaged. This result was less than had been hoped, but it was nevertheless appreciable and certainly superior to those of preceding offensives.

Unhappily the morale behind the front line was rapidly declining, the losses being greatly exaggerated. Nevertheless Nivelle continued his operations. The X. Army took up its position on the plateau de Craonne, between the V. and VI. Armies, but on April 27 Michelet wrote that he had not strength enough for a general offensive toward the north and that he proposed to limit himself to local attacks. Nivelle accepted this solution. It was sought to carry Brimont, to enlarge the position on the Massif de Moronvilliers and to complete the conquest of the Chemin des Dames. These operations, rendered more difficult by the unfortunate intervention of politicians, produced very poor results.

Attitude of the British.—The British Govt. and Sir Douglas Haig saw with regret the arrest of the French operations. Haig was called to Paris on April 26 to confer with Ribot and Painlevé, who pointed out the French losses, deducing from them the necessity of stopping the offensive. Haig held to his opinion and appeared to have won, a result confirmed by two inter-Allied conferences at Paris. Mr. Lloyd George vigorously seconded Haig's view. The French Govt. seemed to be convinced and made promises which were not carried out. The British Offensive continued on the Scarpe and that of the French IV. Army on the Massif de Moronvilliers and on the plateau of Craonne, the latter being captured on May 4. Laffaux mill was carried on the 5th, together with the neighbouring positions. For several months, however, the X. Army could only with difficulty hold on to the crest of the Chemin des Dames.

The Franco-British attack of April 1917, resulted eventually in the capture of 62,000 prisoners and 446 guns. The French had lost from April 16 to 25, 15,000 dead, 60,000 wounded, and 20,500 missing. On the whole 50 m. front of attack the enemy had been obliged to construct new lines of defence. He had lost the Vimy crest, Laffaux mill, Condé Fort, the Chemin des Dames and the Massif de Moronvilliers. Important lines of railway were under fire from the Allies. All the 52 reserve German divisions of April 1 had been employed by May 4, and quiet sectors had been robbed to reinforce the Aisne line. On May 25, 99 divisions had already appeared on the front attacked, of which 11 had appeared twice. This expenditure was triple that before Verdun in 10 months. The Germans could not stand this long, for they had only 150 divisions on the Western Front against the Allies' 178, and it was easier for the Allies to repair their losses, for they had adequate reserves.

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CHANCE: *see* PROBABILITY.

CHANG TSO-LIN, Chinese general, was born about 1875 and little is known of his early life. He first came into prominence as a leader of bandits in northern Manchuria. After the Russo-Japanese War of 1904–5, in which he fought for the Japanese, he joined the regular army, and in 1911 was appointed military Governor of Fengtien. As the Central Govt. weakened Chang Tso-lin became more and more independent, and in 1922 a clash occurred which resulted in his defeat. But the Chihli Army did not pursue him to his stronghold at Mukden, and in 1924 he decisively defeated the opposing forces. Fighting recurred in 1925,

and he again defeated the Chihli Army under Wu Pei-fu, but was robbed of the fruits of victory by the treachery of his ally Feng Yu-hsiang, who seized Peking. As the year 1925 drew to a close, the struggle for mastery entered on a new phase. Wu Pei-fu was for a time eliminated, Chang Tso-lin subdued a revolution in Manchuria, ere Feng Yu-hsiang entered Tientsin after a big battle. In the spring of 1926 Feng was overthrown and fled to Mongolia in consequence of a powerful alliance between the old enemies, Chang and Wu. Regarding the control of Peking and national policy as a whole, his relations with Wu were uncertain, but Chang seemed firmly master of his old ground in the north. (*See* CHINA.) (G. C. D.)

CHANNEL ISLANDS (*see* 5.840).—The population, according to the census of 1921, was 89,614; the effective population, *i.e.*, excluding visitors, was estimated at about 87,500.

During the World War the Islands provided a considerable number of men for overseas service. In 1917, when the Imperial Govt. relieved the Insular funds of the cost, previously borne locally, of the local militia, the question of a contribution from the Islands of Jersey and Guernsey to Imperial funds was raised. In recognition of this relief of their revenue, the States of Jersey voted, in Dec. 1917, a gift of £25,000 towards the cost of the War. In 1918 it was suggested by the British Home Secretary that the Islands should share in the financial burden of the War, and the States of Jersey made further contributions of £50,000 in Dec. 1918, and £25,000 in March 1919, making £100,000 in all. In Dec. 1918 Guernsey made a contribution of £100,000.

The Question of Financial Aid.—In the report of the committee of National Expenditure of Feb. 21 1922 the committee commented on the fact that the Islands made no annual contributions to the Imperial revenue, though they obtained practically the same benefits as though they were part of the United Kingdom. As taxation in the Islands was very light, the committee recommended that the Government might suggest an annual contribution from the Islands to the Imperial Exchequer.

In Jan. 1923 the Home Secretary again invited the Islands to consider the question. In view of the fact that no response was made by Jersey to this invitation, and that the contribution offered by Guernsey was below that the Government considered equitable, a committee of the Privy Council was appointed on March 9 1925 to consider the whole matter. The committee recommended that the contributions to the Imperial funds should be annual sums of £120,000 from Jersey and £75,000 from Guernsey, payable for a period of 100 years.[1] The states of Jersey and Guernsey did not accept this recommendation. Jersey offered a final contribution of £300,000, and Guernsey of £220,000.

Trade.—Exports from the Islands to Great Britain, mainly potatoes, tomatoes, grapes, fresh flowers and granite, are valued at about £3,500,000 annually; imports from Great Britain are valued at some £3,750,000 annually. The two main sources of income in Jersey are agriculture and the tourist trade. Imports increased in value from £1,163,811 in 1913 to £2,744,648 in 1924, and exports from £970,671 to £1,647,214. Cattle rearing is of considerable importance.

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CHANTAVOINE, HENRI (1850–1918), French man of letters (*see* 5.847), died at Galuire (Rhône) Aug. 15 1918.

CHAPLIN, HENRY CHAPLIN, 1ST VISCOUNT (1841–1923), English politician (*see* 5.852). Mr. Chaplin on his return to the House of Commons in 1907 as member for Wimbledon was generally welcomed as a type of parliamentarian who was fast disappearing. He intervened with effect on questions of land and of social and tariff reform, but otherwise was not so prominent in debate as in past years. When the first Coalition Govt. was formed in May 1915, he was left almost alone on the front Opposition bench, and it was felt to be a fitting close of a distinguished career in the Commons, when he was raised to the peerage in April 1916. He died in London May 29 1923.

CHAPLIN, CHARLES SPENCER (1889–), motion-picture actor, was born April 16 1889, of English parentage, and passed his early years in London. At an early age he appeared on the music hall stage with his father and brother Sydney, taking small parts in vaudeville. After a short experience on the legitimate stage he re-entered vaudeville in London, as a member of the Fred Karno Company. In 1910 he went to the United States as leading comedian in a Karno production, *A Night in an English Music Hall.* He attracted the attention of Joseph M. Schenck, and on the latter's suggestion he was engaged by Mack Sennett to make moving pictures with the Keystone Comedy Company at Hollywood, California. In his first picture, made in 1913, he adopted the eccentric costume which has ever since been associated with his name. His success was immediate, continuous and universal. In 1918 he formed his own company, and produced a series of motion pictures which placed him in the front rank of artists and in a category of his own in the field of screen comedy. Among the more successful of his later releases were *A Dog's Life* (1918), *Shoulder Arms* (1918), *The Kid* (1921), *The Idle Class* (1921), *The Gold Rush* (1925) and *The Circus* (1926). In all of these he was the central figure. In 1923 he directed, but did not personally appear in, *A Woman of Paris,* a serious picture, displaying extraordinary skill in construction and ensemble, which has been used as a model by subsequent directors.

CHARACTER.—To ask what character is reveals the confusion of ordinary thought about it. Instincts, habits, impulses, desires, emotions, sentiments all belong to it. But what relation do they bear to one another? What is the part of character that has to be controlled and what is its controlling part? Whence come those things that are called "principles" of conduct, and "ideals," and the multitude of "qualities of character"—courage, steadfastness, sincerity, tolerance, generosity, patience and honesty, and their opposites? We do not know. The first general problem of the psychology of character is therefore to transform the chaos of the ordinary conception of it into one in which the parts of character are seen to bear a clear and intelligible relation to the whole.

There are certain common but useful antitheses "character and intelligence"; "character and circumstances"; "character and conduct." Conduct is the expression of character; only actions that are in some degree under voluntary control are included in conduct. Reflex actions are not included in conduct; instinctive actions are. Character is the driving force; intelligence guides it to its destination; together they sum up the human mind and are inseparable in it.

Stages of Character.—These may be classed under three heads, which roughly correspond to three levels of mental development: (1) the instinctive; (2) the emotional; (3) the level of sentiment; and again roughly these three are represented in (1) the life of the animal; (2) the life of the child; and (3) the life of the adult human being. The first is the most perfect in organisation; but also the most rigid, in which intelligence has least formative influence. The second is the most helpless and marks the transition from a lower to a higher form of organisation, for which the guidance of the adult mind is indispensable. The third is the most plastic and comprehensive; but its organisation is never completed. In it reflection, reason and self-control have their full opportunities; yet it is the region of folly and error, with which we can hardly charge the animals; of mistaken valuations followed by disillusions; of progress and decadence; of constancy and infidelity. It has never been understood.

These three, instinct, emotion, sentiment, each after its kind, are systems. As everything in the body is a system or a part of a system, so is it in the mind. Reason and self-control are priceless; but they do not function in a void. They are the properties of the highest systems of the mind—the sentiments.

The Human Instincts.—Animal instincts are inherited dispositions having specific patterns of behaviour for the attainment of their ends. An impulse felt in consciousness precedes their operation; attention accompanies it, and serves to adapt the pattern of behaviour to the actual situation. Human instincts have lost these patterns except in the case of simple instincts, as sucking, shrinking and clinging; in others the child must learn by

[1] *Report* of the committee of the privy council on the question of contributions to Imperial funds from the islands of Jersey, Guernsey and Man. (Cmd. 2586.)

experience to acquire new means to replace the old. Apart from these acquired processes his instincts are revealed as impulses innately determined to pursue certain ends. But with the loss of their instinctive behaviour they have become more plastic. How many ways of concealment has not man learnt! The end itself has been conceptualised. The end for an animal is perceived—a hole or cover; the end for man may be conceived—a secret thought. In this sense, as instinctive impulses defined by their ends, we can enumerate the most important human instincts. They are flight and pursuit, concealment and display, domination and submission, attraction and repulsion, destruction and construction, crying for protection and giving protection, curiosity and search, and the food and sex instincts. The ends are only proximate ones, assumed to have been selected first for their biological utility; but in man they are also indispensable to the ends which he invents—wealth, power, fame, well-being, happiness, perfection.

The instincts sometimes act independently of emotion, finding in their own impulses when unchecked the force to attain their ends; but (1) when their impulses are obstructed they tend to arouse anger or fear; (2) when they attain their ends, joy or satisfaction; (3) when they fail completely, sorrow or despair. The emotions never act independently of instincts, and tend to organise in their systems all that subserve their ends. Hence we find concealment not only in fear, but in the anger of revenge; in shame; in envy; in sorrow; in the joy of children's games. This seems to be the relation between instincts and emotions.

Difference Between Instinct and Emotion.—They are often confused because so often combined together. An instinct advancing to its end unchecked does not need to arouse emotion. In itself it is unlike emotion; it is most like habit. Both instinct and habit are orderly and stable, showing so little variability in action that we forecast the course of it. Emotion unrestrained is unstable and disorderly; its actions often surprise us. We follow our strong habits often without recognising them; they are calm and unobtrusive; we cannot help recognising our strong emotions. Hence it is, when emotion and instinct are conjoined, the second as it comes into operation tends to calm the first. It is the moments before action, we remark, that are so tense. For the force which emotion brings is for the needs of a certain situation. It should not therefore persist for long, and if it does, it tends to become pathological, as we see in the case of our morbid fears. But it is the nature of instinct and habit, and love and hate, to persist indefinitely.

Besides these differences between instincts and emotions there are those based on the nature of their systems. Emotion is potentially more complex. Concealment is only one of many instincts organised in fear which may choose this instinct or any other better adapted to the actual situation: flight, shrinking or clutching, or shrieks for protection. From the time of Bain it has been recognised that strong emotion is accompanied by a diffused nervous disturbance; and this may render emotion more adaptable to a changing situation; whereas when an instinct is unchecked, and following out the normal course of its behaviour, the nervous discharge tends to be restricted to those channels which sustain this behaviour. Here the intervention of emotion would be not only superfluous but harmful.

The value of emotion lies in these two points of difference from instinct: (1) the force which it brings to deal with a given situation, and (2) its potentially more complex and adaptable system. It is indispensable to the sentiments, and without it there could neither be love nor hate. All great changes of character are initiated by emotion.

The Stage of the Sentiments.—Whence comes the power that man has to hold up his emotions and the ideas of action they thrust upon his attention and would forthwith accomplish? That which has to exercise control must have a wider outlook than that which is to be controlled; but unless it moves us its warnings are ineffectual. It must move us by some other influence than emotion. The emotions cannot cure their inherent defects of impulsiveness and lack of reflection, being without self-control. Self-control comes from a higher system than emotion, and one that by its comprehensiveness more adequately represents the self. Love and hate, the chief sentiments, have this comprehensiveness. They are that governing part of character to which we have referred; and all the part which has to be governed is beneath them, under their authority. But if the sentiments are, as we now take them to be, systems of emotional dispositions, how do these provide them with the self-control they need? Joy and sorrow, hope, anxiety and disappointment, are the common lot of all of them; but there is something else in their systems. The impulses of their emotions become desires, these grow more abstract and general with experience, until at length the desires that change give rise to the desires that are always the same: from meetings and separations, from agreements and discords, the desire for union; from passing enjoyments, happiness and well-being; from acts of love the desire for reciprocity of love. Thus love obtains its great organising desires directed to its unchanging ends of union, happiness and well-being of the loved object, reciprocity of love, and the desire to be happy in the love of the object. But in hate these ends are reversed: not preservation and union, but destruction and separation; not happiness and well-being, but misery and the worst possible state of the object, and yet withal, the desire to be happy in the separation, misery and destruction of the object.

In these great desires love and hate find the principles of their self-control—not in their emotions. Here is the governing part of their systems; the centre on which the rest depends. Hence the long-continued struggle between this central part and the emotions, impulses and momentary desires that surge up against it from the inferior part, the imperfect self-control attained, and from its failures the birth of the highest part of the systems—its ideals. With these ideals come those familiar qualities of character—courage, patience, steadfastness, sincerity, sweetness, tolerance and generosity—some of which every love discovers anew for itself in the mirror of its own failures.

These are the three parts of love, restricted in impersonal forms of the sentiment, but still substantially the same, revealing too the mixture of love and self-love in the very desire for union, reciprocity and happiness.

Repression.—Repression is an extreme form of the self-control of sentiments. For if some of their emotions have to be regulated as being either too strong or too weak, others which are judged to be harmful in view of their ends have to be repressed. Such repression of things within the mind corresponds most nearly to "destruction" of things without us. We would destroy some things in our character if we could; but we can only repress them, which means to exclude them from consciousness, and prevent as far as possible their return to it.

In this sense we not only try to repress emotions, like unreasonable fears and false shames, but loves that are disgraceful or even unfortunate, and most of our hates. Such repressed fears, loves and hates are now called "complexes." For as it is essential to a sentiment to be accepted by the subject of it, so it is essential to a "complex" to be repressed.

There are different degrees of repression: (1) Those with which medical psychology deals. Here the dissociation of the repressed constituents from the consciousness of the individual is so complete that unaided he cannot recall them; (2) those, much more common, which, though completely repressed, he could recall to consciousness if he desired to; (3) those which are imperfectly repressed, and after a certain time reinstate themselves in consciousness independently of his desire. To this class belong all the vices from which man struggles to escape, which, strengthened by habit, make him recognise his weakness: debauchery, perversions, drunkenness, gambling. Repressions therefore in all degrees have great importance for character as indicating the different ways in which self-control may be defective.

Conscience.—There is another sentiment distinct from both love and hate, which, like them, often undergoes repressions. The uniqueness of conscience makes it difficult to interpret, for there is a particular conscience belonging to all love of which its ideals are a part. This is partial to the loved object. The conscience is general, and being neither love nor hate, when it acts, it acts impartially. It has its own emotional system: a calm joy,

sorrow, remorse, shame, fear and indignation; all are penetrated by its approvals and disapprovals. It is the repository of that part of the moral beliefs of the community in which the individual has been instructed and which he has adopted through authority and suggestion. It is therefore apt to differ from one person to another. But when it is a living force of character, it grows with a man's experience of life, and through the illusions and disappointments of love. These impress certain ideals and duties upon his mind differently from hearsay, however often repeated. They become the most vital part of his conscience, being there freed from the partiality to which love at first confined them. And as the ideals of love are much the same in its different varieties, the most general and important duties come to be impressed, sooner or later, on most men. There are those who have to repress some part of them from remorse, and shrink from having to face it again in consciousness; but their denials of its beliefs, to which they try to make other men conform, never wholly convince themselves.

Thus is shewn in merest outline how the parts of character are related to one another and the whole—how the instincts, habits, emotions and desires function in the sentiments of man, and there represent the unity of his character. Yet how incompletely they represent it. The potentials of his character transcend for better and worse everything that he has drawn from them to build up his actual loves and hates, and remain a perpetual enigma to him. See A. F. Shand, *Foundations of Character* (1914).

(A. F. S.)

CHARLEROI, BATTLE OF: *see* FRONTIERS, BATTLES OF THE.

CHARLES (1839–1914), King of Rumania (*see* 5.925), died at the castle of Pelesh, Rumania, Oct. 10 1914.

CHARLES I. (1887–1922), Emperor of Austria and King of Hungary, born Aug. 17 1887 at Persenbeug, in Lower Austria, was the son of the Archduke Otto (1863–1906), and Princess Maria Josepha of Saxony (b. 1867). The death of his father in 1906 and the renunciation by his uncle, the Archduke Francis Ferdinand, on the occasion of his marriage with the Countess Chotek (1900), of any right of succession for the children of this union, made him heir-presumptive to his grandfather, the Emperor Francis Joseph. In Oct. 1911 he married the Princess Zita of Bourbon-Parma. Of this marriage there were several sons and daughters, the eldest of whom, Otto, was born in 1912. Charles' relations with the Emperor were not intimate, and those with Francis Ferdinand not cordial. It was only after the death of Francis Ferdinand that the old Emperor took steps to initiate him in affairs of state; but these studies were interrupted almost immediately by the outbreak of the World War. After a period of duty at headquarters at Teschen, Charles commanded the XX. Corps in the offensive of 1916 against Italy, later commanding an army on the Eastern Front.

Charles as Emperor.—On Nov. 21 1916, he succeeded to the throne, at a period of the most extreme difficulties. The military and economic resources of the monarchy were beginning to fail after two years of warfare. Behind the front there was much shortage and suffering. Anti-dynastic feeling was spreading widely, especially in Slav and Latin territories. Charles' programme on his accession was to combat this feeling, to renew the splendour of the dynasty, to achieve peace abroad and national settlement in the monarchy. With this end he made a complete change in the leading military and political posts in the monarchy. But the new men—except only the new Foreign Minister, Czernin—were, unhappily, less talented than their predecessors. Least of all was Charles himself equal to his exacting position. He was an amiable man of excellent intentions, but his abilities were mediocre and his preparatory training inadequate. He lacked calmness and endurance, and was prone to headlong, precipitate actions. He was powerfully influenced by his immediate entourage—his wife and mother-in-law—while distrusting all other advisers. But he was most bitterly—and justly—reproached for insincerity. Not merely his enemies, but his allies too, particularly German statesmen and the Emperor William, soon felt that they could not trust his word. The peoples of the Danubian monarchy, moreover, gradually began to doubt his sincerity, although he did not spare pains to win them over.

On Charles' accession the constitution in Austria was still suspended. In May 1917, he summoned Parliament once more. The earliest pronouncements of the Slavonic deputies showed how far their separatist ambitions had advanced, and all the concessions now made to them remained fruitless, merely alienating the majority of the German Austrians. In Hungary, too, Charles' wide concessions to the Magyars failed to check the growing separatist movement while earning for him the displeasure of the elements in Vienna which stood by the unity of the Empire and the ill-will of the non-Magyars in Hungary.

Peace Proposals.—Charles soon grew convinced of the necessity in his own interest and in that of the dynasty of securing a peace which would allow of the maintenance of the Empire. Yet the numerous attempts made, always with his approval and often upon his own initiative, to secure advantageous conditions, preliminary to a peace of reconciliation, failed. Undoubtedly Charles neither could nor would consider the proposal of the Western Powers to make a separate peace; not only from regard for his allies, particularly for Germany, but also owing to the refusal of the Italian Govt. to renounce any acquisition promised by the Treaty of London. Charles therefore informed Germany that Austria could no longer carry on war, and that Germany must buy a general peace by territorial concessions in the West.

Count Czernin opened up negotiations to this end with the German Govt. but met with little sympathy from the civilian government, none from the supreme army command. Disputes arose, breeding ill-will on both sides. The mistrust for Charles' sincerity entertained by the Emperor William and his advisers increased, the tension reaching its climax after the publication in the spring of 1918 of Charles' letter of March 24 1917, to his brother-in-law, Sixtus of Parma, announcing his readiness to support in Berlin "the just claims of France to Alsace-Lorraine." Charles' failure during the ensuing polemic openly to avow the authorship of the letter and his resort to subterfuges deprived him of his last remnant of authority abroad and at home. In order to propitiate the Emperor William and the German Govt. he was compelled to accept an arrangement with the latter which, if carried into effect, would have rendered the monarchy entirely dependent upon the German Empire. At the eleventh hour Charles sought salvation for himself and his dynasty in the manifesto of Oct. 16 1918, which held out the prospect of the conversion of Austria into a federal state, in which each race was to form a political commonwealth of its own upon its own territory. But the offer came too late, and was in any case unacceptable to the Southern Slavs, since the Magyars had insisted on a clause affirming the integrity of the Hungarian kingdom.

Departure from Austria.—The disruption of the dual monarchy pursued its way. Charles now mainly attempted to protect his dynasty by means of a separate peace with the enemy; but in vain. Abandoned within the Empire and without, he voluntarily renounced on Nov. 11 1918, all participation in the government in order, as he himself expressed it, "not to hinder the free development of his peoples," but actually because he would otherwise have been compelled to abdicate. Two days later he made a similar renunciation in the case of Hungary. The German Austrian Republic was proclaimed on Nov. 12, the Hungarian on Nov. 16 1918. But Charles did not resign the crown of his dominions. He retired to his castle of Eckartsau; thence he went, the Austrian Govt. having demanded his departure, on March 24 1919 to Switzerland, where he stayed first at Schloss Gstaad and later at Prangins. His attempt at the end of March 1921 to secure his restoration as King of Hungary failed owing to the attitude of the Regent Horthy and other leading Hungarians and the unanimous opposition of the Succession States and the Entente.

Charles returned to Switzerland, where a provisional prolongation of his residence was accorded him subject to certain

conditions. Disregarding his undertakings towards Switzerland, he made a new attempt in Oct. 1921, to assert his claims as King of Hungary. Having made a surprise air flight with his wife from Switzerland to the Burgenland, Charles was there joined by a small force of armed Royalists, at whose head he marched on Budapest. But the Allied Powers, as well as the "Little Entente," at once made it clear that a *coup d'état* would not be tolerated; and there was a strong rally at Budapest to the side of the Horthy Government. The Royalists were met near Budapest and defeated, Charles and Zita being themselves arrested at Tihany.

On instructions from the Powers, the definite deposition of Charles and renunciation of his claims to the throne were insisted upon, and he and his wife were handed over to the custody of the Allies for internment. Refused the right of asylum by Switzerland, on the ground that he had not adhered to the conditions agreed upon, and accorded a reception by Portugal alone, he was conveyed upon the English ship "Cardiff" to Funchal, Madeira. Here he lived in straitened circumstances until released by death on April 1 1922.

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CHARNAY, DÉSIRÉ (1828–1915), French traveller and archaeologist (*see* 5.947), died in Paris Oct. 24 1915.

CHASE, WILLIAM MERRITT (1849–1916), American painter (*see* 5.956), died in New York Oct. 25 1916. In 1912 he was awarded the Proctor Prize by the National Academy of Design for his "Portrait of Mrs. H." At the Panama Pacific Exposition (1915), a special room was assigned to his works.

CHÂTEAU-THIERRY, a small town in the northeast of France, on the Marne, 47 m. east and north of Paris. It was the farthest point reached by the Germans in their offensive of May 27 1918. The 2nd and 3rd Divs. of the American Expeditionary Force were sent to the Marne in the Château-Thierry region to assist the hard-pressed French forces. At Château-Thierry itself a U.S. machine-gun battalion took part in the successful defence of the river crossing, while to the west of the town the 2nd Div., under Gen. Bundy, fought the fiercely contested engagement of Belleau Woods. (*See* GERMAN OFFENSIVE; MARNE, SECOND BATTLE OF THE.)

CHEKHOV, ANTON PAVLOVICH (1860–1904), Russian novelist and dramatist, was born Jan. 17 1860 in Taganrog on the Sea of Azov. This name is also spelled Tchekhov, Tchehov and Chehov. His father was a tradesman and the son of a serf. The writer was educated at the gymnasium of his native town, and in 1879 went to the University of Moscow, where he studied medicine. He took his degree in 1884 but practised very little (except during the cholera epidemic of 1892–3). He began his literary career while yet a student, and soon became one of the most welcome contributors to the comic papers. His early stories appeared over the signature Antosha Chekhonte. In 1886 some of his stories were published in book form (*Particoloured Stories*). The book had a great success and attracted to Chekhov the attention of the publisher and editor Suvorin, who became his friend and through whom Chekhov was able to emancipate himself from the comic papers and from the obligation of being a humorist.

In 1887 he produced his first play *Ivanov*. In 1890 he travelled to the convict island of Sakhalin and the result of his journey was *Saghalien Island* (1891), which had a considerable effect on the mitigation of the penal régime. From 1891 to 1897 he lived together with his parents on a small estate he had acquired not far from Moscow. After 1897, as he was threatened with tuberculosis, he was forced to live the greater part of the year in the Crimea and abroad. In 1896 he produced his second play, *The Seagull*, which met with a complete failure in St. Petersburg (Leningrad). But in 1898 it was revived by the Moscow Art Theatre of Stanislavsky and proved a great success. Henceforward Chekhov's connection with that theatre became very close. *Uncle Vanya* (1899), *The Three Sisters* (1901) and *The Cherry Orchard* (1904) were produced there. In 1901 he married the actress Olga Knipper. In 1900 he was elected an honorary fellow of the Academy of Science, but resigned his fellowship when the election of Maxim Gorky was cancelled by the Government. He died July 2 1904 at Badenweiler in the Black Forest.

Early Work.—The early stories of Chekhov, up to about 1886, are chiefly humorous. They are, in Russia, the most widely popular part of his work, and more people know him by them than by *My Life* or *The Three Sisters*. Chekhov's humour is not strikingly above the level of the papers he wrote for. But very early he began to lay the foundations of that manner which is the essential Chekhov. Such a story as *The Chorus Girl* (1884) is almost a mature masterpiece. It was, however, only after 1886 that he found the necessary leisure and independence to give definite expression to his imaginative experience. The years 1886–8 are a period of transition during which he experimented in various directions. To these years belong a series of stories of atmosphere against a background of nature (*The Steppe, Happiness, Easter Eve*) where the lyrical element of his genius received its fullest expression, and short stories of morbid experience in which the knowledge of the doctor is balanced by the sense of form of the artist. By 1889, however, he had attained perfection in his style. To this and the following years belong a succession of masterpieces, the principal of which are *A Dreary Story* (1889), *The Duel, Ward No. 6* (1892), *The Teacher of Literature* (1894), *Three Years: An Artist's Story* (In Russian *The House with the Maisonette*) (1895), *Peasants* (1897), *The Darling, Ionitch, The Lady with the Dog* (1898), *The New Villa* (1899), *The Bishop* (1902).

Chekhov's art has been described as psychological, but his psychology ignores the individual. His characters are not persons but just men and women, the genus *homo*, an indifferentiated mass of humanity, divided into watertight compartments by the phenomenon of individuality, which does not make one being different from another but only inaccessible to him. A typical story by Chekhov is the life-story of a "mood," of a state of mind, usually of the relation of one person to another and the gradual transformation of that state of mind under the action of the incessant infinitesimal and unforeseen pinpricks of life. Sensitiveness to these pinpricks is the main feature of Chekhov's people, of those at least who are made to kindle the reader's sympathy, and the standard by which Chekhov gauges the worth of a human being. Those who suffer and succumb are the higher race, those who do not are unfeeling brutes. Hence a deep-rooted aversion (present in pre-Chekhov Russian literature, especially in Turgenev, but enormously magnified by Chekhov) for the strong and efficient man. None but "Hamlets" may receive sympathy.

The construction of Chekhov's stories may be described as musical or infinitesimal. It is at once fluid and precise. They are built along exactly calculated curves, of which only certain points are marked in the story, but each two points are sufficient to calculate the whole curve. The curve is the mood which begins as almost a straight line, then under the influence of "pinpricks" begins to deviate and at last shoots out in an entirely opposite direction. By far the greater number of Chekhov's stories end on a minor note, "not with a bang but a whimper." A story where the direction is in the opposite way, as in *The Lady with the Dog* (where the hero begins by regarding his love for the lady as a mere insignificant intrigue and ends in self-forgetful passion), is an exception. The "pessimistic," destructive, descendant tendency of the Russian novelists of the mid and later 19th century reaches its extreme expression in Chekhov, all the more extreme as it is so consistently muffled and "understated." To him, better than to any one, the words of M. Albert Thibaudet apply, that a Russian story is always the story of the undoing of a life.

Somewhat apart from the other stories of Chekhov stand, what are perhaps his two masterpieces, *My Life* (1895) and *In the Ravine* (1900). They have a clearer and harder outline; they are free from the atmospheric, autumnal haze that pervades the others, and animated by a more active sense of moral and human values. *My Life*, especially, is a creation of vast and pregnant

significance, with a symbolical grasp that gives it an almost religious character.

Chekhov's dramatic work consists of the same element as his narrative work. It includes numerous one-act plays which were extremely popular in Russia. Belonging to a later period than the comic stories, they are also on a higher artistic level. The serious plays are five in number—*Ivanov*, *The Seagull*, *Uncle Vanya*, *The Three Sisters*, *The Cherry Orchard*. They have many points in common with his stories; not only is his vision of life the same, but his methods are similar. One main difference is that while the stories are invariably centred round a single person from whose standpoint the situation is developed, the dramas have no such central figure, and all the characters have more or less equal rights on the stage. The plays are, as it were, symphonies for an orchestra of parts, and the resultant is arrived at by the complex interaction of the various voices. They are plays of " atmosphere," the English word that comes nearest to the Russian *nastroenie* (Stimmung). The principal thing in them is not the action but the emotional accompaniment of the action. In the " de-theatricalisation " of the theatre, in the complete avoidance of all traditional stage effects (though he introduced a new kind of " atmospheric " effect, as the famous string (bursting at the end of *The Cherry Orchard*), Chekhov is the logical limit of the preceding development of the Russian drama. He did not go much further in this respect than Turgenev or Ostrovsky, but he built a more consistent dramatic system with a completely adequate technique.

The Novelist's Influence.—The influence of Chekhov on Russian literature has not been extensive. The last realists (Andreyev, Gorky, Bunin, etc.) learned little from him, and soon after his death the rise of an entirely new movement put an end to all possibility of continuing in his tradition. His plays were imitated by Gorky, Andreyev and others, but they invariably missed the constructive principle without which the whole system is stultified. There has been no school of Chekhov, and his work has to be regarded as an end rather than as a beginning. It is the swansong of 19th-century Russia. To the Russia of to-day Chekhov is perhaps more alien than any other Russian writer of his rank.

On the other hand, his vogue and his influence outside Russia have of recent years grown immensely and were in 1926 probably near their zenith. England has proved particularly sensitive to his charm. He is almost universally regarded as the greatest Russian writer and as the greatest story-teller and dramatist of modern times. English critics have even called him the greatest dramatist since Shakespeare. Nor can there be any doubt that English literature has profited by his example as Russian literature never did, and that if there is to be a school of Chekhov it will be in England.

The lovers of Chekhov are attracted as powerfully by the man as by the artist, and will find an infinite source of joy in his letters.

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(D. S. MI.)

CHELMSFORD, FREDERICK JOHN NAPIER THESIGER, 1ST VISCOUNT (1868–), British administrator, born Aug. 12 1868, was the eldest son of Frederick Augustus, 2nd Baron Chelmsford. He was educated at Winchester and Magdalen College, Oxford, and held a fellowship at All Souls' from 1892 to 1899. Having been called to the bar he was a member of the London School Board for four years, and in 1904–5 served on the London County Council. In the latter year, when he succeeded his father as Baron Chelmsford, he was appointed Governor of Queensland and he held that office till 1909. These years saw the inauguration of the new policy of replacing the repatriated Kanakas by white labour. It was also a period of bitter political conflict. Chelmsford's action in granting the request of the Premier, Mr. Philp, for a dissolution of Parliament led to widespread agitation for the appointment of governors in Australia. In Aug. 1909 Chelmsford left Queensland for New South Wales of which state he was governor till 1913. It was a period of great development for the colony, and also of great labour unrest.

Chelmsford, who was created G.C.M.G. in 1912, served in India with the Dorset Regt. in the early part of the European War. From April 1916 to the spring of 1921 he was Viceroy of India. During this period the system of dyarchy founded upon the joint report of the Viceroy and the Secretary of State, Mr. E. S. Montagu, was introduced. A considerable measure of autonomy was accorded to the provinces. The Council of State and Legislative Assembly were to be elected, and the annual budget, with some reservations, submitted to the latter. Indians were given representation on the Viceroy's Council, and India was given the same power over tariffs as the Dominions.

But the new reforms were opposed by a combination of Hindus and Moslems under Gandhi, and a system of non-co-operation adopted, whilst the repressive legislation recommended by Mr. Justice Rowlatt's committee to deal with sedition provoked serious riots in Guzerat and the Punjab, culminating in the Amritsar disturbances (April 1919). However, an amnesty for political offences accompanied the promulgation of the reforms which were gradually accepted by moderate opinion. Meanwhile the Viceroy had also to meet a Mahommedan agitation directed against British policy toward Turkey. This was actively supported by an Afghan Army after whose defeat the subsidy was withdrawn from the Amir, together with the privilege of importing arms from India. The new institutions were inaugurated by the Duke of Connaught early in 1921. On his retirement Chelmsford was created a viscount and received Indian orders. He was First Lord of the Admiralty in Mr. Ramsay MacDonald's Labour Ministry of 1924. (G. LE G. N.)

CHEMICAL ENGINEERING.—The branch of engineering which relates to the " design, construction, erection and operation of plant and works in which matter undergoes a change of state or composition." This definition, due to the Institution of Chemical Engineers, is rather broad but logical. A chemical engineer should possess a good general knowledge of chemistry and physics, a special knowledge of physical chemistry and thermodynamics, a thorough grasp of mechanical and electrical engineering, and those branches of civil engineering which deal with the strength of materials and the theory of design of structures.

Since the object of chemical engineering is ultimately economic, industrial economics and law, business management and factory organisation must be given a primary place. He must be able to devise simple and effective methods of recording operations and determining actual costs, prepare designs, specifications and estimates free from ambiguity and error, report efficiently on any problem investigated, and obtain technical information readily and compile and index it for future use.

Foundations in Practice.—The practice of chemical engineering has naturally preceded the scientific analysis of its principles. Typical chemical engineering operations have been performed in certain industries to such an extent as to evolve special types of plant peculiar to those industries. The chemical engineer, however, must understand the underlying scientific principles upon which such operations or processes depend, so as to be able to design efficient plant for any particular purpose, rather than to allow it to be evolved by rule-of-thumb guess work with expensive large scale experiments and costly alterations in construction before reasonable efficiency is obtained. There is little doubt that the material rewards of scientific chemical engineering are greater to-day than any other branch of engineering can offer, while its national importance cannot be over-estimated.

Scientific Basis.—The adoption in the factory of one unit of weight and volume together with the decimal system is a first step and facilitates recording, avoids errors, saves time and makes the scientific control of processes comparatively easy.

Types of Processes.—Chemical engineering processes are of three general types: (*a*) the conveyance and storage of materials, (*b*) the production, transfer and conservation of heat and (*c*) the treatment of materials. In these processes an exact knowledge is required to secure the greatest industrial efficiency, and questions relating to rent, capital cost, repairs, labour and superintendence, output, material efficiency, character of the market, etc., must be considered. Unfortunately some of these conditions vary from year to year and the chemical engineer must be somewhat of a seer to achieve the greatest success.

Transport.—Transport is often the most important item of the cost of production; in the factory itself, the cost of carrying materials to a machine is often as great as that of the operation conducted. Methods of weighing and measuring materials in their progress through the factory need careful study, for it is only by maintaining the highest rate of output as a uniform thing, that the best results can be obtained.

Flow of Fluids.—In industrial practice fluids may flow in two distinct ways, usually referred to as "stream-line" and "turbulent" flow. The former method offers advantages in certain operations, filtration, classification, separation, etc., while the latter is essential to secure the greatest heat transfer. The criterion by which it can be approximately determined whether stream-line or turbulent flow is occurring in a tube is given by the value of the modulus $\frac{vd\rho}{\mu}$ where v is the velocity of the fluid, d is the diameter of the tube, ρ the density of the fluid and μ its viscosity. The value of the fraction is the same in any system of units and when it exceeds 2,000 the flow is turbulent.

Semi-fluids.—The laws governing the flow of semi-fluids such as dry sand, wheat, etc., which occupy an intermediate position between solids and liquids, must be understood. A peculiarity of such materials is that their flow from an orifice is proportional to the cube of the area of the orifice and independent of the head. The transport of fluids in factories is obviously a simple and cheap process, so that a solid material which is used in solution will be transported more cheaply and conveniently by dissolving it at once and pumping the solution to stock tanks, rather than by conveying the solid itself.

Transfer of Heat.—The production and transfer of heat involves a knowledge of combustion, the study of fuels, their calorific value and intensity, while the electrical generation of heat is becoming more and more important in the development of industrial processes. The design of furnaces of different types, often a matter of rule-of-thumb evolution, involves questions of heat transmission and radiation, the factors of which are very difficult to estimate. The great diminution in density of the hot gases and the increasing importance of radiation as a factor in heat transmission, as the temperature rises, are points needing the most careful study. The loss of heat from exposed hot surfaces by radiation and air contact may be fairly closely estimated, a factor often very important in the operation of a plant.

The transmission of heat through a metal diaphragm from gas to gas, gas to liquid, saturated vapour to liquid, liquid to liquid, gas to solid, etc., varies so enormously as to demand the most careful experimental research. The transmission of heat from a gas to a gas through copper 1 mm. thick, is of the order of 5 calories per square metre of surface per hour, per one degree Centigrade of temperature difference between the gases; under similar circumstances the transmission from gas to non-boiling water is about 20 calories, from liquid to liquid about 350 calories, and from steam to water about 1,540 calories. If the liquid is boiling the heat transfer may be increased greatly; it is usually at least twice and may be over four times that to non-boiling liquid. The importance in steam boilers and evaporators of keeping the liquid constantly boiling is obvious.

Again, an increase of velocity of either fluid will raise the rate of heat transmission considerably by an amount which is capable of estimation. The effects of corrosion, of deposited scale, the influence of salts in solution and of precipitates in suspension on the rate of heat transmission are matters of great industrial importance. When a gas or liquid moves over a solid surface or when a gas moves over a liquid surface there exists a film of the moving fluid over the stationary substance in which there is practically no motion. The thickness of this film is mainly responsible for the great differences in heat transmission already mentioned. Much chemical engineering research is necessary to elucidate these questions adequately, and great wisdom in design is necessary to secure the highest economic efficiency.

Solid Materials.—In the treatment of solid materials, size reduction by crushing, grinding and impact must be well understood. The relative cost of the different methods and machines and the different character of the final products must be known, for the size and uniformity of the solid material treated in a chemical operation has, in practically every case, a profound influence on the cost of production of the final product. The separation of solid particles from each other and from liquids involved in the processes of sifting, electrical, magnetic, hydraulic and air separation, classification, flotation, filtration, centrifuging, etc., often determines the profitable treatment of the material. New discoveries in flotation and similar methods of separation have in recent years proved of the highest value.

Power.—A study of the power required for different processes is of importance and may prevent false conclusions. In size reduction for example, the power required is approximately proportional to the increased surface produced, so that a simple calculation will readily show how costly it is to produce the finest powders from solid materials.

Many processes though well understood are difficult and costly; their avoidance or replacement by some other method of separation at some other stage of the process are important points in the economic possibilities of manufacture. Again, it is a common experience in technical manufacture, that a method by which one process is rendered easy may cause a later process to fail and give rise to a faulty product.

Processes of Separation and Extraction.—Processes of separation in which a change of physical state takes place are peculiar subjects of study to the chemical engineer. Leaching and extracting, evaporation, distillation and condensation, drying, crystallisation, absorption and adsorption, etc., are processes needing the highest research. Processes of extraction which formerly took twelve hours are now being carried out more efficiently in one hour as a result of chemical engineering study. Evaporation is now being done in many works at one-sixth of its former cost, while distillation and condensation in certain industries are now carried on with a fuel saving of nearly 80% in comparison with the methods of a few years ago.

Wet Distillation.—The process of "wet" distillation, *i.e.*, distillation by means of direct steam, is used in many industries for separating a particular substance, essential oil, hydrocarbon, etc. If such substance does not mix with water, then each develops that particular vapour pressure which it would have if heated separately to the same temperature, and the sum of the vapour pressures is the pressure in the still. A study of the vapour pressure curves of each substance and the conditions of decomposition of the particular one, will give the most profitable still pressure at which to work. By this alone, materials which at ordinary pressure require 200 parts of steam to distil one part of substance, may be treated under suitable pressure by which only, say, 30 parts of steam are required. Again, by a reduction of pressure before condensation has taken place, a separation of the particular substance will take place and the steam may be "boosted" back into the still again, thus securing a further economy in fuel.

Drying Processes.—The drying of gases, liquids and solids is a common requirement of many industries. The study of drying and drying plant may mean a change from comparative failure to great success. The drying of gases by chemical reagents such as calcium chloride, which after absorbing moisture is itself dried by hot air or flue gases, cooled and again used, is well understood, but the use of adsorption processes for this purpose is a development in industry of the last few years. The "gels" (silica gel, alumina gel, etc.) are treated in a similar way to the calcium

chloride previously mentioned, but are free from any risk of failure through overheating and have many other advantages. The fuel saving of about 30%, produced by the use of this process for the drying of the air blast of blast furnaces is an important addition to our fuel resources.

Gas Masks.—The efficiency of the gas mask in warfare is paralleled by the importance of the same means in peace to recover benzene and other solvents from air and gas effluents, to remove sulphur from oil and to perform many other chemical functions in a physical way. The absorption of water by "silica gel" is so energetic, and the substance can be so readily regenerated that its general use for refrigeration may be only a matter of time. The chemical engineering problems involved in this process are both interesting and profitable. The treatment of the air of factories to render it constant in temperature and humidity also offers a large field to the chemical engineer.

Chemical Reactions.—The treatment of materials in chemical reactions such as roasting, calcining, destructive distillation, electrolysis, catalysis, hydrolysis, fermentation, etc., demands careful consideration of physical, chemical and engineering factors of increasing exactitude. An examination of these processes on a laboratory scale must precede their study on a manufacturing scale. The chemist does the former and the chemical engineer the latter. Additional factors involving time of reaction, strength of materials, presence of traces of impurity, cost of materials and plant, continuous or discontinuous operation, the handling and disposal of by-products, etc., arise. Great increase in efficiency can be obtained often by changing an operation from an intermittent, or batch, method to continuous working.

Materials.—The design of plant involves the preparation of flow sheets showing the flow and expenditure of material, energy, time and labour, the experimental study of the nature and properties of the materials involved in plant construction and a continuous search for new materials to meet the conditions of service better than those at present in use. The name of a material, unfortunately, is no indication that it is suitable for a chemical engineering purpose. "Chemical cast iron" is a distinct kind of cast iron, characterised by the amount of silicon, sulphur and carbon content and its treatment. Other materials, alloys, bricks, compositions, cements, etc., must be specified for their work both as to composition and history if success is to be made certain. In recent years, great advances have been made in the production of chemical engineering materials of construction, silica-ware, stoneware, glass, alloy steels, alloys, etc., all of which tend to cause modification of design. The effect of heat on the strength of materials is becoming better known every year and the production of non-scaling steels which are as strong at a white heat as ordinary mild steel at the ordinary temperature will make many developments possible which have hitherto failed. The design of the plant from the point of view of the flow of material, charging and discharging, facility of erection and repair, ease of control with a limited staff, etc., calls for experience and wisdom.

Lay-out.—The lay-out and construction of factories involves a knowledge of several branches of civil engineering and cannot be neglected, for the erection of buildings, heavy plant and chimneys on marshy soil is a common necessity in industry. The construction of foundations, roadways, railways, etc., must also be understood. In the provision of power, heat and light, the relative value and use of the different methods must be considered for a sound view to be taken as to whether steam, electricity, gas or water-power shall be used. High-pressure steam providing power by means of turbines which exhaust into receivers from which evaporating steam may be drawn, presents the most efficient power plant in many chemical industries, while electricity generally provides the best method of power distribution, and occasionally of heating, in process work. The use of producer or water gas for heating and other purposes must not be neglected nor the value of compressed air and hydraulic water for many purposes. Finally the chemical engineer must be familiar with the Factory Acts, trade union law and all those legal points which factory managers have to face. (J. W. Hy.)

CHEMICAL WARFARE.—The use of irritant and poisonous substances to diminish the resistance of an opponent is probably as old as organised warfare. Thucydides describes two instances of the use of burning sulphur and pitch in sieges in the Peloponnesian War and throughout classical times and the Middle Ages such methods were frequently employed, Greek fire being a device of this kind. As war became more mobile and the range of actions increased, the opportunities for using such a weapon in its primitive form disappeared, but in 1855 Lord Dundonald proposed a scheme for burning sulphur on a large scale under favourable wind conditions in order to reduce the Malakoff work during the siege of Sebastopol. The suggestion was rejected on the ground of humanity.

International Law.—The use of toxic substances was foreseen at the Hague Peace Conference of 1899 when the governments represented pledged themselves not to use any projectiles, the sole object of which was the diffusion of asphyxiating or harmful gases. At the Hague Convention of 1907 the following rule was adopted: "It is expressly forbidden (*a*) to employ poison or poisoned arms, (*b*) to employ arms, etc., of a nature to cause unnecessary suffering." It has been argued that toxic gases were not contemplated as coming within the scope of this clause, but this was not the interpretation put on it by most of the Powers, and the Treaty of Versailles assumed that their use in any form was contrary to international law. This view was confirmed by the nations represented at the Washington Conference in 1922.

Gas in the World War

At the outbreak of war none of the combatant nations had made any preparation for the use of gas or were equipped with any defence against it, but after the failure of the initial German attack and the development of trench warfare, means were sought by the Germans to assist the artillery preparation for an offensive against entrenched positions, in order to get back to a state of open warfare again. Proposals to use gas were made at an early date and on Oct. 27 1914, shrapnel containing an irritant substance (dianisidine chlorsulphonate) were used by the Germans at Neuve Chapelle without, however, any success. They were followed by shell containing a strong lachrymator (xylyl bromide) in place of part of the charge of high explosive, which were used on the Russian front in Jan. 1915, when the low temperature made the lachrymator ineffective.

The introduction of gas as an effective weapon in modern warfare really dates from April 22 1915, when the Germans discharged chlorine from cylinders on a front of about four m. at Langemarck opposite a sector held by the French. The effect of the discharge, which came as a complete surprise, against unprotected troops, was to eliminate all resistance on the front affected, for a depth of several miles. A similar attack was made on the Canadian front near Langemarck on April 24. Owing to various reasons the Germans failed to take advantage of the opportunity offered by these first attacks for a decisive stroke and within a few days the Allied troops were equipped with a crude form of respirator and the immediate danger was over. The Germans soon found considerable difficulties in combining an infantry attack with a cylinder discharge, which was dependent on a favourable wind. Consequently they abandoned the cloud gas attack except as a means of inflicting casualties on the Allies. From Dec. 1915, their cloud attacks became more dangerous owing to the admixture of an increasing amount of phosgene with the chlorine, which added greatly to its toxicity, but of course the protection of the Allies was improving at the same time.

The Allies were quick to adopt retaliatory measures: the first British gas attack was made at Loos on Sept. 25 1915, with cylinders of chlorine, and from then to the end of the War, frequent cloud discharges were made as the wind was more often favourable to the Allies than to the Germans.

As a weapon for use in an attack, the gas shell offers great advantages over the cloud discharge, as it allows the use of a much greater variety of toxic substances and its employment is independent of the wind. The Germans scored one success with

lachrymatory shell in the Argonne in July 1915, but the French were the first to realise the possibilities of a gas shell filled with a highly toxic gas such as phosgene, with a small bursting charge just sufficient to open the shell. The French shell of this type surprised the Germans in the spring of 1916 and were of considerable assistance in the defence of Verdun. Subsequently the Germans modified their gas shell to the same type and made considerable use of them both at Verdun and in the Somme battle.

Gas in 1917.—In this year gas shell first became a serious factor in the tactical situation, as both the Allies and the Germans had provided themselves with considerable quantities as a result of their experience in 1916. The German shell contained mainly trichlormethyl chloroformate and chlorpicrin, toxic substances of a semi-persistent nature, the French phosgene, or prussic acid, the British chlorpicrin or lachrymators. Gas shell were used mainly during active operations for neutralising the enemy's batteries, for interfering with the movements of troops and for general harassing purposes. By firing gas shell it was always possible to compel the wearing of a respirator and especially at night this resulted in a considerable diminution of efficiency. Also sudden bursts of lethal shell were fired at targets known to be occupied in order to produce casualties by surprise before respirators had been adjusted. In order to achieve this, it was necessary to set up suddenly a high local concentration of gas and the most effective weapon for this purpose was the Livens Projector first used at Arras in March 1917. This was a crude form of trench mortar, firing a bomb weighing 60 lb. containing 30 lb. of phosgene. Large numbers could be installed together and fired simultaneously at the same target, producing very high concentrations of gas without any warning beyond the flash and noise of the discharge and the bursting of the bombs. The projector became one of the deadliest weapons of those used in trench warfare.

July 1917 is notable for the introduction of two new gases by the Germans, who had seen that with the improved methods of protection, gases such as those mentioned above, which all betray their presence at once by their immediate irritant action on the eyes and respiratory tract, were losing much of their value. They therefore introduced two new substances, dichlorethyl sulphide, commonly known as "mustard gas" from its smell or as "Yperite" from the place where it was first used and diphenylchlorarsine. Mustard gas was the most effective agent used in chemical warfare and it was responsible for the majority of gas casualties. Owing to its slight smell it is less easily detected than other gases and although it produces no immediate sensations of discomfort, exposure to a very low concentration is sufficient to put a man out of action owing to the effects of the gas on the eyes and lungs. As the liquid has a low vapour pressure at atmospheric temperature and reacts very slowly with water, it may remain for days or weeks in the soil and continue to produce a dangerous concentration of gas wherever the temperature is high enough. In addition to its effects on the eyes and lungs, serious blisters are produced either by splashes of the liquid or by contact with ground or any object contaminated by it.

Diphenylchlorarsine, a solid melting at 46°C., when finely divided in the air causes sneezing, irritation and intense pain in the nose and throat and nausea. There is a slight delay in the onset of the symptoms. Bottles of this substance were embedded in high explosive shell, so that on the burst of the shell it is scattered as a fine dust in the air. Unless respirators are provided with a special form of filter they may be penetrated by these small particles and the resulting sneezing may compel the removal of the respirator. However, this did not occur in the field of battle.

Gas in 1918.—For their offensive in 1918 the Germans made great use of gas shell on which they relied to produce rapid neutralisation of the Allied artillery, thus enabling them to reduce the length of their preliminary bombardment to a few hours without previous registration. As much as 80% of gas shell was allotted for some tasks. The gas shell available at this date can be divided into two classes from the point of view of tactical employment in an attack:—

(1) Shell containing liquids such as mustard gas, which may persist for long periods in the soil and cannot be used on ground which it is intended to attack or occupy.

(2) Shell containing volatile liquids such as phosgene or diphosgene, or non-volatile solids such as diphenylchlorarsine, which owing to their low persistence may be used immediately before an attack.

The Germans used shell of the first class on the flanks of the attack and in other sections of the front to produce casualties, while the preliminary bombardment before each attack was mainly with gas shell of this second class, which compelled the continuous wearing of the respirator and added greatly to the strain and fatigue of the troops and interfered with movement and communication. The weather conditions in each offensive were suitable for gas shell except on July 15 when the attack failed. The Allies also were using large quantities of gas shell in 1918, including mustard gas after June, and so effective had they proved for various tasks, that the proportion of gas shell was steadily increasing. It is noteworthy that no gas was used in naval actions during the World War, or from aircraft.

Gas as a Weapon.—The use of gas has added many complications to war. It compels all troops to carry a respirator involving additional weight of equipment and training. The presence of gas compels the wearing of the respirator, thereby reducing a soldier's efficiency both by the interference with vision, speech, etc., and by the added fatigue, and the respirator cannot be worn for long periods without arrangements which admit of eating and drinking. Also the possibility of a gas attack increases the strain on troops both by the constant watchfulness that is necessary and the moral effect of gas which cannot be neglected.

Gas accounted for a moderate porportion of the casualties in the War. During the last year of the War 16% of the British casualties were due to gas and 33% of the American casualties, but its tactical value cannot be judged by casualties alone; it proved invaluable in the neutralisation of artillery, interference with movement and hampering communication. Also, by the use of a persistent gas like mustard gas, it was possible to make a position untenable except at the cost of heavy casualties; this occurred at Bourlon Wood in Nov. 1917 and at Armentières in April 1918. In such ways gas proved itself a valuable auxiliary to existing weapons. Again, a heavy gas would penetrate into the deepest dugout which was immune against high explosive or shrapnel, and gas shell might be effective without getting a direct hit, as the gas from each burst to the windward of a target would drift over it. And above all, gas always carries with it the possibility of surprise.

Types of Gas Used.—The gases used in war can be classified roughly as follows according to the predominant effect which they produce on the body, although many gases may belong to more than one class:—

(1) Acute lung irritants, *e.g.*, chlorine and phosgene, which exert an intense irritant action on the respiratory organs leading to acute pulmonary oedema.

(2) Lachrymators, *e.g.*, xylyl bromide, which even in low concentrations make vision impossible by their irritant action on the eyes, although the effect may not outlast the exposure to the gas.

(3) Paralysants, *e.g.*, prussic acid, which in sufficiently high concentration cause death almost instantaneously by their effect on the nervous system.

(4) Sensory Irritants of the Eyes, Nose and Upper Respiratory Passages (also called Sternutators as they often cause sneezing), *e.g.*, diphenylchlorarsine; these are often effective in very low concentrations causing intense pain in the eyes, nose and throat, nausea and subsequent depression.

(5) Vesicants, *e.g.*, mustard gas, which cause inflammation and blistering of the skin, eyes, and respiratory tract, the effect being produced as a rule some hours after exposure.

Broadly speaking, the gases in groups (1) and (3) may be regarded as lethal agents, those in groups (2) and (4) as putting a man out of action immediately though temporarily, while the vesicants are delayed in action but have a great casualty producing power, even when used against troops trained in defensive measures.

The following tables give the principal gases used in the World War with a brief summary of their important characteristics:—

Substance	Chemical Formula	Date of Introduction	Boiling Point, degrees Centigrade	Approximate Concentration to incapacitate a man in a few seconds owing to lachrymation or coughing	Approximate Concentration which if breathed for more than one or two minutes would cause actual damage to the lungs	Used by B = British F = French G = Germans
Acute Lung Irritants						
Chlorine	Cl_2	1915	−33·6	1:10,000	>1:10,000	B F G
Phosgene	$COCl_2$	1915	+8	1:100,000	1:50,000	B F G
Trichlormethyl chloroformate	$Cl{\cdot}COO{\cdot}CCl_3$	1916	+128	1:200,000	1:50,000	F G
Chloropicrin	CCl_3NO_2	1916	+112	1:200,000	1:50,000 (Cumulative)	B F G
Lachrymators						
Xylyl bromide	$CH_3\,C_6\,H_4\,CH_2Br$	1915	+218	1:2,000,000	..	G
Ethyl iodoacetate	$CH_2ICOOC_2\,H_5$	1916	+180	1:5,000,000	1:50,000	B
Paralysants						
Hydrocyanic acid	HCN	1916	+26·5	>1:2,000 (immediately fatal)	No cumulative action	B F
Sensory Irritants of Eyes, Nose and Chest (Sternutators)						
Diphenylchlorarsine	$(C_6H_5)_2AsCl$	1917	+333 (M.P.+43)	<1:10,000,000	1:50,000	G
Diphenylcyanarsine	$(C_6H_5)_2AsCN$	1918	>+300 (M.P.+31)	<1:10,000,000	1:50,000	G
Ethyl dichlorarsine	$C_2H_5\,AsCl_2$	1918	+156	1:500,000	1:20,000	G
Vesicants						
Dichlorethyl sulphide (Mustard Gas)	$(CH_2Cl\,CH_2)_2S$	1917	+217 (M.P.+14)	..	1:1,000,000 with 60 min. exposure	B F G

Methods of Liberating Gases.—The method selected for liberating gas depends partly on the object to be attained and partly on the physical properties of the gas.

Gas can be discharged:—

(1) from cylinders as cloud gas;

(2) from projectiles, *e.g.*, shell, trench mortar bombs, or projectors, either as a true gas or in the form of liquid drops or as a fine dust;

(3) from aeroplane bombs as from other projectiles;

(4) as a spray from containers carried in aeroplanes or tanks.

Cylinder or cloud gas attacks were made by installing a large number of steel cylinders containing compressed gas in the front line trenches, and discharging these in a suitable wind so that the gas was carried over into the enemy's trenches. The gas used must be denser than the air so that it does not rise when discharged, and it must be at a sufficient pressure to ensure that the contents of the cylinders are discharged rapidly when the valves are released. Chlorine and mixtures of chlorine and phosgene were employed mainly for this purpose. Gas projectiles contain a toxic substance and a bursting charge, and the effect on burst depends on the nature of the filling and the size of the burster.

A volatile substance like phosgene forms a small cloud which drifts with the wind, while with a liquid like mustard gas part of the filling is dispersed as a cloud, but a considerable proportion will be scattered over the ground in or near the shell crater, and may continue to give off a dangerous concentration of vapour for days. A solid such as diphenylchlorarsine is dispersed as a cloud of fine dust which drifts down wind leaving no persistent effect. Similar results are obtained with aeroplane bombs. Liquids can be sprayed either from tanks or aeroplanes, but in the latter case there may be considerable losses by evaporation if the drops have to fall from a great height.

Protection Against Gas.—Like all other weapons gas has its antidote. This takes the form of a respirator which filters out toxic materials from the air before it reaches the lungs. The early patterns consisted of a pad of cotton waste dipped in a solution of sodium thiosulphate and sodium carbonate which was tied over the mouth. This was replaced by flannel or flannelette helmets dipped in various solutions, which were worn over the head and protected the eyes as well as the lungs. The measure of protection obtainable by such means is obviously very limited, and the use of a general absorbent such as charcoal has many advantages to offer. All the combatants in the World War finally adopted respirators in which the inspired air was filtered by passing through activated charcoal in a small container, with various admixtures of other substances to increase the protection against specific gases. Pads of cellulose or other filtering material were added to give protection against the fine particles produced by the explosion of shell containing such substances as diphenylchlorarsine. The container was attached directly to an impermeable facepiece held in position by elastic bands over the head so as to make an airtight joint round the face as in the German respirator, or it was carried in a haversack and connected to the facepiece by a rubber tube carrying a mouthpiece as in the British Box Respirator, in which case it was necessary to prevent breathing through the nose by a nose-clip attached to the facepiece. In the French respirator, which resembled the German, the inspired air passed over the glass eyepieces and prevented the depositions of moisture on them, thus securing clear vision.

The ideal respirator represents a compromise between safety and military efficiency. Its weight must be small, it must admit of easy carriage and rapid adjustment, and offer little resistance to breathing, also it must be comfortable to wear and interfere as little as possible with vision and hearing. At the same time it must give a sufficient measure of protection against all gases likely to be encountered in the field.

But the respirator alone is no guarantee of safety; the soldier must be able to recognise the presence of gas by its smell or other effects, and thus know when he needs protection. Also he must be trained to carry out his duties while wearing a respirator for long periods so as to suffer the minimum loss of efficiency.

Apart from these measures of individual protection, there are a number of precautions which may be grouped together under the heading of collective protection. These include arrangements for giving the alarm in case of a gas attack, the provision of protected shelters in which men can remain during a gas attack without wearing respirators, or to which they can go to eat or drink, and the clearing of gas and the decontamination of ground after a gas attack of any kind.

Future of Chemical Warfare.—After the experience of the War there is a general feeling that gas may figure again in some future war in spite of international agreements, and all nations are taking steps to equip their troops with protection against it. Gas proved itself so effective a weapon, it offers such possibilities of surprise and it can be produced so easily in the peace equipment of the chemical industry, that it would be rash to discount the possibility of its use under the conditions of war psychology. Moreover it is difficult to maintain that it is less humane than other weapons. For example, the total recorded British gas casualties were 180,983 with 6,062 deaths, whilst the mortality amongst other battle casualties was about 25%, and it was striking how small a proportion of the gas casualties who survived suffered any permanent disablement.

Most forecasts of future wars assign to gas an important rôle in its use from aircraft against mobilisation and manufacturing centres and even against the civilian population, and under certain conditions there can be little doubt as to its effectiveness. As regards its use in the field, much depends on whether the type of warfare is such as to permit of its employment in sufficient quantity and concentration. Position warfare offers exceptional opportunities for its use,

but the tank and the aeroplane which favour a return to some form of mobile warfare, may themselves become the means by which gas may be discharged most advantageously.

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CHEMISTRY (*see* 6.33) is the study of the components of the universe, of its ultimate materials, a branch of natural science. In ordinary life, we judge of man's character from his actions: so also in chemistry. The science had its beginning when man became a living soul and not only began to see and compare the objects about him and to notice changes but also to make logical constructive use of his observations.

Fire.—Fire, in the form of the sun, must have been his first wonder, but the fear of fire will have come upon him by accident, we may suppose—if not from the volcano, in the thunderstorm. His appreciation of its value will have varied with the conditions under which he lived, whether in a cold or a hot climate. The North American continent is without fire, though at times visited by devastating electric displays. England is not far from mounts Vesuvius and Etna and close to Iceland, one of the great volcanic regions of the world, though a region of ice and snow. The English owe much to their Scandinavian ancestry and, as Carlyle has told us, the primary character of the old Northland mythology was "the impersonation of the visible workings of Nature. Earnest, simple recognition of the workings of physical Nature, as a thing wholly miraculous, stupendous and divine. What we now lecture of as 'Science' they wondered at and fell down in awe before as Religion." Our task to-day is not only to recover this attitude but to put aside mythology and elevate our science into a pure religion—the pursuit and use of truth.

Discovery of Fire.—Sooner or later, man will have sought to make fire for himself. The most primitive method is by friction—by forcibly twisting a stick backward and forward in a hole in another piece of dry wood or by rasping one piece rapidly across another. This method may conceivably have been discovered in drilling holes into stones—in making hammer heads—or through pieces of bone, etc. Women early wore necklaces of rude beads and perhaps began by threading berries or flowers upon grass stems or rushes, as children do to-day, so discovering the decorative effect of colour. That red-ochre was used to decorate the body from an early period is clear from its constant occurrence among the remains of primitive man. The production of fire by friction, however, must have entailed a vast exercise of thought—as the heat that is generated has to be applied in raising easily inflammable material to the burning point. A second primitive method was to catch the sparks produced on striking the mineral *pyrite* with a piece of stone. Modern travellers have found this method in use among the Esquimaux, who actually mine the material for the purpose. We know this method came before the use of flint and steel, as pieces of the mineral have been found in the earliest cave-dwellings along with the most primitive flint implements: the latter method, necessarily, did not arise until the discovery and use of iron—itself one of the marvels of early human inventive power.

The Heat in Lime.—Thunder, as Carlyle tells us, to our Northland ancestors, was not mere electricity, as it is to us—it was the God Donner or Thor, God also of beneficent summer heat. Savages, when they have first seen fire, have thought it to be a devil or God that bit you sharply when you touched it and that lived upon dry wood. Familiar as we are with it to-day, we use it more often than not without a thought of its meaning; indeed the nature of fire has been but slowly disclosed to man, although its effects have long been obvious. Some of these, we can easily picture. In England and throughout Europe, wherever possible, primitive man has lived in limestone caves and excavations. One of the most inhabited parts of the island was the southeastern district where the soft limestone, chalk, prevails—in this region, indications of early human occupation are everywhere present. Living in such caves, man will often have built his fire surrounded by blocks of chalk, as we do to-day with any stones at hand, if we wish to boil our kettle in the open.

The harmless, unobtrusive limestone will thus have been burnt (calcined) and necessarily, from time to time, lumps will have been cast out of the cave and wetted by rain. Some observant person will have noticed that, when thus wetted, the lumps have burst asunder and grown hot, even giving off steam, whilst falling into the finest powder. Thus for all time, the easy method of reducing limestone into powder will have been discovered. Sooner or later, also, the greater growth of grass in places where the powder had been spread about will have been noticed and the use begun of lime and limestone as an agricultural fertiliser. Children playing with the wet lime must have felt its caustic effect, and spilling it upon their skin clothes will also have found out its hair-removing power: hence its use by the tanner. A distinction will thereafter have been made between mild (unburnt) and caustic (burnt) lime. Many such "simple" discoveries will have been made, in course of time.

Other stones will have been collected and burnt, just to see what happened. Being burnt in contact with charcoal, metallic ores will have been reduced and thus metals discovered, such as tin, copper and eventually iron. Tin and copper often occur together and their ores are very easily reduced—so it came, probably, that bronze was the first metal made, though we may suppose that the conception of metal was first excited in the mind of man by gold, which occurs native.

Experimental Science.—Chemistry, above all others, is *the* experimental science. The science began when wise men advisedly made experiments—apparently either with the object of discovering ways of transmuting metals into gold or of finding remedies for sickness, if not of lengthening life. We can almost restore the course of action followed. *Pyrite*, being of household value, will have been collected and stored. When stored, under ordinary conditions, especially if exposed to moist air or rain, it gradually "decays," changing to a soft brown solid, like the rust which so easily collects upon iron that early man must have known well. As when pyrite is burnt a pungent smell is obvious, like that from burning sulphur—a substance well known from its occurrence in volcanic districts—glimmerings of the presence of both iron and sulphur in the mineral will have been excited in observant minds and the foundation laid of modern methods of qualitative analysis. Stored in the open, the heaps of decayed pyrite will often have been washed with rain: here and there the washings may have been collected in pools, and when these dried up, in fine weather, green glass-like crystals of *green vitriol* will have been deposited. Glass-like substances generally were distinguished as *vitriols* by the early workers. They tested everything with fire, so "distilled" this vitriol and thus discovered *oil of vitriol;* later on this was made by burning sulphur under special conditions. The name oil of vitriol is still popular, though *sulphuric acid* is that now given to the liquid because of its connection with sulphur. No doubt, the discovery was very soon made that oil of vitriol or *vitriolic acid* was an extraordinarily corrosive substance, and its effect upon substances generally was therefore studied. When added to common salt, it expelled a vapour or spirit—*spirit of salt*—which was very soluble in water. To the present day, the solution is sold as *spirits of salt* or *muriatic acid*, because of its preparation from salt (*murium*). Vitriolic acid was also found to act upon nitre, again a natural product often met with near to human habitations, giving rise to a very volatile, corrosive liquid, which dissolved nearly all the metals—hence the name *aquafortis*, still in use among jewellers, which later gave place to *nitric acid*. Thus were foundations laid.

Exact Science.—Chemistry came to rank as an exact science with the introduction of the balance. The first *systematic* inquiry involving the use of the balance was that of Joseph Black, in 1755, into the nature of magnesia alba and limestone. His account is a classic, to be read by everyone who has the slightest desire to understand chemical method—for Black's method is our modern method and it is to him, more than to anyone else, that we owe the introduction of the logical quantitative spirit into our subject, though it was not until Lavoisier had made firm the foundations laid by Black that the force of the method was fully recognised and its use became systematised and established.

Let us endeavour, as far as possible, to put ourselves into Black's position. To-day, when cement is so much used in place of lime as a building material, and few of us see lime slaked to reduce it to a fine powder before mixing it with sand, we may best open our inquiry by procuring several lumps of limestone and—if we be unable to make it ourselves—of the lime made by "burning" it and begin by slaking a lump of the lime, laid upon a plate, first weighing the lime. As it is always well to deal with known quantities, we may also take a known amount of water. Tins are at hand everywhere and it is easy to beat out a spout at the edge of a small tin box and to weigh this, say, half-full of water.

Pouring the water over the lime but down a rod—a pencil will do—to prevent spilling, distributing it evenly and allowing it to soak in before adding more, we stop when the lime is visibly wet. Soon, if not at once, the block grows hot, begins to crack and fall to pieces and much steam is given off. The change is marvellous—that cold water should so produce heat is astonishing! What has happened? Is the water all got rid of as steam? On weighing the cold slaked lime, now a fine, dry powder, it appears that from 100 parts of lime and x parts of water, there is produced $100+y$ parts of the slaked lime, only $x-y$ parts of the water having been given off as steam. So the lime has, in some way, been joined to water and apparently the heat has been produced as a consequence of the act. *Limestone* never behaves in this way to water—what happens then when it is burnt to lime? What is the effect of burning things? Usually they are more or less completely destroyed. Is the limestone? Experiment shows that, when strongly heated, all limestones lose in weight, some as much as 42–43 %. The cleaner the limestone, the more it loses, the best whiting (so-called because it is used in making whitewash), prepared by levigating finely ground chalk, losing the

most. Sometimes, in limestone rocks, crystalline masses and even crystals are found of the mineral *calcite;* this also appears in limestone caves in the form of stalactites. When this is burnt, it not only gives lime but more than any other form of limestone. When every possible care is taken to be exact, the amount obtained is constantly—within the limits of experimental error—56 % by weight of the calcite; so 44 % is in some way lost! Precise determinations of the amount of water taken up by the 56 parts of lime so produced show it to be the merest trifle above 18 parts. What of the 44 that are lost in "burning" the limestone?

Tests of Calcite.—As calcite is thus found to have a definite composition and seems to be a pure limestone, the term may be used in preference to "limestone," which is the name not of a mineral species but of a rock that is found all over the world. How is it to be tortured into displaying its character? Its actions must be studied in full. As it is deposited as stalactite by the evaporation of water which has drained through limestone rock, the material must be soluble to some extent even in water. Solvents more powerful than water are known—do these affect it? Muriatic and nitric acids dissolve it readily but with effervescence—*i.e.*, gas is given off, *calcite gas*, let us call it provisionally: how much? The experiment being made in an apparatus which can be weighed before and after the escape of the gas, this also being collected and measured, it is found that 100 grammes of calcite afford about 44 grammes of gas and that these 44 grammes of gas measure about 22 litres. The missing 44 are thus caught and shown to be a gas—no wonder that when limestone is burnt nothing is seen to escape. What of lime? Is lime soluble in acid? Experiment shows that it is and that, as was to be expected, it dissolves without effervescence. It is thus made clear, that a gas is imprisoned in limestone which may be expelled by heating and also by means of acid. Hence the name "Fixed Air," used by Black. What is this gas, this fixed air? Is it one of the gases we know? We know *air*—we feel it as wind—though we do not see it. Everyone knows vaguely that air is life—that we inhale it and that we are kept warm by its use; it is also known that fire is in some way promoted by it: that burning involves an interaction of air and the fuel. Some few have learnt that less than 150 years ago the discovery was made, that the active constituent of air is the gas *oxygen*, of which there is nearly 21 %, all but about 1 % of the remainder, as we now know, being nitrogen, which is inert. Today, oxygen is produced in large quantities by liquefying air under pressure and separating the oxygen and nitrogen by distillation, just as we separate, for example, alcohol from water or petrol from crude petroleum. To compare these gases with calcite gas, we may ascertain the weights which have the same volume as the 44 parts of this gas obtained from 100 of calcite—the weight of the oxygen is 32, that of the nitrogen 28.

Oxygen.—Oxygen being thus easy to get—it is used on the streets from big iron cylinders into which it has been compressed, in welding iron rails by the oxy-acetylene blowpipe—we may test its behaviour in promoting burning. Anything which burns in the air, if kindled and introduced into oxygen, burns far more easily, often with great brilliance and energy. Wood, charcoal, coal, oils and alcohol all burn but only the flame is conspicuous: there is neither visible nor obvious product. Sulphur, used of old on matches, because it is easily fired, evidently yields a product, judging from the smell that is noticeable. Phosphorus, which burns with great brilliancy, yields a white solid. Why the name oxygen? The terminal *gen* is an indication that it is a generative material. The name was devised by the great Lavoisier—who was decapitated by the French revolutionaries in 1796, because the Republic had no need of savants—to express the fact that common combustibles were converted by it into *acids*, from the Greek *oxys*, acid, *gennao*, to produce. Oxygen remains, to-day, the most significant term in chemistry. Lavoisier's prescience in selecting it was absolute. The white snow from phosphorus, the fumes from sulphur, dissolved in water, taste acid and turn a vegetable blue colour, such as violet-juice, red; what of the product from charcoal, if there be one? On kindling charcoal in a current of oxygen and passing on the gas into a solution of blue litmus, the solution is reddened, though not made red. All vegetable matters, when burnt, together with more or less water, give a similar product, in that it is weakly acid. What of the gas from calcite? Passed into a solution of litmus, it causes faint reddening: at least a clue to its nature is thus obtained. That it is to be connected with coal or carbon was known at an early date—not only to Black but to his forerunners. Let us now consider how the connection may be established. Calcite, we have seen, is easily resolved into lime and calcite gas.

Can the gas from calcite be reunited with lime to reproduce calcite? Though but slightly soluble, lime is more soluble than calcite: lime-water has long been used medicinally: so if the lime in lime-water were to associate with the gas, when the two are brought together, the reproduced calcite might become evident by falling out of solution as it was formed. On passing the gas from calcite into lime-water, a white precipitate is formed. Having ascertained the solubility of lime, it is easy to prepare enough lime-water and from this make enough of the product to find out whether it can be burnt to lime and, if so, what percentage will be lost, also how much gas be set free on dissolving it in acid. The values agree with those obtained with calcite—moreover, seen under the microscope, the crystalline form of the product is like that of calcite. It being thus established that calcite can be reproduced from the two substances into which it is resolved by "burning," lime-water becomes a test for calcite gas. On burning charcoal or other "carbonaceous" material in oxygen and passing the product into lime-water, precipitates are obtained which prove on examination to be *calcite*, being like it in crystalline form and in composition, 100 parts yielding 56 of lime and 44 of gas. It is thus discovered not only that *carbon* is a constituent of limestone but that calcite gas contains both oxygen and carbon: the proportions in which these are associated are found, by burning known weights of carbon, to be as 12 to 32 in the 44 parts of gas obtained from 100 of calcite. As equal volumes of the gas and of oxygen weigh as 44:32, the gas may be said to contain its own volume of oxygen. It is now possible and desirable to use the more significant name *carbonic acid gas*, in place of calcite gas.

Having thus resolved limestone into three components, lime, carbon and oxygen, we may ask, what of lime? What happens when it is attacked by, say, muriatic acid? This latter is a solution of the *spirit of salt* in water—take away the water, which is known to have but a slight solvent effect upon lime, what will be the action of the spirit of salt?

On passing the gas from salt through a tube containing lime, this grows very hot and gradually liquefies; ultimately, with care, a liquid may be distilled off. On examination, this behaves exactly as if it were *muriatic acid*, a solution of the "spirit" *in water*. Apparently, water has been produced from the two interacting materials—what is water? What else is formed? The tube contains a solid, looking much like fused common salt. Is this "muriate," perhaps, common salt? If so, it should behave like salt and give spirit of salt when "tortured" by vitriolic acid. The experiment being tried, spirit of salt is found to be given off—but the residue differs from that obtained on thus treating salt, being but slightly soluble in water. The product from lime and spirit of salt is, in fact, a muriate, a *sea-salt* like substance—a *haloid*—but not sea-salt. When the "vitriol" from the lime is studied, it is eventually found to be the well known common mineral *gypsum*, which thus becomes connected with limestone. Clearly, something passes from the spirit of salt to the lime—does the reverse happen, perhaps? Is it a case of exchange? What is water? What is spirit of salt? Such questions were only recently answered. The compound nature of water was not suspected until towards the close of the 19th century. Priestley, in 1781, observed that "inflammable gas," as it was then called (made by dissolving iron, zinc or tin in muriatic acid), gave *dew* when exploded with air. Cavendish, repeating the experiments, came to the conclusion that the dew was plain water and subsequently produced water by exploding inflammable air with oxygen. Even earlier (1776), Macquer, in France, had recognised that water was produced on burning inflammable air. Lavoisier then studied the matter fully and eventually gave the name *hydrogen* (water-producer) to inflammable air. The first step toward proving that spirit of salt was a compound was the accidental discovery of the gas we now call *chlorine*, by Scheele, in 1774, on dissolving a new mineral (manganese) *pyrolusite*, which he was examining in "marine" or muriatic acid. Gay-Lussac and Thénard subsequently showed (1809) that hydrogen was produced on passing the gas spirit of salt over heated iron, and that spirit of salt could be formed by the interaction of equal volumes of hydrogen and chlorine gas (*cf.* T. M. Lowry's *Historical Introduction to Chemistry*).

The Caustic Alkalies.—The production of water from lime and the spirit of salt or hydrogen chloride is, therefore, a proof that lime is an oxide—of what? The nature of the caustic alkalies was scarcely suspected until Davy, at the Royal Institution, in 1807, obtained the metals potassium and sodium from caustic potash and soda, by decomposing them by an electric current. Limestone had long been classed with the common alkalies—soda and potash. Moreover, Lavoisier had conjectured that the alkaline earths (lime and baryta) were compound substances and like metallic oxides. This view was confirmed when Davy prepared calcium from lime (1808). The 56 parts of lime in 100 of calcite are now known to consist of 16 parts of oxygen and 40 parts of the metal calcium. As no further simplification can be affected by the means at the disposal of chemists, nor even by any mental process, the conclusion has been drawn that oxygen, carbon and calcium are simple materials or elements—within the meaning of the act chemical, the act in which an element is defined as a chemically unresolvable substance, for chemists are ruled by acts. Taking the percentage composition of calcite into account, it is noticeable that the ratio in which oxygen is present in the two oxides is $16 : 32 = 1 : 2$, which justifies us in speaking of lime as a *monoxide* (calcium oxide) and of calcite gas as a dioxide (carbon dioxide).

A vast amount of labour has been expended in determining the composition of water—the quantity obtainable from 56 parts of lime is 18·016, of which 16 are oxygen and $2 \times 1{\cdot}008$ hydrogen. To produce this amount of water from lime, hydrogen chloride (spirit of salt) must be used in the proportions of 56 of lime to nearly 73 of chloride. The amount of chloride used contains $2 \times 1{\cdot}008$ of hydrogen and 70·92 of chlorine. Calcite, we have already seen, is a substance of unvarying composition.

Such values found an interpretation in the doctrine proclaimed by the Latin Lucretius (B.C. 99–55) in his celebrated poem "On the

Nature of Things." The doctrine was borrowed, in the main, from Democritus, a Greek philosopher (*c.* 460–380 B.C.). Lucretius taught that everything was formed of indivisible particles or atoms, eternal and unchangeable; these atoms, " by various combinations, in infinite time, with the void in which they move, formed the universe." The doctrine was resuscitated and developed by John Dalton in 1808; to-day it is the accepted, proved basis of chemistry.

Matter is known to us in the three states of gas, liquid and solid. In the true gas, the particles are practically independent and very far apart, yet, as they are in very rapid motion, the distance they are apart is constantly varied and they often come into collision; they also constantly come into collision with any object exposed to their blows. Gaseous pressure is due to the impact of the particles upon the surface affected.

There is a temperature—the critical temperature—above which no pressure will cause a gas to liquefy: below this temperature, if a gas be compressed, ultimately its particles are brought sufficiently close together to exert an inherent attractive force—more or less powerful, according to the nature of the gas. The gas then liquefies. When the liquid is sufficiently cooled, it becomes solid and crystalline: the particles then take up certain definite positions.

Avogadro's Theorem.—Avogadro, in 1811, was the first to enunciate the view that the similar behaviour of gases, under comparable conditions, is to be explained by the assumption that *equal volumes contain equal numbers of particles:* consequently, the relative weight of the particles or molecules are as the relative weights of equal volumes at the same temperature and pressure; *i.e.*, as the densities of the gases. Taking hydrogen and oxygen, for example, the latter is found to be 15·880 times as heavy as the former. Having acquired a strange affection for the number 16 in connection with oxygen, having so often to deal with oxygen in their analyses, chemists have preferred to retain this number and to raise that of hydrogen to $\frac{16}{15{\cdot}88} = 1{\cdot}008$, although hydrogen is their unit of reference in practically every other respect—being the lightest of known elements. Though oxygen molecules are thus determined to be about 16 times, nitrogen about 14, carbon dioxide about 22 times as heavy as hydrogen molecules, it in no way follows that these are more than the relative masses of the molecules. Reflection shows that Avogadro's theorem has important consequences. If we consider compounds, taking water as the most familiar, the gas obtained by vaporising water (dry steam) is only 9 times as dense as hydrogen under comparable conditions. We know that of 9 parts of water, one is hydrogen, whilst eight are oxygen. The oxygen molecule, however, is 16 or 2×8 times as heavy as the hydrogen molecule—so that if there be one particle of oxygen in a molecule of water, there must be two particles of hydrogen. As a matter of fact, we know that when water is formed, by exploding a mixture of hydrogen and oxygen, twice as much hydrogen, by volume, as of oxygen is required—twice as many molecules, therefore, of the one as of the other interact.

As the volume is diminished by a third during the explosion, the number of water molecules formed must be only two-thirds the number of hydrogen and oxygen molecules concerned in their production—some division of both molecules, some new association of their parts, must have been effected. It is thus discovered that the molecules have parts: how many? we may ask. Extending the inquiry to the formation of other compound gases from hydrogen, taking spirit of salt or hydrogen chloride, this is found to contain hydrogen and chlorine in the proportion of 1·008 : 35·46. The density of the gas, however, is only about $18 = \frac{36}{2}$, compared with that of hydrogen: a value, however, one-half of the minimum value (1·008+35·46) which can be assigned to the amount containing the unit weight of hydrogen. Interaction of hydrogen and chlorine gases to form hydrogen chloride, moreover, takes place between equal volumes, without change of volume. Therefore, the two molecules must be supposed to have been each divided into two, one half of the one going to one half of the other: each molecule is a similar composite, the product being a dissimilar composite. It is as if a couple, say, two lively boys, dancing in a ball room, were to meet a dissimilar similar couple, say two sedate girls, and the two couples exchanged partners: there would still be two couples dancing, their joint effect in the room in occupying the floor would be the same as that of the original two couples, though they might be less agile than the one of these and more agile than the other.

Chemists have chosen to term the ultimate constituent of the molecules, atoms. The chemist to-day constantly applies the term molecule to the kinetic unit—the dancing couple, the term atom being reserved for the ultimate chemical unit. Physicists, thus far, have not made up their minds to use the terms consistently. The atoms, as in the case of mercury, for example, sometimes elect to dance alone, as molecules. Molecules are not necessarily complex units. Emphasis may also well be laid here upon the fact, that the *molecular weight* of any uniform substance, in the gaseous state, relatively to that of hydrogen, is arrived at very simply, hydrogen being taken as the unit of gaseous density, *by doubling the value of the gaseous relative-density.* Moreover, representing the hydrogen molecule as H_2, as 2 grammes of hydrogen occupy 22·32 litres at 0° and 760 mm. pressure, the gramme-molecular proportion (the molecular weight in grammes) will occupy 22·32 litres. Equations written in terms of molecules can, therefore, be at once read in gaseous volumes, as well as in mass proportions.

Symbols.—The entire system of atomic weights and of chemical formulae rests upon the foundations afforded by Avogadro's theorem. Each element is indicated by a special symbol, wherever possible the initial letter of its name—as H, Hydrogen, C, Carbon, O, Oxygen, Cl, Chlorine, Ca, Calcium. This symbol represents an atomic proportion and with it is always associated a certain numerical value—the atomic weight, *i.e.*, the smallest proportional weight known to be present in any molecules of the compound, hydrogen being given unit value, thus—

Hydrogen . .	H = 1·006	Chlorine . .	Cl = 35·46
Carbon . .	C = 12	Sulphur . .	S = 32
Nitrogen . .	N = 14	Calcium . .	Ca = 40
Oxygen . .	O = 16		

Properties of Elements.—The properties of an element are not to be defined in terms of any one set of measured values but from its behaviour generally—in fact, the portrait of an element is a great composite into which much must be read that cannot be expressed in exact terms. Chemistry is an art as well as a science and, as in all walks of life, few of its adherents have the artistic sense sufficiently developed to be able to appreciate fully the works that may be set out before them. To give an example. We deduce the properties of the element oxygen, not from the gas as we know it—which indeed is itself an oxygen compound O_2—but from the behaviour of this and all other oxygen compounds. We probably come far nearer in water and in ozone to what would be the behaviour of oxygen-stuff if it were alone than we do in that of the gas oxygen upon which we live. It were far better if we had distinct names for each of the stuffs we think of as an element, and for the compounds which the atom forms with itself. We are told that the diamond consists of carbon, but the conception the chemist has of atomic carbon (carbon-stuff) is as far removed from diamond as any two conceptions possibly could be. No elemental name could be more appropriate than that of azote, given by Lavoisier to the inert gas in our atmosphere—no name better for the stuff of which it is composed, one of the most active known, we have reason to believe, than that he had in mind, though unfortunately he did not know enough to justify him in proposing its use: aminogen. Ordinary oxygen gas were far better spoken of as azote—unfortunately the name is unpalatable. Chlorine is a particularly fit name for the gas we so-call; the name chlorhalogen (green salt-forming) would be more suitable for the atomic component of its molecules were it not that it lacks euphony.

Diverse Properties of the Elements.—Some of the elements are gases, very few are liquids, most are solids. Some, the majority, are *metals*—a term that needs no special explanation; some are very different from metals, *non-metals;* some show a half-way behaviour, whilst looking like metals—these are called *metalloids.* In all about 90 are known. It is being said that only 92 are possible. The elements are not only thus divisible into three types but into families. The members of human families tend to be more or less alike in their general conduct—though very different maybe in some particulars; indeed we class animals and plants in families because of resemblances—what is more, we think of the members of a family as genetically related. The lion, the tiger, the leopard, the domestic cat are all cat-like, we call them all *felidae.* Hydrogen stands alone in the esteem of chemists—it is Jove: they have made it their unit of adoration, they measure the loves of other atoms by comparing them with the hydrogen atom. Oxygen, however, is the most potent of all the elements; its character is the most marked, it is the most full of energy and shows the widest range of affection for other elements—few decline to be associated with it; it compels all the active non-metals, except fluorine, to join with it in forming acidic compounds; it marries with all the metals to form compounds which neutralise the acids, alkylic (alkaline) oxides—though if the metals be allowed sufficiently to satisfy their polygamic tendencies towards oxygen, they are in the end overcome by it and the outcome of the union is acidic; it also has particular affection for itself.

The Halogens.—As to families, chlorine—the major con-

stituent of common salt—is one of a family of four *halogens:* fluorine, chlorine, bromine and iodine. They are a striking company, in so much as they are all more or less coloured and directly offensive to the nose and animal tissues, being highly corrosive and poisonous. Their chief chemical peculiarity is their ability to enter into association with hydrogen, atom for atom, forming the hydrides HF, HCl, HBr, HI. These are all colourless gases, very soluble in water; though not acids themselves, they form acids when thus dissolved. The halogens form compounds with the metals generally.

The Oxygens.—Oxygen is remarkable among the elements as the dominant parent of water. This is commonly represented as a neutral substance and appears so to us, because it is so much a part of ourselves: actually it is the most universally active and potent of known compounds. With it are to be associated, as members of its family, though somewhat distant relatives in many of their characters, the elements sulphur, selenium and tellurium. These all form hydrides characterised by powerful odours, analogous to *Hydrone,* OH_2, the unit-molecule of water, in composition; they also form a series of corresponding acidic oxides, SO_2, SO_3, etc. They combine with the metals generally.

Aminogens.—Lavoisier hesitated whether he should not give the alternative name *Nitrogen* to the chief constituent of air. In selecting *azote*—a name which the French have logically preferred to the present day—he recognised the peculiarity which renders it of value as a diluent in our atmosphere. Recognising the remarkable properties of *ammonia,* he was inclined to use the term *aminogen,* but was eventually led to select nitrogen, because of the relation of the element to nitre and nitric acid. At that time, little was known of the great part played by nitrogen in nature and of the existence of ammonoids derived from other elements. Nitrogen is to be associated with the elements phosphorus, arsenic and antimony, because these all form hydrides like ammonia, NH_3; they also form acidic oxides and acids like those formed from nitrogen.

Carbon is a host in itself, the most wonderful of all elements, in giving rise to a vast number and variety of compounds, all of which may be regarded as built upon the single simple foundation stone afforded by its lowest hydride, CH_4, *methane* or marsh gas. It is usual to associate it with silicon and titanium, particularly because of the analogy in the empirical composition of the oxides; the relationship is a distant one, however. Methane is an entirely neutral substance.

Metals.—The non-metals are distinguished, speaking generally, by the formation of simple gaseous hydrides. The metals are not to be thus characterised, though hydrides of many are known. They are to be recognised rather by their behaviour towards acids, from which they displace hydrogen, forming salts; also by combining with chlorine and with oxygen in characteristic proportions.

Several families are to be distinguished. The sodium family containing lithium (7), sodium (23), potassium (39), rubidium (85·4) and calcium (40), is characterised by the fact, that they are all soft metals which act vigorously upon water, liberating hydrogen and forming hydroxides, such as caustic soda (NaOH) and its analogues. They all unite with the halogens, forming halides or haloids similar to common salt, NaCl.

The metals of the calcium family, calcium, Ca, strontium, Sr, barium, Ba, are also soft and readily attack water, forming hydroxides resembling " caustic lime " $Ca(OH_2)$, and combining with the halogens to form dichlorides, $CaCl_2$, etc.

In fine, if the symbols of the elements generally be written in a continuous series, in the order of their atomic weights, it is obvious that throughout the series there is a progressive alteration in properties, accompanied by a periodic rise and fall, certain properties reappearing at intervals throughout the series. This peculiar relationship was specially insisted upon by the Russian chemist Mendeléeff and is commonly referred to as Mendeléeff's periodic classification. This periodicity comes out most strikingly when the volumes calculated as occupied by atomic proportions are contrasted with the atomic weight, and also when comparison is made of the variation in the heat-capacities of the elements at the boiling point of hydrogen (−253°), as in the following diagram:—

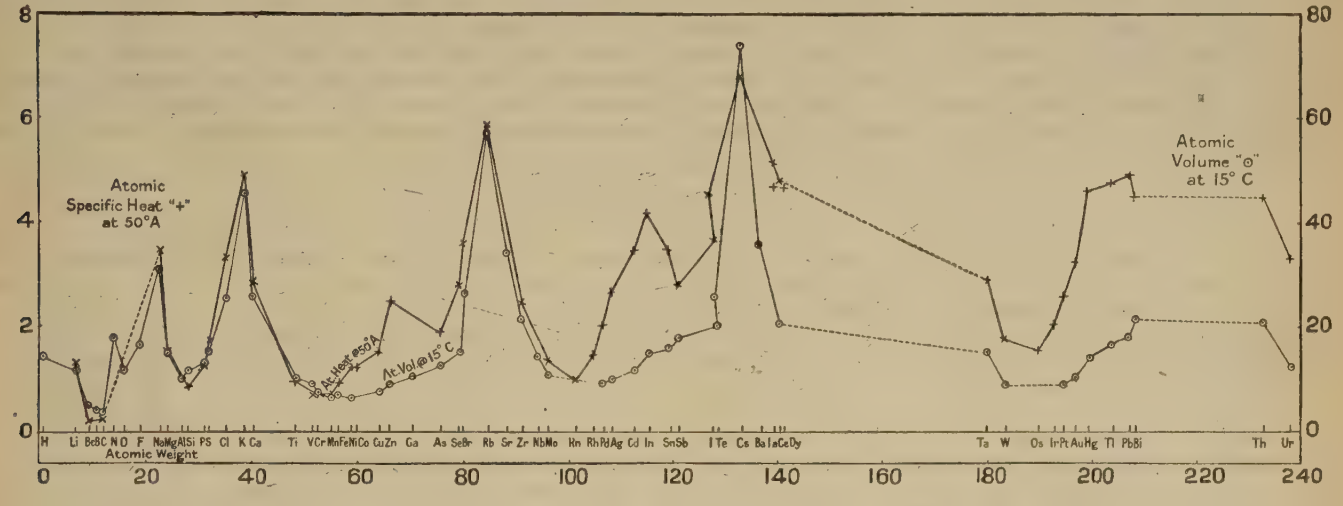

Atomic Specific Heat "+" at 50°A
Atomic Volume "o" at 15° C
At. Heat @50A
At. Vol @15° C
H Li BeBC N O F NaMgAlSi PS Cl K Ca Ti VCrMnFeNiCo CuZn Ga As SeBr Rb Sr Zr NbMo Rn RhPdAg Cd In SnSb ITe Cs BaLaCeDy Ta W Os IrPtAuHg Tl PbBi Th Ur
Atomic Weight
0 20 40 60 80 100 120 140 160 180 200 220 240
0 2 4 6 8
0 20 40 60 80

FIG. 1. Diagram showing periodic variations of heat capacity and atomic volume.

Radium.—Chemists, especially those who are conversant with the manner in which function is correlated with structure in carbon compounds could not fail to be struck by these relationships. They have, therefore, long held the belief that ultimately the supposed elements would be found to be composites that were in some way structurally related. The important discovery of radium (*q.v.*), suddenly gave substance to this view, and the modern electronic conception of the structure of matter is no more nor less than its justification. At present, radium is the riddle of our chemical universe. To all appearance an element, in that it closely resembles the metal barium, it differs from all that were previously known, except thorium and uranium, in that it spontaneously undergoes decomposition, at a definite rate, giving rise to helium and another gas (radon), the which gas, in turn, again gives off helium and is ultimately converted into lead (*see* RADIO-ACTIVITY). Strangely enough, we cannot influence these changes by any of the means at our disposal. Whatever lead may be, radium and the intermediate elements seem to be its helides. Helium (*q.v.*) is suddenly become to the chemist one of the most interesting of known substances.

Isotopes.—Ballistics (*q.v.*) have played a great part in the further recent development of our knowledge. The molecules in gases are always in turbulent motion. First Sir J. J. Thomson, then F. W. Aston, have developed methods of firing atomic molecules (molecules reduced to their ultimate degree of fineness) through a very narrow tube and directing their course of travel by electric

and magnetic controls, so that they are delivered at a photographic plate at points determined by their mass and the electric charge they carry. From the photographs so obtained, it is possible to deduce the masses of the impinging particles (*see* Isotopes). Treating nitrogen and oxygen in this way, hits are scored in positions 14 and 16—showing that the ordinary diatomic molecules of the gases are resolved into monatomic molecules. Hydrogen hits are scored slightly off position 1, in agreement with the conclusion that it is slightly heavier than unity.

The strangely fractional atomic weight of chlorine, 35·36, has always puzzled chemists: some have even thought it to be a mixture. Aston has shown that this is so. Firing the molecules at his photographic plate, he has scored hits at two points, 35 and 37, the impression produced at 35 being about double as intense as that at 37, justifying the assumption that ordinary chlorine is a mixture in the proportion of 2:1 of two sets of molecules, one of mass 35, the other of mass 37. These two constituents of chlorine, apart from the difference in atomic mass, differ so little in chemical behaviour, that they pass as alike: they are like "identical" twins born at slight intervals apart. Such are termed *isotopes*.

Classification of Elements.—Chemists are still further indebted to physicists for the aid they have recently received from them in classifying the elements and "fixing" their possible number. When a slit of light falls upon a plate upon which fine lines have been ruled close together (a diffraction grating) the slit is spread out into a coloured band or spectrum. In like manner, when X-rays fall upon a crystal surface, striking the atomic centres, which may be regarded as forming lines corresponding to those on a grating, they are deflected to an extent which depends upon the atomic masses (*see* Crystallography). When the X-ray spectra of the elements are arranged in the order of the atomic weights, one below the other, they form a stepped series. The staircase is seen to be complete, except in very few places—the number of steps indicated between hydrogen and uranium being 92; in the table below the elements are arranged in the order of their atomic weights, horizontally and vertically in great families. As in human families, there may be marked diversity of character within a family.

Electricity.—Having thus sketched, in barest outline, the manner in which chemists have gradually developed their knowledge of the materials open to study and established an atomic theory of the constitution of matter, of which an extension is foreshadowed in the electronic conception of atomic matter, we may pass on to consider the value of the several pieces on the chemist's chessboard and the manner in which the game of chemistry is played in the laboratory and in Nature. Progress has not always been premeditated but has often been the outcome of some happy accident to a shrewd observer. Such was the case when Galvani (1779) noticed that a frog's leg was caused to twitch when pieces of two different metals touching at the one end were placed, some distance apart, upon the bared muscles; hence arose the discovery of what became known as the Galvanic current. Soon afterwards (1780), Volta constructed his electric pile, consisting of alternate discs of copper and zinc separated by discs of paper moistened with a solution of salt. Workers were thus provided with a means of producing an electric current. Good use was soon made of this, especially by Sir Humphry Davy. His successor, Faraday, was the first to show, though not until 1833, that the electricity of Volta's pile was

GENETIC TABLE OF ELEMENTS

				1. Hydrogen 1·008 o				
2. He 4	3. Li 6·94 (7–6)	4. Be 9·1	5. B 10·9 (11, 10)	6. C 12 o	7. N 14·01 o	8. O 16 o	9. F 19 o	
10. Ne 20·2 (20, 22)	11. Na 23 o	12. Mg 24·32 (24, 25, 26)	13. Al 27·1	14. Si 28·3 (28, 29)	15. P 31·04 o	16. S 32·06 o	17. Cl 35·46 (35, 37)	
18. A 39·88 (40, 36)	19. K 39·1 (39, 41)	20. Ca 40·07	21. Sc 44·1	22. Ti 48·1	23. V 51·06	24. Cr 52	25. Mn 54·93	
							26. Fe 55·85	
							27. Co 58·97	
							28. Ni 58·68 (58, 60)	
	29. Cu 63·57	30. Zn 65·37	31. Ga 69·9	32. Ge 72·5	33. As 74·96 o	34. Se 79·2	35. Br 79·92 (79, 81)	
36. Kr. 82·92 (78, 80, 82, 83, 84, 86)	37. Rb 85·45 (85, 87)	38. Sr 87·83	39. Yt 88·7	40. Zr 90·6	41. Nb 93·5	42. Mo 96	43. ———	
							44. Ru 101·7	
							45. Rh 102·9	
							46. Pd 106·7	
	47. Ag 107·88	48. Cd 112·4	49. In 114·8	50. Sn 118·7	51. Sb 120·2	52. Te 127·5	53. I 126·92 o	
54. Xe 130·2 (129, 132, 131, 134, 136)	55. Cs 132·81 o	56. Ba 137·37	57. La 139					
			58. Ce 140·25					
			59. Pr 140·6					
			60. Nd 144·3					
			61. ———					
			62. Sa 150·4					
			63. Eu 152					
			64. Gd 157·3					
			65. Tb 159·2					
			66. Dy 162·5					
			67. Ho 163·5					
			68. Er 167·7					
			69. Tm 168·5					
			70. Yb 173·5					
			71. Lu 175					
				72. Hf 178·6	73. Ta 181·5	74. W 184	75. ———	
							76. Os 190·9	
							77. Ir 193·1	
							78. Pt 195·2	
	79. Au 197·2	80. Hg 200·6 (6) 197 to 204	81. Tl 204 (various radio elements)	82. Pb 207·2 206, 208 (various radio elements)	83. Bi 208 (various radio elements)	84. Polonium (various radio elements)	85. ———	
86. Nt 222 (Th Em 220 Ac Em 218)	87. ———	88. Ra 226 (Th X 224 Ac X 222)	89. Ac 226 (Ms Th II 228)	90. Th 232·15 (various radio elements)	91. U X 2	92. U 238·2 (U II 234)		

(For latest Isotope numbers *see* Isotopes.)

identical with that produced by friction or let loose in the thunderstorm. The difference was only in concentration or potential. Frictional electricity, though small in quantity, is of high potential—able to leap across considerable spaces—whilst that from the Voltaic pile or Galvanic battery (both terms were long in use together) is of low intensity but of any desired quantity. Prior to Faraday, in 1801, Nicholson and Carlisle had passed the electric discharge through water, obtaining hydrogen and oxygen; Davy, in 1807-8, obtained the alkali and alkaline-earth metals by similar means.

Electrolysis.—Faraday, from 1834 onwards, systematically studied, in an exact manner, the effect of electric currents upon compound substances generally. Some, relatively few, carried or conducted the current and, as a consequence, were decomposed. He established two classes of electric conductors—(1) Metallic conductors, the metals generally (all *elements*), which carried the current more or less well, conductivity always diminishing as the temperature rose; (2) Electrolytic conductors, compounds which carried the current but were decomposed as a consequence—conductivity increasing as the temperature rose. All such compounds belonged to the class of "salts," including acids and alkalies, in this class. Apparently, no compound acts as a metallic conductor. The term electrolysis was coined by Faraday to express decomposition by an electric current; he termed the compound affected the electrolyte; electrolysis being effected by plunging two platinum plates attached to the two poles of an electric battery into the fused substance or a solution of the substance in water. He termed the plates electrodes, the one the kathode, the other the anode. The two substances into which the salt was immediately resolved were termed *ions*—travellers—one the kation, the other the anion.

By no means are all salts by themselves electrolytes, in the liquid state. Sodium chloride, silver chloride, lead chloride and tin dichloride are all easily electrolysed; beryllium chloride, stannic chloride, $SnCl_4$, mercuric chloride, $HgCl_2$, to mention only a few, are not, however. In fact, *per*-salts generally are non-conductors. There is reason to think that only metallic salts are conductors, and proof has yet to be given that these would be electrolytes, if free from all impurity. The liquid hydrides, apparently, are non-conductors. Thus, the conductivity of water diminishes rapidly as it is purified and is ultimately so slight, that if the impossible were done and all impurity removed, we may well suppose that it would be a non-conductor. *There is no other logical conclusion to be drawn from the facts.* Liquefied hydrogen chloride behaves similarly. Yet if the two be mixed, solutions are obtained which conduct readily: the specific conductivity rising rapidly, as the chloride is diluted, to a high maximum, then falling but much less rapidly to nil when water is reached. It seems that two types of electrolyte must be distinguished—(1) simple: certain fluid salts; (2) composite: solutions of salts in water (and a few other media).

Electrolysis is a very definite operation. The substance affected is always split into two equivalent portions or radicles (ions). If a current be passed through a series of solutions, the radicles are separated in equivalent proportions, which are not necessarily atomic. Thus sodium, silver and lead chlorides yield their radicles in the proportions

Cl	Na	Ag	Pb/2
35·46	23	108	103

—Faraday recognised that a definite quantity of electricity was associated with the atom and that the unit quantity (the equivalent) carried the unit electric charge. Much later, Helmholtz insisted on the importance of the conception of atomic charge and Johnston Stoney termed it an electron. Finally, Sir J. J. Thomson gave precision to the idea, claiming that the electron is, as it were, a material particle of negative electricity, about 1/1800 of the mass of the hydrogen atom. None the less, it seems to be the most masterful unit with which we have to deal. To-day, it is supposed that the atoms consist of highly-condensed, positively charged mass centres surrounded with electrons, in numbers depending upon the mass of the nucleus (*see* ATOM; ELECTRICITY; ELECTRON; MATTER).

All such speculation is of infinite interest but at present it is outside the chemist's ken; he must await the time when the physicist has developed the subject to the point at which it may be of constructive use to him, particularly in explaining dynamic peculiarities which thus far have met with no feasible interpretation. His own formulae are sufficiently vague and wooden, in their implication. The poor paraphrase, those who dabble in electrons would substitute, has no real meaning at present. In fact, the time is not yet ripe for the considered use of the electron in chemistry: the substitution of an artifice for a system of proved efficiency, by no means yet exhausted of value, is to be deprecated. At the present day we need more than ever to go back to the laboratory and work seriously and constructively at things we understand and dare speak of truthfully—without pretence of knowledge.

Nature of Chemical Change.—The electric current "reverses" chemical change but is itself produced by means of chemical interactions—in the voltaic cell. Faraday was the first to recognise the *inseparability* of the two phenomena. No student of chemistry should fail to study his electro-chemical researches from this point of view. A cheap reprint is published in the *Everyman Series.*

What is a voltaic cell? How does it function? Volta's pile consisted of discs of zinc and copper with an electrolyte (a solution of salt) in between. This has served as the model of all developments of the "cell," which always consists of a metal used as anode, which can be associated with one radicle of the electrolyte, the kathode being an inert metal, usually platinum—or a conducting char (coal). *Three* conductors, therefore, are thus coupled in a circuit: *one* of them, however, is composite and a conductor. This is the inevitable arrangement of an electrolytic couple or voltaic element. Originally, common zinc was used but this is readily attacked by acid when "uncoupled" and so is used wastefully. Gradually, it was discovered that the less impure the zinc, the less readily it was attacked when uncoupled: then it was found that if it were coated with mercury (amalgamated) it was not attacked in open circuit.

Notwithstanding this definite statement made by Faraday, and his insistence (in 1833) upon the essentially electrolytic character of the change when a metal, like zinc, is attacked by an acid, like sulphuric, practically to the present day, in the text-books generally, little or no heed is taken of his findings. Hydrogen is spoken of as prepared by dissolving zinc in sulphuric acid. Hydrogen and oxygen are said to interact to form water, etc. etc., and bare equations are given in illustration. The conditions under which such changes take place are rarely, if ever, pointed out and made clear. During the past 50 years, however, a large amount of exact work has been done, particularly by H. B. Baker, which entirely justifies Faraday's statements. It was early observed, by Wanklyn and others, that carefully dried chlorine has little if any action on metals which are readily attacked by the undried gas. Then H. B. Dixon showed, that a mixture of carbonic oxide and oxygen could not be fired, if it were dry.

H. B. Baker extended the observations to charcoal and phosphorus, showing that these did not burn in dry oxygen. On this last occasion (1885), H. E. Armstrong insisted that the conditions required by Faraday's generalisation must be fulfilled, if chemical action were to take place in such cases. Taking the formation of water, as an illustration, he contended that oxygen and hydrogen could not interact, as neither was an electrolyte; further, that interaction would not be induced even by the presence of water, as this was not an electrolyte and did not form one with either oxygen or hydrogen: the presence of impurity (a trace of acid or alkali) was essential to constitute the needed electrolyte. Several years later, this forecast was verified by H. B. Baker, and so many similar verifications of the view have been secured that it may now be regarded as an expression of the facts generally. Apparent exceptions have been shown, one by one, to fall out, when proper precautions have been taken to secure the necessary freedom from dirt—defining dirt as matter in the wrong place.

The equation of chemical change may be written generally

$$A_2 + \epsilon\delta + B_2 = AB + AB + \epsilon\delta$$

where $\epsilon\delta$ represents *maybe a mere trace* of the indispensable *electrolytic determinant*.

Catalysts.—The term *determinant* should not be confused with that of *catalyst* (*q.v.*) which is of frequent occurrence in modern chemical literature. The latter term was first applied by Berzelius not only to the action of sulphuric acid in promoting the formation of ether from alcohol and of glucose from starch but also to the action of platinum black in promoting the oxidation of alcohol to acetic acid, as well as to the action of the enzyme (ferment) diastase in malt upon starch. These are not comparable changes: the first two occur in solution, the second two at the surface of solids and, as the solid has a specific surface-effect in hastening the change, such actions may be treated apart. It is desirable, in fact, to confine the term catalyst to the solid agent which thus acts, not as mere determinant but in quickening a change already proceeding or which may proceed under the influence of a determinant, the change being one which could not occur in the absence of this latter. The equation of change, when a catalyst (κ) is operative, may be written:

$$A_2 + \epsilon\delta\kappa + B_2 = AB + AB + \epsilon\delta\kappa.$$

Even when the necessary condition of impurity (the determinant) is secured, no metal can be caused to dissolve in an acid, *unless it have a positive heat of dissolution*—or, stated more simply, unless the heat of formation of its oxide be in excess of that of hydrogen. Thus copper is insoluble in acids generally. The approximate heat of formation of copper oxide being only 40,800 or 37,000 units, according as that of cuprous or of cupric oxide be taken, that of hydrogen being 68,000 (gramme degree) units—these being the quantities of heat liberated in the use of 16 grammes of oxygen at atmospheric temperature. If, as is contended here, water be concerned, at least in most chemical interchanges, this is but a rational result. Though insoluble alone, copper is easily dissolved in presence of oxygen—which acts as an *adjuvant*, throwing energy into the circuit—as shown in the following empirical equation:—

$$Cu + SO_4 \ldots H_2 + O_2 = CuSO_4 + \ldots + H_2O_2.$$

The action of copper sulphate in the Daniel cell and of nitric-nitrous acid in the Grove cell is of the same kind: $Zn + SO_4 \ldots H_2 + SO_4 \ldots Cu + Cu = ZnSO_4 + \ldots H_2SO_4 + \ldots + CuCu$.

In a simple zinc-sulphuric acid-copper couple, the copper plate soon becomes "polarised" by the accumulation of hydrogen. This is prevented by the copper sulphate, as copper is displaced from the salt by the hydrogen and the electrode surface remains uniform; but such displacement involves the liberation of energy, so the compound cell has both a higher electromotive force than the simple cell and gives a steady current. Substances which thus act as adjuvants are termed, generally, *depolarisers*. The importance of this limiting effect, imposed by the need of electrolysing water in a circuit of chemical change, has yet to be recognised.

Acid Action.—Had simple considerations of this kind and the function of the depolariser been appreciated, the complex series of interactions observed on dissolving metals in more or less impure nitric acid—one of the most involved chapters in chemistry—would have been interpreted without difficulty. It would have been realised that the acid proper acts only in one way—as a compound of the two ions, H and NO_3. It must be incapable of acting directly as a depolariser. The depolarising action of the impure acid is to be attributed, if not to nitrogen dioxide itself, to some nitrous compound which this forms with the acid. The various products, other than the nitrate, obtained in dissolving metals in the acid, are all reduction products, less or more remote, formed by the interaction of hydrogen displaced in the electrolytic current in which the nitrous compound acts as depolariser, the rapidity of delivery of the hydrogen determining the extent to which the reduction is carried.

Corrosion of Metals.—In recent years, there has been a vast amount of discussion over the corrosion of metals. In this case also, had the elementary principles of chemical interchange been grasped and taken into account, much of this would have been unnecessary and a more useful direction would have been given to the work. To take only the rusting of iron—this may clearly occur in two ways, either in a simple or in an aided circuit. In so far as the iron itself is concerned, it may be said, without hesitation, that it is acted upon only by acid and in one way: $Fe + 2HX = FeX_2 + H_2$ (*see* Rustless Steel). Out in the open, carbonic acid is the effective agent; in towns this may be anything. If the liquid film in which the action takes place be free from oxygen or reducible substance, the negative element in the couple (carbide or other active impurity in the iron) is soon polarised and the action takes place irregularly and slowly. If, by the intervention of dissolved oxygen, the polarisation be prevented, action will not only be continued but accelerated, owing to the adjuvant effect exercised by the depolariser. Such attack is corrosion but not rusting. Rusting is due to the separation at the surface of the iron of oxide either from the ferrous salt which is initially produced or from ferric salt formed from this ferrous salt: these salts are continually being hydrolysed as they are produced. So long as acid can penetrate through to the iron surface, the action must continue. The character of the deposit will depend upon secondary changes, due, usually, to the intervention of oxygen as depolariser.

Water.—Of all substances known to us not only the most active and useful but the most marvellous is water. Without water, apparently, "chemical change," as we know it, could not occur—the world would not merely be lifeless but subject only to "mechanical" decay. The contrasts water affords, in its three states, is shown by no other compound—specially remarkable is the change that attends the passage from the liquid to the solid state, involving a sudden growth in volume of about one-tenth. Some new "planetary system" may well be supposed to come into existence, owing perhaps to a great rearrangement of orbits. When this can be fully explained, in terms of electrons, chemists may well begin to take these seriously in their work—not before. The life-history of water is a wonderful story. Commencing with the two gases, hydrogen and oxygen, two of the least coercible that are known to us, on interaction (under the influence of a determinant and probably also of a catalyst), these afford the liquid *water*. Much "energy" is set free in the process, ultimately as heat, the amount developed in the creation of the gramme-molecular proportion (18.016 grammes) being enough to raise the temperature of nearly 700 grammes of water from 0° to 100° C.

What meaning are we to attach to the word *water*, however? It should be reserved for and applied to *the liquid alone*, which undoubtedly is a complex. The fundamental unit molecule, represented by the symbol OH_2, is best spoken of as *hydrone*. This is a gas under ordinary conditions. The formation of water from this gas may be pictured as a chemical process or interaction in no way distinguishable, in principle, from that involved in the primary interaction of the gases hydrogen and oxygen. Aitken's experiments are held to have proved that the condensation of "aqueous vapour" and the formation of drops of (liquid) water in the atmosphere—of cloud—only takes place around a solid nucleus—a catalyst, in fact. It is more than probable, that it will eventually be found and admitted that a *determinant*—a trace of some "salt"—is also necessary. Such impurity is always present, in the form of carbonic acid, nitrous and nitric acids, if not of sulphurous or sulphuric acid, an ammonium salt or sea salt. The nature of the interaction, the composition of the product, is undetermined. Probably, water is a mixture of various liquid components, of *polyhydrones* $(H_2O)_x$, $(H_2O)_y$, etc., saturated with the gas hydrone OH_2, the proportions of the constituents depending upon the temperature. Even above 4°, the point of maximum density, the liquid must be saturated with ice-molecules: the complexity of these is also undetermined—maybe the hydrone unit simulates the carbon unit and preferentially combines in sixes. It is a matter of interest that "ices"

of greater density than ordinary ice may be obtained by subjecting ice cooled to various temperatures to great pressure. All suggestions hitherto advanced as to the composition of " water " molecules, under various conditions, may be regarded as purely speculative.

Water is a specially active solvent of compounds—after its own heart: of compounds of oxygen and of the halogens, in a lesser degree of nitrides (compounds of the ammonia type), not at all of " neutral " compounds of carbon (the hydrocarbons). Dissolution—whatever the solvent—presumably, is a chemical process, in the main: not a mere intrusion of the dissolved molecules among those of the solvent but the consequences of some degree of " affinity " between the contending molecules. The process cannot, therefore, well be considered without reference to the affinities of molecules and of their constituent atoms.

Affinity and Valency.—The gas hydrogen, as we know it, is an almost neutral material. It is condensed to a liquid only under high pressure, at a low temperature; the liquid boils at $-253°$. The molecules of hydrogen, therefore, have but little affinity for each other. The molecule is diatomic, being represented by the formula H_2. As the two atoms are firmly held together in the molecule, they must have considerable affinity for each other and nearly satisfy one another: the molecule has but a slight, obvious, *residual* affinity. The same may be said of gaseous oxygen. Being far heavier than those of hydrogen, the molecules are, in a measure, less swift in movement and more easily " caught " by other molecules. Oxygen is definitely more active and displays a high degree of residual affinity. Moreover, we must picture atomic oxygen, like atomic hydrogen, as gifted with intense affinity—with an almost indiscriminating affinity, as excepting the argonides and fluorine, it forms compounds with all the elements, most of which are of a relatively high order of stability. It is a far more companionable element than hydrogen. Bring hydrogen and oxygen together, in presence of the necessary negotiators of change, allow them to interact in the sense of the equation,

$$2H_2 + \epsilon\delta\kappa + O_2 = 2H_2O + \epsilon\delta\kappa$$

they give rise to hydrone and eventually to water. These products differ in an astounding way from their generators. The molecule of hydrone has little more than half the mass of that of oxygen, yet—given proper conditions—it condenses, with the greatest ease, to water. Not only so, the amount of energy set free in the interactions of the molecules of hydrone, $x\,OH_2 = (OH_2)_x$, is about one-tenth of that liberated in the original gaseous interaction. The molecules of hydrone are thus shown to be possessed in a far higher degree of residual affinity than is even oxygen. Hydrone, indeed, may be said to be a really active form of oxygen-stuff—far more so than oxygen itself. Hence water is so good a solvent: at least, there are molecules in the liquid mass which are very active, chemically speaking. Water, we shall see, must be regarded as a complex mixture, in which are present molecules of varying degrees of complexity: H_2O, $(H_2O)_x$, $(H_2O)_y$, etc., in proportions which depend upon temperature.

Hydrogen and Chlorine.—Similar considerations apply to hydrogen and chlorine and to hydrogen chloride, the product of their interaction—under appropriate conditions. Although chlorine is much more easily condensed than is oxygen, and therefore is to be credited with an even greater store of residual affinity than is oxygen, strange to say, hydrogen chloride, though a more massive molecule than hydrone, has little attraction for itself, being far less easily liquefied than is hydrone; moreover, the liquid is a poor solvent compared with water. Nevertheless, hydrone and hydrogen chloride attract each other irresistibly—the chloride is very soluble in water. We have to consider what the nature of the interaction may be in this and in other cases of dissolution in water.

Azote.—Azote is more extreme in its behaviour than is even hydrogen. The molecule N_2 is all but inert under ordinary conditions, yet we have every reason to believe that its component, atomic nitrogen, is gifted with intense affinity. Whereas hydrogen and chlorine, respectively hydrogen and oxygen, interact readily, when merely brought together in presence of the necessary determinant and the mixture is sparked, azote and hydrogen interact only under high pressure, at a fairly elevated temperature and in presence of special catalysts. The interaction, moreover, is very partial: in fact, the product, ammonia, is formed reversibly: $N_2 + 3H_2 \rightleftharpoons 2NH_3$, interaction taking place far more readily backwards than forwards.

Ammonia.—Ammonia, like hydrogen chloride, has little affinity for itself, though more easily liquefied than the latter; the liquid has special solvent properties of a most interesting character. The gas is readily dissolved by water but is easily expelled from the solution. Most characteristic of ammonia is its behaviour with hydrogen chloride: the two interact, when properly impure, on admixture, forming the white crystalline solid, ammonium chloride

$$HCl + \epsilon\delta + NH_3 = NH_4Cl + \epsilon\delta$$

a salt which bears the closest possible resemblance to common salt.

Carbon.—Lastly, we have to consider the most attractive to the fair sex of all elementary materials—carbon. We ought to confine this term to the ideal represented by the symbol C—which we cannot directly handle. We only know it in its compound polyatomic form, as diamond: a compound of extraordinary interest. If the chemist were properly mindful of the wondrous power of carbon as the foundation stone of the organic world, he would wear the biggest diamond procurable—as " mark of the beast." It is customary, in the text-books, to speak of forms of carbon other than the diamond—to wit, graphite and the charcoal-carbons. No proof has yet been given that these are carbon—much may be said in favour of the view that they are but highly condensed hydrocarbons.

Carbon and hydrogen interact only under special conditions—at the high temperature of the electric arc—the product being the gas acetylene, C_2H_2. The simplest " hydrocarbon " is methane, CH_4, known generally as miners' fire damp (*dampf*, vapour) and as marsh gas, as it is often met with as the product of the natural decay, under the influence of special micro-organisms, of cellulosic materials. Methane is an inert material, in so far that the four affinities of the carbon atom appear to be satisfied by the four hydrogen atoms and, reciprocally, the affinities of the hydrogen atoms by those of the carbon atom: it is one of the least coercible of gases. Derivatives are only to be obtained from it by displacing one or more of the four hydrogen atoms by some equivalent radicle or radicles.

The four hydrides considered, taken in conjunction with hydrogen, form a remarkable series:—

$$H_2 \quad HCl \quad H_2O \quad NH_3 \quad CH_4.$$

Three of these are eminently active compounds, obviously possessed of residual affinity, whilst the fourth, methane, appears to be individually inert: in this compound, carbon and hydrogen, apparently, are mutually *satisfied*. What is to be the conclusion from such evidence? Is it to be, as appears from the behaviour of hydrogen itself and of methane, that the hydrogen atom is a single-minded individual, able to grasp at most a single other atom: that the unsaturated character of the hydrides of chlorine, oxygen and nitrogen is a consequence of the inability of one, two and three atoms of hydrogen respectively to satisfy the desires of these elements? This, indeed, has long been the opinion of chemists generally. Hydrogen is considered to be a consistently *monadic* or univalent element and those with which it associates are often elements of variable valency, the desires of which it cannot fully satisfy. In recent years, the reputation of hydrogen as a simpleton has been impugned—yet not seriously: on careful consideration of the statements made, in the light of the facts, there seems to be little reason as yet to regard them as of more than imaginative value.

The hydrides of fluorine, bromine and iodine—all elements of the chlorine family—are in most respects scarcely to be distinguished from hydrogen chloride.

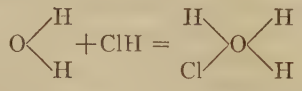
Water may be said to be entirely peculiar in that the " restraining " effect of hydrogen upon the oxygen atom, in the unit molecule OH_2, is so slight. The hydride of sulphur—the element akin to oxygen and next below it in the oxygen family—although similar to hydrone in composition, hydrogen sulphide, has none of the properties of the oxide. It is gaseous and not easily liquefied and the liquid is a poor solvent. Strangely enough, however, if the hydrogen in the two hydrides be displaced by the hydrocarbon radicle (C_2H_5), compounds are obtained in which the properties are, in a measure, reversed. Ether, $(C_2H_5)_2O$, has little tendency to associate with other compounds. The diethyl sulphide $(C_2H_5)_2S$, however, is readily combined with the iodide C_2H_5I, forming the iodide $S(C_2H_5)_3I$, a beautifully crystalline substance in which sulphur appears to be definitely quadrivalent—like carbon in methane. In short, affinity, the valency of a radicle, like human affection, is clearly a relative rather than an absolute function: valency is a variable, not a constant, at least in many cases. Perhaps the only element of constant valency is hydrogen—but this is singular in many ways. This assumption is, at least, a desirable one to make, so long as it cannot be disproved: *in fact, it is that upon which our entire system of structural formulae in organic chemistry has been built up.* The consistency of that system is so marvellous, that our confidence in it will not easily be disturbed.

Accepting the conclusion that oxygen has more or less residual affinity when associated with two hydrogen atoms, as it is in hydrone, what interpretation is to be placed upon the process of dissolution in water? What is water, as compared with hydrone? By what act do two diverse liquids give rise, upon admixture, to a solution conducting more or less well, which apart are without the power of acting as electrolytic conductors? When hydrogen chloride is dissolved in water, a highly conducting solution is obtained; when ammonia is similarly dissolved, the conductivity of the solution is low, at best. What is the difference? When hydrogen chloride and ammonia gases are mixed in equal volumes, they at once interact in the sense of the equation

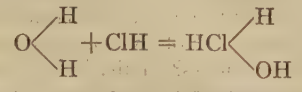
$$NH_3 + \epsilon\delta + HCl = NH_4Cl + \epsilon\delta.$$

The product is a crystalline solid, a definite compound, the salt ammonium chloride, which most closely resembles common salt, NaCl. We cannot well do otherwise than assume that whilst only tervalent to hydrogen, the nitrogen in ammonia becomes excited to a higher valency when a fourth *positive* hydrogen atom is offered to it *together* with a fifth *negative* (chlorine) atom. The two molecules, ammonia and hydrogen chloride, do not merely combine but that of the chloride, apparently, *is divided and distributed upon the ammonia molecule*, the nitrogen functioning as a quinquevalent radicle.

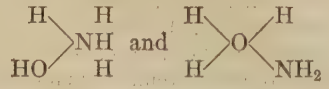
If the same simple assumption be made, the interaction of hydrogen chloride with hydrone, in water, may be represented in the following manner



As, however, oxygen and chlorine are observed to act in a similar and equivalent manner, interaction should also take place as expressed in the equation



The interaction of ammonia and hydrone molecules, in like manner, should give rise to molecules of two kinds, viz.,

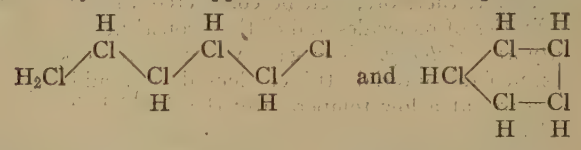


In such compounds, formed by the exercise of secondary affinity, the *negative* radicle in each complex is clearly less firmly held than in the simpler compounds from which it was formed and, therefore, should be more easily separated, we may suppose: the " residual " affinity of the radicle must be greater than it was in the simple molecules. For example, in the complexes formed from hydrogen chloride and hydrone,

$$H_3O{\cdot}Cl \text{ and } H_2Cl{\cdot}OH$$

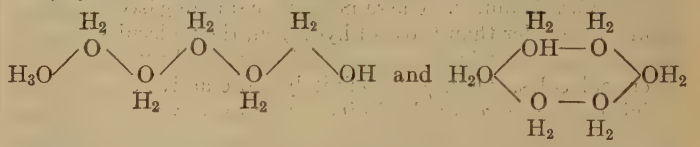
the chlorine radicle in the one, the hydroxyl in the other, is less firmly held than it was in the original simpler molecule. The atoms are all less firmly knit together in the complexes. Their condition is, perhaps, that sometimes spoken of when such molecules are said to be " electrically charged."

Complexes such as are here contemplated are also formed, it is to be supposed, from the fundamental units which constitute the gaseous substance. On liquefaction, these undoubtedly become associated in various ways. Thus, liquefied hydrogen chloride may well be supposed to consist of complexes such as

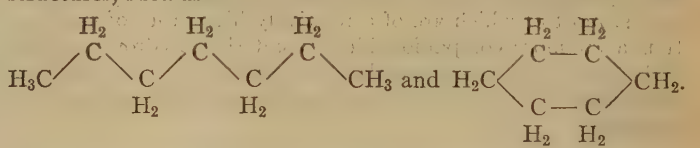


saturated with the simplex HCl. It is impossible to say in what proportions these are present: possibly the one form is dominant.

Water, we may aver, is equally a mixture of the fundamental unit, hydrone, OH_2, with complexes such as



Carbon compounds of these types are well known as stable structures, such as



There is general agreement among chemists and physicists that the carbon compounds are thus constituted. The angles at which the carbon atoms meet in the diamond, the distance apart of the atomic centres (of the carbon atoms), have been exactly determined, in recent times, by means of X-rays. The carbon atoms meet at 109°28′, the tetrahedral angle; the centres are little more than an Ångström unit (one hundred-millionth of a millimetre) apart. There is no reason why we should not see, with the mind's eye, in the liquefied hydrides of chlorine, oxygen and nitrogen, a structure such as we have seen, largely with the actual eye, in hydrides of carbon.

Common water will convey or conduct an electric current—electrolytically. The more it be purified, the less readily it conveys the current. *It is logical to assume, that water free from every contamination, would be a non-conductor.* Such water is an ideal. Water cannot be dealt with without a containing vessel: whatever be the nature of the vessel in which it be received and stored, the surface will be more or less contaminated and more or less subject to attack. The " best water " that has been made, has been made in glass and measured in glass—glass we know *is attacked* by water. In testing electrically platinum electrodes are used—platinum, we know, is an absorptive material and pure platinum is inconceivable as a reality. A *pure* substance is the thing itself—there may be degrees of impurity but not of purity. We are so accustomed to an impure world, that it is difficult to rise into the empyrean of ideal purity: physicists have long been noted for their lack of the sense of cleanliness; chemical sanitation is not yet generally at the height at which it should be—and gullibility, of the order pictured by Carlyle, still plays a large part in our Society. Naughty and undisciplined as we may seem to be, the general tendency is to obey and follow the pretending leader.

Electrolytic Action.—To explain the observation that any electromotive force, however small, would produce electrolysis in a solution, causing the ions of the solute, say the hydrogen

(H) and chlorine (Cl) of hydrogen chloride (HCl) dissolved in water, to pass to opposite electrodes and there unite and appear as hydrogen (H_2) and chlorine (Cl_2), Clausius long ago "pretended" that some few of the molecules of the chloride "banged themselves to pieces"—so that no work had to be done by the electric current in separating the ions: it only was necessary to give them direction and set the one to wander to the negative, the other to the positive electrode. This electrical test, however, is one of infinite delicacy—no thought has been given *to the fact* that the reduction of the "impurity" at an electrode surface to an extent beyond or even equal to that of the delicacy of the electrical test is a practical impossibility. Chemists have been led to base their faith, the entire theory of chemical change, upon the observations of two German physicists working in the dim and distant past of 40 years ago—both honourable men but both physicists and mathematicians, not practised chemists alive to the need of the most excessive sanitary precautions, if a chemical clean bill of health were to be secured. Helmholtz is supposed to have electrolysed water by means of non-polarised electrodes. In fact, he used two platinum plates and a third plate of palladium charged with hydrogen: his solution was, therefore, necessarily charged with hydrogen and one or other of his plates was "hydrogen polarised."

Arrhenius, in 1885, extended the Clausius hypothesis but dropped his mechanical explanation. To account for the development and increase of electrical conductivity on dissolving a "salt" in water, to an extent varying with the nature and the proportion of salt used, he assumed that the molecules of the dissolved salt just fell to pieces into separate *electrically charged ions*. Why or wherefore they did so, where the energy to break them up came from, was never explained.

As a matter of fact, what has to be explained is the appearance of electrical conductivity and also of chemical activity, on bringing together two substances which, if logic have any meaning, by themselves are inert. Logic seems to indicate some *interaction* as the only possible cause of the change. The electrolytic dissociation school did, after a time, attribute the change to the high "specific inductive capacity" of the solvent—whatever that may mean. Directly the solvent is called in, the explanation becomes chemical, however, not merely mechanical nor based upon a display of mere wilfulness. "We will dissociate, nothing shall prevent us," was the war cry of the molecules, according to Arrhenius. The chemist had more belief in their moral character and that they would observe the marriage tie.

What Arrhenius really did—and the service was a great one at the time—was to lay great stress upon the existence of an active as distinguished from a passive part, in a chemically active medium, by correlating the electrical conductivity developed in a solvent by the addition of a "salt" with the chemical activity of the dissolved substance—assuming the dissolved substance (in the form of its ions) to be the sole active agent. He also developed Kohlrausch's conception of molecular conductivity, as distinct from that of specific activity (of the solution as a whole), by referring the conductivity to the ions of the solute alone and correlating this, to some extent, with chemical activity.

The generalisation came at a time when much attention was being paid to the determination of molecular weights of dissolved substances. Raoult especially had shown that equimolecular proportions of many substances produced the same effect upon the properties of a solvent: for example in raising the boiling point; moreover, that, within limits, the effect was proportional to the concentration, *at low concentrations*. Van't Hoff also had advanced a kinetic explanation of the phenomena of so-called osmotic pressure—the pressure developed within a cell, containing a solution, by water passing through the lining membrane without the solute passing out.

Osmotic Pressure.—The pressure developed within a cell, by the entry of water (as shown by the rise of liquid in a gauge tube attached to the cell) *into dilute solutions*, appears to be the same as would be developed by the entry of a gas, in equivalent amount, into a cell already filled with the gas, at a known pressure, through a wall permeable only by the entering gas. For example, when a cell of palladium (which is permeable by hydrogen and not by nitrogen) filled with nitrogen at atmospheric pressure, is surrounded with hydrogen at atmospheric pressure, the hydrogen passes through until equilibrium is reached—when the hydrogen pressure is the same within and without the vessel: at this stage, the molecules of hydrogen are travelling at equal rates and in equal numbers both ways. The pressure within the vessel is thus raised to two atmospheres—by the addition of the atmosphere of "pressure" due to the hydrogen. In the same way, when a dilute solution, say of x grammes of sugar in 22·3 litres of water, filling a finely porous cell provided with a gauge tube, is plunged into water, the liquid rises in the gauge tube until the pressure is $\frac{x}{342}$ of an atmosphere, 342 being the relative weight of the molecule of sugar. The late Prof. E. F. FitzGerald, a distinguished physicist of unusual breadth of outlook, speaking of this phenomenon, says:—

> It is a most remarkable thing that osmotic pressure should be even roughly the same as what would be produced by the molecules of the body in solution if in the gaseous state but to imply that the dynamical theory of the two is at all the same or that the dynamical theory of a gas is in any sense an explanation of the law of osmotic pressures is not at all in accordance with what is generally meant by the word "explanation." This so-called explanation is not a dynamical explanation at all, it is only a very far-fetched dynamical analogy. These osmotic pressures are much more closely connected with Laplace's internal pressure in a liquid, which is essentially dependent on the forces between the molecules than with the pressure of a gas, which is essentially almost independent of the forces between the molecules. There must be some dynamical reason why the solvent gets through the membrane while the body in solution does not. It must be due to capillary forces between the solid and the molecules of the solvent (Helmholtz Memorial Lecture, *Chem. Soc. Jour., 1896*).

An understanding of osmotic phenomena is a matter of great importance, because of the part they play in the exchanges between the cells which constitute living structures: the cell walls acting as discriminating septa.

It should be noted that solutions in water have a lower vapour pressure and therefore a higher boiling point, also a lower freezing point than has water. This is true of solutions generally, whatever the solvent. In fact, all the properties of a solvent are modified by the presence of dissolved matter, whatever its nature may be, the alteration being proportional to the amount dissolved—so long as the solution remains dilute.

The striking contribution made by Arrhenius in discussing van't Hoff's generalisation was in associating the superior, if not abnormal, effect of electrolytes upon the solvent with the increase in molecular electrolytic conductivity of dissolved salts upon dilution. Whereas non-electrolytes produce the unit osmotic effect, molecular proportions producing the same effect, electrolytes have more than unit effect and as the solution is diluted the effect increases, until, in the case of binary compounds such as hydrogen chloride, HCl, for example, the molecular effect is practically doubled—as if the radicles H and Cl were acting independently.

Arrhenius made the assumption that they were, but that the water remained unchanged. It is impossible to grant such an assumption. No valid reason has ever been given which will account for the separation, which is one involving a great absorption of energy. Actually, a not inconsiderable amount of heat is evolved when hydrogen chloride is dissolved in water, part of which, of course, is due to the liquefaction of the gas. Again, the assumption is one that involves a sharp distinction being drawn between hydrogen chloride and hydrone—speaking chemically, this is impossible, what is generally true of the one being true of the other.

The nature of the change which it is conceivable takes place when hydrogen chloride and hydrone interact has already been pictured. In view of the known behaviour of hydrogen chloride towards ammonia, the chemist is in a position to assert that hydrogen chloride and hydrone must be able to interact and do interact in a similar manner. He can produce and exhibit in a crystalline form a compound formed from methylic oxide, $(CH_3)_2O$—the analogue of hydrone—and hydrogen chloride.

The question then arises—how are the alterations in the properties of water and of solvents generally induced by the presence of a substance in solution to be explained—how, in particular, is the peculiar and enhanced effect of (potential) electrolytes as compared with non-electrolytes to be pictured. The first assumption that may be made is—that, in all cases, the primary, chemically active unit is the simple molecule, hydrone, OH_2, in the case of water. It will easily be granted that water is saturated with hydrone, the proportion varying with the temperature. As a matter of fact, the vapour pressure of an aqueous solution is lower than that of water. One effect of the solute molecules is, therefore, to capture and restrain a certain proportion of the hydrone molecules. It may be urged that as soon as hydrone molecules are withdrawn, others should come forward—produced by the breaking down of polyhydrones—to take their place and restore the equilibrium. The facts negative this assumption: the dissolved substance exercises an abiding influence. It is almost necessary to assume that the residue of the solvent is modified: that the complexes present along with the simple, fundamental molecule exist in a different proportion: that inasmuch as the freezing point is lowered, the crystallisable form is diminished in amount. Water near to its freezing point must be saturated with "ice-molecules" whatever the complexity of these may be. When a substance is dissolved in water, the hydrone solute complexes which are formed—whatever their nature—doubtless exercise a disturbing influence upon the rest of the liquid and the equilibrium is perhaps altered in such a way that fewer "ice-molecules" are present.

As to the peculiar influence of electrolytes—we know that the departure from the "normal" behaviour of non-electrolytes varies with the compound dissolved and the strength of the solution, the specific molecular effect being always greater the more dilute the solution. Let it be assumed that hydrone and the solute, AB, interact in the following manner

$$\overset{+-}{AB} + OH_2 = \overset{+-}{AB}\begin{matrix}H\\OH\end{matrix}$$

$$\overset{+-}{AB} + OH_2 = H_2O\begin{matrix}\overset{+}{A}\\B\end{matrix}$$

Each of these products will be an active unit—one that is more active than the molecule from which it is derived—than hydrone on the one hand, than the salt molecule on the other. The relative proportions in which the two are formed will vary with the concentration. In concentrated solutions, however, a large proportion of the salt molecules will not form active complexes but, it may be supposed, will be associated in grouped or closed systems, *e.g.*,

$$AB + 4OH_2 = AB\begin{matrix}H_2O\\O\\O\\H_2O\end{matrix}$$

which are non-valent and only possessed of slight residual affinity.

Non-electrolytes may be regarded as differing from electrolytes in that they are not divisible against hydrone, interactions taking place only in one way

$$\overset{+-}{XY} + OH_2 \leftrightharpoons \overset{-+}{XY}\begin{matrix}H\\OH\end{matrix}$$

To explain the enhanced effect of potential electrolytes and the increase of the effect as the solution is more and more diluted is more difficult. As these are effects of dilution, they are clearly due in some way to the action of the water. The solution of the problem suggested by H. E. Armstrong (*Roy. Soc. Proc. 1923*, vol. A103, p. 610) is, that when the "couple" formed of the two systems

$AB\begin{matrix}H\\OH\end{matrix}$, $H_2O\begin{matrix}A\\B\end{matrix}$ and hydrone (OH_2) is resolved, it may and does give rise to hydronol, $H_2O\begin{matrix}H\\OH\end{matrix}$—a more active unit even than hydrone itself. Further, that as dilution proceeds, AB is more and more completely resolved against hydrone and converted into $H_2O\begin{matrix}A\\B\end{matrix}$. When this action is complete, AB has exercised its maximum effect. Hydronol, however, being produced concurrently, is ultimately present in an amount equivalent to that in which the system $H_2O\begin{matrix}A\\B\end{matrix}$ is formed. Finally, two active systems are present: if the action be complete, the combined effect they produce is twice the unit effect.

When a solution is placed in contact with water, separated by a diaphragm through which only the water can pass, hydrone is attracted into the solution, molecule for molecule of the active systems present. The so-called osmotic pressure within the cell may be conceived of as due to the directed oscillatory impacts of the hydrone molecules paired with the active systems.

In a sufficiently dilute solution, ultimately, two osmotically active, reciprocal molecules would be produced, at the expense of each single molecule of the salt: in other words, the single molecule of the potential electrolyte, hydrogen chloride, would apparently have double the effect of a single molecule of a non-electrolyte.

Assuming that electrolysis involves the interaction of two diverse "distributed" systems, under the influence of an electromotive force, the (molecular) conductivity of the dissolved chloride would also be at its maximum in the fully diluted liquid.

Solutions.—The activities operative within solutions are too little considered. They are best realised by studying the interactions of soluble salts. When, for example, potassium chloride and magnesium sulphate, $MgSO_4 \cdot 7H_2O$, are dissolved in equivalent proportions and the solution is sufficiently concentrated, a large amount of the double sulphate $MgSO_4 \cdot K_2SO_4 \cdot 6H_2O$, gradually crystallises out. It follows that much of the chloride is converted into sulphate and of the sulphate into chloride, in fact, magnesium chloride is ultimately obtained from the liquid. Often, in such cases, a number of double salts and of salts with varying amounts of water of crystallisation are produced, the product varying with the concentration and relative proportions of the materials present. The presence of the variety of salts met with in natural salt deposits, such as those in Alsace and Hanover, is thus accounted for.

Finally, it may be urged that extreme caution is required in dealing with the problems of solution, because of the fact that the molecules are crowded together. Whatever seeming analogies their behaviour may present with that of the gaseous state, the effects cannot be really gaseous effects—as intermolecular affinities come into play which are practically excluded in the gas.

The conclusions deduced by studying solutions made by dissolving substances all to the same volume—a method in no way comparable with that involved in dealing with equal volumes of gases—are obviously not comparable, as the molecular proportions in which solute and solvent are present will vary more or less, according to the nature of the dissolved substance. Most of the peculiarities to which attention has been directed are traceable to this illogical practice. At most, very dilute solutions prepared in this manner will afford comparable results. On the other hand, if the molecular proportions of solvent and solute be kept constant, there is always the difficulty that the ultimate volumes vary—that the volume occupied within the solvent by the solute is subject to variation. In fine, it would seem to be impossible to make any strict comparison of solutions—the conclusions must always be open to many corrections.

Electrolysis of Water.—The production of hydrone by the interaction of hydrogen and oxygen has already been discussed. The inverse change must be subject to similar conditions. Water itself and by itself cannot be electrolysed—*ex hypothesi*, it has

no conducting power. To speak of the production of hydrogen and oxygen by electrolysis, as if the process were simple and direct, is as wrong as to speak of the production of water itself from oxygen and hydrogen: the electrode face must be the seat of a whole series of changes. Without considering the nature of the internal process (within the liquid), it may be assumed that the complex $HX\langle^{H}_{OH}$ (formed from the acid HX) at the one electrode surface is initially converted into a perhydrol

$$HX\langle^{H}_{OH} + 2(OH) = HX\langle^{H}_{O\cdot OH} + OH_2.$$

Such compounds are well recognised products of electrolysis. At times, they undergo hydrolysis and perhydrone HO·OH is formed, but this, apparently, is never an initial product.

At high concentrations and particularly at high current densities, the attack by OH becomes more and more concentrated upon the molecule and probably higher perhydrols are formed, which break up at the electrode surface into oxygen or ozone—whether directly or owing to hydrolysis or perhydrolysis.

Acidity: Apparent and Effective.—The term *acid* has long been a bone of contention among chemists and there is great need of a clear understanding on the subject. A Latin term, the equivalent of the Teutonic *sour*, it appeals to the ear and is familiar because of the occurrence of acids in foodstuffs—in vinegar, fruit, etc. The opposite of an acid—an alkali or base—in the sense that it will neutralise the acid and destroy its sourness to the palate—is unfamiliar, as such substances are not in ordinary use, at least in connection with food. When acid and "base" interact, a salt is formed. The base, however, is no more *the base* of the salt than is the acid: it happens to have been so-called, only because "acid" was already appropriated and had a distinct, identifiable meaning. "Alkali" has no etymological significance in itself and the conventional use of base is misleading when transferred to chemical practice.

Acids were known long before the isolation of the vital principle of air. When this was isolated, Lavoisier gave it the name oxygen, because the oxides formed on burning common combustibles, such as carbon, sulphur and phosphorus, were "acid."

The oxides of the non-metallic elements then became known as acids. To the present day, the public speak of the acidic oxide of carbon as carbonic acid, a far better name for general use than that of the chemist, carbon dioxide, which by a silly and most reprehensible practice is now often converted into *See-Oh-Too* (CO_2), especially in biological circles. Formulae should never be used as spoken words. Lavoisier supposed that acids generally contained oxygen and, on this account, being a constituent of muriatic acid, chlorine was supposed to be an oxygen compound. When this was disproved by Davy and "spirit of salt" was shown to consist simply of hydrogen and chlorine, the swing of the pendulum set in and acids were defined to be compounds of hydrogen (hydrogen salts) in which the hydrogen could be displaced by metal, if not directly, through the agency of a metallic oxide or base. The name sulphuric acid was then transferred from the oxide SO_3 to the hydrate, $SO_3+OH_2=H_2SO_4$, oil of vitriol or vitriolic acid, as it was long called. Fifty years or so ago, there were two contending schools—one calling the oxide the acid and the hydrate either simply monohydrate (a name long used in commerce) or hydric sulphate. A salt was said to be formed by the union of acid and base and, in hydric sulphate, hydrone was supposed to take the place of the base soda in sodic sulphate: the acid, in fact, was regarded as a hydrogen salt.

The other school regarded a salt as derived from its acid by the displacement of hydrogen and the hydrogen as itself present in the form of hydroxyl (OH). The halhydrides were again treated as peculiar. The basicity, we may say equally well the acidity, of an acid varies with the number of displaceable hydrogen atoms. Phosphoric acid H_3PO_4 has long been supposed to be an acid in which the three atoms of hydrogen are of different value but sulphuric acid has almost always been formulated as if the two hydrogen atoms were alike in function. It has been customary to represent the latter acid as symmetrically constituted—$(SO_2)\langle^{OH}_{OH}$. When the matter is studied historically, it is clear that this view is largely an academic conclusion. No significant evidence of structure can be adduced in proof of such a formula and we must admit that we do not exactly know how the acid is constituted—simple as it is.

Acidity.—The issue is complicated by the fact that "acids" vary greatly in strength—some are "strong"; the majority are weak. Defining *apparent acidity* as the equivalent proportion of "acid" present in a solution, which is measured by determining the amount of standardised alkali required to neutralise the liquid, the *effective acidity* is measured by using the acid as a hydrolytic agent, for example, in effecting the resolution of cane sugar into glucose and fructose:—

$$C_{12}H_{22}O_{11} + OH_2 = 2C_6H_{12}O_6.$$

The activity of an acid such as acetic contrasted with that of an equivalent amount of chlorhydric or nitric, is very slight—it has not one-two hundredth of the strength of these strong acids as a hydrolytic agent. There is very little, if any, doubt that the explanation of this fact is, that but little of the acetic "acid" becomes real and active. On the other hand, almost the whole of the dissolved hydrogen chloride in muriatic acid seems to be in the active state—as the electrolytic conductivity, referred to the molecular proportion of hydrogen chloride present, is relatively little changed and increased by high dilution. Nearly 90% of the chloride appears to be present as the active acid even at low dilutions.

Instead of representing real or effective acidity as a fraction of the apparent acidity, thus avoiding the introduction of any hypothetical interpretation of the facts, an unfortunate practice has grown up of representing real acidity in terms of "hydrogen-ion-concentrations." Nay, worse, the hydrolytic effect has been represented as due to the hydrogen ion and not to the ions of the acid acting in conjunction. Terms are thus used which only the elect can understand—which is undesirable in all interests. At the moment, the term acid has no clearly defined meaning.

Much light is thrown upon the nature of multiacidic (multibasic) acids by the study of their action as hydrolytic agents. Especially is this true of sulphuric acid. This acid readily acts upon a variety of hydrocarbons and other compounds, forming *sulphonic acids*, e.g.,

$$C_6H_6 + H_2SO_4 = C_6H_5\cdot SO_3H + OH_2.$$

The sulphonic acids are strong unibasic acids. It is usually said that they are formed simply by the displacement of one of the two hydroxyl groups (OH) in sulphuric acid by a hydrocarbon or similar radicle. If so and the two (OH) groups be of equal value, the sulphonic acids, it might reasonably be supposed, should have about half the effective strength of sulphuric acid. As a matter of fact, tested by cane sugar, they have little less than 90% of its strength. Hence, it would seem probable, that sulphuric acid is in reality uniacid (unibasic) but has a slight residual acidity. The argument may be extended to all multiacid inorganic acids. These seem to be comparable with lactic acid, $CH_3\cdot CH(OH)\cdot COOH$, which from early times has ranked as part alcohol, part acid—as essentially uniacidic. The argument is of consequence as pointing to some dissymmetry in the structure of sulphuric, carbonic and other multiacidic acids. (Compare *Roy. Soc. Proc. 1914*, vol. A90, p. 73.)

Function as Determined by Structure.—Having thus considered a case in which function and structure are clearly in close connection, attention may now be directed to carbon compounds, which afford a vast mass of evidence of the absolute correlation of function with structure.

The structural basis of chemistry is very simple—one of astounding simplicity, in fact. It is expressed in the fixed series: HCl, H_2O, H_3N, H_4C. Taking the hydrogen atom as unit, the atom-fixing power or valency of the four elements indicated is one, two,

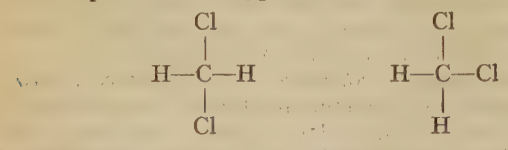
three, four-fold. Chlorine and its analogues are monads, oxygen and its analogues dyads, nitrogen and its analogues triads, carbon and its analogues tetrads. All other elements (excepting the inert) fall into one or other of the four classes. The facts of chemistry generally show that hydrogen is consistently a monad. The facts also show that generally carbon does not exceed the tetradic power of which CH_4 is witness. The other elements and their analogues are not so fixed in their affections. Thus nitrogen, in the ammonium compounds, such as ammonium chloride NH_4Cl, carries two additional units, five in all. Oxygen and chlorine also may carry two additional units but their hold upon these is never so firm as is that of nitrogen. The problem of varying valency (atom-fixing power) has given rise to much discussion, over a long period of years; it is in no way ended. At one time, the view was held that in ammonium chloride, the two molecules H_3N and HCl, were still existent, as radicles; such compounds were in consequence termed "molecular." Phosphorus pentachloride, PCl_5, in like manner, was thought to be a compound of the chloride PCl_3 with a molecule of chlorine Cl_2. Of late years, the alternative view has prevailed, that the two molecules interact and do not merely "associate," so that the units are distributed and arranged about a central atom.

Chemistry, however, is an art as much as a science and the chemist is full of feeling which cannot be quantified. He is satisfied that, in some way, there is a difference which he is in no way yet able to define between the two orders of compounds. Fancy pictures have been drawn of late, in terms of the electronic hypothesis, to represent the two kinds—but these are but paraphrase and as they carry us no further are premature. At most, we know, from the behaviour on electrolysis, that the various atoms carry atomic electric charges (electrons) corresponding to the primary valency—the hydrogen atom one, oxygen two, nitrogen three. The evidence thus far seems to be against the view that the atomic charges may be varied. What then is to be our explanation of secondary valency and still further of the residual affinity which is manifest when secondary affinities are engaged!

No compounds, not even the inert gases, helium, etc., nor hydrogen, methane, etc., are entirely without attractive power or affinity. If they were, they would not be liquefiable. All display a certain amount of *residual affinity:* in other words, whatever the nature of primary and also of secondary affinities, some affinity is left over in the compounds in which such affinities are exercised.

In the early days of structural formulae, chemists were satisfied with plane representations upon paper, in which lines were drawn proceeding from the symbol of the element in accordance with its valency, thus

Then models were constructed of balls with holes drilled into them, in number according to the valency of the elements represented. Other atoms were attached by inserting rods into the holes in the balls. No attempt was made to give any special direction in space to the affinities thus signified. Gradually, it was realised that such formulae and models implied both too much and too little. On the one hand, they gave rise to expectations which were not fulfilled. Thus, two pictures can be drawn of a compound of the type CH_2Cl_2



In the one, the two atoms of chlorine are *opposite*, in the other they are *contiguous*. Exhaustive inquiry failed to discover any difference in the compound, however prepared. On the other hand, many compounds were found to exist which were of the same composition but structurally similar—differing only in one peculiar respect: in that one was the morphological and optical opposite of the other. When the crystal of the one form was compared with that of the other, they were seen to be identical, except that the one was a mirror-image of the other, as a right hand to a left hand. There was a corresponding difference in the behaviour of solutions of the two compounds in plane polarised light—the rays of light being twisted in one direction by the one, equally (if the solutions were of identical strength) in the opposite direction by the other. This was Pasteur's great discovery, made in 1848. Van't Hoff, in 1875, building upon Pasteur's suggestion, that such compounds were geometrically different in structure, resuscitated and expanded Pasteur's suggestion that carbon was itself a tetrahedral unit and in his *Chemistry in Space* fully developed a doctrine of spatial structure already foreshadowed by Kekule, which has proved to be very generally applicable. Representing carbon by a regular tetrahedron (such as may be made by joining together four equilateral triangles), he drew attention to the well-known fact, that if one, two or three faces only were different, two being alike, object and mirror image were alike—they could be superposed. If all four faces were different, the image could not be superposed upon the object—such compounds were asymmetric, their models could not be halved, as could those in which only two or three faces were different. He was able to show that all known optically active compounds might be regarded as constituted in the manner suggested and to predict that all such compounds would be optically active. His forecast has been verified in all respects (*see* ISOMERISM, 14.881).

Van't Hoff represented the four affinities of carbon as proceeding from the centre of mass of the regular tetrahedron to the four solid angles. They therefore meet at an angle of 109°28′. He represented compounds in which carbon atoms were united by single affinities by tetrahedra joined at their apices—not as filling space. Sir William Bragg has shown, by means of X-rays, that in the diamond the atoms of carbon are thus related—each being surrounded by four others, each of the four meeting it at the tetrahedral angle (*see* CRYSTALLOGRAPHY). A model of the diamond—a sheet of atoms in the diamond—may be made by arranging cardboard tetrahedra side by side, placed alternately base downward and base upward (choosing any face arbitrarily as base). The van't Hoff generalisation has thus been verified in its entirety in principle.

Van't Hoff doubtless found more than sufficient material needing discussion to extend his explanation and correlate it with the crystalline form of solids. The "solid significance" of the doctrine was never considered by him. Before dealing with this, it is desirable however to consider certain peculiarities in the behaviour of carbon.

Carbon Combinations.—The atoms of most of the elements seem to be capable of uniting with themselves and even with others only in very limited numbers. The number of carbon atoms which can unite with one another, however, appears to be illimitable and there seems to be no falling off in grip as the number grows. The simplest hydride, CH_4, is but the beginning of a long series of hydrocarbons, known as the *Paraffins*, in all of which carbon and hydrogen are present in the relative proportions in which they occur in methane, so that they may be represented by the general formula C_nH_{2n+2}. Like methane, these are all *saturated*, in the sense that they do not combine with any substance whatever. The name paraffin is derived from the fact, that especially chemically, they have little affinity for chemical agents in general. They may be oxidised, they are acted upon by chlorine and bromine, yet not easily. They yield only *substitution* derivatives, *i.e.*, one or more hydrogen atoms are exchanged for an equivalent radicle. Thus—

$$CH_4 + Cl_2 = CH_3Cl + HCl$$
$$CH_3Cl + Cl_2 = CH_2Cl_2 + HCl$$
$$CH_2Cl_2 + Cl_2 = CHCl_3 + HCl$$
$$CHCl_3 + Cl_2 = CCl_4 + HCl$$

The solid paraffin, used in making candles, is a mixture of higher members of the series. Petrol contains low terms—such as hexane, C_6H_{14}, heptane, C_7H_{16}, etc.—the illuminating and

lubricating oils from petroleum are mixtures of terms intermediate between those in petrol and paraffin.

Organic chemistry has often been spoken of as the chemistry of the hydrocarbons and their derivatives, because all other compounds may be derived from the hydrocarbons by processes of simple substitution, by the introduction of various simple atoms or compound radicles (groups of atoms) in place of one or more of the hydrogen atoms of the hydrocarbon.

The paraffin hydrocarbons may be built up to any desired degree of complexity by various simple methods. Thus methane is converted into methylmethane or ethane by the process indicated in the equation:

$$CH_3I + CH_3I + 2Na = CH_3{\cdot}CH_3 + 2NaI$$

Etnane is converted into the next term, propane, in a similar manner:

$$CH_3I + CH_3{\cdot}CH_2I + 2Na = CH_3{\cdot}CH_2{\cdot}CH_3 + 2NaI$$

or into tetrane:

$$CH_3{\cdot}CH_2I + CH_3{\cdot}CH_2I + 2Na = CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CH_3 + 2NaI$$

It will easily be seen that there are two ways of introducing CH_3 (methyl) into propane:

$$CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CH_3 \longleftarrow CH_3{\cdot}CH_2{\cdot}CH_3 \longrightarrow CH_3{\cdot}CH(CH_3)_2$$

Tetrane — Propane — Isotetrane

In one the " chain " is simply extended, in the other, two links are associated with the one terminal link. Three and even four links may be attached to one, as in trimethylmethane $CH(CH_3)_3$ and tetramethylmethane $C(CH_3)_4$.

Compounds of the same gross or molecular formula, differing in structure, are termed *isomeric* (*see* 14.881). The successive terms in the series are termed homologues. They are homologous in the sense, that apart from differences in physical properties, boiling point, density, etc., they are generally alike in their chemical behaviour. This is true also of the isomeric hydrocarbons.

Hydrocarbons are all more or less easily attacked by chlorine or bromine but not by iodine; the iodo-derivatives are obtained by indirect methods.

They are also easily oxidised but the product is often, if not usually, a mixture, as the products are more easily oxidisable than the original hydrocarbons. We speak of oxidation but in reality the process is always initially *one of hydroxylation* and, for the sake of simplicity, may be represented as effected by perhydrone, H_2O_2. Thus ethane is converted into ordinary fermentation or ethylic alchol:

$$CH_3{\cdot}CH_3 + HO{\cdot}OH = CH_3{\cdot}CH_2(OH) + HOH$$

The primary product of the oxidation of methane, in like manner, is methylic alcohol—the alcohol of wood spirit

$$CH_4 + HO{\cdot}OH = CH_3{\cdot}OH + HOH$$

The alcohols are the organic analogues of caustic soda (sodic hydroxide) thus—

$$Na{\cdot}OH + HCl = NaCl + HOH$$
$$C_2H_5{\cdot}OH + HCl = C_2H_5Cl + HOH$$

This is true so long as only the (OH) radicle be attacked. In the carbon compound, however, the hydrocarbon radicle is attackable, as in the oxidation process:

$$CH_3{\cdot}CH_2{\cdot}OH + HO{\cdot}OH = CH_3{\cdot}CH(OH)_2 + OH_2$$
$$CH_3{\cdot}CH_2{\cdot}OH + HO{\cdot}OH = CH_3(OH){\cdot}CH_2(OH) + OH_2$$

Both actions take place, according as one or other oxidising agent be used. The two products differ in a characteristic manner, the one being unstable, the other stable. Whenever two hydroxyls are associated with a single carbon atom, the product is unstable, readily losing the elements of a molecule of hydrone

$$CH_3{\cdot}CH_2(OH)_2 = CH_3{\cdot}COH + OH_2$$

Aldehydrol — Aldehyde

In aldehyde, the dyad oxygen atom takes the place of two monad hydrogen atoms in the hydrocarbon and of the two monad hydroxyl radicles in the alcohol which is the initial product of hydroxylation. Hydroxylation may be carried a stage further

$$CH_3{\cdot}CH(OH)_2 + HO{\cdot}OH = CH_3{\cdot}C(OH)_3 + OH_2$$

The trihydrol thus formed is even less stable than the dihydrol and easily loses hydrone

$$CH_3{\cdot}C(OH)_3 = CH_3{\cdot}CO(OH) + OH_2$$

The product, acetic acid, is methane in which a single atom of hydrogen is displaced by the radicle *carboxyl*, CO(OH). This radicle is characteristic of organic acids generally—the term acid is given only to compounds which contain it or an equivalent radicle, such as SO_3H.

Methane may be oxidised in the following manner:—

$$CH_4 + HO{\cdot}OH = CH_3{\cdot}OH + OH_2$$
Methylic alcohol

$$CH_3OH + HO{\cdot}OH = CH_2(OH) + OH_2$$
Formaldehydrol

$$CH_2(OH)_2 + HO{\cdot}OH = CH(OH)_3 + OH_2$$
Formacidhydrol

$$CH(OH)_3 + HO{\cdot}OH = C(OH)_4 + OH_2$$
Orthocarbonic acid.

Formaldehydrol passes by dehydration into formaldehyde, $CH_2(OH)_2$, formacidhydrol into formic acid, orthocarbonic acid into carbonic acid, $CO(OH)_2$, ultimately into carbon dioxide.

The possibility of the formation of isomeric compounds must not be overlooked. Thus, propane may be hydroxylised only to two monohydric alcohols but each of these may conceivably be oxidised in several ways, thus

$CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}OH$	$CH_3{\cdot}CH(OH){\cdot}CH_3$
Propylic alcohol	Isopropylic alcohol
$CH_2(OH){\cdot}CH_2{\cdot}CH_2{\cdot}OH$	$CH_3{\cdot}CH(OH){\cdot}CH_2{\cdot}OH$
$CH_3{\cdot}CH(OH){\cdot}CH_2{\cdot}OH$	$CH_3{\cdot}C(OH)_2{\cdot}CH_3$
$CH_3{\cdot}CH_2{\cdot}CH(OH)_2$	

These dihydric alcohols are all known, though they are not produced exactly in the manner indicated. Attention should be drawn to the isomeric compounds

$$CH_3{\cdot}CH_2{\cdot}CH(OH)_2 \qquad CH_3{\cdot}C(OH)_2{\cdot}CH_3$$

Deprived of hydrone, these yield

$CH_3{\cdot}CH_2{\cdot}COH$	$CH_3{\cdot}CO{\cdot}CH_3$
Propionic aldehyde	Acetone

both keto-compounds, closely related in character, the one, however, an aldehyde, the other a ketone. The difference between these is particularly well brought out by their behaviour on oxidation

$$CH_3{\cdot}CH_2{\cdot}CH(OH)_2 + HO{\cdot}OH = CH_3{\cdot}CH_2{\cdot}C(OH)_3 + OH_2$$
$$CH_3{\cdot}C(OH)_2{\cdot}CH_3 + HO{\cdot}OH = CH_3{\cdot}C(OH)_3 + CH_3{\cdot}OH$$

The one yields the corresponding acid, a characteristic of aldehydes, the other is broken down. Actually, the methylic alcohol shown in the equation is further oxidised as it is produced and escapes recognition. Both propaneglycols should yield a stable trihydric alcohol on further hydroxylation

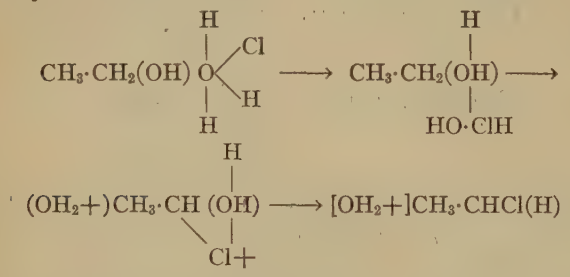
$$CH_2(OH){\cdot}CH_2{\cdot}CH_2(OH) \qquad CH_2(OH){\cdot}CH(OH){\cdot}CH_3$$
$$\searrow \quad CH_2(OH){\cdot}CH(OH){\cdot}CH_2(OH) \quad \swarrow$$

Actually, this change has not been realised but the alcohol indicated is the well-known substance glycerol (glycerine), obtained as a by-product in making soap, by saponifying hard animal fats and fatty oils with caustic soda.

Reduction.—Hydroxylation (oxidation) is the process involving the displacement of hydrogen by hydroxyl (OH); it is one of the most important of natural processes, especially of those in a downgrade direction. The reverse operation, the displacement of hydroxyl by hydrogen—reduction—is equally frequent and important, especially in upgrade changes. More often than not the two occur, if not in conjunction, in rapid

succession. All the changes above considered are reversible by hydrogen (atomic) acting " in circuit " with the hydroxy compound.

Hydroxylic Interactions.—Although similar in their functions to metallic hydroxides, the alcohols are in one respect strikingly singular in their behaviour, inasmuch as they do not give rise to conducting solutions when dissolved in water. Metallic hydroxides and acids interact immediately; alcohols are but slowly attacked by acids. The apparent outcome of the interaction of alcohol and acid is the substitution of the acid radicle for the hydroxylic radicle. Actually, the interaction may be more complex and involve a structural change. To give a specific illustration, alcohol and hydrogen chloride do not interact, except in the presence of water. Hydrogen chloride and water together, however, form an electrolyte. The process of interaction, in their presence in association (as a composite electrolyte), may be less direct and more complex than is commonly supposed, perhaps broadly as follows:—



The H in brackets is that which may be supposed to take the place of (OH) originally in the alcohol. Some such process as this may be at the root of the Walden inversion, in which an asymmetric compound is produced of opposite sign to that taken, the change being reversed when the inverse interaction is effected. It is probable that such " inversions " often happen unperceived, and that not a few inferences of structure may be affected by the occurrence, particularly in the sugar group. The active part taken by " a neighbouring hydrogen atom " may also be at the root of the " steric " hindrance observed in " etherifications."

Unsaturated Hydrocarbons.—So soon as hydroxyl is introduced into a saturated hydrocarbon—one in which the four affinities of the carbon atom are separately satisfied—a condition of instability is established. The hydroxyl tends to separate with hydrogen as hydrone—thus alcohol gives ethylene, $C_2H_5{\cdot}OH = C_2H_4 + OH_2$. " Dehydration," in reality, is an indirect process and may be effected in various ways, as by heating alcohol with either sulphuric or phosphoric acid: a sulphate or phosphate is first formed and decomposed. The loss of OH and H by alcohol is equivalent to the withdrawal of two atoms of hydrogen from the hydrocarbon ethane, C_2H_6. The operation may be repeated —ethylene may be converted into acetylene, C_2H_2, now a common frequenter of society in company of the motorists and largely used in welding and cutting steel. It is also made more directly by heating carbon together with lime, CaO, in an electric furnace, so producing calcium carbide, Ca_2C_2, which is transformed back into lime and acetylene by the action of hydrone (water) thus: $Ca_2C_2 + OH_2 = 2CaO + C_2H_2$

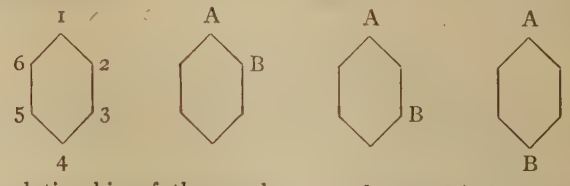
Ethylene differs by two units, acetylene by four, of affinity from ethane. Both hydrocarbons combine with bromine, giving rise to compounds of the ethane type, $C_2H_4Br_2$ and $C_2H_2Br_4$ The structure of these unsaturated hydrocarbons is not yet settled. Frankland said originally: " Let it be assumed that two affinities of the one satisfy two affinities of the other carbon atom in ethylene, three of the one, three of the other in acetylene—write $H_2C{=}CH_2$ and $HC{\equiv}CH$." It was so assumed—the conception was simple and easily committed to memory. Van't Hoff said, join two tetrahedra edge to edge to represent the carbon in ethylene, solid-face to solid-face to represent acetylene: the mandate was obeyed, so open to suggestion are we.

Whether or no such conjunction be possible, the fact remains that both compounds behave as if they were *un*saturated and full of energy. Julius Thomsen, as the result of his determinations of " heats of formation," has contended that actually less work is done in " doubly "-combining two carbon atoms, still less in " trebly "-combining them, than in combining them by single affinities. For the present, it is better to term the one " *linkage* " ethenoid, the other *acet(yl)enoid*, than double or treble bonded. The ethenoid linkage is commonly repeated but not the acetenoid.

The paraffins (C_nH_{2n+2}) and the corresponding *ethenes* (C_nH_{2n}) and *acetenes* (C_nH_{2n-2}) are all open-chain hydrocarbons: carbon atom is united to carbon atom in a continuous series, we may now say, in a zigzag, each setting to the other at the tetrahedral angle 109° 28′. This conception is now found to be in agreement with the verdict given by X-rays.

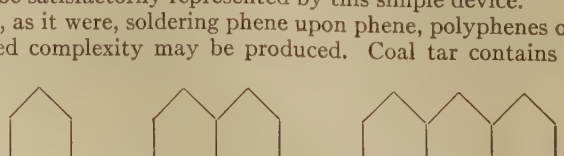
Phenoid Carbon.—A change comes over the scene as more and more hydrogen is removed and the compounds become less and less saturated algebraically. Faraday, a hundred years ago, discovered in the liquid condensed from " oil gas "—the gas obtained by decomposing oil at a red heat—the hydrocarbon, C_6H_6, which is now known as benzene. Theoretically, it is derived from the paraffin Hexane, C_6H_{14}, one of the chief constituents of petrol of low boiling point. It is a highly refractive liquid, whence the name *Phene*, which was given to it by Laurent, obvious to-day in phenol (carbolic acid). It crystallises readily. Benzene is nearly *saturated*. Chemists account for this fact by supposing the six carbon atoms arranged in a " closed chain or ring," and that each carries a single hydrogen atom.

The distribution of the fourth affinities has given rise to much controversy, in large part futile, because no clear conceptions were behind it and discussion was based upon imperfect appreciation of the facts. Chemical formulae, in the main, are but symbols of character—" shorthand " expressions indicative of the general behaviour of the compounds represented. They also portray the general structural relationships or arrangement of the atoms. They do so, however, only in terms of certain conventions. It has been customary to represent ethylene as $H_2C{=}CH_2$. To represent benzene as containing three pairs of carbon atoms related as in ethylene, which is often done, is to use a symbol that is in no way an expression of the facts. The general chemical behaviour of benzene is that of a but weakly, though not of a highly, unsaturated compound, and it is obviously peculiar in its behaviour. Fortunately, the extraordinarily complex chapter of the chemistry of its derivatives may be written irrespective of the structure of the hydrocarbon itself. Regarding it as a closed system, with six symmetrically arranged hydrogen atoms, all that is necessary is to represent it by a regular hexagon with H written at each of the corners. Derivatives are formed by displacing one or more of these hydrogen atoms: when several are displaced the derivatives vary in character according to the relative positions of the displacing radicles —these are easily indicated by numbering the positions relatively to some one, thus



The relationship of thousands upon thousands of compounds may be satisfactorily represented by this simple device.

By, as it were, soldering phene upon phene, polyphenes of any desired complexity may be produced. Coal tar contains three such:



benzene C_6H_6 — naphthalene $C_{10}H_8$ — anthracene $C_{14}H_{10}$

These are the foundation stones upon which the great modern dyestuff industry is built. The various " chars " (charcoals)

are probably highly complex compounds of this pattern with but a very small number (in proportion to the carbon atoms) of hydrogen atoms, which prevent the carbons from lapsing into the diamond state.

Diamond is one great carbon-phene—the benzene unit is but a small, highly symmetrical block dissected out from a single layer of atoms in the diamond and clothed with six hydrogen atoms.

Model Representations.—To obtain a model of the diamond, it is only necessary to make a considerable number of regular tetrahedral groups of equal spheres and to arrange these interlocked in sheets, placing them alternately upon base and upon apex, then piling sheet upon sheet, all closely interlocked. Each unit tetrahedral group within such a close packed mass will be equally surrounded with four other like tetrahedral groups interlocked in *face contact*. Each face-centre between two blocks being a centre of affinity, the model will embody the conception that the carbon atom has four equal affinities ranging outwards and operating, in so far as other carbon atoms are concerned, at the tetrahedral angle, from the centre of the mass. Occasion may be taken here to point out that the individual atoms at the surface of any mass of diamond must each have an affinity free. This must generally be true of all compounds. It does not follow, however, that such affinities have their full force.

An attempt to correlate crystalline form with chemical structure and develop solid models of complex carbon compounds was first made by Barlow and Pope in 1899.

They advanced two primary propositions—first, that valency may be given volume significance. Taking an arbitrary sphere of unit volume to represent a monad atom such as that of hydrogen, a sphere of twice the volume was used to represent a dyad atom such as oxygen, one of thrice the volume to represent a triad (nitrogen), and one of quadruple volume to represent the tetrad carbon. Second, that the relative valency volume remained the same in a series of related (corresponding) compounds, though the absolute volume might vary. This assumption is made to satisfy the facts of isomorphism—for example, in a series such as that of the three halides, NaCl, NaBr, NaI. If the densities of these salts, referred to molecular proportions—the volume occupied by the gramme molecular proportion—be taken and the assumption made that the sodium maintains its relative volume in the three compounds, the volume increases from chlorine to iodine. This is true generally. Pope and Barlow assumed that there was mutual adjustment and that the 1:1 volume ratio was retained in all the compounds. This is not only rational but apparently necessary.

Unfortunately, the use of spheres varying in volume entailed the construction of models on which the units were not close packed, and the attempt was unsuccessful on this account.

Mr. Barlow has elaborated a simpler method of treatment which appears to satisfy the conditions to be met. Using a sphere as unit of valency, the dyad is represented by two, the triad by three, the tetrad by four such spheres. Models so constructed can be "close packed" to any extent. If a mass of spheres be compressed, the units are ultimately reduced to dodecahedra and are then in contact over their entire surface. Mr. Barlow adopts such a dodecahedral unit in constructing his models. The carbon atom is represented by a pyramid of four dodecahedra. When two such are brought together to represent atoms united as in the diamond, the faces interlocked may be said to be *terfaces*, as surfaces of three of the four constituent units of the tetrahedron are present. A series of tetrahedra united in this manner, in a rectilinear zigzag, represents the paraffin structure. Lines drawn between the mass-centres of contiguous units meet at the tetrahedral angle in a zigzag. Whilst such straight chains may be dissected out of a sheet of diamond atoms to form the paraffins and their derivatives generally, benzene and the phenoid compounds may be built up from hexagonal blocks—sets of six carbon units— dissected out from the diamond sheet. To produce the benzene model, three "sameway" oriented tetrahedra should be placed symmetrically, each resting upon a surface, apex meeting apex at a common centre; then, three other similarly arranged tetrahedra should be placed upon these, so that each rests upon an apex, thus filling the three spaces between the lower three, the six together forming a block in which three affinities appear at the upper and three at the lower surface, each of the carbon units in the mass being united to two contiguous units. In such models there are two layers of valency units. To typify benzene, six hydrogen units have to be attached around the hexagon, one being assigned to each carbon atom and alternately placed one in the lower, the other in the upper plane of valency units. The engaged affinities are thus all operative in two planes, as it were.

Mr. Barlow has thus constructed solid, close-packed geometric models of a large number of benzene derivatives, taking into account the crystallographic data. In all but a few cases the models are a direct representation of the compound. In some instances, notably in that of parabromophenol, to obtain a model which is in harmony with the crystallographic data it is necessary to effect a slight readjustment of some of the units attached to the carbon complex, which remains fixed and invariable. The shift is of an entirely rational and simple character. The hydrogen unit remains attached to its appropriate carbon atom but is moved from an upper into a lower—or the reverse—plane of the carbon unit.

The models serve to bring out relationships which are patent to the chemist but not hitherto quantified, particularly in connection with the residual affinities shown by compounds generally. The higher paraffins and fatty acids are solid compounds, maybe of high melting point. It has always been difficult to account for this fact. In the model of a paraffin, the carbon skeleton is a two-layered structure like that of benzene; but whereas, in benzene, the carbon units rest upon "terfaces," in the paraffin the chain rests upon a succession of simple dodecahedral faces: the carbon units are, in fact, skewed. The hydrogen units are arranged in pairs on either side of the chain, therefore *not* at the tetrahedral angle; again, the affinities are exercised in two planes, those of the single carbon atom. In consequence, although each carbon affinity is engaged, it is but "partly covered or spoilt" and there is a considerable uncovered carbon surface. When the unit models are superposed or conjoined these surfaces come into apposition, thus typifying the exertion of what for want of a better expression, may be termed residual affinity. It is impossible, using such models, to typify carbon atoms as united by more than single "full" affinities. Only two forms of union seem possible, one that described, characteristic of paraffin and bezene; the other less complete in one sense, though it is such as to affect and "spoil" two affinities of each atom.

In the paraffins, three dodecahedra in each carbon unit are concerned in the single union. In the second geometrically possible mode of union, the jaws as it were of two atoms are interlocked—the result is that only two dodecahedra of the one are in contact with two of the other; the dodecahedra, however, do not belong to one "affinity face" as in the paraffin but to two. The model does indeed typify the eminently unsaturated condition of the ethenoids. In the acetenes, the third affinity of each of two carbon atoms is frankly to be regarded as unsatisfied, if the model be in any way a representation of the actual conditions. Whatever their ultimate value in connection with crystalline forms, such solid geometric models are undoubtedly bound to prove of great importance in the study of structure; their use, however, would seen to entail the use of a "geometric sense" but little developed hitherto.

Colour.—Whatever be the nature of the ethenoid form of union, it is the cause especially of marked optical peculiarities and in many cases of visible *Colour*. It is almost possible to assert that coloured compounds are all of one type—all *Quinonoid*. Quinone is a benzene derivative, formed by the removal of the two hydrogen atoms from the two hydroxyl groups in paradihydroxybenzene (the photographer's hydroquinone) or quinol

The white quinol becomes yellow. To mention other simpler

cases, mercuric iodide, which is a yellow or red crystalline solid, is colourless in certain solutions. Probably it is present in these as the simple molecule HgI_2, and in the solid form as a complex $(HgI_2)_x$. Iodomethane and diodomethane, CH_3I and CH_2I_2, are colourless liquids; triodomethane (iodoform) is a yellow solid. In these iodo-compounds the appearance of colour is probably determined by the "residual affinity" of the iodine. It is uncertain whether or no the simple molecule of iodoform be coloured; perhaps it is not, and the solid may be better formulated as

$$\begin{array}{ccccc} & & (CH) & & \\ I & & I & & I \\ \vdots & & \vdots & & \vdots \\ I & & I & & I \\ & & (CH) & & \end{array}$$

and the assumption made that the *three unsaturated* centres developed between the three iodine atoms co-operate to produce visible colour. If so, a sufficient number of simple molecules of mercuric iodide may be supposed to associate to give at least three unsaturated ethenoid centres. The faint blue colour of liquid oxygen may well be due to the association of several molecules in a complex system.

The three centres in quinone are conceivably the phene nucleus itself plus the two unsaturated CO groups. It is, however, possible that the simple quinone molecules are associated—through the CO group—and that the origin of the colour is in part extra-molecular. This is certainly true of a number of cases in which colour is apparent. When the number of unsaturated centres is increased, the colour is intensified and almost reaches black. The blackness of charcoals is perhaps to be explained in this way: probably these and graphite are highly complex molecules in which carbon is present not in one form as in diamond but as ethenoid carbon, together with phenoid and paraffinoid. It is possible that it will ultimately be found that there is but one form of carbon—diamond—and that the supposed allotropes contain a very small proportion of hydrogen—that they are complex hydrocarbons in fact.

Organic Chemistry.—Organic chemistry, now a vast science, including hundreds of thousands of compounds, is entirely built upon the carbon foundations which have been described: the paraffinic and the benzenoid, the one open, the other a closed system. Infinite as is the variety of compounds, they are nearly all formed from the hydrocarbons by the introduction of oxgyen (in relatively few cases, sulphur) or nitrogen, sometimes both, in place of one or more atoms of hydrogen. No two compounds are alike, and yet, within families, the resemblances are close. At bottom, the power of the carbon atom to combine with the carbon atom almost indefinitely is the reason why so many carbon compounds are possible. No other element appeals and clings to itself in the same way. No other element could well give rise to life. We are essentially creatures of carbon, using water as lubricant and oxygen as stimulant. Perhaps the greatest work before us is to interpret molecular structure and the functions of the materials made use of by the organism in terms of solid geometry. We shall then begin to have feeling knowledge of ourselves.

To be a chemist, it is necessary to have full appreciation of the characteristics of the families that enter into the world of carbon and to be in close acquaintance with many of its individuals. It is a difficult but fascinating occupation: once engaged in, the proper spirit of wonder and reverence being developed, it will be found to be the forecourt to many mansions of marvellous beauty.

We can only deal with life as built upon life, but our knowledge of the materials upon which its images are graven and of the graving processes is already astounding. Yet we are only on the outermost fringe of the inquiry, the difficulty of the problems to be solved is clear only to those who are absorbed in the study. The beauty of the solutions already found is in many cases beyond description, but to how few is this revealed! The plant is the great builder. Beginning with the simplest materials, it raises these to levels at which they become available to the animal organism, whose constructive power is limited to the arrangement and incorporation, not of simple bricks such as are handled by the plant, but of larger units previously fashioned by the plant. Plant, in turn, is dependent upon soil, as well as upon sun. We are indeed of the earth, earthy whilst children of the sun.

Plant Activities.—Falstaff, in his day, could well say, "The World is mine oyster, which I with sword will open:" such was the method of old. To-day, we work with knowledge, and hope to have done with swords—for a time, at least; the more we use our knowledge the more our cry may be, "The world is one great gasholder, whose holding we with our lungs devour." As the rays of the rising sun strike the earth, they enter upon their daily task of keeping the holder filled, whilst its contents are constantly consumed by plant and animal alike, chiefly by the latter. Our great luminary has been thus engaged throughout time, and much of his energy has been founded for us in ways and forms of which we take too little cognisance. We dispute much over coal and oil but take scant notice of oxygen—without which they would be worthless and life impossible: yet we have no full understanding of the ways of that oxygen, we pay little heed indeed to its marvellous power.

The initial act, on the part of the plant, is the absorption of carbon dioxide—present in the atmosphere in the minute proportion of only about three parts in ten thousand. Under some conditions, where much organic matter is undergoing decay, more may be present and there is much evidence that growth is more rapid when the concentration is above the normal. It is beyond question that oxygen is evolved, in proportion to the amount of carbon dioxide assimilated, as if action took place in the sense of the equation:—

$$CO_2+OH_2=COH_2+O_2$$

that is to say, as if the final oxidation product of carbon had been lifted back and up two steps towards methane, CH_4. No one doubts the explanation, although the compound COH_2, formaldehyde, has never been shown to be present in the plant cell by means which preclude the idea that it has not been developed in the course of testing. Chemists generally accept the explanation, because it appears to be the only one that will satisfy the conditions of the problem, the visible products of assimilation being such that not only may their production be accounted for by assuming that "formaldehyde" is their progenitor, but it is scarcely possible to suppose that they are produced in any other way. Moreover, formaldehyde, in the guise of $CH_2(OH)_2$, its hydrol, is a compound of intense chemical activity, and it is not to be supposed that it could accumulate in the vegetable cell.

This is not to say that we know precisely how the aldehyde is produced: we do not. Still, it is already proved that assimilation only takes place under the influence of light absorbed by the chlorophyll, in the green region of the visible spectrum. The process may, therefore, be regarded as an electrolysis. Every chemical interaction, be it remembered, is an electrolysis effected by light, in which water is electrolysed in circuit with carbonic acid, this latter being eventually reduced to the aldehyde, whilst the complementary product, perhydrone, is resolved into oxygen and water. Written empirically, the change may be expressed by the equation:—

$$CO(OH)_2+(H,\ldots.OH)_4 = COH_2+2OH_2+2HO{\cdot}OH$$

If so, the oxygen in reality is derived from water. The carbonic acid primarily serves the purpose of taking charge of the hydrogen which must be separated from hydrone to produce oxygen. The reduction product is alone of special (constructive) value to the plant; oxygen is returned to the atmosphere, in place of the carbon dioxide removed, sooner or later to play a destructive part, but, in so doing, to let loose and pass on the energy derived from the sun. Much energy from the sun is also stored in the formaldehyde. The quantity of solid formaldehyde corresponding with the formula (CH_2O) expressed in grammes (30 grammes, since C=12, H=1, O=16), when burnt, gives rise to 122,880 gramme-calories, that is to say, sufficient heat to raise the temperature of this number of grammes of water 1° Centigrade.

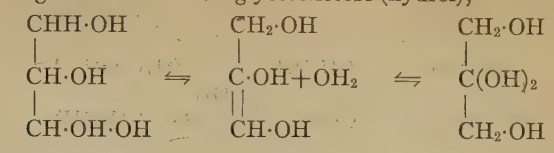
The contained carbon and hydrogen, if burnt alone, the former in the form of charcoal-carbon, would furnish 96,960+68,360 gramme-calories. Formaldehyde, therefore, has within itself about three-fourths of the energy of the contained carbon and hydrogen. It is thus shown how great a work is done by the sun.

Chlorophyll.—As chlorophyll is concerned and solar energy made operative through its absorptive action, it is necessary to assume that the electrolytic circuit is one in which the chlorophyll is included. Chlorophyll is a nitrogenous compound of great complexity and one of the most remarkable known. It is closely related to blood haematin, but, whilst iron is a characteristic constituent of the latter, magnesium is similarly the outstanding constituent of chlorophyll. Haematin has the power of combining with oxygen; it combines even more firmly with carbonic oxide (CO), but not with carbon dioxide. Chlorophyll shows no such associative tendencies, yet to explain its action we are almost forced to assume that it can combine, at least loosely, with carbonic acid. It has been surmised—it is only a surmise—that the association is through the magnesium atom, that this becomes partially unclasped through the action of carbonic acid, so that an acid carbonate, XO·CO (OH), is formed. That such a carbonate might undergo reduction, in an electrolytic circuit, to the *formaldehydrol* derivative $X{\cdot}O{\cdot}CH_2(OH)$ is possible, to say the least; indeed, it is probable that it would. Still, as chlorophyll is a pyrole derivative and laden with nitrogen, it is conceivable that it may act basically, apart from its magnesium. More it is impossible to say: the problem is one, however, which should not be put aside.

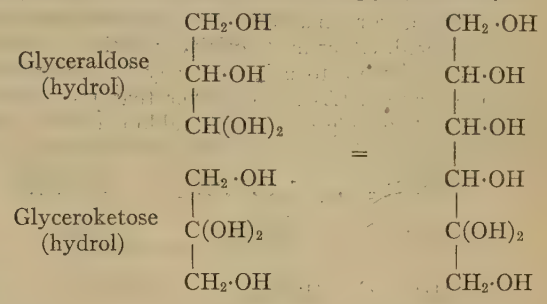
Whatever be the precise nature of the operation whereby formaldehydrol is produced, we have no reason at present to believe that it is otherwise than the sole immediate product of solar activity. In like manner it is at least probable that the higher carbohydrates which are formed by its condensation are the only compounds which are in the direct line of succession as solar products; of these, be it said, cellulose is the only one which is of structural value as cuticular material. The plant cell is a laboratory of wondrous activity. Within it are built the great variety of products which form the plant—quietly, without perceptible ostentation, at ordinary temperatures, often in the dark, underground, as in the potato tuber. Thus we have been unable to prepare starch or even cane sugar. To imitate the operations of nature we need most elaborate and expensive appliances, and often work at high temperatures and pressures. When we think of the way in which nitrogen and hydrogen are converted into ammonia in the root nodules of leguminous plants, apparently by a minute organism living an imprisoned, airless life—when we contrast this with the great array of pumps, compression vessels and many other mechanical appliances used in the factory to the same end, we may indeed hang down our heads in very shame at our ignorance of all that is fundamental in the minute operations of nature. To pour such material, so made, as fertiliser upon the soil, when the humble bacterium by which it is populated can do the work on the spot if only properly encouraged, may some day come to be regarded as soil sacrilege.

Formation of Carbohydrates.—Under laboratory conditions, formaldehydrol rapidly undergoes change in presence of a mere trace of an alkali. The product is a complex mixture and has never been successfully unravelled: it contains *fructose*, however, one of the components of cane sugar. The process of change is only partly understood, and is in doubt, so far as the precise nature and succession of the changes between aldehydrol and sugar is concerned, but is, in essence, a *condensation* and typical of a great number of up-grade changes which take place under natural conditions. It may therefore well be discussed at length. Perhaps *three* molecules interact simultaneously thus:—

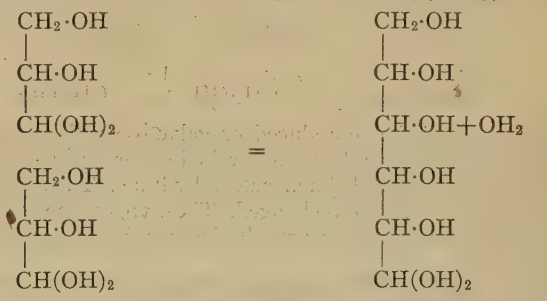
This product, glyceraldose (hydrol), the aldehyde of glycerol, at once suffers internal change and is converted into the corresponding isomeric ketone—glyceroketose (hydrol),



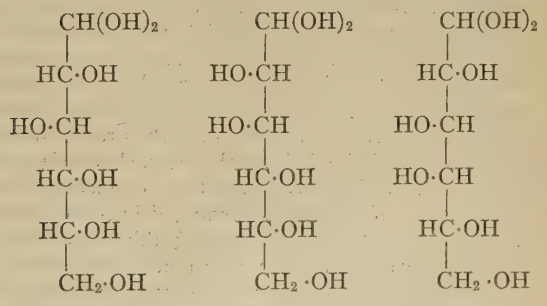
These triplets interact, in pairs, in various ways. The production of fructose may conceivably take place in the following manner, by the condensation of glyceraldose and glyceroketose,



The production of glucose may be represented as involving the interaction of two molecules of glyceraldose (hydrol),

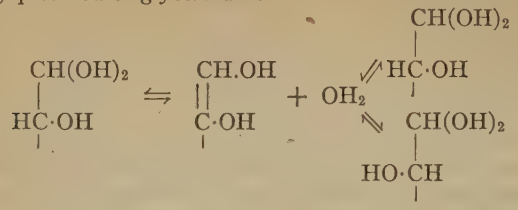


The formulae here used are mere paper-written expressions and not intended to indicate actual structure—they do so only broadly. It will be noted that in the glucose formula four of the carbon atoms, and in the fructose formula three, each carry four different radicles; the two sugars are therefore structurally asymmetric materials and should be optically active. The natural products are but the compounds produced in the laboratory, are not optically active simply because the latter are mixtures of compounds of opposite optical activity. In point of fact, variations in internal structure are brought about by merely varying the relative position of the (OH) groups in the CH(OH) member of the structure. In all, 16 isomeric glucoses are possible: these form two sets of eight, corresponding terms in which are of equal, opposite structure and optical activity. The three isomeric natural sugars, glucose, mannose and galactose, are represented by the following expressions, showing the relative arrangement of the hydroxyl groups in the asymmetric members:—

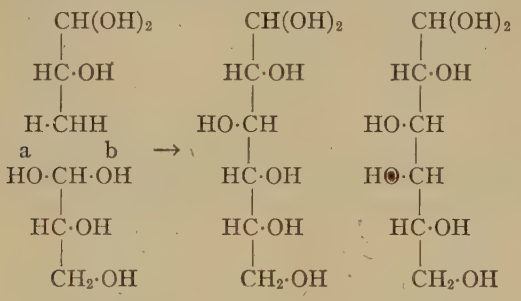


The structural relationship between these three forms is of a very simple character. If the position of the topmost OH group in glucose on the right of the formula be reversed, the formula becomes that of mannose. As a matter of fact, this change gradually takes place, to a slight extent, when merely a little alkali is

added to a solution of glucose. The process is probably that already pictured of glyceraldose:—



The peculiar ethenoid linkage developed by withdrawal of hydrone from the aldehydrol may be broken on either side and the OH may be restored, either in its original position or reversed. The change from glucose to galactose may be pictured in an equally simple manner. Assuming either that the glucose be first resolved into two molecules of glyceraldose, or that the two sugars be each formed directly from two such molecules,



either glucose will be reproduced or galactose will be formed, according as either the OH group marked (a) or that marked (b) be removed in the extruded molecule of hydrone. The position of only one of the OH groups is changed. These are not mere matters of speculation: such changes actually happen, before our eyes, in the laboratory.

Optical Activity.—When compounds are produced artificially which are potentially (by structure) optically active, the two optically active forms, of equal opposite activity, are both produced and in equal amounts, so that the product is optically inactive. The chances of the action going this way or that, unless specially directed, are equal. In nature, all such compounds are produced initially in the one optically active form—nature, as it were, is one-handed and wears but a single glove. Nature's factory turns out only gloves for, let us say, right-handed wearers. When both appear, as happens in a few cases, there is reason to believe that a change has taken place after nature has ceased to exercise her directive influence.

Of all the facts disclosed by the study of natural products, this restriction placed upon herself by nature is the most remarkable. The discovery is the outcome of Pasteur's initial, most wonderful, prime discovery that racemic acid, an optically inactive product got from wine-lees, could be resolved into equal parts of ordinary right-handed tartaric acid and of a left-handed twin thereof. It is an important consequence of this generalisation that natural chemistry is, in a sense, simpler than laboratory chemistry.

How is the natural process by which a sugar such as glucose is formed to be pictured? It is as if the formaldehydrol molecules were threads the two ends of which are passed through contiguous holes in a piece of canvas. A number of such threads, being thus arranged, may obviously be tied together at the back of the canvas in various ways and the loose ends then clipped off, leaving distinctive elements of the thread arranged in some pattern on the front. Such a pattern might conceivably be produced by lowering upon the canvas a plate with holes through which the threads could be drawn only at certain points, and thereby determining the ways in which they could be tied together. In the plant, more probably, the reverse influence may be at work. The pattern may exist in the plant in the form of the substance to be produced: a sugar molecule may conceivably be formed upon what is practically a sugar molecule; that of starch upon a starch molecule; hence the apparently immediate appearance of starch. If such be the case, we can understand the formaldehydrol molecules becoming properly placed upon the guiding molecule, particularly in virtue of the attraction exercised by the (OH) groups in this upon those in the corresponding positions in the formaldehydrol molecules, leaving others in the position of loose ends to be snipped off at the right moment. When models of benzene derivatives such as have been described are packed together to form the crystal, more often than not they form a stepped pavement, as it were, alternate units being at one or other of two levels. Starch may well be so constructed, and it is possible to picture a series of formaldehydrol molecules dropping into place, in orderly arrangement, upon such a platform, ready to be tied together.

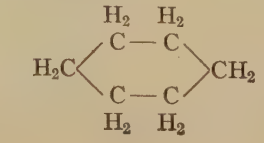
Enzyme Action.—How is the tying done? it may be asked. The operation is so easily effected in the laboratory that no special mechanism may be required. A trace of alkali or even acid may suffice. On the other hand, there is much evidence that, under natural conditions, the more complex carbohydrates are usually broken down through the agency of special agents, known as *enzymes;* therefore, it is at least probable that they are formed by the converse process, as such interactions are known, in many cases, to be reversible, and should be in all, though the point of equilibrium may be so near to the side that the change may appear to be unilateral. The general equation of enzymic hydrolysis may in fact be written thus:—

$$A'B' + \epsilon\delta\kappa OH_2 \rightleftharpoons A'(H) + B'(OH) + \epsilon\delta\kappa.$$

The difficulty that arises in the attempt to apply this generalisation is that the necessary agent is not always obvious. Thus, it is known that the constituents of cane-sugar, glucose and fructose both travel down in large quantity from the leaf to the bulb, and there become associated as cane-sugar: the bulb, however, does not contain the enzyme *invertase,* although this is present in the growing leaf. The enzyme appears to travel down into the bulb only when the growing period sets in, and the store in the bulb is utilised in forming a new season's growth.

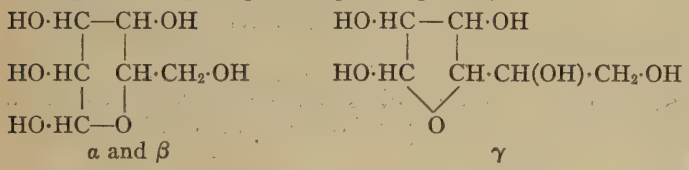
A further structural peculiarity in the sugars may now be referred to, as it is one that must be taken into account in discussing their formation. In the paraffins, as already explained, the carbon atoms are simply arranged in a series or row, atomic centres meeting at an angle of 109′28″, at successive corners of a zigzag. In the phenes, the angle of the approach of the carbon atoms may be supposed to be the same, but they are arranged in compact closed systems—in sheets of more or less frequently repeated hexagons. The sugars are also peculiar. Glucose is derived from the alcohol mannitol, which, in turn, is derived from the paraffin hexane, by the displacement of six of the hydrogen atoms, one from each carbon atom, by the radicle (OH). Glucose bears to mannitol the relation of aldehyde to alcohol, but the aldehydic properties are so feebly displayed that chemists have always dubbed it an aldehyde with hesitation. One peculiarity of glucose is the ease with which it is etherified. When it is dissolved in methylic alcohol, and the solution is slightly acidified with hydrogen chloride, it is soon converted into a mixture of products chief of which are two monomethylic derivatives—α- and β-methoglucoside, $C_6H_{11}O_5(OCH_3)$. In neither of these is the slightest trace of aldehydic behaviour to be found. A (third) γ-glucoside isomeric with the α and β forms has also been isolated, which is chemically a far more active substance. A solution of glucose appears to contain but a minute proportion at most of this form, and consists mainly of the α and β forms in equilibrium.

Chemists are now of opinion that the glucoses and these glucosides are closed systems, analogous to that of phene (benzene), but saturated. Phene itself may be converted into a saturated system, C_6H_{12} (hexahydrobenzene or hexamethylene), which is scarcely distinguishable chemically from the paraffin hexane.

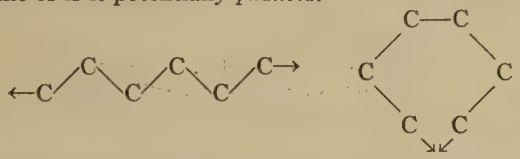


A hexhydric alcohol, $C_6H_6(OH)_6$, derived from this hydrocarbon, is a natural product. Being closed systems derived from phene, but saturated like methane and its substitution derivatives, such compounds are conveniently spoken of as *phanes*.

Phanes.—A simple and rational formal expression of the peculiar behaviour of glucose, and especially of the methoglucosides, is given if it be assumed that they are *oxophanes*, phanes in which several atoms of carbon are linked in a closed system by means of an oxygen atom. If so, one end of the paraffinic chain of mannitol becomes, as it were, soldered to a link along the chain, when, by hydroxylation, the terminal carbon atom is converted into the aldehydrol and a molecule of hydrone is thereupon withdrawn from the compound. To what "link" down the chain is the terminal atom thus united? The problem has given rise to a large amount of work and an equal amount of speculation, extending over years—we are not yet satisfied that the solution is in our hands. The most probable "interpretation" of the character of glucose and the glucosides, however, is now thought to be that given by the assumption that they are *phanoids:* that α- and β-glucose and the corresponding glucosides—are hexaphanes (hexoxophanes) and γ-glucose and the γ glucosides pentaphanes (pentoxophanes).



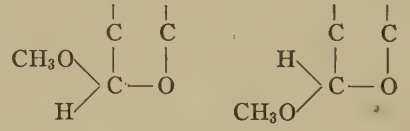
Assuming such to be the case, what is mannitol—is it truly paraffinic or is it potentially *phanoid?*



When hexane is gradually hydroxylised, does the carbon chain remain essentially a straight one, like a billiard cue, or does it bend? If the latter, when is the "screw" put on? This is an inquiry into the art of the chemical stevedore which the X-ray analysts must help to solve. Whenever it occurs, the "bending" is doubtless a necessary consequence of the loading of the molecule with oxygen and the attraction which oxygen has for oxygen. It may be added that although the formulae are written as "rings": actually in the model the carbon atoms are close packed either in clumps or in closed systems. Four and five may be united by an atom of oxygen, but the minimum number of carbon atoms in a closed system is probably six.

Returning now to the consideration of the manner in which carbohydrates are formed in the plant, it may be pointed out that although glucose is the fundamental carbohydrate unit, the opinion prevails, at the moment, that cane sugar, not glucose, is the primary product; starch may also be a primary product, but, as it is scarcely present in the leaves of monocotyledons, it is no longer supposed, as it once was, that this is *the* one and only initial product of assimilation. In any case, the carbohydrates should be regarded as immediate primary products of solar activity, if built up, as such, from carbonic acid, as this is reduced under the immediate influence of chlorophyll. If formed from formaldehydrol first set free in the cell fluid they are but secondary products. The fact remains that in some plants the chloroplasts become laden with starch; in others, in which cane sugar rather than starch seems to function as reserve material, they do not. Yet in these latter, if the concentration of the sugar within the leaf be raised by dipping the cut end into a strong solution of sugar, their chloroplasts equally become laden with starch. Apparently, in monocotyledons, the conditions of concentration are not normally those required for the production of starch; or maybe they are such that the starch is no sooner formed than it is hydrolysed and passes out as a lower sugar. The more probable explanation seems to be that the units assembled upon the template are tied together perhaps only in pairs and that these float away. Dilution would operate against continued linking up of molecules.

The essential carbohydrates are certainly glucose and fructose, cane sugar, starch, inulin and cellulose. Whilst cane sugar is compounded of glucose and fructose, inulin is composed of fructose, starch and cellulose, being formed of glucose alone. The units are differently arranged and in different numbers in the higher sugars, in unknown numbers in inulin, starch and cellulose. The difficulty of dealing with starch is enhanced by recent discoveries: that what is commonly called starch is not a single substance, and that, apparently, a single layer in a granule may be a mixture of "starches." Though starch and cellulose are ultimately resolved by hydrolysis into the same glucose, diverse products are obtained on the way—the one yielding *maltose*, the other *cellobiose*, both isomerides of cane sugar. The relation of these three, however, is simple, as fructose, which is associated with glucose in cane sugar, is but glucose slightly modified, and the other two are perhaps respectively α and β glucosides corresponding to the α- and β-methoglucoside already considered, the difference between these being simply that the methyl group is attached in one or other of the two possible positions to the carbon atom next to the oxygen link in the oxophane.



There is still much uncertainty on these points. Taking all the peculiarities into account, which are thus apparent, it is clear that the formation of sugar is a directed process from the beginning—that the sugars are all, as it were, formed against templates or patterns present in the plant cell. Whether formaldehydrol be produced and sent into circulation, or whether it be directly laid down to one or other carbohydrate, matters little—the primary elements are ultimately arranged and linked up in definite ways. The pattern cannot well be other than the thing itself. Cane sugar, however, being an intensely soluble material, cannot be thought of as acting as such. Yet it is not difficult to picture molecules of cane sugar being built into the protoplasmic structure of the chloroplast and the assembly, at such centres, either of formaldehyde or of glycerose molecules, which thereupon interact and give rise to cane sugar itself. But how? Some mechanism must be imagined to tie the threads (OH+OH) and cut off the spare ends (as OH_2) in the way previously considered. Formaldehydrol and the sugars are in themselves inert—they are not electrolytes. They must be made into electrolytic conductors, by means of acid or alkali, before they will act together or give way to attack. We know that, in the fermentation process, glucose is first associated with a phosphate. We know that in the plant phosphate plays a determining part. It is not going far to assume that phosphate comes into play in the formation of carbohydrate: how exactly, whether in the shape of a floating mechanism—such as an enzyme—or as a molecule held in the protoplasmic complex, much as the crane is now placed on a building in course of erection, it is impossible to say. That the phenomena are of such an order would seem to be highly probable. Away from the leaf, leucoplasts are met with in which transitory starch is often found, so that the enzymic mechanisms would seem to be widely distributed.

These mechanisms are clearly things apart—little factories in which special operations are carried on. For example, in sorrel, which is a strongly acid plant, the chloroplasts in the leaf are to be seen tucked away, as it were, in corners of the cells and are clearly independent of the acid in the fluid in which they float, their lining membrane being impervious to acid; for if this membrane be broken down by exposing the leaf to chloroform, at once the chlorophyll is changed in appearance. Normally, it would seem, sugar must be able to pass out, although acid cannot pass in—but sugar is not an electrolyte. Such observations are the

clearest possible evidence that the reduction of carbonic acid takes place within the chloroplast: that the formation of carbohydrate is effected under its influence would also seem to be open to little doubt. In the starch granule, there seem even to be traces left, between "the starch molecules," of the erecting mechanism. We have yet to learn whether the silica in the cereal stem be not such a survival, not a mere strengthening inclusion.

Constructive Metabolism.—Having made sugar, the plant proceeds to use it in its many wondrous feats of constructive metabolism. The micro-organism—the yeasts and all unicellular organisms—we know is able from sugar alone as organic pabulum, with the aid of a few mineral salts, to reproduce itself to an unlimited extent. Raulin's nutrient solution, much used by Pasteur, was composed as follows:—

Water	1,500	Carbonate of Magnesia	0·4
Sugar candy	70	Sulphate of Ammonia	0·25
Tartaric acid	4	Sulphate of Zinc	0·07
Nitrate of Ammonia	4	Sulphate of Iron	0·07
Phosphate of Ammonia	0·6	Silicate of Potassium	0·07
Carbonate of Potassium	0·6		

Apart from the singular power possessed by the higher plants, with the aid of chlorophyll, of reducing carbonic acid and of meeting the many requirements of cells of different orders, the chemical functions of unicellular and multicellular organisms would seem to be similar. When the compounds other than sugar present in the plant and more particularly in the animal, in which sugars play a very minor constructive part, serving mainly as fuel, are considered, it is obvious that they all contain very much smaller proportions of oxygen than the sugars. The life of the plant is essentially a reductive process—as indeed it is in the beginning, as the evolution of oxygen is but an accident of the reduction of carbonic acid by means of hydrogen derived from hydrone, the oxygen being cast aside as a by-product of no account to the plant. We have to explain the constant withdrawal of oxygen. Only one agent is at disposal for the purpose—that used in the first act: hydrone. We have to account for the disposal of its oxygen—without further direct assistance from the sun. Inasmuch, however, as starch contains about half the energy the carbon and hydrogen that are in it would furnish if burnt alone, the plant actually continues to work even in the dark with energy derived from the sun, the more as it also makes use of oxygen. Whatever the carbohydrate reserve material, it is brought down to a hexose, chiefly glucose, for use. Experimental evidence favours the view that glucose first undergoes resolution, by hydrolysis, into two molecules of glycerose. This seems the first stage in alcoholic fermentation under the influence of the complex enzymic mechanism in yeast (zymose).

$$\begin{array}{l} HO\cdot HC\!-\!CH\cdot OH \\ \quad\quad | \quad\quad | \\ HO\cdot HC \quad CH\cdot CH_2\cdot OH \\ \quad\quad | \quad\quad | \\ HO\cdot HC\!-\!O \end{array} + {}_2OH_2 \;=\; 2 \begin{array}{l} CH_2OH \\ | \\ CH\cdot OH \\ | \\ CH(OH)_2 \end{array}$$

It is noteworthy that the presence of phosphate is essential, and that, in a preliminary stage, the phosphate and hexose interact. The argument has already been put forward but may be repeated, that, in the converse process, in the plant, phosphate is also operative and that this is an indication of at least one reason why phosphate is essential for plant growth. The reason why phosphate is essential is perhaps not far to seek. Glucose by itself, in aqueous solution, is not an electrolyte and, therefore, should not be open to attack—by the introduction of an acidic radicle into its structure, it becomes an electrolyte and can therefore be included in a circuit of change.

The two isomeric trioses, glyceraldose and glyceroketose, like the two isomeric hexoses, glucose and fructose, are mutually interconvertible—under the influence of a trace of alkali. The process is probably of the following order:—

$$\begin{array}{l} CH_2\cdot OH \\ | \\ CH\cdot OH \\ | \\ CH\cdot OH\cdot OH \end{array} \rightleftharpoons \begin{array}{l} CH_2OH \\ | \\ C\cdot OH \\ \| \\ CH\cdot OH \end{array} + OH_2 \rightleftharpoons \begin{array}{l} CH_2\cdot OH \\ | \\ C(OH)_2 \\ | \\ CH_2\cdot OH \end{array}$$

This change takes place rapidly and, when equilibrium is attained, both compounds are present in large proportions. Glucose is only very partially changed into fructose and the reverse, by a similar isomeric change. In the fermentation process, this type of change is carried a stage further, apparently under enzymic influence, though it can be effected with the aid of alkali:—

$$\begin{array}{l} CH_2\cdot OH \\ | \\ CH\cdot OH \\ | \\ CH(OH)_2 \end{array} \rightleftharpoons \begin{array}{l} CH_2 \\ \| \\ C\cdot OH \\ | \\ CH(OH)_2 \end{array} + OH_2 \rightleftharpoons \begin{array}{l} CH_3 \\ | \\ C(OH)_2 \\ | \\ CH(OH)_2 \end{array}$$

The compound thus produced (pyruvic aldehydrol) is eminently oxidisable and easily oxidised to pyruvic acid—$CH_3\cdot CO\cdot CO(OH)$. It is thought that this acid is formed and, by hydrolysis, resolved into aldehyde and carbonic acid—$CH_3\cdot CO(OH)+OH_2 = CH_3\cdot COH+CO_2+OH_2$. It is known that yeast contains a peculiar enzyme, *carboxylase*, which will effect this change. Also, that if the fermentation be carried out in presence of a sulphite, aldehyde may be obtained in large quantity, in place of ethylic alcohol. Further, if the liquid be maintained alkaline, much of the glyceraldose (ketose) escapes oxidation and is reduced to glycerol—which is but a very minor product of fermentation under ordinary conditions. It is thus seen how the glycerol of fats may be produced.

The production of alcohol in the fermentation process may be regarded as one in which two separate molecules are concerned and *reciprocally hydrolysed in circuit*, the one being hydrogenised, the other hydroxylised:—

$$CH_3\cdot CH(OH)_2 + \begin{array}{l} H \ldots OH \\ H \ldots OH \end{array} + CH_3\cdot CH(OH)_2 = CH_3\cdot CH_2(OH) + OH_2 \qquad +OH_2+CH_3\cdot C(OH)_3$$

The ordinary hydrolysis of cane sugar may be regarded as a change of this order but one in which two separate halves of the molecule are affected, the one being hydrogenised, the other hydroxylised.

To bring the two processes into complete agreement, proof is required of some mechanism in the fermentative process, whereby the two aldehyde molecules are assembled in circuit with hydrone. Possibly, only suitable determining conditions of acidity and concentration are necessary—no special catalyst.

It is possible to ferment sugar in a variety of ways. Thus, from it may be produced normal butylic alcohol and acetone, instead of ethylic alcohol. It is not difficult to explain the process. Aldehyde is easily condensed in the following manner:—

$$CH_3\cdot CH\cdot OH\cdot OH + CH_3\cdot CH(OH)_2 = CH_3\cdot CH(OH)\cdot CH_2\cdot CH(OH) + OH_2$$

This compound is convertible, by direct reduction, into normal butylic alcohol, whilst on oxidation it gives acetoacetic acid, $CH_3\cdot CO\cdot CH_2\cdot CO\cdot OH$, which is easily resolved into acetone and carbonic acid. It is not difficult to visualise the formation of complex fatty acids as a consequence of continued condensation and reduction, accompanied by the necessary amount of hydroxylation to form the necessary hydrogen.

Proteins.—The origin of proteins is to be sought in this same direction. It is known that these are but collocations of simple molecules, formed by condensation of molecule upon molecule, a great variety of molecules being thus linked together. The units range from amino-acetic acid, $CH_2(NH_2)\cdot CO\cdot OH$ upwards, as shown in the following table.

Glycine $CH_2(NH_2),COOH$
Alanine $CH_3\cdot CH(NH_2)\cdot COOH$
Valine $(CH_3)_2{:}CH\cdot CH(NH_2)COOH$
Leucine $(CH_3)_2{:}CH\cdot CH_2\cdot CH(NH_2)\cdot COOH$
Isoleucine $(CH_3)(C_2H_5){:}CH\cdot CH(NH_2)\cdot COOH$
Serine $CH_2OH\cdot CH(NH_2)\cdot COOH$
Lysine $H_2N\cdot CH_2CH_2CH_2CH(NH_2)\cdot COOH$

Arginine $HN{=}C\begin{array}{l}/\,NH_2 \\ \backslash\,NH\cdot CH_2\cdot CH_2\cdot CH_2CH(NH_2)\cdot COOH\end{array}$

Phenylalanine $C_6H_5{\cdot}CH_2{\cdot}CH(NH_2){\cdot}COOH$

Tyrosine $HO{\cdot}C_6H_4{\cdot}CH_2CH(NH_2){\cdot}COOH$

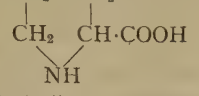
Aspartic acid $HOOC{\cdot}CH_2{\cdot}CH(NH_2){\cdot}COOH$

Glutamic acid $HOOC{\cdot}CH_2{\cdot}CH_2{\cdot}CH(NH_2){\cdot}COOH$

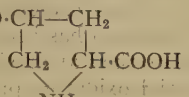
Hydroxyglutamic acid $HOOC{\cdot}CH_2{\cdot}CHOH{\cdot}CH(NH_2){\cdot}COOH$

Cystine $HOOC{\cdot}CH(NH_2){\cdot}CH_2S{-}SCH_2{\cdot}CH(NH_2){\cdot}COOH$

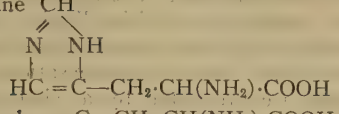
Proline



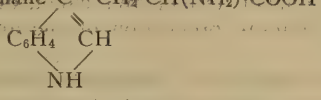
Hydroxyproline



Histidine



Tryptophane



The production of such amino-acids is to be accounted for without much difficulty, bearing in mind what is said above, of the manner in which hydroxy-(keto) acids, such as pyruvic acid, are formed in the fermentation process and the readiness with which these are attacked by ammonia:—

$$CH_3{\cdot}C(OH)_2{\cdot}CO{\cdot}OH+NH_3=CH_3{\cdot}C(OH){\cdot}(NH_2){\cdot}CO{\cdot}OH+H_2O$$

Such acid, on reduction, is converted into aminopropionic acid or alamine, a constituent of many proteins. Aminoacetic acid (glycine) is conceivably derived in a similar way from glyoxylic acid, $CH(OH)_2{\cdot}CO{\cdot}OH$ this being one of the normal oxidation products of glycerose.

The only series of compounds present in plants of which the origin is at present obscure are the phenoid derivatives, phenylalanine, tryptophane and tyrosine, which are present in most of the proteins. Broadly speaking, however, it is clear that they are formed from simple materials by condensation processes such as those explained.

As to the structure of the proteins, we have no conception, at present, whether their molecules are long-drawn-out systems like those of the fatty acids or compressed like the saccharons. The latter is the more probable. Regarding them as forming sheets of a pavement-like character, it is possible to conceive the arrangement of the several units upon pre-existent molecules of the protein and the consequent determination of the order of arrangement. Without some such interpretation, it is impossible to explain the persistence of particular proteins in particular materials of either animal or vegetable origin.

Nitrogen Absorption.—Plants of non-leguminous orders apparently derive their nitrogen, at least for the most part, from ammonia in the soil. Nitrate, we know, passes into the plant and may even be stored in the cells in considerable amounts. Nitrates are not easily reduced, however. Still, proof has yet to be given that they are directly utilised by the plant. The remarkable direct absorption of nitrogen by organisms in the soil and by others living in the nodular growths found especially upon the roots of leguminous plants is in no way understood at present. Probably, it is to be associated with the occurrence of intense oxidative changes, which make hydrogen disposable at a high potential. The absorption of so inert a material appears to be less remarkable than it did, now that vast quantities of ammonia are produced by the direct interaction of hydrogen and nitrogen under the influence of a catalyst—but this is effected at a high temperature and under a high pressure not within the cold soil. Strangely enough, the production of ammonia by direct reduction of nitrogen has never yet been observed under ordinary simple laboratory conditions.

Methyl Alcohol.—A reference may be interposed to modern synthetic methods of producing organic materials which may well put fermentation processes and natural sources into the shade. Methylic alcohol has long been produced as a by-product in the manufacture of charcoal—formerly much used for gunpowder. Formaldehyde, which has been greatly in demand of late years, has been prepared by oxidising such alcohol. It has recently been shown that, in presence of a suitable catalyst, under appropriate conditions of temperature and pressure, carbonic oxide and hydrogen interact directly and may be converted all but completely into methylic alcohol. At higher pressures the product is more complex, and apparently a whole series of paraffinic alcohols may be produced. Clearly, it is a case in which formaldehyde molecules are formed and brought into interaction and condensed, as they are in the plant, the product being, however, at once reduced.

Oxidation.—In the animal, oxidation is at the root of muscular activity. The extent to which it is effected as an independent process is not clear but, at least, the fats must be primarily oxidised to some extent before they are rendered available for the purposes of muscular activity. Oxygen is so essential to plant life that the gas must take part in its vital activity, but it is in no way clear what special function oxygen subserves. Many organisms can live without air, the yeasts all do; oxygen becomes necessary, however, at the reproductive stage, though only in minimal amount. Aerobic organisms use up a large amount of oxygen. In the animal, oxygen is stored in haemoglobin as oxyhaemoglobin and thence passes into solution as required, a definite equilibrium being maintained between the oxygen within the red-blood corpuscles and the solution without the cell. Oxyhaemoglobin itself, apparently, has no action as an oxidising agent. At root, the oxidation (hydroxylation) process in plant and animal is alike in its nature, it may be supposed. Usually, if not always, a catalyst as well as a determinant, is involved in the change—the oxidising catalysts are known generally as oxidases. These have been classed as enzymes, but modern work is tending more and more to show that, though they may differ and be limited in their range of activity, they are not enzymes in the sense of being selective agents, in some way structurally related to the compounds they affect. The enzymes, as a class, are apparently all hydrolytic agents; at least, it may be desirable to confine the use of the term to agents exercising this function alone.

Thanks to the refined work of Fletcher, Hill and Hopkins in particular, it is now clear that the act of muscular contraction derives its energy from an essentially enzymic process, akin to that of fermentation, whereby hexose (glucose) is converted into lactic acid, $CH_3{\cdot}CH(OH){\cdot}CO{\cdot}OH$—only then does oxygen become directly operative. It may well be that the lactic acid is merely hydroxylated and that the product, $CH_3{\cdot}C(OH)_2{\cdot}CO{\cdot}OH$, is resolved into carbon dioxide and a residue which is rebuilt to hexose.

In this connection, it may be well to discuss more closely the phenomena of oxidation in general. It may be submitted that not only, as already stated, (1) is oxidation primarily, in so far as the oxidised compound is concerned, a process of hydroxylation, but (2) that oxygen or whatever oxidising agent be used is active only indirectly—as depolariser and adjuvant in an electrolytic circuit. The oxidation of hydrogen has already been formulated from this point of view, thus:—

$$\begin{matrix} H & HO & H & O \\ | & \cdot\cdot & \cdot\cdot & | \\ H & HO & H & O \end{matrix} = 2H_2O+HO{\cdot}OH$$

Note.—Dots are used here and elsewhere to indicate the electrolyte of which HO and H are the terminals.

Whereas hydrogen and oxygen interact readily, at the surface of a platinum plate (in presence of the necessary determinant), a mixture of carbonic oxide and oxygen not only remains unaffected but, if carbonic oxide be added to the mixture of oxygen and hydrogen, it actually inhibits their interaction, under the influence of platinum.

Carbonic oxide and hydrogen have very nearly the same heats of combustion, that of hydrogen (to liquid water) being slightly

above, that of carbonic oxide, slightly below, 68,000 units. It may be suggested that 68,000 is a *limiting value* and that no interaction in which a less amount of energy is developed will take place directly—without an adjuvant or depolariser. This seems to be an immediate corollary to the view, that as the action is electrolytic the determinant is necessarily liquid and composed of water and a salt. Carbonic oxide should be incombustible in the absence of a depolariser, if this view hold good, as water must be electrolysed in the circuit of change.

The fact that it explodes when moist may be accounted for by the assumption that the spark or flame applied to the mixture causes the production or introduction of a slight amount of hydrogen, which is burnt along with it, a supply of hydrogen being kept up by a slight decomposition of water in the wave front as the explosion spreads. Prof. Bone has found that the mixture becomes less and less easily exploded, requiring the application of a greater and greater intensity of current to force a discharge across the sparking gap, as the drying is more and more complete. Using phosphoric anhydride as drying agent, a limit is reached but only after several months. Explosion ultimately takes place but only when a very powerful electro-motive force is applied and is attended with a most brilliant flash of light, but the interaction is far from complete. What is the explanation of this behaviour? It may be either a case in which a sufficient amount of the electrolytic determinant is expelled from the platinum wire electrodes by the discharges in the form of previously imprisoned hydrogen molecules and "spluttered" platinum motes, or one in which the gas is dissociated into its elements and the released carbon is exploded in *statu nascendi* under the influence of the traces of determinant liberated from the sparking wires and the walls of the vessel. There is urgent need to consider problems of this kind, in view of the importance attached to the discharge of electricity through gases by physicists, who are paying no attention whatever to the purity of the materials and the possible variation in the system through which the discharge is passed.

Carbonic oxide is perhaps the most interesting of all oxidisable gases. It needs little drying to render it incombustible, and its combustibility grows as the amount of moisture present is increased over a considerable range. The probable explanation of this behaviour is that it is hydroxylised, not as such but indirectly through the determinant which becomes associated with it. The compound $CO\langle^{H}_{OH}$, being of a very low order of stability, would necessarily be in very small proportion unless a considerable proportion of hydrone molecules were present. Its condition is comparable with that of a *very weak* acid in solution.

The influence of hydrogen and of hydrocarbon in promoting the combustion, when present together with the gas, may be ascribed to the initial formation of perhydrone from the hydrogen, which then functions as active depolariser in the carbonic oxide circuit.

$$CO\langle^{H}_{OH} + \begin{matrix} HO\ldots H \\ HO\ldots H \end{matrix} + \begin{matrix} HO \\ | \\ HO \end{matrix} = CO\langle^{OH}_{OH} + OH_2 + \begin{matrix} \cdots \\ \cdots \end{matrix} + 2H_2O$$

In other words, carbonic oxide, in reality, is burnt at the expense of pre-existent perhydrone, not in any "direct" way, at the expense of oxygen.

In most cases of oxidation under laboratory conditions, the agents used are salts and therefore electrolytes. The only agents which are not are perhydrone and oxygen (or ozone) itself. There is much evidence to show that these are inert in themselves; they need the aid of a determinant. Thus, to make perhydrone effective, it is commonly associated with ferrous sulphate and is probably active as the perhydrol $Fe\langle^{SO_3H}_{O\cdot OH}$, an electrolyte.

The oxidases, to which reference has been made, seem to be, in the main, colloid catalysts—substances which are reversibly hydroxylisable and convertible into perhydrols. Some are undoubtedly iron or manganese compounds. Apparently, the activity of these is largely dependent upon the effective acidity of the media in which they are placed, and they are mostly active only if it be near to the point of neutrality.

Control of Oxidation.—Warm-blooded animals are gifted with a remarkably efficient heat-controlling mechanism. Considering the high average temperature of the blood and the amount of easily oxidisable material available, it is probable that without such control temperature would rapidly rise to "impossible" heights, as in fever. The question may be put: To what extent, if at all, is any chemical control exercised? It is only during recent years that special attention has been called—particularly by Moureu and Dufraisse—to the way in which an oxidation may be antagonised and potential oxidation prevented by the presence of a second oxidisable substance. The aldehyde acrolein, $CH_2{:}CH{\cdot}CHO$, a highly volatile, tear-exciting liquid, is extraordinarily sensitive to oxidation; it soon becomes acid and then rapidly passes over into a hard, resinous condensation product. This and similar changes are prevented by a whole series of oxidisable substances—phenol, quinol, pyrogallol, even by potassium iodide, only a minute proportion of the antagonising agent being necessary.

Many such instances are known. Phosphorus does not glow in the presence of a trace of volatile oil. Solutions of ferrous sulphate and of alkaline sulphite, taken separately, are easily oxidised by air: in admixture, they are not. Perhaps the most remarkable case is that already referred to—the prevention of the interaction of hydrogen and oxygen at a platinum surface by carbonic oxide, which itself is not oxidisable at such a surface, however.

It may well be that such antagonisms play a determining part, at least at times, in the economy of animal and plant life. Poisoning by hydrogen cyanide has long been thought to be a consequence of the inhibiting effect on oxidation which it exercises at certain nerve centres. It at once puts a stop to the evolution of oxygen from perhydrone by yeast and also by finely divided platinum. Arsenic may perhaps have a similar influence. It is conceivable that the intense poisonous activity of some alkaloids may be of a similar order: it cannot be a mass effect, the quantity required is so minute. The nearest explanation of such antagonistic action would seem to be that the oxidisable materials in competition are "reversibly" oxidised and converted into "perhydrols," which in turn interact, reproducing oxygen and the original substances.

Such matters are assuming great technical importance in connection with the internal combustion engine, using vaporised liquid fuel (*see* INTERNAL COMBUSTION ENGINE). The various petrols differ greatly in explosive behaviour—in the rapidity with which they are "burnt." The most successful regulative agent hitherto used has been lead tetrethide, $Pb(C_2H_5)_4$. It would seem likely that the effect this exercises—whatever its precise nature—must depend upon the lead functioning as an oxidising "catalyst."

Lastly, we are becoming more and more alive to the fact that life is regulated by a number of mysterious secretions from special glands, in different parts of the body—the pituitary, the thyroid, etc. (*see* ENDOCRINOLOGY). Our vegetable food is proved to contain accessory factors or adjutants, in minute amount, in absence of which nutrition breaks down (*see* VITAMINS).

Another case in point is insulin (*q.v.*), a characteristic pancreatic secretion but of frequent occurrence in animal tissues and apparently also in yeast. If used in very small amount, this material makes good the disturbance in function, whatever it may be, from which diabetics suffer; actually, it causes the disappearance of glucose from the blood. Such agents are all active in very minute amount and their effect would appear to be regulative. One of the most striking cases yet brought forward is the apparent need of a most minute, indeed altogether infinitesimal, amount of borate by the nodules which form on the roots of leguminous plants. Unless borate be present, the nodular organisms are not brought into effective, reciprocal relationship with and fed by the plant.

The chapter is one of infinite importance in its vital connection but scarcely entered upon as yet, especially on the theoretical side.

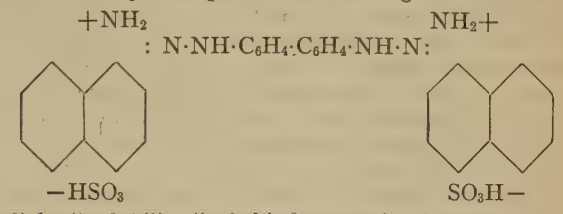
The Colloid Nature of Natural Products.—Apart from the compounds dissolved in the cell fluid and certain reserve materials (the simpler sugars), the components of animal and plant structure are all highly complex, slightly soluble, if not insoluble materials—proteins for the most part. The term colloid (*q.v.*) was early applied to them by Graham, because of their glue-like character. It is to be deplored that the term has been widened and applied generally to finely divided materials in suspension in liquid media—still more that a bastard, hybrid nomenclature has been developed which successfully serves but to obscure the obscure. As Jacques Loeb has shown, when the proteins are fairly considered from a chemical standpoint, they are as other compounds in general behaviour.

Thus far, the phenomena of solubility have been dealt with in the vaguest possible manner; structural considerations have scarcely if at all been taken into account.

Solid paraffin is not even wetted by water: the hydrogen in it would appear to be unattractive and in the " saturated state " in which the carbon is present, this also, apparently, has no residual affinity to water. Yet the molecules are not without residual affinity. Sir William Bragg's X-ray measurements show that when paraffin is fused upon glass and then cooled, the molecules become ranged like scaffold poles side by side, and these interlocked poles become erect and ranged in rows. When the terminal group is oxidised and the paraffin is converted into stearic acid, it is wetted by water but only at the carboxylic tip: in other words, it is soluble at the tip but not as a whole. The higher fatty acids form such films upon water, the molecules standing upright, side by side, the carboxylic tips resting upon the liquid. The paraffins are efficient lubricants, because they are so slightly attracted to solid surfaces. All other fluids are more or less " held " by the surface, their " grip " depending upon the nature of the surface and the character of the material; this is clearly a function of structure, and the effect would seem to be exercised at and upon the centres of residual affinity in the molecules.

It would seem to be permissible and rational to extend this point of view to substances in solution. Difficult as it may be to define the term solubility and confine its use, it were time that we had some definite conception of the nature of the reciprocal relationship of solvent to " dissolved " substance. In view of what is said above, stearic and oleic acid may be said to be in solution only at the carboxylic tip. When the alkali-metal salts of these acids (soaps) are dissolved in water, again only the carboxylic tip is in solution; definite reciprocal relations are established between it and the near-by water molecules, but the rest of the molecule is to be thought of as merely making a hole in the water, as it were. Hence, perhaps, we may arrive at a distinction between dissolved and undissolved substance and picture this as, in a measure, analogous to that to be drawn between airship and balloon. The balloon but makes a hole in the air. It is a mere floating body, itself mechanically inert but knocked about by the impacts of the air molecules. So is the *body* of the airship—like the balloon, it merely makes a hole in the air. In virtue of the engine and propeller, however, as the propeller grips the air, the airship is brought into more active relationship with the air; at least, it has a directing mechanism, though, as in the balloon, the interaction between ship and air is purely kinetic—no selective affinity of any kind comes into play. A neutral particle—if there be such—suspended in a fluid may be pictured as in the condition of the balloon; under the microscope, the particles are seen to be in rapid movement (Brownian motion), due apparently to their bombardment by the active unit-molecules within the liquid. Perhaps the only strictly neutral particle conceivable is that of a paraffin—all other materials seem to be possessed of some degree of surface attraction, to display some affection for fluid molecules in general.

The airship, however, is the analogue of nearly all organic molecules more or less soluble in water. There is an all but insoluble body, often very large, which is associated with a radicle more or less avid of water. Alcohol is a derivative on the one hand of the hydrocarbon ethane C_2H_6, which is insoluble in water; on the other hand, of hydrone, being formed by the withdrawal of an atom of hydrogen from each and the fusion of the residues. It is miscible with water in all proportions—such is the avidity of the residual OH for water. None the less the ethane residue is to be thought of as but dragged under by the associated oxygen. Benzene, C_6H_6, spreads out as a layer upon water and is practically insoluble; phenol, $C_6H_5{\cdot}OH$, is but moderately soluble; the sulphonic acid, $C_6H_5{\cdot}SO_3H$, formed by the interaction of benzene and sulphuric acid, is intensely soluble. A large class of dyestuffs, the direct cotton dyestuffs, is formed from benzidine, $NH_2{\cdot}C_6H_4{\cdot}C_6H_4{\cdot}NH_2$, an insoluble material, by coupling it through the agency of the NH_2 groups with certain more or less complex sulphonic acids. Congo-red is one of these.



The slight " solubility " of this huge molecule may be ascribed to the two primary SO_3H groups. As a matter of fact, there is reason to believe that the dissolving influence this group usually exercises is greatly lowered in amino-compounds of the type shown by the " control " exercised by the basic nitrogen atom. The lower sugars are easily soluble—cane sugar liquefies in one-third of its weight of water. As already explained, in these each carbon atom carries an oxygen atom and the oxygen atoms undoubtedly are centres of attraction for " water." As complexity grows, the sugars become less soluble and starch is practically insoluble; in some way, the residual affinity of the oxygen atoms becomes lowered. Starch, however, is a typical colloid when properly distributed in water. The proteins are equally so. In these the centres of attraction are either oxygen or nitrogen, and such centres are frequently repeated. Such colloids may be pictured as having " water " collected about them at the various active centres. They are " held up," as it were, by these in the liquid. Only compounds of this type deserve the name of colloids.

If such be a true picture, we cannot well say where dissolution begins and where it ends; the passage from soluble to insoluble must be continuous. Degree of solubility must be a question of relative affinity, as between the molecules of solute, between the molecules of solvent and between the molecules of solvent and solute, that of the molecules of solute being more and more easily overcome, the greater the attraction exercised by the molecules of solvent. From this point of view, the plasticity of clay is practically the " plasticity " of thin films of water. Very finely divided (deflocculated) particles of clay, in an alkaline medium, may be pictured as the condition of soap molecules swimming in water; if the medium be made acid, in either case, molecules are formed which have less affinity for water and, therefore, tend to aggregate. Finely suspended matter may be of three kinds: acid, alkaline or neutral. Neutral particles show no tendency to wander to either electrode in an electrolytic field; the acid form wanders to one electrode, the alkaline to the other, and in this behaviour we may have before us what may be visualised as happening to dissolved (potential) electrolytes.

(H. E. A.)

CHEQUERS.—Chequers Court, Buckinghamshire, a typical English country home of the early Renaissance period, became an official residence of British Prime Ministers in 1921. It is situated in a beautiful part of Buckinghamshire, not far from Princes Risborough and 38 m. from London. The house and estate, about 1,500 ac. in extent, with adequate means for maintaining them, were generously put in trust for this purpose by their owners, Lord and Lady Lee of Fareham.

Here Caractacus had a stronghold, of which the earthworks are still visible. " Radulphus," clerk to the Exchequer, was

owner under Henry II., and the place appears to have taken its name from his office. Here, in 1565, his descendant, William Hawtrey, remodelled the house of his ancestors and gave it much of its present character and appearance. Here in the 18th century, came, and still remains, a unique collection of Cromwell portraits and other relics, the Russells, who had inherited the estate, being descended from one of the Protector's daughters. The Russells maintained the Elizabethan house with little alteration, but Robert Greenhill, who inherited from them early in the 19th century, plastered the whole of the outside and redecorated the interior in Strawberry Hill Gothic fashion.

When the Lees entered on a long tenancy in 1909 they sought to reveal all the remaining ancient features, and to introduce others characteristic of the days of the Hawtreys and the Russells. Their activities covered not only the interior and exterior of the house, but its immediate environment, forecourt and formal gardens with due architectural features completing the picture. To much that was interesting in the way of pictures, books and furniture belonging to the house, a great deal of fine quality was added, and thus Chequers became one of the most beautiful and complete expressions of the historic English country house. In 1917 Lord and Lady Lee changed their tenancy into a freehold, and proceeded to create a trust, which, on their deaths should make the house an adequate seat where the Prime Ministers could entertain guests. The original draft for the Chequers Trust declared that:—

> The main features of the scheme are, therefore, designed not merely to make Chequers available as the official country residence of the Prime Minister of the day, but to tempt him to visit it regularly, and to make it possible for him to live there, even if his income should be limited to his salary. With this object a sufficient endowment is provided to cover the cost of a permanent nucleus staff of servants, of keeping up the gardens and grounds, of maintenance and repairs, and other necessary outgoings. There is also a residential allowance for the official occupant calculated in a fashion deliberately designed to encourage regular week-end visits.

The draft, however, insisted upon the unaltered preservation of both house and contents:—

> Another cardinal object of the scheme is to preserve, so far as possible, the main architectural and archaeological features of the house and surroundings in their present restored condition. It will, therefore, be provided and strictly enjoined in the trust deed that no alteration, mutilation, addition or subtraction shall be made to the principal features of the house.

In 1920 Lord and Lady Lee resolved that this generous scheme should not await their demise but should take immediate effect. All the preparations for establishing and working the trust having been completed by the end of that year, Mr. Lloyd George, then Prime Minister, held his house-warming on Jan. 8 1921. After that date Mr. Lloyd George and his successors, Mr. Bonar Law, Mr. Stanley Baldwin, Mr. Ramsay MacDonald, and Mr. Baldwin again spent part of their time here during their respective terms of office. (H. A. T.)

CHEQUE WRITER: *see* OFFICE APPLIANCES.

CHESS (*see* 6.93).—Chess has gained very considerably in popularity since 1910, and especially since the conclusion of the World War. During the War, tournaments were promoted and financed by local authorities at Hastings, Scarborough, Weston-super-Mare, Stratford-on-Avon and other places in England; and at San Sebastian, Scheveningen, Carlsbad, Baden-Baden, Marienbad and several other resorts on the European continent.

Although no international contests were held during the War, 18 first-class international tournaments were played in different parts of Europe and America between 1910 and 1925. The principal events were:—San Sebastian, 1911 and 1912, the first won by J. R. Capablanca, and the second by A. Rubinstein; Petrograd, 1914, first E. Lasker, second Capablanca, third A. Alekhine; London, 1922, first Capablanca, second Alekhine, third Milan Vidmar of Yugoslavia; and New York, 1924, first Lasker, second Capablanca, third Alekhine.

In the tournaments mentioned only three new players came to the fore, namely, Alexander Alekhine, of Moscow; E. D. Bogoljuboff of Ukraine; and Richard Réti of Czechoslovakia. Alekhine won several first prizes in competitions only slightly less important than the Petrograd, London and New York tournaments. He established a record for blindfold play, by playing 28 games simultaneously *sans voir* in Paris.

Bogoljuboff's best performance until 1926 was winning the first prize in a strong tournament at Breslau in 1925. Réti, a strong original expert, won some notable honours. At Göteborg in 1920 he won the first prize from Rubinstein and Bogoljuboff, and at the New York meeting in 1924 he was the only competitor who won a game from Capablanca. An expert blindfold player, he became the leader of a new school, and published a book, *Modern Ideas in Chess*. Honourable mention should be made of Sir George Thomas, Bart. and F. D. Yates, England; Max Euwe, Holland; F. Samisch, Germany; and the clever Mexican player, C. Torre.

After many years of negotiation a match for the World's Championship was contested at Havana in 1921 between Lasker and Capablanca. The result was disappointing. The conditions stipulated for 24 games, but after the fourteenth game, with the score Capablanca 4, drawn 10, Lasker 0, Lasker resigned the match and the chess Championship of the World. An International Masters' Tournament was held at Moscow in Dec. 1925, being subsidised by the Russian Govt. to the extent of about £3,000. The competitors included the champion, Capablanca; the ex-champion, Lasker; the United States champion, F. J. Marshall; also Rubinstein, Réti, Tartakover, Torre, several very strong Russian players, and last, though by no means least, Bogoljuboff who, despite the fact that he was beaten by Capablanca and drew only with Lasker, nevertheless won the first prize, with a score of 15½ points out of a possible 20. In Great Britain excellent work has been done by the British Chess Federation, the organisers and managers of the London International Congress, 1922, and of the annual national chess congresses.

Methods of Play.—No vital changes in the actual playing of chess since 1910 can be recorded. A slight alteration in the technique of opening games has been observed, though none of it is new. The development, for example, of the king's bishop, at K Kt2, instead of at Q3, in the queen's pawn game, is, at least, as old as the days of Blackburne and Steinitz. The selection of Kt to KB3 for the first move was consistently practised by Zukertort, in the London tournament of 1883. "Réti's Opening" (1.Kt. to KB3, P to Q4, 2.P to QB4) is an unimportant deviation of the customary development of the queen's pawn game. Finally, there is the so-called "Alekhine's Defence" (P to K4, Kt to KB3), first adopted by Alekhine in a tournament at Budapest in 1921, but, as a matter of fact, often played in London before Alekhine was born. The games played for the World's Championship in 1921 appear only slightly different from those contested between Lasker and Steinitz in the World's Championship match of 1893.

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(L. VAN V.)

CHETWODE, SIR PHILIP WALHOUSE (1869–), British soldier, was born Sept. 21 1869, and in Nov. 1889 was commissioned to the 19th Hussars from the Militia. He saw active service in Burma and South Africa, and later became assistant military secretary to Sir John French at Aldershot. Promoted to the command of the 5th Cavalry Brigade in May 1914, his brigade accompanied the Expeditionary Force to France and helped to cover the retreat from Mons, bringing off at Cérizy one of the rare cavalry charges of the War. He went out to Egypt to command the Desert Column in 1916, and won early distinction by the decisive surprise attack at Rafah, which finally freed Sinai from the Turks. After the second battle of Gaza in April 1917, he succeeded General Dobell in command of the whole Eastern Force. When General Allenby came out to take over the supreme command he based his plan on Chetwode's plans, and the latter, commanding the XX. Army Corps, after

the reorganisation of the forces, played a distinguished part in the advance to Jerusalem and in the crowning victory in Sept. 1918. Shortly after the War, Chetwode was appointed military secretary at the War Office, then in Sept. 1920, succeeded General Harington as deputy chief of the Imperial Staff, and two years later became adjutant-general to the forces. This post he gave up in April 1923, taking the Aldershot Command.

CHEVALIER, ALBERT (1861–1923), British comedian, (*see* 6.113), produced at the Lyceum Theatre, London, in 1920, a play *My Old Dutch*, based on the famous song of that title. He last appeared in Nov. 1922 at the same theatre in a revival of this play. He died in London July 10 1923.

CHEYNE, THOMAS KELLY (1841–1915), British divine and biblical critic (*see* 6.116), died at Oxford Feb. 16 1915. His later works include *The Two Religions of Israel* (1910); *Mines of Isaiah Re-explored* (1912); *The Veil of Hebrew History* (1913), and *Fresh Voyages on Infrequented Waters* (1914).

CHICAGO (*see* 6.118).—With a population in 1920 of 2,701,705, an increase of 23·6% over 1910, Chicago easily maintained its position as the second city of the United States. The census bureau estimated the population on July 1 1925 at 2,995,239. On the basis of the daily increase it was announced that the city had passed the 3,000,000 mark Aug. 10 1925. While the city's growth from 1910 to 1920 was greater proportionally than that of New York it was considerably less absolutely. The percentage of increase was less than that of any other decade, and the estimates of present growth indicate a still smaller rate of increase for the present decade.

In common with most American cities, the population growth of Chicago has decreased relatively to the growth of the outlying communities of its metropolitan area. The total population of the city and these districts was estimated officially as 3,986,331 on Jan. 1 1925. The rate of regional growth about the city seems to be increasing as the rate of strictly urban growth declines, largely because of the extension of motor traffic and hard surfaced highways. Chicago's percentage of population increase in the last census decade was smaller than that of Detroit, 113·4%, and Cleveland, 42·1%, these two cities being Chicago's closest rivals in the Middle West.

Negro Population.—In 1920 the negro population was 109,594, an increase of 148·5% over the preceding census. The influx of negroes was due to the demand for unskilled labour, especially in the packing industry, during the period of the World War, when European immigration was slight. A shortage of housing facilities for these negro labourers was one of the underlying causes of the race riots of 1919. The negro influx slackened during the industrial depression of 1920–1, to be resumed in 1923. In the following year it again declined, and with the rapid development of conveyor and construction machinery to displace manual labour the movement has probably passed its crest. By annexation of suburban areas and accretion on the lake front the area of Chicago increased from 191·4 sq. m. in 1910 to 204·9 in 1925.

Industries.—The value of manufactures produced in Chicago increased enormously between 1921–3, but as 1921 was a year of industrial depression and 1919 a year of very high prices, the rates of change between the three censuses are not an accurate index of physical volume. The value of all products in 1919 was $3,657,424,471; in 1921 $2,185,819,374; in 1923, $3,323,341,460. But the physical volume of the output of 1923 was undoubtedly greater than that of 1919. In 1923 there were 9,334 manufacturing establishments within the city limits of Chicago. These employed 385,685 persons, paying wages which amounted to $571,724,743.

Despite financial difficulties and reorganisation of two of the great corporations the packing industry has maintained a growth in its receipts and output, in the face of the pronounced trend toward decentralisation of the industry. In 1924 the industry showed the turnover of livestock to be 18,653,539 head, valued at $528,489,268. The trend of the grain trade is shown by the following facts. Between 1920–4 flour increased from $955,000 to $1,858,000, wheat from $28,997,000 to $69,012,000, corn from $85,487,000 to $99,524,000 and oats from $74,939,000 to $82,831,000, and in the case of corn and oats higher figures were reached in intermediate years. The growth of the city's financial power has been marked by the growth of the independent suburban banking, fostered by the Illinois laws, and associated with real estate and suburban operations building up the ring of communities about the city. Some of the outlying institutions can now rival the central banks.

The City Plan.—The most striking feature of Chicago's recent history is the plan for the reconstruction of the city and the progress of its execution. This plan had its genesis in a report, prepared under the guiding spirit of Mr. Daniel H. Burnham. The first step was the appointment of the Chicago Plan Commission, composed of aldermen and citizens. In furtherance of the Chicago plan, Roosevelt road was widened between Ashland avenue and Michigan avenue; Michigan avenue was widened between Roosevelt road and the river, and between the river and Chicago avenue. Widening the part of the street between Randolph street and Chicago avenue was a difficult matter, involving the acquisition of valuable private property and the construction over the Chicago river of a large two-level bascule bridge. The new thoroughfare was opened to traffic in 1920.

Twelve major street improvements are now either under way or finished. The street scheme in the plan of Chicago is divided into four phases, the first of which is the project to reduce congestion by means of the development of a quadrangle of wide streets about the business centre. Other phases of the plan, all of which are designed to provide through traffic systems by the widening of streets, the creation of boulevards, drives through the growing park system, and bridges over the river and railway depressions are in process of piecemeal execution. The Chicago plan is being carried out in co-operation with the park boards and forest preserve system with the view of realising the artistic and humanitarian advantages of three features of the city, the lake front, the Chicago river and the belt of wooded country about the city.

The South and Lincoln Park boards have been reclaiming land from the lake until nearly half of the city's water front now consists of parks and artificial lagoons. Over two sq. m. have been added to this area and a further extension of Lincoln Park northward has been authorised by the voters. The lake front park system and the smaller inland parks have a total of 71 bathing beaches and pools attended in 1924 by 3,523,393 people. The large and small parks together number 211, with an area of 5,524 ac.; there are 25 free and 41 private golf courses, and 73 playgrounds frequented by 5,000,000 annually. Inland, the city is being gradually encircled by the forest preserves, which contained over 28,000 ac. in 1925 and are being extended. The recreational facilities of the forest preserves were used by over 3,000,000 visitors in 1924.

The development of the South Park system on the lake front south of the Chicago river, is proceeding hand in hand with railway terminal development and the opening of new boulevards through the park to provide better access to the south side of the city. The Illinois Central Railway, formerly on the lake front, is now inland occupying a depressed area in the parks. Electrification of this railroad within Chicago will be completed in 1932. The new building for the Field Museum, located on made land on the lake front, was completed in 1920 at a cost of $6,000,000, which was provided by the will of Marshall Field. It is 350 ft. wide and 700 ft. long, and is built of Georgia white marble in the Ionic style of architecture. South of the Field Museum is a large stadium—Soldiers' Field, the ultimate seating capacity of which is expected to be 100,000.

Railways.—Although Chicago is the greatest railway centre in the world and the hub of the American rail system, its terminal problems have not yet been solved, although a great advance toward that end has already been made. In 1911 the new passenger station of the Chicago and North Western Railway, a dignified structure, was opened to service.

The railways using the Union station—the Pennsylvania, the Burlington, the Chicago and Alton and the Chicago, Milwaukee and St. Paul—completed in 1925 their terminal just south of the

Northwestern station at a cost of $75,000,000. With the construction of a mail terminal this settled the problem of the six railroads with terminals on the west side of the Chicago river, but the 32 railways using the three stations on the south side of the business district have not worked out a comprehensive plan among themselves or with the city. The new Illinois Central station to be constructed at 12th street may be used by all, or other terminals may be built further south, but any plan involves the straightening of the Chicago river and the opening of five new direct north and south streets. Chicago took front rank in the great building revival that marked the end of war conditions. Under the zoning ordinance the height of buildings is limited to 264 ft.; but towers, if set back, are permitted.

Municipal Undertakings.—One of the most important municipal undertakings is the municipal tuberculosis sanatorium, erected after 1909, in which year a site of 164 ac. was acquired in the north western part of the city. Its revenues, derived mainly from taxation, amount to more than $1,000,000 a year; in 1920 there were about 1,000 patients. A notable structure completed late in 1915 is the municipal pier. It projects 3,000 ft. into Lake Michigan just north of the mouth of the Chicago river. The outer portion, 660 ft. in length, is a three-decked structure devoted to recreation purposes. The new pier has not been much used by shipping interests but the recreation part of the pier proved popular from the outset.

Industrially the trend of Chicago is toward the electrification of manufacturing and transport. The city's electrical equipment now includes the largest steam generating station in the world, and a series of great stations to the north and south interconnected for the exchange of current. Within the city proper the consumption of electric current in 1924 was 845 kw. hour *per capita* against a general American average of 518.

Education and the Fine Arts.—In Chicago there are two large universities of national reputation—Northwestern University and the University of Chicago. Students to the number of 25,400 were enrolled in the seven recognised universities in Chicago in 1924. There are 304 public schools with an enrolment of 485,885 pupils, employing a teaching staff of 12,125. Three large public libraries contain a total of 2,000,000 vol., with an average daily circulation of 33,300 volumes. The Art Institute of Chicago has a larger attendance than any other art school. Five of the city's music schools alone had an attendance in 1924 of 19,000 pupils. The trustees of the Art Institute administer the Ferguson monument fund, left by the will of Benjamin Franklin Ferguson, to be used for the erection of statuary and monuments in Chicago. Among others, two notable pieces by Lorado Taft have been purchased; one "The Fountain of the Great Lakes," stands just to the south of the Art Institute; the other "The Fountain of Time," at the head of the Midway, between Washington and Jackson parks.

Chicago was the first American municipality to give direct official encouragement to local art. In 1914, at the suggestion of Mayor Harrison, the city council appropriated $2,500 for the purchase of works by resident artists and sculptors, and an appropriation has been made each year since. The city's musical life has been stimulated by grand opera, which became a fixed institution in 1910, with the establishment of the Chicago Opera Association. The Chicago Civic Opera Co. has lengthened its season and in 1925 inaugurated a policy of employing Americans although retaining notable European singers.

Finance.—Chicago's finances have been readjusted to post-War values and the disappearance of excise revenues from the liquor traffic, but the city's capacity to incur debt is still restricted by provisions of the state constitution to a degree unknown by other great cities of the world. A summary of the city's most important revenues and expenditures for 1923, the last report available, gives a total revenue of $137,928,745.09 and expenditure of $130,765,478.19. This does not include expenditures for the larger parks, for the sanitary district, or for other purposes which are in the hands of separate taxing bodies.

History.—Carter H. Harrison (Dem.), who was elected in 1911 to his fifth term as mayor of Chicago, was succeeded in 1915 by William Hale Thompson (Rep.), who was re-elected in 1919. After the United States entered the World War, Thompson was criticised for various actions that seemed to indicate a reluctant support of the War policy of the Government. William E. Dever (Dem.) was elected in 1923. To the surprise of the "Liberal" element the mayor publicly announced that the police would hereafter be required to act in sympathy and co-operation with the governmental agencies striving to enforce prohibitory laws.

The long-drawn-out litigation over the right claimed by Chicago to withdraw 10,000 cu. ft. of water per sec. from Lake Michigan for diversion into the drainage canal for the dilution of sewage resulted adversely to the city in the Supreme Court of the United States in 1925; but fears of a disaster to health were alleviated by a permit to withdraw 8,500 cu. ft. per sec. pending the execution of a programme for metering the consumption of water by domestic users to eliminate waste, and the construction of sewage disposal plants over a period of years to dispose of sewage according to modern methods. During the execution of this programme the amount of water withdrawn is being progressively reduced. A proposal to settle the transportation difficulties of the city by the municipal purchase of the surface lines and building elevated extensions and subways was defeated by a referendum vote in 1925.

The disappearance from the newspaper field of *The Inter-Ocean* and *The Herald* left Chicago for a time with only two English morning dailies, *The Tribune* and *The Herald and Examiner.* In 1920 *The Chicago Journal of Commerce* was established as a morning paper for business men. The Joseph Medill School of Journalism was opened in Feb. 1921 as a part of the Northwestern University. *The Chicago Tribune,* of which Joseph Medill was founder, agreed to underwrite the deficit of the school for a five-year period.

Abandonment by the American steel industry of the "Pittsburgh plus" system, under which the price of steel to consumers was formerly the market rate plus the freight from Pittsburgh to the point of consumption, no matter where the steel was made, has already resulted in great stimulation to the steel industry on the lake front south of the city.

The twenty-eighth Eucharistic Congress of the Roman Catholic Church was held in Chicago, June 20–24 1926, being attended by the Papal Legate, Cardinal Bonzano, and seven other European cardinals, in addition to the American cardinals. This was the first occasion upon which a Eucharistic Congress was held in the United States. (H. LE.*)

CHICAGO, UNIVERSITY OF (*see* 6.125).—The grounds of the University of Chicago increased between 1908 and 1925 from 60 to 100 ac. so that the university's holdings occupied both sides of the Midway Plaisance continuously for three-quarters of a mile. New buildings were erected, at an aggregate cost of $2,000,000, for a general library (William Rainey Harper Memorial), for classics, for geology and geography (Julius Rosenwald Hall), for pathology (Howard Taylor Ricketts Laboratory), and for a women's gymnasium, refectory and clubhouse (Ida Noyes Hall). In 1916–7, funds amounting to $5,461,000 were secured for the development of the medical work of the university, and arrangements were made for co-operation with the Presbyterian Hospital, the Otho S. A. Sprague Memorial Institute and the McCormick Memorial Institute. A Graduate School of Social Service Administration, continuing and developing the work previously done by the Chicago School of Civics and Philanthropy, was added to the schools by the university in 1920.

Upon the entrance of the United States into the World War, the president placed the resources of the university at the disposal of the Govt. and led a political and philanthropic mission to Persia in 1918–9. In all, 4,355 members of the university, including students, alumni and members of the faculties, were in the service of the Govt.; 70 of these gave their lives for their country. Between 1908 and 1920 the university's total resources more than doubled, and on June 30 1922 exceeded $50,000,000.

Upon the retirement of President Judson in February 1923, Prof. Ernest DeWitt Burton became president. He immediately carried through the Northern Baptist Convention a change in

the university's charter, increasing the number of trustees from 21 to 25, the proportion of Baptists becoming three-fifths instead of two-thirds, and abolishing the requirement that the president should be a Baptist. In his brief administration (1923–5) President Burton vigorously carried forward the organisation of the Medical School and the erection of buildings previously projected. The consolidation of the Rush Medical College with the university was effected in 1924, and the Rawson Clinical Laboratory was erected on its site adjoining the Presbyterian Hospital. In 1925 the erection of the Medical School, the Billings Hospital and the Epstein Dispensary, costing over $4,000,000, was begun. In 1924–6 the Theology Building and the Joseph Bond Chapel of the Divinity School were erected at a cost of $600,000. The Whitman Laboratory of Experimental Biology was built in 1925. President Burton resurveyed the needs of the university and set in motion large plans for its further development. As the first step the university undertook to secure $17,500,000 in 1925, and this fund was nearly half raised when he died, May 26 1925. Prof. Max Mason was appointed to succeed him in August.

The libraries of the university contained in 1925 nearly 1,000,000 volumes and pamphlets. The University Press, the first to be organised under university ownership in the United States, publishes from 30 to 60 books annually, and 12 scientific journals. Beginning in 1914 the Meadville Theological School united its summer quarter with that of the Divinity School, and in 1915 the Chicago Theological Seminary (Congregational) became affiliated with the university. Between 1892 and 1925, 95,000 students matriculated and more than 15,000 took degrees; 1,500 of them that of Doctor of Philosophy. In 1924–5 the university enrolled nearly 14,000 students.

See T. W. Goodspeed, *A History of the University of Chicago: The First Quarter Century* (1916), and *The Story of the University of Chicago* (1925). (E. J. G.)

CHICHERIN, GEORGHY VALENTINOVICH (1872–), Russian politician, was a member of a diplomatic family that had filled important positions in the intellectual and public life of Russia. He was nephew of the distinguished economist Professor Chuprov and of the great Russian jurist, Boris Chicherin, who was mayor of Moscow at the time of the coronation of Alexander III., and who was summarily dismissed from that office because he suggested to the new Emperor that it was the first duty of a ruler to inaugurate reforms. Chicherin began his career in the diplomatic service, being attached to the Russian Embassy in Berlin, in which city he came in touch with the local Social Democrats in 1905. Imbued with socialistic ideals he threw up his appointment, renounced the estates he inherited and associated himself with the Socialist movement. In 1907 he became a member of the central committee of the Berlin Social Democratic Bureau, and played an important part amongst the Russian political emigrants in Germany. In 1908 he was arrested at Charlottenburg, fined and banished from Germany. He went to Paris, where he lived for some time, and subsequently to London. After the Russian revolution of March 1917 he worked in London to assist in the repatriation of Russian refugees. After the Bolshevik revolution in Nov., when Russia was no longer considered an ally, but an enemy, Chicherin was arrested on the ground of " enemy associations " and placed in Brixton Gaol. On Jan. 3 1918, however, he was liberated and banished from England. He returned to Russia, and was appointed People's Commissary for foreign affairs in March 1918. In 1922 he headed the Soviet delegation to the conference at Genoa (*see* RUSSIA).

CHICKEN POX: *see* INFECTIOUS FEVERS.

CHILDERS, ROBERT ERSKINE (1870–1922), Irish politician, the son of Prof. Robert C. Childers of London, was educated at Haileybury and Trinity College, Cambridge. From 1895 to 1910 he was a clerk in the British House of Commons. He served as a trooper in the South African War in 1900 and from 1910 to 1914 was engaged in political work and writing for Irish Home Rule. During the World War he served in the Royal Naval Air Service and in the Royal Air Force, in which he attained the rank of major and won the D.S.C. From 1917 to 1918 he served on the secretariat of the Irish Convention. On his demobilisation he returned to Ireland and was elected to Dail Eireann as deputy for Wicklow in May 1921. He was principal secretary to the Irish delegation of plenipotentiaries to Westminster, Oct.—Dec. 1921. He afterwards opposed the Anglo-Irish Treaty of 1922, supported Mr. De Valera in the Dail and joined the Republicans when they again took up arms. He was captured in Wicklow Nov. 10 1922 and tried by military court martial on Nov. 17, on the technical charge of having possession of an automatic pistol without proper authority. He was found guilty of treason, and executed on Nov. 24 1922.

Among his publications are: Vol. V. of *Times History* of the South African War, dealing with the guerilla campaigns; *The Riddle of the Sands* (1903); *The Framework of Home Rule* (1911); *Military Rule in Ireland* (1920).

CHILD LABOUR AND CHILD WELFARE (*see* 6.138).—Systematic child welfare work, the object of which is to promote the mental, moral and physical well-being of children, is a comparatively modern development and it received little official recognition in any country before the middle of the 19th century. At first, the work was developed on local national lines. Later, under progressive influences, the work became of common interest to different countries and a subject of mutual co-operation between them. Finally, child welfare has been definitely accepted as a subject of international concern and interest, and this aspect has been further emphasised by the inclusion of international child welfare work among the social and humanitarian activities of the League of Nations.

I. CHILD WELFARE

In all civilised countries there will be found legislation directed towards securing care and protection for children. Side by side with these official provisions, there will be found work carried on by voluntary and charitable organisations which supplements, and has even in many cases initiated, official child welfare measures. An outline of the English system gives the chief features of the work and a general indication of the lines on which, subject to local differences of outlook and of organisation, each country covers the field of child welfare.

Welfare of Children of School Age.— Under various Education Acts, and notably the Act of 1918, provision is made for the primary, secondary, technical and higher education of school children. The Board of Education administers the Acts through the Local Education Authorities. Special provisions are made for the education and care of physically and mentally defective children, for the feeding of necessitous cases, and for school medical inspection and treatment. The Board of Education has power to give grants to voluntary societies organising supplementary work, such as play centres, continuation classes and educational club work.

Neglected or Necessitous Children.—Under the Poor Law Act 1889, as amended by the Act of 1899, Boards of Guardians have powers enabling them to adopt neglected children. Such children may also be dealt with by Juvenile Courts under the Children Act 1908. The reorganisation of the poor law, under consideration in 1926, contemplates the transfer of the powers of boards of guardians to the local authorities.

Progressive movements in child welfare work tend to spread beyond the country of their origin. The main reasons for this extended influence are that child welfare is an interest common to every country, that much of the work is carried on by organisations which are international, and, lastly, that the co-operation of one country with another is necessary for solving certain child welfare problems.

The Influence of National Schemes.—New experiments in other countries often lead directly to the local development of national schemes. Thus, the *Consultation des Nourrissons*, started in Nancy in 1890, and the *Gouttes de Lait*, instituted a few years later in France, attracted widespread attention, and were largely instrumental in inspiring other countries, including England, to develop infant welfare work. Codifying and consolidation of

national child welfare legislation, as exemplified in the English Children Act 1908 the Belgian Loi sur la Protection de L'Enfance 1912, and in the Children's Codes of the United States of America, have also influenced the legislation in other countries. The Federal Children's Bureau, established in Washington in 1912, is another interesting national scheme, consisting of a special department of State established to deal with child welfare.

Influence of Voluntary Societies.—Voluntary societies, engaged either on general or on some specialised child welfare work, are often international, and so form another channel through which progressive ideas pass from country to country. These associations, from their central office, guide and develop the policy of their many branches throughout the world, and can thus introduce enlightened methods from one country into their institutions in another. Official international child welfare work will be shown, later, to derive its source from the formation of international child welfare organisations and from their congresses. Even where international associations are not primarily concerned with children, it is common to find at their congresses, whether on penology, on industry, on hygiene, or whatever the subject may be, resolutions which encourage international co-operation in some branch of child welfare.

Agreements Between Different Countries.—Lastly, where there are problems affecting the mutual interests of two or more countries a national solution is insufficient, and must be replaced by agreements for reciprocal action. As regards child welfare such problems arise chiefly in questions of relief, of repatriation, and of emigration. Reciprocal agreements for relief often contain clauses to include the relief of children. France has recently concluded a series of "assistance" agreements with other countries, *i.e.*, with Italy (1919), Poland (1920), Belgium (1921), and with Luxembourg (1923). Belgium and Luxembourg exchanged a "Declaration" on similar lines in 1923. General repatriation agreements concluded between States cover also cases in which children are to be repatriated. There are two agreements which relate only to minors, *i.e.*, between Belgium and Holland in 1913, and between Belgium and France in 1925. Where these two agreements apply, a minor can be repatriated to his home country, but it must be judicially proved that this is done in his own interests.

A few agreements on emigration and kindred subjects contain clauses relative to young people. There is, for instance, an arrangement between France and Italy, dated June 15 1910, regulating the formalities which govern young workers of the one country emigrating to work in the territory of the other. Child migration from Great Britain to her colonies is subject to regulations made on either side, but not usually to joint agreements. An exception to this arrangement is the agreement of April 11 1923 between Canada and Great Britain concerning a grant towards the cost of emigrating children. The First Hague Convention 1902 relates to the guardianship and protection of the person and of the interests of minors in a foreign country. By Dec. 1923 this Convention had been ratified by Germany, Belgium, Spain, Hungary, Italy, Luxembourg, Netherlands, Portugal, Rumania, Sweden and Switzerland.

International Child Welfare

It is convenient to consider international child welfare work under three divisions. Firstly, there is the history of its development, which includes Children's Charters; secondly, there is the organisation and scope of the work under the League of Nations; and, thirdly there is the specialised subject of the regulation of child labour, which falls within the province of the International Labour Office.

Development of International Child Welfare.—Several international congresses were held in Belgium between 1890 and 1911, which were known as Congrès des Patronages. These "Patronages" were semi-official associations which dealt primarily with the after-care of prisoners; but, so far as child welfare was concerned, they early began to interest themselves in the particular type of child who was in moral danger or who was delinquent. Switzerland, in 1911, was the first country to plan the institution of a central office to deal with all branches of child welfare on an international basis. The Belgian Govt. also interested itself in the matter and organised the First International Congress for the Promotion of Child Welfare at Brussels in 1913. The congress resolved to found an international child welfare association, but the outbreak of war in 1914 prevented any immediate realisation of this project.

In 1921 the Council of the League of Nations had before it a suggestion from three international organisations recommending that international child welfare work should be carried on by the League itself. This suggestion was based on Article 24 of the Covenant, which provides for placing under the direction of the League all international bureaux to be established "for the regulation of matters of international interest." After consideration the Council decided to await the outcome of another child welfare congress about to be held in Belgium.

The second International Congress for the Promotion of Child Welfare was held in Brussels in 1921, and resulting from this Congress the International Association for the Promotion of Child Welfare was founded in Brussels. It was established to facilitate study by centralising all information on child welfare work, to assist co-operation between one country and another, and generally to further and encourage international interest and progress. The new office did not, however, obtain the full measure of support that had been anticipated, since some countries desired, as a matter of principle, to see its work carried on by the League of Nations. This principle was finally accepted, and the Council was asked to recommend to the Assembly that the League of Nations should undertake international child welfare work. The recommendation was made, and was agreed to by the Assembly in 1924. The Association continues its activities as a private organisation, serving as a link between voluntary child welfare work in different countries.

The famine and privation in many lands after the War told especially heavily upon the children. Relief was organised by the Save the Children Fund, and branches of the society were established in many countries. Starting at first as a relief organisation the Save the Children Fund gradually enlarged its scope to include general child welfare work. The headquarters of the Save the Children Fund (International Union) was established in Geneva in 1920, and under its auspices the First General Child Welfare Congress took place in Geneva in 1925. In America, also, a general Child Welfare Association was set up in Montevideo in 1924, as a result of Pan-American Congresses for Child Welfare. It is known as The American International Institute for the Protection of Children.

Children's Charters.—National measures for the protection of children are generally found embodied in a special child welfare law, and this legislation is often popularly described as a Children's Charter. The term has, however, been applied specifically to a new development in the field of child welfare. It seems to have been felt that though in theory child welfare had been accepted as an international responsibility, yet practical results would not follow unless a clear statement was drawn up as to what that responsibility represented. To meet this requirement a Children's Charter was enunciated by the International Council of Women in 1922. This Charter sets forth under headings, and in some detail, the minimum rights which should be accorded to childhood. The form of the Charter is general, but it is intended that each nation shall remodel the Charter for its own use, and make it an exposition of practical child welfare aims capable of being worked out locally. The National Council of Women of Great Britain, in conjunction with the Save the Children Fund, have followed this lead, and issued in 1924 a Children's Charter for Great Britain.

Akin to these Children's Charters is a shorter and more generalised expression of the duty of humanity to childhood known as the Declaration of Geneva. This Declaration, published in May 1923, was drawn up by the Save the Children Fund (International Union) and has been translated into many languages. The League of Nations has recommended the Declaration as a guide to the principles which should inspire child welfare work.

Child Welfare under the League of Nations.—By resolution of the Fifth Assembly on Sept. 26 1924, the League of Nations undertook the promotion of international child welfare, and the work of organisation was entrusted to the Advisory Commission on Traffic in Women and Children, which is served by the Social Section of the Secretariat. The Advisory Commission reconstituted itself into two Committees, one to deal with traffic in women, and the other to be known as the Child Welfare Committee. The Child Welfare Committee consists of the delegates of certain governments named by the Council, and of special assessors, representing international organisations dealing either with general child welfare, or else with special branches of the work, such as recreation. In addition, a representative from the Health Section of the League, and one from the International Labour Office, serve as liaison officers. The scope of the work falls into three categories:—documentation, or the collection and analysis of national child welfare laws, which includes the administration of these laws; research, or the local investigation of child welfare schemes or problems; and discussion or the consideration by the Child Welfare Committee of the results of the work of documentation and research. A subject of special international importance may be referred for consideration to international conferences, and may form the material for an international convention. The Child Welfare Committee, as reconstituted, held its first annual meeting in March 1926. The subjects submitted included infant welfare, child labour, the legal age of marriage and the age of consent, the repatriation of foreign children, family allowances and the effects of the cinema. Other matters of equal importance will, in due course, claim attention.

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II. CHILD LABOUR

The most important question relating to the protection of children against industrial exploitation is the fixation of a minimum age below which all employment is prohibited. As a consequence of the adoption by the International Labour Conference of the I.L.O. of Draft Conventions in which the minimum age is fixed at 14, a general tendency has developed to incorporate this age in national legislation. A survey of existing national legislation will make this clear.

Argentina.—The Act of Sept. 30 1924 forbids the employment of children under 14 in industry or commerce. It also prohibits the employment of children under 12 in agricultural work.

Australia.—In Australia labour legislation comes within the competence of the states of the Commonwealth. In five of the states the minimum age for industrial employment is 14, viz.: New South Wales (Factories and Shops Act, 1912), Victoria (Factories and Shops Act, 1915) with a minimum age of 15 for girls, Queensland (Factories and Shops Act, 1900, 1908 and 1914), Western Australia (Factories Acts, 1904 and 1911) and Tasmania (Factories Acts, 1910, 1911 and 1917); in one state, South Australia (Factories Acts, 1907, 1908, 1910 and 1915) the minimum age is 13.

Austria.—The Act of Dec. 19 1918 provides that children under 14 shall only be employed insofar as health is not injured and the carrying out of compulsory school attendance is not prevented.

Belgium.—The Act of June 14 1921 provides that children under 14 shall not be employed.

Canada.—The Act of July 19 1924 provides that no child under 14 may be employed on board ship. In the case of employment in industry, conditions are governed by Provincial legislation. The minimum age is fixed at 14 in the following Provinces: Alberta (girls 15), British Columbia (girls 15), Manitoba (girls 15), Nova Scotia, Ontario, Quebec and Saskatchewan (girls 15).

Chile.—The Act of Sept. 8 1924 fixes 14 as the general minimum.

China.—The Provisional Factory Regulations of March 29 1923 provide that employers shall not hire boys under 10 or girls under 12.

Czechoslovakia.—The Act of Dec. 19 1918 provides that in industrial undertakings and also in agriculture and forestry children shall not be employed before the conclusion of their compulsory school attendance and before they are 14. The Act of July 17 1919, however, permits, with certain provisos, the employment of children over 12, and the employment of children on light work in agriculture and domestic work as soon as they attain the age of 10.

Denmark.—The Act of July 10 1922 provides that children under 14 shall not be employed in undertakings, in handicrafts, industry or transport or in branches of such undertakings, and the Seamen's Act of May 1 1925 provides that children under 14 shall not be employed on board ship.

Estonia.—The Act of May 20 1924 provides that children under 14 shall not be employed or work in any public or private industrial undertaking.

Finland.—The Act of Oct. 24 1919 respecting conditions of employment in shops and commercial establishments, offices and warehouses, provides that no child under 14 shall be employed in any establishment to which the Act applies.

France.—The Labour Code (Bk. II. Sect. 2) fixes the general minimum age for the employment of children at 13.

Germany.—The Act of March 30 1903 fixes the general minimum age for the admission of children to industrial employment at 13, if the child is not required to attend school. In some respects this Act has been amended by the Home Work Act of June 30 1923.

Great Britain.—The Act of Dec. 23 1920, Women, Young Persons and Children (Employment) Act, provides that no child (*i.e.*, "person under the age of 14 years") shall be employed (*a*) in any industrial undertaking, or (*b*) on board ship, except to the extent to which and in the circumstances in which such employment is permitted under the relative Draft Convention. Detailed measures with regard to the employment of children are also embodied in the Education Act, 1918, and the Education (Scotland) Act, 1918.

In certain British Colonies special Ordinances are in force governing child employment. Thus in Ceylon the Ordinance of July 30 1923 provides that no child under 14 shall be employed in any industrial undertaking, and further that no child under 14 shall be employed in any ship. In Hongkong the Industrial Employment of Children Ordinance of 1922 provides that no person shall employ any child under 10 in any factory, and further that no person shall employ any child under 12 in carrying coal or building material or debris.

Greece.—The Act of July 29 1922 provides that "young persons who have not attained the age of 14 years shall not be employed unless they are provided with a certificate showing that they have completed their attendance at an elementary school."

Hungary.—The Act of Feb. 23 1922 provides that children liable to compulsory attendance at an elementary school shall not be employed in undertakings covered by this Act or the Act XVII. of 1884. The Act of March 24 1923 provides that children under 14 years of age shall not be employed in the work of manufacture in industrial undertakings for the production of bread, bakers' wares or confectionery.

India.—The Act of July 1 1922 provides that no child shall be employed in any factory under 12. This Act also prohibits night work of persons under 15, and stipulates that no person under 15 shall be employed in any factory for more than six hours per day. By the Act of Feb. 23 1923 it is further provided that no child under 13 shall be employed in a mine or be allowed to be present in any part of a mine which is below ground.

Italy.—The Act of Nov. 10 1907 provides that no child under 12 shall be employed in work in factories, workshops, building operations or above ground in mines, quarries and pits. For work below ground a higher age limit is fixed. The Regulations of June 14 1909 contain further detailed provisions.

Japan.—The Act of March 29 1923 stipulates that persons under 14 shall not be employed in industry; provided that this rule shall not apply to persons over 12 who have finished the course at an elementary school. This Act has not yet been enforced. Another Act, of March 29 1923, provides that persons under 14 shall not be employed as seamen, except as permitted by the Genoa Convention.

Latvia.—The Acts of March 24 1922 and April 26 1924 fix 14 as the minimum.

Mexico.—The Federal Constitution of 1917 provides that the work of children under 12 shall not be made the subject of a contract.

Netherlands.—The Act of July 21 1922 provides that a child who is under 14 or who is still bound to attend school shall be excluded from all work. This general prohibition is, however, modified by provisions permitting the employment of children of 13 who are exempt from school attendance. The Decree of Oct 7 1922 provides in addition that boys under 14 shall not be employed in mines or works above ground, and boys under 16 shall not be employed underground. The Decree of Dec. 19 1924 provides that a child under 14 shall not be employed on board ship.

New Zealand.—The Factory Act prohibits the employment of children below the age of 14 in any building, office or place in which two or more persons are employed.

Norway.—The Act of Sept. 18 1915 fixes 14 as the minimum age for admission to employment in factories and works where handicrafts or other industrial operations are carried on. By the Act of Feb. 16 1923, it is provided that children under 15 shall not be employed on board ship.

Persia.—By the Decree of Dec. 17 1923, concerning the protection of workers in carpet factories in Kerman and Baluchistan, it is provided that boys under 8 and girls under 10 shall not be employed in carpet factories.

Peru.—The Act of Nov. 25 1918 provides that children under 14 shall not be employed in industrial or commercial undertakings. But children under 14 but above 12 may be employed if they are able to read, write and reckon, and if they produce a medical certificate of physical fitness.

Poland.—The Act of July 2 1924 fixes 15 as the general minimum.

Rumania.—The Acts of Feb. 11–24 1906 and July 3 1924 fix 12 as the minimum if the required educational standard is reached.

Russia.—The Labour Code of Soviet Russia (Nov. 9 1922) fixes the general minimum age for employment of children at 16. It is, however, provided that the labour inspector may give permission in exceptional cases for the engagement of young persons of 14.

Kingdom of the Serbs, Croats and Slovenes.—The Act of Feb. 28 1922 provides that children under 14 shall not be employed in undertakings carrying on handicrafts, industry, commerce, transport, mining and similar activities.

South Africa.—The Act of April 15 1911 fixes 14 as the minimum.

Spain.—The Act of March 13 1900 fixes the general minimum age for admission to employment at 10. For work on board ship, however, the age of 14 is fixed by the decree of May 31 1922.

Sweden.—The Acts of June 29 1912 and June 17 1916 fix 14 as the minimum age for the employment of girls and 13 as the minimum age for the employment of boys in industrial work. The Acts of June 15 1922 and Feb. 27 1925 provide that children under 14 shall not be employed on board ship.

Switzerland.—The Act of March 31 1922 and the order of July 5 1923 provide that children who have not attained 14 shall not be employed in the undertakings covered by the Act (in general, industry and transport, but not agriculture or commerce).

Turkey.—The Labour Act of 1925 contains a provision that no children under 12 may be employed in any public or private undertaking, either as apprentices or as workpeople.

The legislation which has just been analysed relates to industrial undertakings and in some cases to work on board ship or in commerce, but it does not usually cover employment in agriculture. The scope of its application to industrial undertakings varies widely, as the definition of "factory" or "workshop" is by no means uniform. Minimum age legislation usually does not apply to work-places or ships in which only members of the same family are employed, nor to work done by children in technical schools, provided that such work is approved and supervised by public authority. In the case of dangerous or unhealthy work, and night work, employment is often forbidden under 18. For work in mines the minimum age is usually fixed at 16. Enforcement usually depends on the factory inspectors, and in order to facilitate their work it is often provided that every employer of young persons shall keep a register of all such workers up to 16 or 18 showing their date of birth. The provisions of minimum age legislation are reinforced, in actual everyday practice, by a variety of other measures.

Under the family allowance system, for instance, now widely applied in France, Belgium, the Netherlands, Germany and other countries, by which wage earners in certain industries receive, in addition to the basic wage, allowances for dependent children, an age limit is fixed beyond which children are not considered to be dependent. As this age limit is usually 14, the system has some influence in inducing parents not to put the children to regular employment before this age. The same sort of influence is exercised by social insurance systems. While national systems of workmen's compensation, health insurance, unemployment insurance and other forms of social insurance differ greatly from country to country, the existence of dependent children is generally taken into account in assessing benefits. These provisions, therefore, tend to protect the children from being sent to work at too early an age. Most important of all, in this connection, is the system of compulsory school attendance regulations. In most industrial countries the statutory age-limit is now 14, coinciding, as it logically should, with the minimum age for admission to employment.

In general, it may be added, most labour legislation has some sort of repercussion, however remote, on the welfare of the children. Legislation providing for the establishment of minimum wages, for instance, by preventing the payment of sweated wages, results normally in safeguarding the standard of life of the family as a whole. Similarly, legislation fixing an eight-hour day may be considered to have a real influence on child welfare, inasmuch as it permits the normal man to devote more of his time to family life and to the well-being of his children.

The American System

The U.S. Census of 1920 reports over one million (1,060,858) children 10 to 15 years of age, inclusive, as "engaged in gainful occupations" in the United States. This number was approximately one-twelfth of the total number (12,502,582) of children of that age in the entire country. The number of child workers 10 to 13 years of age, inclusive, was 378,063. The census does not report the number of working children under 10 years of age, but it is known that such children are employed in large numbers in agriculture and in smaller numbers in other occupations.

Of the child workers 10 to 15 years of age, inclusive, in 1920, 647,309 or 61%, were reported to be employed in agricultural pursuits, the majority (88%) as labourers on the home farm. There were 185,337 children, or 17·5%, employed in manufacturing and mechanical industries. Over 80,000 children were engaged in some type of clerical occupation; approximately 63,000 were in trade; 54,000, the majority of them girls, were working at occupations classified under "domestic and personal service"; and 7,191—almost all of them boys—were employed in the extraction of minerals.

During and since the World War the number of working children fluctuated greatly. The serious industrial depression which followed the outbreak of the War brought a sharp decrease. By the latter part of 1915 the effect of foreign orders for war goods was beginning to make itself felt, and an unprecedented rise in the number of employed children followed. After the United States entered the War, the rising cost of living, the absence of older members of the family on military duty, high wages because of labour shortage, and a restlessness on the part of the children themselves, led many under 16 to leave school for work. Available statistics show that in most places the peak in the employment of children was reached in 1918. The shutting-down of war industries and the return of soldiers resulted in a temporary decline in 1919.

The census of 1920 records a considerable decrease since 1910 in the number of children reported at work. Although the total child population 10 to 15 years of age, inclusive, increased 15·5% the number of working children reported decreased almost half (46·7%). A corresponding decrease took place in the proportion of all children of these ages who were employed in gainful occupations, from 18·4% in 1910 to 8·5% in 1920. The decline is most striking in connection with agricultural pursuits, in which the number of children employed decreased 54·8%.

The most important legislation between 1910 and 1920 was the enactment of the first Federal child labour law, which came into operation in Sept. 1917. This Act prohibited the shipment in interstate or foreign commerce of the product of any mine or quarry in which children under 16 were employed, and the products of any mill, cannery, factory, workshop or manufacturing establishment in which children under 14 were employed or children between 14 and 16 were employed more than eight hours a day, or six days a week, or before 6 A.M. or after 7 P.M. It was attacked as unconstitutional and on June 3 1918 the U.S. Supreme Court held, by a vote of 5 to 4, that it did not constitute a valid exercise of Congress' constitutional authority to regulate foreign and interstate commerce. A child labour tax clause was then inserted in the Revenue Act of 1918. It placed a 10% tax on the net incomes of establishments employing children of the ages and for the hours specified in the Act of Sept. 1 1917. This was held an unconstitutional exercise of Congress' authority by the Supreme Court in 1922. A proposal for an amendment to the United States Constitution specifically giving to Congress the right to regulate or prohibit the labour of persons under 18 years of age received the requisite two-thirds vote in Congress and was submitted to the States in June 1924. Up to Jan. 1 1926 four States had ratified the amendment and it had been rejected by both Houses of the Legislatures of 21 States.

In the child-labour legislation enacted by the various states there are many differences. It is usually required:—

(1) That a child must reach a specified age and an educational and physical standard before he can be industrially employed;
(2) That an official work permit must certify his ability to meet the standards established by the statute;
(3) That the age at which children may be employed at night or in hazardous or unhealthful occupations must be higher than the age at which they may be employed in general occupations.

Of these standards the minimum age was the first to be generally adopted. With some exceptions, every state except two (Utah and Wyoming) has prohibited the employment in industry of children under 14 years of age. That the present tendency is toward the establishment of a higher age is indicated by the fact that seven states (California, Maine, Michigan, Montana, Ohio, Rhode Island and Texas), representing all parts of the country, have raised the age above 14 years.

In 44 states child-labour laws prohibit the employment at night of children at least up to 16 years of age in an enumerated list of occupations. The hours vary. For example, New York prohibits the employment of children under 16 years after 5 P.M. or before 8 A.M.; California after 10 P.M. or before 5 A.M. In 31 states, including those of most importance industrially, laws prohibit the employment in certain unhealthful processes of children, usually under 16 years of age, sometimes 18 years of age.

Dependent Children.—According to a census taken in 1923, there were in the United States nearly 220,000 dependent children being cared for away from their own homes. Of this number approximately 140,000 were in institutions and 80,000 in family homes. Information compiled by the Children's Bureau indicates that approximately 125,000 were supported in their own homes through so-called mothers' pensions. The first laws providing for such pensions were enacted in Illinois and Missouri in 1911. This movement for public aid to dependent children in their own homes spread rapidly so that by Jan. 1 1926, 42 states (all except Alabama, Kentucky, Georgia, Mississippi, New Mexico and South Carolina) and Alaska and Hawaii had adopted legislation of this sort. The principal consideration was aid for the children of widows, and many of the laws are restricted to such children. The trend of recent legislation is toward a broader application of the law, giving the benefit of the aid to all dependent children if the circumstances are such that in the interests of the child the home should be maintained and assistance is necessary to secure that end. In 25 states the aid may be given for all children under 16 and in two states under 17 years of age. In New York City allowances were paid to 8,440 widows for the care of 23,108 children in their own homes at a cost of $4,500,000 in 1923. That year the city paid $4,000,000 for care of 13,680 children in institutions.

The laws of six states—Arizona, Colorado, Maine, Massachusetts, Rhode Island and Virginia—do not specify the amount of the aid that may be granted to each child or each family but leave the determination of the amount to be made on the basis of the family need for providing adequately for the children. Most of the states fix a maximum amount varying with the number of children. For three children the maximum is between $50 and $70 in eight states, and less than that in 27 states—10 states fixing the maximum monthly allowance for three children at from $20 to $29. For delinquency among children, *see* CHILDREN'S COURTS. (G. AB.)

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Texts of Child Labour Laws are in the *Bulletin of the International Labour Office* (Basle, 1906 and 1919), and in the *Legislative Series* (International Labour Office, Geneva, 1919). Information on the application of legislation is contained in the Factory Inspectors' Reports and in official reports issued by Government departments in the various countries. (R. CR.)

CHILDREN, DISEASES OF.—The study of this subject, known also as Paediatrics, is comparatively modern. There was no recognition of the need for special instruction in it as part of the curriculum at the medical schools, until, in 1899, King's College Hospital (London) appointed a physician to treat children only and to teach the students this subject. Gradually the recognition of this need has spread to other medical schools, or been forced upon them by examining bodies.

Infant feeding has passed through various phases. In the 17th century, when the mother was unable to suckle, wet nursing was the recognised alternative. In the 18th century hand-feeding began to replace suckling and brought with it the ills of faulty feeding; in the latter half of the 19th century the importance of infant feeding as one of the largest factors in infant mortality and diseases began to be recognised.

Methods of Feeding.—An attempt to replace the haphazard methods of the time was made by the introduction of percentage feeding in America. This necessitated an exact knowledge of the percentage composition of milk, cream, etc. Directions for feeding were given as a prescription ordering the percentage of proteid, fat, and sugar, and laboratories were established in which such foods could be prepared. This method involved fallacies of theory and practice, but it encouraged more accurate and intelligent understanding of infant feeding.

A new departure is the so-called calorie feeding. The energy-producing value of a food, calculated in units of heat which the food would produce on combustion (1 calorie = heat required to heat 1 kilo of water 1° C.), determines its adequacy for the infant. At certain ages a certain number of calories per lb. weight are found to be requisite, so that food requirements can be determined by mathematical calculations. The fallacies of this method are considerable, but it is occasionally useful.

Whilst the physicians and laboratory workers were investigating the subject from the scientific standpoint, a great step forward was made by the establishment of Consultations de Nourrissons (1892) in France, and a little later of Infant Consultation Centres or Infant Welfare Centres (1906) in Great Britain and in other parts of the world. Mothers take their healthy infants to these and are instructed as to their feeding and care.

Biochemical research has shown that, besides the gross chemical composition of foods, there are subtler constituents, viz, "accessory factors" or "vitamins," which are essential to health and, indeed, to life. (*See* BIOCHEMISTRY.) Related to lack of these vitamins are two diseases, infantile scurvy and rickets, the former definitely due to lack of vitamin C, the latter to deficiency of some anti-rachitic factor of which little is known.

In connection with the latter, the value of ultra-violet rays has recently been recognised; whether from sunlight, arc lamp, or mercury vapour lamp, these rays improve the general health and vigour and are beneficial in certain diseases, particularly rickets, in which they effect a rapid cure of the bone affection. To a less degree they are useful in some forms of tuberculosis. Amongst diseases affecting nutrition in infancy, congenital hypertrophy of the pylorus was formerly one of the most fatal; but now has been so successfully treated by surgery that the majority recover.

The rise of bacteriology has revolutionised our views of many diseases of children, but some still await fuller knowledge. Infantile paralysis is one of these. Flexner and his co-workers in New York, by a series of experiments on monkeys, have shown that, as had already been suspected, this disease which wrecks the lives of so many children is due to some infection, and they have investigated the conditions and ways in which it can be communicated (*see* SPINAL MENINGITIS). The exact nature of the virus is uncertain, but experiments have shown that infection may enter by the naso-pharynx and may probably be spread by carriers. Isolated cases occur every summer and occasionally epidemics, as in England in 1911 and in America in 1910.

The specific fevers (*see* INFECTIOUS FEVERS) to which children are most liable, scarlet fever, measles, chicken pox, and mumps, are still a mystery as to their exciting cause. Whooping cough, however, has been traced to a specific bacillus and a vaccine of this organism has been used extensively, but with doubtful benefit. The discovery of an antitoxin for diphtheria in 1893 led to a large reduction in the mortality from that disease; the deaths from laryngeal diphtheria fell within two years from 62% to 28%, and a few years later to 11·7%.

Tests for Diphtheria.—Various efforts have been made to immunise children against measles by serological methods and successes in this connection have been reported. The most

notable advance touching specific fevers has been the Schick test for diphtheria (1913). Susceptibility to this disease can be detected by intracutaneous injection of a minute dose of the toxin of diphtheria; a slight redness or swelling at the site of infection within 24–48 hours indicates that the person showing it is susceptible. Such a means of distinguishing between children liable to infection and those who are not liable is clearly of great value when diphtheria occurs in a school or institution. As a sequel to this a new method has been introduced of conferring immunity by subcutaneous injections of a toxin-antitoxin. In this way a child found by the Schick test to be susceptible can be immunised for several months, whereas an ordinary antitoxin protects only for a few weeks. A similar test, the Dick test, has been used to detect susceptibility to scarlet fever by the intracutaneous injection of a very dilute toxin prepared from streptococci.

There has been a striking decrease in the mortality of the specific fevers of childhood during the past forty years. The annual mortality in England and Wales per million persons living was in 1883: scarlet fever 1270, measles 962, whooping cough 1086; in 1923, scarlet fever 83, measles 508, whooping cough 399.

The effects of congenital syphilis (*see* VENEREAL DISEASES), first studied in detail by Diday of Lyons in 1854, have been more fully realised since the introduction of the Wassermann test (1906), in which the examination of the blood indicates the presence or absence of this disease. It may be present when no characteristic symptoms occur, indeed without symptoms of any sort.

Applied indiscriminately to children attending hospitals, this test has shown a positive result in proportions varying from 0·59% in London to 10·4% in Glasgow, but for the general child population these figures are probably too high. Syphilis causes a large waste of potential lives by miscarriages and still-births, of which there were 40% in a series of 187 pregnancies in syphilitic families, whilst of 112 live-born children in these families 33% died in infancy or early childhood. Nor does this represent the full extent of its mischief, for mental deficiency, various forms of paralysis, impaired sight, deafness, and various deformities in the child are in some instances direct or indirect results of syphilitic parentage. Of late, a wider knowledge of the effects of syphilis and its prevention and treatment in adults has reduced the frequency and severity of the inherited disease in children. The latest treatment is by subcutaneous or intravenous injections of arsenical or bismuth preparations.

Tuberculosis.—Amongst the diseases which not only account for a considerable mortality in childhood, but also add to the number of the unfit when the child grows up, are tuberculosis and rheumatism (*see* TUBERCULOSIS). Of children dying in hospitals about one-third have tubercle, although in some of these it is not the cause of death. Tuberculous disease of bones or joints in children is responsible for much lifelong crippling, and tuberculosis of the lungs or other organs often means at a later age years of delicacy and unfitness for the battle of life. Tuberculosis takes its heaviest toll during the first five years of life, especially in the second year, to which belong 26% of the deaths from tuberculosis in children under 12 years of age. The danger of tuberculous cow's milk has become recognised. In 1913 9·3% of samples of London milk showed tubercle bacilli. The education of the public to the danger of unboiled milk is tending to safeguard children from this infection.

Rheumatism.—Rheumatism, unlike tuberculosis, hardly ever occurs under three years of age. It affects chiefly children from 5 to 12 years of age of the hospital class, and perhaps more amongst the poorer middle class than amongst the very poor. Of children from 6 to 12 years old admitted to the medical wards of a hospital, nearly 25% were suffering from some rheumatic affection and in an out-patient department of children 5 to 12 years old 13% were attending for rheumatic troubles. Rheumatism in children affects the joints much less than in adults. Often, especially in girls, it takes the form of chorea, often the only indication is vague pain mistaken for growing pains, or perhaps a stiff neck, but however slight such manifestations the rheumatism which they indicate is specially liable in children to attack the heart. Heart disease in childhood is mostly rheumatic; sometimes it is rapidly fatal, more often after some years of invalid existence the heart gradually fails and the child dies. The duration of life in these children with rheumatic heart disease depends chiefly on the possibility of prolonged rest and careful restriction of exertion, perhaps for two or three years. Complete recovery is not impossible in some cases, and in others life may be prolonged many years in usefulness and comfort if such treatment can be obtained.

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CHILDREN'S COURTS (*see* 6.140).—Special tribunals for dealing with juvenile offenders. The system, first suggested and established in the United States has since been extended to the principal civilised countries.

I. COURTS IN THE UNITED STATES

Age of Delinquency.—The age of delinquency has been raised in most states to include all children under the age of 18 years, and in two states (Wyoming and California) under the age of 21 years. To be consistent with the disabilities of minors in civil matters, it is believed that eventually the age of delinquency will be made 21 in all the states, with exceptions covering certain serious felonies like highway robbery, murder, etc. The theory underlying these special laws for delinquent minors is not an assumption that the child cannot commit a crime, nor do they aim at excusing him for it without punishment in proper cases, any more than in civil cases is it assumed that a child could not make a contract. He could; but only under conditions different from those applying to adults. In the same way a child (if over the age of seven) could commit a crime, but the commission of a crime in this case is assumed to differ sufficiently from the commission of such crimes by adults as to justify a different, more elastic, intelligent method in dealing with the offender.

Methods of Probation.—The laws referred to also provide for the use of probation in the cases of offending children. The power to place a person on probation in these courts was legally authorised and used in Massachusetts as early as 1878. Probation in such cases is an effort of the state to enable offending children "to overcome evil with good," to accomplish their own redemption with the aid and assistance provided in the juvenile court. The "good" is the more intelligent attitude of the state in literally teaching children, brought to these courts, to overcome bad things. This is generally attempted in the child's own home. Proof of a child's good conduct is furnished in some courts by reports from his parents, teachers, playground or community-house directors in the neighbourhood. Similar reports are also obtained by the visitation of probation officers who keep in kindly touch with the child and his parents.

There may be more severe methods of discipline provided by these laws, such as confinement in a detention home school, or in the industrial or training school, or even in a jail, but always with the proviso that if so incarcerated the child is to be separated from adult criminals. In this so-called "jail" there is generally a tutor or teacher and a kind of home life which, while designed to correct children, is also designed to protect them against the evil influences which attach to other jails.

Methods Employed.—In juvenile courts, the state now furnishes probation officers, doctors, psychiatrists, child experts and social workers, with their various agencies to search for the causes of crime in childhood and youth. The child's health, mental condition, social and economic status, as well as that of his parents, his neighbourhood, his opportunities and temptations *as causes* of crime are all carefully considered. There are few limitations upon what the juvenile court may do since its

chancery procedure is free from the hampering and inflexible rules of criminal courts. As the entire purpose of the court is to help and not to hurt the child, its actions are seldom questioned. Not one case in thousands heard in juvenile courts is ever excepted to or appealed to other courts. The juvenile court may in fact be properly regarded as a moral hospital rather than a court. It is believed that 80% to 90% of offenders dealt with in this attitude correct their faults and become good citizens, as against what has been shown to be about 75% who usually repeat the offence or return to serious crime when dealt with only by the old criminal court and incarceration methods.

Enlarged Activities.—The juvenile courts of the United States, especially in the years following 1910, show a marked widening of scope. The power of *parens patriae*, as first applied to children, has in a limited way and in some states notably in Colorado, been applied to adults, their jurisdiction being broadened to include all cases concerning children or adult persons (parents or others) whose offences are against children or whose conduct, responsibilities or controversies concern them. A judge, selected for his particular qualifications to preside in such a court, is specially appointed or elected for that purpose.

In this type of juvenile court, as well as in that conducted as a part of the already established judicial procedure, in which different judges are usually assigned to the juvenile court for limited periods, the jurisdiction differs in different cities. Even in the juvenile courts, administered as part of the regular judicial system, a tendency is observable to assign one particular judge to this special work. While good results may be accomplished in either type of court, the weight of opinion in the United States (1926) seems to be in favour of the separate special court presided over by a specially chosen judge, for the handling of all cases concerning children and also cases of adults who offend against or have responsibilities for or controversies over them. (*See* also BORSTAL SYSTEM; PROBATION; PUNISHMENT.)

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II. COURTS IN OTHER COUNTRIES

Great Britain.—For the main provisions of the Children's Act (1908) regarding juvenile delinquency *see* 6.140d. Section 131 of the Act defines "a child" as "a person under the age of fourteen" and "a young person" as "a person aged fourteen and upwards and under the age of sixteen." By section III. (5) separate juvenile courts for the metropolis may be set up by order in council. The London courts function now, however, under the provisions of the Juvenile Courts (Metropolis) Act 1920, by which the holding of the courts is arranged in places other than ordinary police courts, and the court is constituted of a police magistrate, nominated by the Secretary of State and two justices, one of whom should be a woman, selected on the grounds of special qualifications for dealing with juvenile cases. These arrangements operate at seven out of the nine London juvenile courts. Another special feature of the London system is that twelve highly qualified probation officers are attached to these courts. They are appointed by the Home Secretary and all of them are women.

Juvenile delinquency has diminished considerably in recent years. Returns furnished by the children's branch of the Home Office in 1905 show that the number of persons tried in the juvenile courts was 38,351 in 1912 and that the figure had fallen to 29,264 in 1924. It should be stated that during 1917 the number rose to 51,323. Since the passing of the Children's Act in 1908, there has been a marked increase in the number of juveniles placed upon probation. In 1910, 10·62% of the persons tried in juvenile courts were placed upon probation. In 1924 the figure had risen from 3,568 to 5,812 or 19·62 per cent. At the same time the number of children and young persons committed to Home Office schools has decreased from 5,744 in 1913 to 1,891 in 1924.

The practice of the various courts in dealing with juveniles is marked by wide divergencies, and suggestions for widening the scope and character of the juvenile courts were considered (1925) by a departmental committee presided over by Sir Thomas Molony.

The evidence given showed that Liverpool, for instance, was the only city possessing a juvenile court specially constructed for the purpose. In 676 cases there was no rule requiring the police to attend in plain clothes. Reports on the children's homes were obtained in 404 courts from the police. Only 203 courts relied entirely on the probation officer. The school record was obtained in 303 courts, but 285 dispensed with it altogether. Only 27 courts made a medical examination an essential preliminary of dealing with the case. In 260 cases no medical examination was asked for at all, and in 462 cases only when it appears necessary. The question of further medical help for the courts, of extending their jurisdiction to young persons up to 18 years and especially of altering their general procedure by applying the principle of the chancery court in place of a criminal jurisdiction were considered by the committee.

The British Dominions.—To Ontario (Canada) and to South Australia belongs the honour of having taken the initiative of setting up children's courts by legislative enactments as early as 1893 and 1894. Ontario, by section 30 (1) of the Protection of Children Act 1893 required towns with a population of more than 10,000 inhabitants to make separate provision for the detention of children awaiting trial, and laid upon the judge the duty of trying children's cases in premises other than police courts or where this was not practicable in the private room of the judge or in some room in municipal buildings. Under the Juvenile Courts Act 1914, power was taken to pay the magistrate or officer constituting the juvenile court.

The Juvenile Delinquents Act 1908 and its amendments operate in most of the larger centres of the Dominion of Canada. The spirit of the measure may be judged from Section 16 (5) which provides that "the action taken shall in every case be that which the court is of opinion is for the child's own good and the best interests of the community."

Juvenile courts were established by ministerial order in South Australia in 1890. Legislative action followed in 1895, when it was laid down by Section 31 of "The State Children Act," that the hearing of complaints against children within the city of Adelaide and the town of Port Adelaide should be held in some room or place approved by the chief secretary but not in any police or court house. Outside the city, hearings were to take place at a different hour from ordinary trials. Special children's courts are now the rule throughout the Commonwealth of Australia.

In the Union of South Africa there are juvenile courts in operation at Cape Town and at Johannesburg.

The Continent of Europe.—On the continent of Europe the provision of juvenile courts has made much headway. By the Belgian law of Mar. 15 1912 for the protection of children ("La Protection de l'Enfance"), special children's magistrates are appointed under Art. 11, whose jurisdiction extends to all minors under 16 and to young persons charged with begging and vagrancy up to 18 years. This measure is notable for requiring full investigation into the physical and mental health of the children charged and into the social and moral condition of their environment (Art. 27). In the Netherlands and in Austria and Germany, the jurisdiction of the juvenile courts is concerned with young persons up to the age of 18. This is the case also in the canton of Geneva and in Sweden.

In France the children's courts only deal with juveniles under the age of 13, offenders between 13 and 18 being tried *in camera* in the ordinary courts. There are no juvenile courts in Italy, but cases of child offenders are heard *in camera*. Juvenile courts have been set up in Egypt and since 1922 in Japan. The Japanese law of 1922 defines minors under the age of 18, as "juveniles."

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CHILE (*see* 6.142).—A republic of South America and a member of the League of Nations. Its area is 289,810 square miles. By the census of 1920 the population was 3,754,723, an increase of approximately 15·5% over that recorded at the previous census of 1907. The southern provinces showed an increase and the northern a decrease from 1907 to 1920, attributed largely to a movement into the towns. The chief towns and their populations in 1920 were: Santiago, 507,296; Valparaiso, 182,422; Concepción, 64,074; Antofagasta, 51,531; Iquique, 37,421; and Talca, 36,079. The population of the country was estimated at 3,937,678 in October 1925.

I. POLITICAL HISTORY

Apart from the economic repercussions of the World War, the period 1910 to 1920 was not of great significance in the history of Chile; but the years 1920 to 1925 were more pregnant with troubles than any period since the civil war of 1891. The election on Dec. 23 1910 of Ramón Barros Luca as president marked a triumph of the moderate Liberal over the Conservative and Clerical party. In the same year the celebrations of the centenary of Chilean independence were held, and, apart from their effects in stimulating patriotism and national pride, they were made the occasion for according special honours and attention to Argentina, thereby strengthening the *rapprochement* that had been growing between the two nations since the settlement of their boundary dispute in 1902. The opening in 1910 of the Transandine Railway, to connect Santiago with Buenos Aires, formed another link with the sister republic. Relations with the United States were strengthened by a settlement in 1911 of the long outstanding Alsop claim, in accordance with the award of George V. of England. Two years later the Arica-La Paz Railway, built by the Govt. of Chile with the co-operation of Bolivia, was opened; although a useful aid to the prosperity of both countries, the treaty governing its construction and working later provided matter for controversy, for Bolivia desires free and unhampered access to the sea. The immediate pre-War years were years of optimism and progress, with a comparative quiet in internal affairs. There was no really important political event, and little to record beyond the continuance, at intervals, of uneasiness in the northern provinces, because of the outstanding boundary dispute with Peru, which assumed serious proportions from time to time.

The War Period.—The outbreak of war in 1914 placed Chile in a position of difficulty. An influential section of her population was dominated by German ideas and ideals, fostered by a thoughtful propaganda. The Chilean Army was trained on the German system, by German officers; the educational system was largely German; southern Chile contained many German colonists; and the clergy were mostly favourable to the Central Empires, because of France's anti-clerical policy. The commercial position was also an important factor, for Germany was the chief source of Chilean imports, and ranked third amongst her customers abroad. The navy, which for some years had followed English ideas, was largely favourable to England. The third section of the population, that which leaned toward French culture, was small but influential, and showed its existence by skilled propaganda. With these factors at work there was only one safe course for the Govt. to pursue, and that was one of strict neutrality, which was not altered even by the entry of the United States into the War, or by the sinking of the German cruiser "Dresden" in Chilean territorial waters by British warships.

The presidential election of 1915 was marked by great excitement and disorder, and resulted in the election of Juan Luis Sanfuentes, representing a coalition of Liberal Democrats with Conservatives and Nationalists, as against a combination of Radicals, Liberals and Democrats. The relative strength of the different political parties caused a continuance of the instability of Cabinets, which had long been characteristic of political history in Chile. The years 1917, 1918 and 1919 saw the fall of one government after another, and consequently the general impossibility of achieving any satisfactory solution of national problems. Anti-Peruvian riots at Antofagasta and Iquique were followed by the mutual withdrawal of consular officers of both countries. Had it not been for a general wave of prosperity during 1917 and 1918 (due to the Allied demand for nitrate and other materials used in the manufacture of munitions) serious unrest might have occurred. With this wave of prosperity came a consciousness in the working classes of the desirability and necessity of better conditions of life generally; the agitation which followed, and led up to the presidential election of 1920, was significant as the real turning point in the general Conservative tendency which Chilean politics had, without serious interruption, always shown.

Post-War Years.—In 1920 the political parties consisted of three groups (*a*) the Conservatives, (*b*) the Nationalist Liberals and Democratic Liberals, known as the Union, and (*c*) the Left wing Liberals, Radicals and Democrats, known as the Alliance. The Union had a majority in the Senate and the Alliance in the Chamber of Deputies. The Union candidate for the presidency was Don Luis Barros Borgoño, and Don Arturo Alessandri represented the Alliance. The presidential election was held on June 25 after a campaign of unprecedented intensity and excitement, and when the result was declared a month later Alessandri was victorious with 179 votes against 174 to Barros Borgoño. Under the constitution it remained for Congress to proclaim as president the candidate who had secured an absolute valid majority (178 of the total 354 votes) and it was thought that, when the Chambers met in joint session for this purpose, a means would be found of preventing Alessandri from assuming office. A cry was raised that he was to be robbed of his victory, and it was generally felt that the defeat of the popular, as against the aristocratic candidate, would lead to revolution. It was finally agreed that a tribunal of honour should be formed of seven members to decide the question, and that their decision should bind Congress. This was published on Sept. 30 giving Alessandri 177 valid votes and Barros Borgoño 176.

Alessandri assumed office on Dec. 23 1920 in circumstances which did not favour the working of the ambitious democratic programme he had promised during his election campaign. Political parties were so represented in the Senate and the Chamber of Deputies that the formation of a Cabinet capable of receiving sufficient support for government was almost impossible. The high cost of living, the industrial and commercial stagnation and the steady increase in unemployment, with the inevitable instability of currency and budget deficits, all added to the difficulties. Furthermore there was the relentless hostility of traditionalist politicians to the reform policy, in which the Senate, with its safe Union majority, could block any measure. The country itself was impatient to see some materialisation of the promised measures of reform. The political atmosphere of 1921 was one of expectancy, and was marked by a steady decrease in the President's influence: the forces against him were from the outset too strong, and, faced with the open hostility of his enemies, he began to lose his friends through his inability to carry out his promises. A split in the ranks of the Alliance (which followed a general election to the Chamber of Deputies) added to the strength of the Conservative groups; and a strong working-class agitation, resulting from increased unemployment, further jeopardised Alessandri's position.

After several attempts to govern in accordance with his ideas, the President, finding the obstructions insurmountable, tendered his resignation on Nov. 17 1921, partly for that reason and partly on grounds of ill-health. Dissuaded from this step by Don Ismael Tocornal, head of a non-party Ministry, he remained in office, but almost powerless to effect not only his projected reforms but even the ordinary measures that were imperatively necessary to the routine of government. The main activities of Congress in 1922 centred round national finances and the old Tacna-Arica problem, which was productive of the most bitter controversy; a revival in the nitrate industry relieved for the time the pressing labour problem, which had been the chief cause of tension during Alessandri's first year of office. Many ministerial crises occurred, for neither of the two most powerful parties—Conservatives and Radicals—would consent to take part in the formation of a Cabinet. Nevertheless two very important laws were passed, the first on Feb. 6 reserving all traffic along the coast to Chilean vessels, and the second ratifying the Washington Protocol of Arbitration for the boundary dispute with Peru. The holding in April and May 1923, at Santiago of the fifth Pan-American Congress helped momentarily to distract attention from the anxiety that prevailed throughout the year, during which no solution was found for any of the serious political problems.

The Coup d'Etat of 1924.—The year 1924 opened with a repetition of the events of 1923—ministerial crises followed by

deadlocks, which continued until September. In that month a military *Junta* was formed under Gen. Dartnell; having obtained the adherence of the navy, a joint memorial was presented in the form of an ultimatum to the President, demanding that certain legislative measures be immediately passed. The existing Ministry of Aguirre Cerda thereupon resigned, and the President accepted unconditionally the terms of the ultimátum. A "Committee of Government" (*Junta de Gobierno*), which had the support of public opinion and was received almost without disturbances, was formed under the leadership of Gen. Altamirano on Sept. 5. Having notified the public and his representatives abroad of the success of this *coup d'état*, President Alessandri resigned on Sept. 8, his place *ad interim* being taken by Gen. Altamirano; Congress rejected the resignation, and, instead, granted the Señor Alessandri six months leave of absence, which he accepted. On Sept. 10 he left for Buenos Aires by special train under the U.S. flag, escorted by the ambassadors of the United States and Argentina. The self-creation of the *Junta de Gobierno* with executive and legislative powers, the dissolution of Congress and the appointment of a Ministry by the *Junta* on Sept. 12 1924 marked the final departure from a constitutional régime.

Early in Nov. a very elaborate scheme was passed, based upon electoral reform, for the restoration of constitutional government. A series of laws, in the form of decrees, was inaugurated and applied to the most varied subjects, with the intention of effecting the reforms which the wasted time of Congress in preceding years rendered imperatively necessary. The municipalities of Santiago and Valparaiso were dissolved and replaced by local boards appointed by the *Junta;* provincial governors were replaced; general investigations into the working of government departments were instituted; and, generally, the activities of the *Junta* made themselves felt everywhere. No violence or bloodshed accompanied this revolution; the country accepted the position, in the hope that at last it might be possible to purify political life and thus obtain relief from the anomalous and uncomfortable state to which it had drifted.

The Return of Alessandri.—The revolutionary Govt. appeared to be making steady progress with the necessary reforms when, on Jan. 23 1925, a new *coup d'état* overthrew the provisional Govt. and established a new *Junta* in its place. The new movement was directed by Señor Bello Codesido, Gen. Dartnell and Adml. Ward, who, recognising Alessandri as the constitutional President, appealed to him to resume office. All political parties approved of this appeal, which reached Alessandri at Venice; and he having assured himself that his return was desired by the whole country, agreed, upon conditions, to do so. A new Cabinet was appointed to carry on the government until his return on March 20, on which date he was received with enthusiasm by ministers, officials and the populace. The system of decree-laws inaugurated by the first *Junta* was copied by their successors, and the President found himself, in the absence of Congress, obliged to legislate on this system. The public soon began to demand the return of constitutional régime, but Alessandri, fearing a recurrence of political chaos (which he had attributed to the impractical constitution), refused, declaring that before Congress could be convoked a thorough revision of the old constitution of 1833 would be necessary. On April 16 this was completed, and on Aug. 31 a plebiscite was held to take the opinion of the country on the proposed changes. The revised constitution was given a great majority; it was promulgated on Sept. 18, and came into force a month later.

The new constitution is presidential in character. Its chief points of difference from that of 1833 are:—

(1) Ministers are now responsible to the President only; theoretically no amount of adverse criticism can affect their position if they can count upon presidential confidence; (2) the budget must be presented to Congress four months before it is due to come into force; it becomes law automatically if, by the end of that period, it has not been passed by Congress; (3) a provincial assembly is created, to control the finances of municipalities and to report yearly thereon to the President; (4) all religions not subversive of public morals or peace are permitted—and the Roman Catholic is no longer the state religion.

Apart from these important changes in the constitution the year 1925 was one of many changes in the general trend of affairs. After an embittered controversy (regarding candidatures for the forthcoming presidential election), Alessandri resigned on Oct. 16, his place being taken by Barros Borgoño, the Vice-President. On Oct. 24 the election was held—under the new constitution—and passed off without disorder, the result being that Don Emiliano Figueroa was elected by a large majority over Dr. Salas, the ultra-democratic candidate. Two days later the supporters of the defeated candidate declared a general strike, and on Oct. 26 Santiago was the scene of serious rioting; business and traffic were suspended, a few shops were looted, and at one time the mob was in complete command of the city. By the end of the year there were still many signs of the prevalence of the restless democratic spirit, and that, combined with the grave state of the national finances, provided a difficult problem for the new President.[1]

Defence.—Military service is compulsory for one year, recruits being called up in their 20th year, followed by nine years in the active reserve, and thereafter up to the age of 45 in the second reserve. The active army in 1924 consisted of 18,700 men and 1,100 commissioned officers. The first-line reserve numbered about 100,000 trained and 125,000 untrained men, with a second-class reserve of 200,000. The army has been trained and organised largely on the German system. Cadet, artillery, cavalry, engineering and infantry schools are maintained by the state; in 1924 a school for non-commissioned officers was formed. The navy consisted in 1925 of one battleship, five cruisers, five destroyers, six submarines and various minor craft, personnel being 650 officers and 7,000 ratings. Service aviation is divided between army and navy. In 1925 the army air force acquired some 83 new machines of various makes, giving a total of 100 machines; 36 pilots were gazetted in 1924. The naval air force was still in its infancy in 1925, when 12 hydroplanes were ordered. The police force numbered 10,237 officers and men in 1922.

Education.—Primary education was made free and compulsory in Aug. 1920. The state also assists higher schools and the universities. In 1924 there were 3,271 primary schools with 8,779 teachers and 392,183 pupils; 92 secondary schools and 15 public normal schools with 420 teachers and 2,391 pupils; a number of vocational and professional schools, and the University of Chile with 5,000 students.

II. FINANCIAL AND ECONOMIC HISTORY

National Finance.—The unit of currency is the gold peso valued at 18d., but paper, issued by the Govt. and guaranteed by a conversion fund, is chiefly used. Exchange fluctuated considerably from 1910–25, declining from 9·75d. in 1913 to 5·73d. in 1924 with an increase in the premium on gold of from 85·31% to 218·89% in the same period. In 1912 a demand was made for a new issue of Treasury notes, and permission was given to the *Caja de Emisión* to issue notes against gold at the rate of 1s. to the peso. The Govt. had guaranteed to convert the existing paper currency into gold at 18d. a peso, but this project had to be deferred owing to political conditions and to economic stress generally. In 1914 the conversion fund stood at 108,160,754 and in 1925 114,721,780 gold pesos. The following table shows the state of national finances in 1913 and from 1920 to 1925, the figures being translated into sterling:—

Year	Revenue	Expenditure	Public Debt[1]
	£	£	£
1913	13,714,270	12,395,582	46,936,000
1920	16,522,000	19,812,860	51,675,000
1921	15,150,000	15,675,000	63,050,000
1922	15,000,000	14,880,000	65,100,000
1923	20,775,000	23,250,000	62,608,317
1924	15,500,000	16,350,000	66,612,534
1925	17,945,000	17,950,000	Not available

[1] Includes government guarantees.

The Kemmerer Financial Mission spent three months in Chile in 1925 inquiring into the financial system of the country. It dealt with tax laws, banking, currency and the financial administration of the state. A number of recommendations were made to the Govt., three of which were adopted up to Sept. 1925:—

(*a*) A central bank, called the Banco Central de Chile, was created by Decree Law No. 486 of Aug. 21 1925, for the purpose "of stabilising currency and regulating the rate of exchange and discount"; the bank's operations were to be limited to member banks and it was to have the exclusive right of issuing notes in terms of gold pesos as set out in the Monetary Law;

(*b*) A monetary law was signed on Sept. 16 1925 (Decree Law No.

[1] The dispute with Peru in regard to the provinces of Tacna and Arica is treated in a separate article. (*See* TACNA-ARICA.)

528) establishing as the monetary unit of Chile the gold peso containing ·183057 gm. of fine gold;

(*c*) A bank law was signed on Sept. 23 1923 (Decree Law No. 550) creating a superintendency of banks, and making regulations for the establishment and operation of all national and foreign banking institutions.

Production.—That part of Chile which lies between latitudes 33° and 44° contains the agricultural districts, the chief of which is the great central valley between the Andes proper and the smaller range running along the coast. Irrigation has been developed and this, together with the introduction of modern methods and machinery, caused considerable increase in production after 1910. Wheat, the chief product, is cultivated from Chiloé to Atacama. Other products are barley, flax, forage, fruit, maize, oats, potatoes, rye, and in Tacna, sugar-cane. Viticulture has been assisted by the Government. In 1921 the area planted in vineyards was 66,585 hectares; from this 1,250 thousand hectolitres of wine, grape cider and other beverages were produced. In 1924 Chilean livestock comprised 329,454 horses, 33,580 asses, 43,816 mules, 1,995,538 cattle, 4,569,166 sheep, 525,106 goats and 263,330 pigs. A Ministry of Agriculture was formed in 1924 to encourage and assist the development of national agricultural production.

Industry.—National prosperity depends mainly upon the nitrate industry, some 75% of the state revenue being derived from the export duty on nitrate; Chilean companies produced 55% of the total national output. Conditions resulting from the War affected the industry in that Germany (Chile's greatest buyer before 1914) was compelled to increase her domestic supply by synthetic products; so that, whereas Chile in 1913 supplied 54·7% of the world's nitrate, in 1924 she supplied only 30%; nevertheless 1925 saw an improvement, and it was believed that the synthetic product could never satisfactorily supplant the natural, in which Chile has great resources. From 1910 to 1918 the production of copper grew steadily, the output increasing from 38,231 tons in 1910 to 44,665 tons in 1914, 106,814 tons in 1918 and 235,000 tons in 1924. The production of coal increased from 898,971 tons in 1909 to an annual average of over 1,000,000 tons. Imports of foreign coal decreased during the same period from 1,303,000 tons to 165,517 in 1923, with little difference during 1924 and 1925. Manufactures showed considerable growth from 1910 to 1925, especially during the years of the World War. In 1910 there were 5,270 manufacturing establishments in the republic; in 1923 there were 9,000 employing nearly 100,000 workpeople. The chief industries, apart from mining, were: foodstuffs, flour-milling, sugar-refining, and other by-activities of agriculture; next in importance came leather goods, clothes, chemical products, printing, lumber-mills, metal-working, textiles, tobacco products and construction materials, in that order. The mining industry is that upon which Chile mainly relies for her prosperity, and, apart from nitrate, copper and coal, mentioned above, she also works iodine, iron ore, borates, silver, gold, sulphur, salt, lead, manganese, lime, guano and gypsum. Kieselguhr and apatite are found, but up to 1925 there was no export demand for them.

Trade.—A large portion of the national revenue comes from the customs tariff, of which a revision is considered every five years. The 1921 amendment provided for an increase of 50%; but the year 1923 showed a decrease of £864,393 on the 1913 figures. The outbreak of the World War interrupted trading, but from 1915 onwards there was a steadily increasing demand for nitrate, meat, wool and metals. In the five years 1914–8 the value of exports exceeded that of imports by $1,200,000,000 gold.

Foreign Trade 1913–24

	Imports £	Exports £
1913	24,713,836	29,723,283
1914–20 (Annual average)	24,568,321	39,285,145
1921	28,597,688	33,281,485
1922	17,788,618	25,394,027
1923	24,698,299	40,742,069
1924	27,244,307	45,448,437

Trade with Foreign Countries

	British Empire		U.S.A.		Germany	
	Imports	Exports	Imports	Exports	Imports	Exports
	%	%	%	%	%	%
1911	24	44	13	15	26	21
1913	35	38	17	21	25	21
1919	26	24	48	42	..	..
1924[1]	26	24	23	41	13	..

[1] Estimates.

The chief imports in 1925 were: Manufactured goods (chiefly textiles), machinery, crude petroleum, sugar, metal goods, printing paper, chemical and food products, tea and yerba maté. The principal exports in order of importance were nitrate, bar copper, iodine, borax, iron ore and miscellaneous mining and agricultural products.

Communications.—In 1925 Chile had 5,624 m. of railway of which 3,100 m. were state-owned, the remainder being worked by private enterprise. The state lines run north-south down the centre of the country, with branches to the coast. By treaty of 1904 Chile agreed to pay Bolivia the value of the Chilean section of the Arica-La Paz International Railway, and the last payment was made in 1924. A state line of 128 kilometers from Iquique to Pintados was commenced in 1914 and was nearly completed by the end of 1925. The Chilean and Argentine sections of the Transandine Railway came under unified administration in 1921, and in 1922 a convention with Argentina was signed for the construction of a second transandine line viâ Salta and Lonquimay concomitantly. Electrification schemes were begun in 1920 and by 1924 the first zone of the state railways was completed, from Valparaiso to Santiago viâ Llai Llai and from Llai Llai to Los Andes, thus connecting with the Transandine which it is also proposed to electrify. Many minor schemes have been planned, since ample hydroelectric power can be made available.

Telegraphs in 1922 totalled 16,494 m., of which 10,141 m. belong to the state. Telephones numbered 25,000 subscribers in 1922, and new trunk lines between Valparaiso and Santiago were planned in 1925. In 1922 there were 22,101 m. of roads in the country. Shipping in 1922 totalled 101 steamers with 69,790 tons, and 26 sailing vessels with 9,252 tons. From Aug. 9 1922 a new law reserved all coastwise shipping to Chilean vessels, and this gave impetus to the national mercantile marine. A chain of wireless stations has been erected along the coast from Arica to Punta Arenas.

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CHINA (*see* 6.166), a republic since 1911 and a member of the League of Nations. Its area, including Mongolia, Chinese Turkestan and Tibet, is 4,278,352 square miles. The population according to the 1910 census is 342,639,000, including the Chinese estimate of the population of Tibet at 6,500,000.

The years following 1909 were marked in China by changes which were to work a greater revolution in the civilisation of the country than had been known for many centuries. These changes were due primarily to the impact of western peoples upon China. The impact had been continuously in progress since the close of the 16th century, and in it traders, missionaries, diplomats and armed forces had all had their share. It was not, however, until the last decade of the 19th century that Chinese culture had begun to show any marked modifications. Then, after the fleeting reforms of 1898 and the spectacular failure of reaction in the Boxer uprising (1900), the long resistance that had been presented to the West seemed suddenly to crumble, and old institutions, ideas and customs were discarded or modified with unprecedented and startling rapidity. The political revolution of 1911–2, with the deposition of the Manchu rulers and the substitution of a republican for a monarchical form of government, accelerated the alterations in other phases of the nation's life, and by the beginning of 1926 this more inclusive revolution had proceeded far and was still in progress. The changes were especially marked in the realm of government, of education and of literature, but they were also noteworthy in religion and economics, and had begun to appear in social customs and the structure of the family. The entire movement may in time prove to have been one of the most important developments in human history. It has already shown itself to be one of the most noteworthy in the long history of China.

I. POLITICAL HISTORY

To the uninitiated observer the political history of China of the years from the beginning of 1910 to the close of 1925 must seem a hopelessly confusing kaleidoscope of names and factions, accelerated as the years passed and tending more and more rapidly toward the breakdown of all ordered government. Even for the expert observer it is often difficult to distinguish more

than the main figures of the drama, a drama that often appears to degenerate into melodrama. Certainly the years have witnessed increasing political chaos and a progressive weakening of the central government. There have not, however, been wanting some movements that give promise of a more stable and hopeful future.

It helps to simplify the situation to recognise that in the main two factors have been at work, the traditions of China's past and contact with the West. It has long been one of the features of Chinese history that when one dynasty has given way to another the transition has been marked by a period, sometimes prolonged, when the processes of government have broken down in whole or in part, when banditry has been rife and when rival military leaders have been striving to achieve the mastery of the entire nation and to ascend the imperial throne. Often no one of these rivals has been able to control the entire country, and the empire has been divided into warring principalities which have risen, altered their boundaries and then disappeared, all with disconcerting rapidity. Eventually, however, some one has always succeeded in reuniting the country under one imperial sway. This traditional process was in part repeated in and after 1911. The Manchu dynasty had long been decadent, and after the death of the great Empress Dowager it needed only a timely rebellion to topple it off the throne. That rebellion came in 1911, and the Manchus promptly collapsed. From time to time various leaders, most of them military men, have been in supreme power in Peking, but they have each had to face rebellions and none has succeeded in long remaining in power. Here and there men, supported by more or less well-organised bodies of troops, have for longer or shorter periods made themselves masters of part of a province, an entire province or several provinces; and between these leaders, either acting singly or in cliques or "parties," there has been intermittent civil war.

The entire process was complicated by relations with the West, for this contact brought with it new political ideas, the interference of foreign powers, and the incentive to a strong feeling of nationalism. For more than 2,000 years a change of dynasty had meant little alteration in the form of government. The new rulers adopted, usually with some modifications, the laws and institutions of their predecessors. Now, however, there was an effort to substitute for a monarchy a republic—a purely Western creation—and to recast political institutions in moulds that were partially occidental. No people, however, can hope to destroy its traditional political structure and erect a new one without a near approach to anarchy. Then, too, as though the nation were not confronted with enough difficulties, foreign powers did not permit it to work out its problems alone, but insisted upon interfering, either to extend their possessions and privileges or to prevent others from doing so. On the other hand, contact with the West and the aggressions of foreign peoples helped to arouse among the Chinese a new sense of nationalism, and this displayed itself in deep resentment against alien interference and in the attempt to bring about the reorganisation.

The Fall of the Monarchy

Yüan Shih-k'ai.—Most chroniclers are agreed in dating the revolution of 1911 from the outbreak which took place at Hankow in Oct., after the accidental explosion of a bomb and the arrest of a number of anti-dynastic plotters, but the country had undoubtedly contained all the materials for an upheaval since the death of the Empress Dowager in 1908. For 100 years it had been evident that the dynasty was about to pass the way of its predecessors. The ability of its leaders was declining, and internal rebellions and the encroachments of foreign powers were constantly bringing problems. With the passing of the Empress there was removed the last person strong enough to postpone the débâcle. The Manchus, seeking some means of averting the impending crisis, had tried several methods of concession intended to placate their opponents. In 1906 there had been announced a plan for reorganising the government. The central ministries of state were to be remodelled and the gradual introduction of representative bodies had been promised. In accordance with this project, provincial assemblies had been convened in 1909, a national assembly had met in 1910, and a national parliament had been promised. In Nov. 1910 the Manchus had yielded to the demand of the National Assembly and had promised the convening of the promised parliament for 1913; six months later, the Regent had agreed to replace the Grand Council by a responsible Cabinet. The imperial clan was divided against itself at this critical juncture, but even had it presented a united front the forces which brought about the abdication of the dynasty were beyond its strength.

If those leaders who came rapidly to the front after the initial successes of the rising at Hankow were able to bring about the downfall of the Manchu dynasty and the establishment of a republic almost without a struggle, it was not because they represented any conscious objection to the monarchical form of government on the part of the masses, but because they constituted at the moment practically the only organised body of educated opinion in the country and were inspired by definite aims and ambitions. Dr. Sun Yat-sen and other active leaders of the revolutionary movement had for some years been conducting an anti-dynastic propaganda in the central and southern provinces, and their activities led to the formation of numerous associations which displayed great activity in the press and in the National Assembly. The signing with a foreign banking group of the Hukwang Railway loan agreement (April 5 1911) led to friction in one of the provinces affected, Szechwan.

In Sept. the province was in rebellion. On Oct. 10, in consequence of a revolutionary plot in Hankow, there occurred in Wuchang a mutiny of troops which was the signal for the formal beginning of the revolution. When, immediately after the outbreak at Hankow, the mutineers captured the Wuchang mint and the arsenal at Hanyang, it became apparent that the Regent possessed no resources either of strength or of statecraft. Seriously alarmed by the rapid spread of the rebellion, he was persuaded to call to his aid the famous viceroy, Yüan Shih-k'ai, whom he had disgraced and dismissed from office in Jan. 1909. In Oct. 1911 Yüan was recalled from his retirement and appointed viceroy of Hunan and Hupeh, with supreme command of the imperial forces. Yüan's military operations on behalf of the monarchy were half-hearted at best, and require but little comment. He took the field toward the end of Oct., but returned to Peking in Nov., having been chosen Prime Minister. At the end of Nov., after desultory fighting, the position of the rebels in and around Hankow had become untenable, but by this time the propaganda of Sun Yat-sen's emissaries, combined with the helplessness of the Manchus, had borne fruit.

The Emperor's Abdication.—Fourteen provinces had declared against the monarchy. Nanking, moreover, was captured by the revolutionaries. In Dec. Yüan Shih-k'ai agreed to an armistice. At the outset Yüan was not in favour of a republic, but the Manchus were hopelessly incompetent, officialdom and the revolutionaries would have made it impossible for him to seize the throne for himself even had he desired then to do so; he failed to win the moral and financial support of the foreign powers; the regent had abdicated (Dec. 6), and Tang Shao-yi, the ablest of Yüan's lieutenants, had declared his sympathy with the Cantonese republican party. The only courses open were surrender or negotiation.

The armistice negotiations commenced at Hankow in Dec., with Tang Shao-yi as imperial delegate. On the 18th they were transferred to Shanghai. The result was a foregone conclusion; before the end of the month the Manchu court had agreed to submit to a national convention the question of monarchy or republic. Late in Dec., Sun Yat-sen, who had been out of the country when the revolution began, arrived at Shanghai, and a council of provincial delegates at Nanking elected him President of the Republic. In Feb. the Emperor's abdication was proclaimed in an edict which transferred the government to the people's representatives, declared that the constitution should henceforth be republican, and gave Yüan Shih-k'ai full powers to organise a provisional republican government. The Nanking Govt. agreed that the Emperor should

retain his title through life and receive a large pension. Sun Yat-sen resigned the presidency in favour of Yüan Shih-k'ai, who was thereupon elected provisional president by the Nanking parliament. Li Yüan-hung, who had come into prominence in the initial stages of the rebellion at Wuchang, was elected vice-president. A provisional constitution was promulgated in March by the Nanking parliament. On April 2 the government was transferred from Nanking to Peking.

Yüan Shih-k'ai's position as President was one of great difficulty and danger. From the outset he was held in suspicion by the Radicals, who in Aug. 1912 took the party name of Kuo Min Tang[1] and who were in control of Parliament. Rival military leaders were, moreover, already beginning to appear and to engage in the time-honoured struggle for supremacy. Then, too, Yüan was faced with grave financial problems, chiefly due to the fact that the fiscal machinery of the country had been disorganised by the revolution. There were, moreover, difficulties in the field of foreign affairs. Nevertheless during the next four years Yüan brought something like order out of the chaos, and gradually restored in the provinces the authority of the central Government. In April 1913, after prolonged negotiations, Yüan concluded the "reorganisation" loan with a financial group representing Great Britain, France, Germany, Russia and Japan. This loan was a large one, and was secured by a lien on Chinese revenues, principally on the income from the salt monopoly. His financial position and the moral support of the foreign powers thus assured, Yüan proceeded to defy the Kuo Min Tang. The latter had obtained a majority at the elections held in the beginning of the year, and came to Peking for the opening of Parliament in a belligerent mood, greatly exasperated by the assassination at Shanghai of one of their ablest leaders, Sung Chiao-jen, the Speaker-elect, whose death was probably due to the President's orders. Assembled under these conditions, the new Parliament was destined to have a stormy career. Yüan Shih-k'ai refused to recognise its claim to supervise his loan negotiations, and ordered the conclusion of the agreement with the foreign banks in spite of the protests of the Radical leaders. Realising the danger of their position, many of these now fled from Peking, and in the central and southern provinces "a war to punish Yüan" was begun. It lasted only two months and ended in complete rout. Yüan was now firmly in the saddle.

Monarchical Activities.—After thus forcibly asserting his authority, Yüan proceeded to consolidate it. In the first place, in Oct. 1913, he forced through his election as President for a term of five years, his title having hitherto been provisional. A few weeks later, by a mandate endorsed by his docile Cabinet, he ordered the unseating of all the Kuo Min Tang members of Parliament, on the ground of their treasonable conspiracies. As half of the Senate and more than half of the House of Representatives were thus disposed of, no parliamentary quorum was left. The surviving remnant of Parliament was soon replaced by a political council, and "an administrative conference for the revision of the constitution," composed almost exclusively of officials and literati of the old school, selected by the President or by his agents and representatives in the provinces, and the provincial assemblies were dissolved. By the beginning of 1914 it was evident that Yüan intended to restore the old orthodox autocracy. In 1914 a revised provisional constitution lengthened the presidential term to 10 years and gave the President decisive control over Parliament. Late in 1914 the President performed the time-honoured imperial Winter Solstice ceremony at the Temple of Heaven. In the summer of 1915 the movement for the restoration of the throne assumed definite form and direction.

The Chou An Hui, a group composed chiefly of Yüan's supporters, organised an energetic monarchical propaganda at Peking and in the provinces. One of the ablest and most influential scholars in China, Liang Ch'i-ch'ao, who had strongly supported Yüan's fight for the preservation of the monarchy in 1911, boldly denounced the Chou An Hui's propaganda and warned the President of the perils which threatened the course upon which he was embarking. Resigning his position on the State Council, Liang proceeded to publish his opinions in the Peking *Gazette*. Yüan, well aware of the far-reaching influence of Liang's views, did all in his power to win his support. Failing in this, he made a pretence of constitutional procedure by referring the question of the monarchy to a vote of the provinces, or rather to the vote of a number of individuals appointed by himself to represent them. The result, a foregone conclusion, was a practically unanimous vote in favour of Yüan's accession.

Yüan's Failure.—Yüan, however, was to fail to seize the coveted throne. The World War had broken out, in the Far East the Entente powers were submissive to the wishes of Japan, and Japan was opposed to the proposed change. In the autumn of 1915 Japan, Great Britain, Russia, Italy and France joined in counselling Yüan to delay the change to a monarchy, and Japan later reiterated the advice. There was, too, among many of the articulate classes of the country opposition to a monarchy. Moreover, and this was extremely important, many military chieftains were by no means content with the assured mastery of Yüan and the formation of a new dynasty, for this might check their own ambitions. In Dec. 1915 a rebellion, led by Tsai Ao, a military official educated in Japan, broke out in far-western Yünnan, and the province, through its officials and local gentry, declared its independence in opposition to the monarchy. The insurrection spread with a rapidity which justified the foresight of Liang Ch'i-ch'ao and emphasised the fact that, as matters stood, Yüan had not achieved either the personal prestige or the pecuniary resources sufficient to command for his authority as Emperor the loyalty of the semi-independent chieftains.

By the end of Jan. Kwangsi and Kweichow had renounced their allegiance and other provinces were wavering. His star was so rapidly declining that his advisers persuaded Yüan to issue an official announcement postponing indefinitely the establishment of the monarchy. Having thus confessed to failure, Yüan's fate was sealed. By the end of March his opponents had become so many and so active that his remaining friends advised him to resign the presidency. A month later he had been denounced as a usurper in nearly every province by the very men who had "elected" him to the throne in Nov., and even at Peking there were but few to do him reverence. Nevertheless he declined to retire, but to placate his opponents he announced his intention of reintroducing parliamentary government without delay. The Kuo Min Tang leaders, however, were not disposed to come to terms with Peking. Repudiating Yüan, they proclaimed the establishment of a provisional government at Canton and elected Li Yuan-hung to the presidency. But at this juncture Yüan died (June 6 1916), Li Yuan-hung, as Vice-President, duly succeeded to the presidency.

While these developments were taking place in China's internal politics, events of great moment were happening in her foreign relations. The revolution had brought few startling changes in the country's relations with the Powers. Tibet and Outer Mongolia, at best none too firmly attached to the empire, took the opportunity afforded by the change in government to effect their virtual independence, and Great Britain in the former case and Russia in the latter were not slow to attempt to extend their influence over states which so directly abutted on their territory. China recognised the autonomy of Outer Mongolia in return for the acknowledgment of her suzerainty, but she was less pliant in yielding to British ambitions in Tibet. On the whole, the Powers made little objection to the republic, although recognition was more prompt on the part of some than of others.

The World War

The outbreak of the World War, however, brought to China some very serious difficulties. Germany was well established in Shantung, with the leased territory of Kiaochow and its port

[1] The Kuo Min Tang was the first purely party organisation in China. With a strong nationalist and anti-foreign bias, it was evolved out of the Tung Meng Hui founded by Sun Yat-sen and other advanced leaders in Japan, and gradually acquired a membership of 500,000, scattered throughout the world. Throughout the revolutionary period it has been exceedingly active, especially in Canton, and worked for the accession of Sun Yat-sen to the presidency. Its left wing is very favourable to the Bolsheviks.

Tsingtao, and with railway lines and mining concessions. The British naturally looked askance at this occupation, and the Japanese were not at all averse to finding in the Anglo-Japanese Alliance a reason for coming to the assistance of Great Britain in the Far East. Japan had for some years been extending her influence in China. Firmly seated in Southern Manchuria by the Russo-Japanese War and subsequent events, and with a rapidly expanding trade throughout China, the World War seemed to afford her an opportunity for assuming the leadership in the affairs of her great neighbour. To this policy her economic interests seemed to urge her. In need of a source of raw materials, especially of coal and iron, and of a large market for her manufactures, she believed that both of these were to be most conveniently found in China. Western powers had threatened to close the door there against her, and now that they were absorbed in war Japan's statesmen believed that theirs was the chance to control the inchoate republic. Japan's future prosperity and even her existence seemed to depend upon propping open the door into China. Accordingly, Japan entered into the war against Germany in Aug. 1914, sent an expedition to Shantung, and with the co-operation of a small British force captured Tsingtao and the other German possessions. It was supposed[1] that the German property would eventually be returned to China, but Japan had disregarded Chinese neutrality, and had been high-handed in dealing with the Chinese population in Shantung. In Jan. 1915 she presented to Peking a formidable array of 21 demands in five groups.

1. In Shantung, China was to agree to any transfer of German possessions to Japan that the latter might obtain. China was not to alienate to a third power any territory in the province, she was to declare additional cities to be open ports and was to grant certain railway privileges.
2. In South Manchuria and Eastern Inner Mongolia, the lease of Port Arthur, Dairen (Dalny) and the railways was to be extended from 25 to 99 years. Japanese might anywhere in these regions lease land and travel or reside. There were, too, demands for mining and railway concessions, and for the Japanese control of loans and the employment of Japanese official advisers.
3. The Han Yeh P'ing Company, the largest Chinese iron-mining and smelting concern, was to be made a Chino-Japanese enterprise and China was not to sell her interest in it without Japan's consent.
4. China was to promise not to cede or lease to any third power any harbour, bay or island along her coast.
5. China was to employ Japanese as advisers to the central government; the police departments in certain districts were to be jointly administered by Japanese and Chinese; China was either to buy 50% or more of her munitions from Japan or to establish a Sino-Japanese arsenal, which was to use Japanese materials under the direction of Japanese; Japanese were to be granted the privilege of owning land in the interior of China for schools, hospitals and churches; certain railway concessions in the Yangtze Kiang valley were to be promised, and Japan was to be allowed to scrutinise all proposed loans of foreign capital for mines and works in Fukien.

For a time Japan kept the demands secret, but as they became known a wave of indignation swept over China, and there was criticism both in Great Britain and in the United States. After some weeks of negotiation, the first four groups were granted in a modified form, but the fifth was indefinitely postponed. Japan had made gains, but at the expense of alienating the Chinese.

In Aug. 1916 there was trouble on the Manchurian-Mongolian border between Chinese and Japanese troops which led to further ill-feeling and fresh demands upon China—demands from which, however, Tōkyō subsequently largely retreated. Then, in Feb. and March of 1917, Japan made secret arrangements with Great Britain, France, Russia and Italy[2] whereby she was assured of the support of these Powers at the Peace Conference in her demands for the former German holdings in Shantung.

Internal Difficulties.—The War was, too, to bring still further problems for China. With the death of Yüan Shih-k'ai, the prospect for the early unification of China under a strong central government did not immediately disappear, but it became remote, and in 1917 complications arising out of China's entrance into the World War hastened the process of disintegration. Tuan Chi-jui, the Premier of the new Cabinet, endeavoured to disarm the opposition of the southerners by convening the Parliament which Yüan had broken up in 1913. At the opening of Parliament two facts were speedily made manifest: first, the Kuo Min Tang's repudiation of Peking's authority had not been inspired solely by Yüan Shih-k'ai's attempt to restore the monarchy and would not end with it; second, the existence and proceedings of Parliament, no matter under what constitution convened, were completely at the mercy of the military governors. Parliament, in which the Kuo Min Tang predominated, declared its intention of adhering to the Nanking provisional constitution, pending the completion of a new and permanent instrument, for the preparation of which a special drafting committee was appointed. But the military governors made it plain that their practice would continue to be determined by their own necessities.

During the latter part of 1916, however, progress seemed to be made toward the establishment of order and unity, and it is possible that this might have continued had it not been for an internal conflict over the country's relations with the Central Powers. In the winter of 1916–7, the question of China's joining the Allies came to be seriously considered by Tuan Chi-jui's Cabinet. The premier and most of his colleagues were eager to take this step, but among the older officials there were some who preferred a policy of passive neutrality. In Feb. 1917 the American minister at Peking invited the Chinese Government to follow the example of the United States by formally protesting against Germany's submarine campaign and by severing diplomatic relations. On Feb. 9 the Chinese foreign office sent a warning to Germany, and on March 14 broke off diplomatic intercourse with that country. The premier and his supporters were now eager, and especially after the declaration of war by the United States (April 1917), to secure the benefits of complete identification with the cause of the Allies by declaring war against the Central Powers. A conference of military governors convened by the premier at Peking on April 26 voted for war; a few days later the Cabinet adopted a unanimous resolution to the same effect. But members of Parliament who professed to see in the attitude of the military governors a menace to parliamentary government, or who were alarmed by the increasing rumours of secret agreements between Tuan's party and Japan, constituted an opposition sufficient to prevent the Cabinet from carrying its resolution into immediate effect.

On May 19 Parliament adopted a resolution to the effect that it would decline further to consider the question until the Cabinet had been reconstructed. Tuan countered the move by a communication from the military governors to the president demanding the immediate dissolution of parliament. Thus challenged, the president issued a mandate (May 23) dismissing the premier. Tuan fled from the capital and, taking refuge with the military party's leaders at Tientsin, announced his intention of defying the President's authority. The military governors of several provinces north of the Yangtze Kiang thereupon proceeded to declare their independence of the central Government, and at the beginning of June established a "Provisional Government" at Tientsin with an aged ex-viceroy, Hsu Shih-chang, as titular head. At the same time they warned Li Yuan-hung that if he desired to remain president he must dissolve Parliament. To enforce their demands they proceeded to mass troops in the vicinity of the capital. Li Yuan-hung now summoned to his aid as "mediator" Chang Hsun, a famous swashbuckler chieftain. Chang promptly came north with a "bodyguard" of several thousand troops, but the value of his mediation was discounted by the announcement that he would insist upon the dismissal of Parliament. On June 12 Li Yuan-hung yielded, and Parliament was dissolved by presidential mandate.

Personal Feuds.—The question of joining with the Allies against Germany was now by common consent relegated to the background, and all attention concentrated on the struggle of

[1] A statement made by Count Okuma, the Japanese Premier, early in the Tsingtao campaign, ran as follows: "I now state to the American people and to the world that Japan has no ulterior motive, no desire to secure more territory, no thought of depriving China or other peoples of anything which they now possess."

[2] For the text of these understandings see H. W. V. Temperley, *History of the Peace Conference*, Vol. vi. p. 63.

personal ambitions at Peking. Tuan Chi-jui, with his tuchun supporters, was still in watchful waiting at Tientsin. Many members of the Kuo Min Tang had fled to Shanghai and Canton and were preparing to take the field against Peking. The vice-president, Feng Kuo-chang, announced that the region in which he was in control, the lower Yangtze Kiang Valley, would remain "neutral." The danger of internal dissensions on a wide scale was unmistakably more serious than at any time since the overthrow of the Manchus. In June the United States addressed a note to the Chinese Government deploring the prospect of civil war, and intimating that the restoration of national unity was a matter of more immediate importance to China than the declaration of war against the Central Powers. This advice aroused resentment in Japan, and was proclaimed by the Kuo Min Tang as an intimation that the United States was opposed to the policy of Tuan Chi-jui. Chang Hsun soon showed that he had no intention of attempting to bring about a reconciliation between president and premier. His policy became fully revealed by a *coup-de-main* (July 1) which withdrew the young Emperor from his retirement and proclaimed the restoration of the Dragon Throne. Tuan Chi-jui and the northern military chiefs were not, however, disposed to see Chang Hsun thus easily assume a dominating position, and while they had no especial enthusiasm for the republic their personal ambitions left them no other recourse but to denounce the change and to take active measures against it. Tuan, therefore, led his army to the capital to defend the republic. After a few days of desultory and half-hearted fighting, Chang Hsun capitulated (July 12) and the young Emperor was consigned once more to the tranquil dignity of his court without a kingdom. Tuan Chi-jui now resumed the premiership, and with enhanced prestige and power. The position of Li Yuan-hung as president had, however, become impossible, and from the Japanese legation, whither he had fled for safety upon the proclamation of the monarchy, he announced his intention of retiring into private life. He was succeeded by the vice-president, Feng Kuo-chang, who declared his readiness to endorse the policy of the premier. The declaration of war was formally issued on Aug. 14.

The Kuo Min Tang members of the former Parliament continued to denounce the Peking Govt. as illegal, and, under the leadership of Sun Yat-sen, in Sept. organised a provisional Goverment which they declared to be the only constitutional one in China. Not to be outdone by Peking, moreover, this government issued a separate declaration of war against the Central Powers. Almost before the new president had assumed office at the capital, his adherents were in conflict with the premier concerning the policy to be adopted in dealing with the south, Tuan Chi-jui being for strong measures, and Feng Kuo-chang for conciliation. As the result of these differences, Tuan Chi-jui once more resigned; but again his friends intervened and proclaimed their intention of carrying on the war against the south, with or without the consent of the Government, and Chang Tso-lin, the tuchun autocrat of Manchuria, moved a body of troops into Chihli. Tuan Chi-jui thereupon resumed the premiership and took the offensive against the southern provinces.

Having "vindicated the Republic," it was necessary for Tuan Chi-jui to maintain the appearance of constitutionalism. He therefore convened an assembly, which proceeded to revise the law for parliamentary elections. This having been duly promulgated (Feb. 17 1918), a new parliament was chosen in time to deal with the quinquennial election of the president. On Sept. 4 the presidential election took place, but the matter had been decided in advance by the tuchuns assembled in conference at Tientsin. Feng Kuo-chang was passed over, because he could not work with Tuan Chi-jui, and Hsu Shih-chang was elected.

China's Part in the War.—China's internal discord and financial straits were such that she could take no active part in the World War. She permitted, it is true, the recruiting of labour battalions for service behind the lines in France, Mesopotamia and Africa, and about 175,000 Chinese served in this way; but the Government's part was passive, for the initiative was taken and the transportation and organisation were conducted by the Allies. China seized, too, the German and Austrian vessels interned in her ports, and chartered at least some of them in the service of the Allies. She obtained, moreover, relief from the payment of instalments on the Boxer indemnities, for she cancelled the unpaid portions due to Germany and Austria and was permitted to suspend for the time the sums due to the Allies. There was some promise made of her helping in the maintenance of order in the north against disintegrating Russia, and in May 1918 Japan and China entered into an agreement for defence against disorder and possible invasion from that direction.

A "War Participation Board" with a Japanese adviser and an "Arms Contract" of Jan. 1918 still further betokened the increase of Japanese influence at Peking. The augmented revenues were squandered, largely by selfish militarists. The United States had seemed to the Chinese their strongest foreign support against the encroachments of Japan, and now (Nov. 2 1917) Washington, partly to insure friendliness with Japan while the two were in the War, entered with Tōkyō into what is known as the Lansing-Ishii Agreement, which, while reaffirming the open door into and the territorial integrity of China, carried the recognition by the United States that Japan had "special interests" in China and seemed to surrender the Asiatic republic to the will of her island neighbour. Moreover, the group around Tuan Chi-jui, the "Anfu" clique, were concluding agreements with Japan for the construction of railways in Shantung, Manchuria and Mongolia (Sept. 1918) and were borrowing extensively from the Japanese on the security—not all of it very reliable—of railways, mines, forests, telegraphs, taxes and bonds.

The Peace Conference.—When the War at last came to an end, China—thanks to her participation in the conflict—was allowed representation at the Peace Conference. The delegation was ably led, and presented a strong plea for the restitution to China of the former German properties in Shantung. It also asked for the cancellation of spheres of influence within China's borders, for the withdrawal of foreign troops, post offices and wireless and telegraphic communications, for the abolition of consular jurisdiction, the relinquishment of leased territories, the restoration of foreign concessions and settlements and for tariff autonomy. In all of these requests, however, China was doomed to disappointment. The American delegation favoured the restoration of the Shantung properties, but against it were the agreements of 1917 between Japan and the European Allies. The remaining questions were held not to come within the purview of the conference. By the Treaty of Versailles, therefore, Japan was confirmed in the possession of her holdings in Shantung. Her assurances that these would eventually be returned were not taken very seriously either by the Chinese or by the rest of the world. The hopes of the younger educated Chinese had been raised by the war speeches of President Wilson, and this seemingly utter failure of their cause at Paris both disillusioned and angered them. Their indignation was so great and so forcibly expressed that the pro-Japanese Peking Govt. could not but instruct the Paris delegation to refuse to sign the treaty with Germany, and two members of the Cabinet who had been most prominent in the loan negotiations with Japan were forced to resign. In 1919 there followed a very effective nation-wide boycott against Japanese goods.

China was not, however, to emerge from the war period without some gains. She obtained membership in the League of Nations by signing the treaty with Austria, for that document did not contain the objectionable Shantung clauses. In her separate treaty with Berlin, the German share of the Boxer indemnity and German participation in extra-territoriality were cancelled, and her treaties with the new states that arose in Europe out of the War did not concede extra-territorial privileges. In 1920 the payments to Russia of instalments on the Boxer indemnity ceased, and Russian extra-territorial privileges fell into abeyance. Moreover, in 1920 there came into existence, largely through the efforts of Americans, a new financial consortium whose purpose it was to assume international control of all further foreign loans to China, and so to avoid the granting of special privileges to individual nations.

Washington Conference.—The Treaty of Versailles was followed in 1921 and 1922 by the Washington conference (*q.v.*). Not all the agreements and treaties which arose out of the conference affected China, but the Chinese question loomed larger than any other except possibly that of disarmament. The main actions, in so far as they concerned China, were as follows:—

1. One treaty between Japan, the United States, the British Empire, France and Italy, limited naval armaments and forbade the construction of new fortifications and naval bases on most of the island possessions of the first three Powers. One of the effects of this treaty was to confirm Japan in the naval domination of the north-eastern coast of Asia. No Power could now hope to penetrate by force through her curtain of islands to the coast of China.

2. Peace in the Pacific was further assured by the "Four Power Treaty" between Great Britain, France, the United States and Japan, which pledged the signatories for a term of years to respect each other's insular possessions in the Pacific and to confer on any controversy which arose concerning these and which could not be settled through the ordinary channels of diplomacy.

3. A "Nine Power Treaty" signed by all those represented at the conference, was an agreement to respect the sovereignty, independence and territorial and administrative integrity of China, to give China opportunity to develop a stable government, to maintain the principle of equal opportunity in China for the commerce and industry of all nations and to refrain from taking advantage of conditions in China to seek special privileges that would abridge the rights of subjects or citizens of friendly states.

4. The nine powers signed a treaty whereby the customs schedule of duties was within four months to be raised to an effective 5% and provision was made for the convening of a special tariff conference and for the periodical readjustment of the customs tariff, first at the end of four years and thereafter at the end of every seven years.

5. By a resolution a board of reference was to be established in China to which questions connected with the enforcement of the "open door" and equal railway rates could be referred.

6. A resolution expressed the sympathy of the powers with China's desire to see removed "immediately or as soon as circumstances will permit existing limitations upon China's political, jurisdictional and administrative freedom," and provided for the early establishment of a commission to inquire into the practice of extra-territoriality in China and the progress in judicial reforms.

7. On Jan. 1 1923 foreign postal agencies in China were to be abolished.

8. The powers declared their intention to withdraw their armed forces from China as soon as China "shall assure the protection of the lives and property of foreigners," and resolved that as soon as China should request it they would appoint representatives to see whether these conditions had been fulfilled.

9. There were resolutions concerning radios in China.

10. There were resolutions concerning the unification of the railways of China, the employment of foreign technical experts for these railways and the Chinese Eastern Railway.

11. The conference expressed the earnest hope that immediate and effective steps would be taken by China to reduce her military forces and expenditures.

12. There was provision for machinery by which the powers were to be notified of all treaties, conventions and agreements with or concerning China.

So far as formal declarations could do so, then, the Powers agreed to respect China's independence, to seek no special privileges, and to look with favour upon the aspirations of Young China to achieve freedom from foreign control.

The Washington conference also afforded Japan and China an opportunity to come to an understanding over the thorny Shantung question. Following the signing of the Treaty of Versailles, Japan had made attempts to adjust the dispute, but always on conditions which had been repulsed by the Chinese. Now, however, Japan adopted a much more conciliatory attitude, and an agreement was reached whereby the former German holdings in Shantung were to be returned to China. There were conditions attached into which there is no space here to enter fully. It is well to note, however, that the Japanese still retained a share in some mines in the province and large commercial interests and land-holdings in Tsingtao, that China borrowed from Japanese on the security of the railways the sum needed for the redemption of the roads and that during the continuation of the loan the roads were to have a Japanese traffic manager. The Lansing-Ishii Agreement which had never been satisfactory either to America or to China, was terminated (March 30 1923).

The better relations established between Japan and China at the Washington conference were to continue until after the close of 1924, but not always without difficulty. China still recalled the humiliation of the Twenty-one Demands, and in the spring of 1923, as there approached the termination of the 25 years for which the lease on Dairen (Dalny) and Port Arthur was originally made, Peking requested that the Sino-Japanese agreements of 1915 be abrogated. Tōkyō, of course, refused, but a formal protest which might later be useful had been lodged against the extension of the lease to 99 years.

China After the World War

Post-War Policy of Powers.—Following the World War the Powers were disposed to act somewhat less aggressively in China than they had in the preceding half-century or more. This change in attitude had been shown at the Washington conference, and further evidence of it was to appear as the years passed. In May 1924 the Congress of the United States authorised the remission of the unpaid portion of the Boxer indemnity and plans were developed for using it to promote education in China. Russia, by an agreement dated May 31 1924, assigned her portion for educational purposes. Great Britain, France and Japan also allocated their portions partly to philanthropic enterprises and education in China, the arrangement being completed in June 1926. The danger was that the sums so released would be used to promote educational propaganda in favour of the respective powers; in other words, that there would appear in China educational "spheres of influence." This danger was particularly marked in the case of Russia, who, under the Soviets, seemed intent on using the indemnity once due to her—larger than that exacted by any other power—for the inoculation of Chinese youths with Bolshevist principles.

At the close of 1924, indeed, one of the outstanding features of China's relations with other powers was the growing influence of Soviet Russia. The Soviet Republic had (1919 and 1920) assumed the attitude that China was the prey of capitalistic states, and that she could look for different treatment from the new *régime* in Russia. By agreements and declarations signed May 31 1924 the Soviet Govt. seemed to adopt a most conciliatory policy, remitting the unpaid portion of the Boxer indemnity, relinquishing extra-territorial consular jurisdiction, and recognising Outer Mongolia as an "integral part of the republic of China," and providing for the ownership and administration of the Chinese Eastern Railway (*q. v.*). This policy led to a growing admiration for Russia on the part of many of the Chinese, but others were not without a suspicion that the seeming change of front was only another form of the time-honoured Russian policy of penetrating China under the guise of friendship.

Faction Fights.—At the close of the World War, it will be recalled, Hsu Shih-chang was in the presidential chair and Tuan Chi-jui, the Premier, was in control. There was a separate Government at Canton, maintained largely by members of the Kuo Min Tang, under the leadership of Sun Yat-sen, Tang Shao-yi, and Wu T'ing-fang. For a time most of the provinces in the south and southwest were in sympathy with Canton, and the alignment seemed to be between the north and the south. Then dissensions broke out in the south. A Kwangsi faction ousted Sun Yat-sen and his associates from Canton. These latter were offered support by T'ang Chi-yao, tuchun in Yunnan, but he was discomfited, and it was under the aegis of Ch'en Ch'iung-ming, who drove out the Kwangsi faction, that Sun Yat-sen and his group returned once more to Canton. Here, in April 1921, Sun Yat-sen began another chapter in his varied career by being elected "President of the Chinese Republic" by such members (about one-fourth) of the Parliament of 1913 as could be got together. His government professed to be the only constitutional one in the country, and he proceeded to organise an expedition to seize control in the Yangtze Kiang Valley and the north. In 1922, however, he fell out with Ch'en Ch'iung-ming and for a time was an exile from Canton. When, in 1923, he was able to return to that city he had support sufficient only to maintain a precarious foothold there and in a part of Kwangtung. Southern and southwestern China were a confusing medley of warring factions, and leaders and troops from Yunnan, Kwangsi, Hunan, Kiangsi and Kwangtung rapidly appeared and disappeared

on the stage. In 1923, Sun, in dire need of funds, made an attempt to seize the revenues of the Canton customs, but failed to do more than involve himself in controversy with the Powers.

Peking in the meantime was largely the victim of warring factions. The group in control, the Anfu clique, was arousing enmity. Especially did one of its members, the notorious Hsu Shu-tseng (" Little " Hsu, assassinated Dec. 1925) come in for criticism. In 1920 the rising powers in the north were Wu P'ei-fu, a scholarly and able commander, his titular superior, the tuchun of Chihli, Ts'ao Kun and Chang Tso-lin, the master of wealthy Manchuria. These three came into collision with Tuan Chi-jui, and in the summer of 1920 drove Tuan and the Anfu leaders out of power. Hsu Shih-chang was for the time being left in the presidential chair, and rapidly changing ministries tried to carry on the nearly bankrupt government. In 1921 friction arose between Chang Tso-lin and Wu P'ei-fu which in the spring of 1922 led to war. Wu P'ei-fu defeated Chang Tso-lin and drove him back into Manchuria. Wu thereupon took steps which he hoped would reunify the country. Hsu Shih-chang resigned the presidency and fled to Tientsin. Li Yuan-hung, who since his retirement in 1917 had been living in a foreign concession in Tientsin, once more assumed the presidency, and the Parliament of 1913 (dismissed by Yüan in 1913, reassembled after his death and dissolved by Li in 1917), which seemed to be the last elected body on which the whole country had been united, was recalled to Peking. The hopes of a unified China thus aroused proved disappointingly fleeting. Funds for the government were insufficient. Parliament proved venal, cabinets were unstable, and in June 1923 President Li Yuan-hung again fled from the capital. In Oct. 1923 Parliament, probably as the result of heavy bribes, elected to the presidency Ts'ao Kun. In the same month there was promulgated a " permanent " constitution on which Parliament had long been working, and which had been rushed to completion to synchronise with the accession of Ts'ao Kun to the presidency.

The Christian General.—During the remainder of 1923 and the first eight months of 1924 no new major incident occurred in internal politics. Early in Sept. 1924, however, there broke out a fresh civil war which was to lead to a new government at Peking. Lu Yung-hsiang, the tuchun of Chekiang and a member of the Anfu group, and Marshal Chi Hsieh-yuan, one of the supporters of Wu P'ei-fu and in power in Kiangsu, fell to fighting. The struggle shortly involved the major military figures. Chang Tso-lin, eager for an opportunity to retrieve his defeat of 1922, espoused the cause of Lu Yung-hsiang, and Sun Yat-sen also announced his determination to support him. Wu P'ei-fu could not but come to the help of Chi. Then, in Oct. 1924, came a surprising development. General Feng Yu-hsiang, one of Wu P'ei-fu's major subordinates and in control of the forces in Peking, abandoned Wu, deposed Ts'ao Kun, and ousted the Manchu ex-emperor from his palace. Feng Yu-hsiang, for several years past one of the rapidly rising men in China, had been brought up in the military life. He had become a Protestant Christian, and his new faith led him to make his army exceptional for its iron discipline and for the absence of the vices usually attendant upon camp life. A large proportion of Feng's troops professed the Christian faith. Feng's defection from Wu led to the withdrawal of the latter to the central Yangtze region. Chang and Feng now conferred at Tientsin with Tuan Chi-jui, who had helped to bring about the new alignment of forces, and late in Nov. 1924 Tuan assumed the office of chief executive (not president) of the republic and announced a provisional government. Sun Yat-sen came north at the close of the year to have a part in the new *régime.* At the end of 1924, then, Sun Yat-sen, Feng Yu-hsiang, Chang Tso-lin and Tuan Chi-jui were co-operating—with more or less friction—and Wu P'ei-fu was in the Yangtze Kiang Valley, where he was still strong.

Civil War and Strikes.—The hopes entertained that 1925, which was to witness the opening of the tariff conference, would put an end to the civil wars, were not realised; on the contrary, the possibility of an increase of duties being sanctioned by the Powers meant more money for the Government of Peking, and therefore an additional temptation to war-lords anxious to increase their authority and replenish their waning resources. The year opened with better prospects for Marshal Tuan Chi-jui, the " chief executive of the Republic of China," who summoned to Peking on Feb. 1 a " Reorganisation Conference " for the purpose of securing some working arrangement between the central government and the tuchuns—a project impossible to realise in the distracted state of the country. In connection with this conference Sun Yat-sen as head of the Kuo Min Tang and president of the southern Republican party travelled to Peking, but was seized with illness and died at Peking on March 12.

To the middle of Oct. despite the continued rivalry of Chang Tso-lin and Feng Yu-hsiang, there was comparative quiet, but the uneasy peace was broken when the difficult position of Chang Tso-lin with his long communications and his heavy responsibilities in Manchuria began to be realised. The first blow came from Sun Chuan-fang, the energetic tuchun of Chekiang, who had driven out Lu Yung-hsiang in Oct. 1924. He invaded Kiangsu and after having driven Chang's forces as far as Hsüchow on the Pukow railway, consolidated his position in the five provinces of Chekiang, Kiangsu, Kiangsi, Anhwei and Fukien. It was then expected that Feng would make a move, but possibly owing to fears of the renewed activity of Wu P'ei-fu, the Christian general came to an understanding with Chang Tso-lin.

The truce was short for an attack on Fengtien troops retreating in Chihli was generally accepted as the beginning of another long struggle between the two war-lords. But a dramatic revolt on the part of Kuo Sung-ling, commander of a Fengtien army, compelled Chang Tso-lin to retreat suddenly to Manchuria and to Tientsin, while another blow came from a declaration of independence on the part of Li Ching-lin (tuchun of Chihli and Chang's own nominee). Feng was now master of the situation. Kuo advanced 100 m. into Manchuria, and Feng prepared to advance on Tientsin. He, however, found himself confronted by a serious obstacle in Li Ching-lin, and it was only after desperate fighting and after the successful retreat of Li Ching-lin towards Shantung that he reached his objective. Chang's fortunes now began to revive, and were greatly strengthened by an overwhelming and mysterious victory over Kuo on Dec. 24.

As a result of these fluctuating struggles, Chang was able once again to threaten an advance on Peking and Tientsin. Wu P'ei-fu resumed activity by advancing slowly into Honan, and Feng took refuge in Mongolia, declaring in reply to the requests of his hard-pressed generals for his return that he was finished with warfare. Early in 1926 Wu P'ei-fu and Chang Tso-lin joined forces and in the late winter and early spring drove the Kuo Min Chun (Feng Yu-Lsiang's army) out of Peking. The Peking government was now left without a head, for both Ts'ao Kun, the former president, and Tuan Chi-jui, the chief executive, disappeared for the time from official scenes. The able W. W. Yen was in June 1926 trying to gather a cabinet and to hold together some semblance of a national government. In the meantime (May 1926) Sun Chuan-fang declared the independence of the province in the Yangtze basin. The early summer of 1926 found the chief figures on the political landscape Chang Tso-lin in Manchuria and the Northeast, the Kuo Min Chun in the Northwest, Wu P'ei-fu in the central north and the heart of the Yangtze Valley, Sun Chuang-fang in the lower part of the Yangke Valley, and the Canton government in the South. Large portions of China, especially in the West, South and Southwest were not under the control of any of these major forces.

In addition to the vicissitudes of civil war, China was distracted in 1925 by a recurrence of anti-foreign demonstrations " such as have not existed since the Boxer Rebellion " to quote Mr. Kellogg, the American Secretary of State. In Shanghai particularly a strike in a group of Japanese-owned cotton mills led to demonstrations and disturbances which, aggravated and brought to a head by the shooting down of some students on May 30 1925 by the foreign police in Shanghai and then taking an anti-British and anti-Japanese direction, caused serious trouble to the trade and shipping of these two countries. This anti-foreign movement was fanned by the Bolsheviks, by the Red

Government of Canton, and by Feng, who published a series of manifestos against what he called "foreign imperialism." There was a widespread movement through the nation, partly led by students, which demanded the abolition of the "unequal treaties," and which was directed especially toward the cancellation of extraterritoriality and the recovery of full customs autonomy. Towards the end of the year, there were signs that the anti-British movement was losing much of its force, but in Canton and adjoining sections it persisted, and it produced a most serious situation in Hong-Kong.

Despite these struggles, the tariff conference, in accordance with the terms of the Washington treaties, opened at Peking on Oct. 26 1925 but soon met with difficulties owing to the inability of Chinese delegates to give any adequate guarantees for the abolition of that irregular taxation (likin) which has caused such damage to trade in China. An agreement was reached for the restoration of full customs autonomy and the cancellation of likin, but delays were caused by discussion of ad interim duties, and with the increasing disorder in Peking due to the civil war, the conference practically came to an end in June 1926. The extraterritoriality commission, also arranged by the Washington treaties, began its sittings early in 1926.

II. ADMINISTRATIVE AND SOCIAL CONDITIONS

Government and Administration.—The revolution of 1911 brought with it a greater change than had occurred since the Han dynasties (206 B.C.–214 A.D.). The institution of emperor, which had its origin in prehistoric times, was abolished, and with it much of the political theory of the Confucian school on which the state had so long depended. In the struggle to find a substitute, ambitious military and political leaders, old ideas and standards and new political concepts from the Occident were inextricably mixed. It is no wonder that chaos resulted. Of paper constitutions there were a number, chief among them being the provisional one of 1912, which, much as in France, made the cabinet responsible to parliament and left the president largely a figurehead; the various attempts under Yüan Shih-k'ai; and the "permanent" constitution of 1924, with a division of powers between the central and provincial governments, a bicameral parliament, a president elected and partly controlled by parliament, and a premier responsible to the lower house. These constitutions were more honoured in the breach than in the observance, however, and were important chiefly as tentative and interesting experiments. In practice there was a president with a good deal of power, a premier and a cabinet constituted by the faction or factions in control in Peking, usually with scant regard to parliament, and during much of the time some kind of parliament. Political parties in the European and American sense of the term were largely unknown. The Kuo Min Tang, led by Sun Yat-sen and representing the radical elements that brought about the revolution, was probably the nearest approach to a party as that term is understood in the Occident.

The provincial and local administrations did not change as greatly as did the central Government. The old 21 provinces were maintained and a new one, Sinkiang, was added. New administrative areas were from time to time created, usually in the dependencies. At the head of each province there were in theory a military governor (tuchun) and a civil governor, with powers divided between the two, but in practice there was often no civil governor and the tuchun was usually supreme. There were, too, usually major divisions of the province, taos, with a *tao yin* over each. As in imperial days, the chief local administrative unit was the county, or *hsien*, and over each *hsien* was a magistrate with judicial, tax-collecting and policing powers and duties. The method of choosing or appointing officials has, in practice, varied greatly. Here and there were developments toward a different type of city government. Modern police forces of varying degrees of efficiency appeared in many cities.

Civil Service.—The political unrest and disorganisation is to some extent ascribable to the suddenness with which the ancient system of classical examinations for the public service was abolished (1906), and to the subsequent failure to develop a scheme which ensures the continuity of the competitive principle. Under both the empire and the republic there were various attempts to construct a new system of examinations, but none of these had the prestige or the success of the old plan. Nevertheless, the holding of office remained the chief highroad to wealth and distinction in China, and the number of aspirants to position under the government continued very large.

Justice.—Even before the Republic, beginnings had been made toward the compilation of new codes of law, partly on Western and Japanese models, but with the old code partly in theory and largely in practice remaining the law of the land. The chief new codes are the Provisional Criminal Code promulgated in 1912 and amended in 1914, the Penal Procedure Code, 1921, and the Civil Procedure Code, 1921. The Criminal Code seems to be the only one of these that is widely in operation. There has been sitting uninterruptedly since 1914 a Law Codification Commission, with able leadership and foreign advisers. A system of courts is planned in three grades, one in each department (*fu*), a higher one in each province, and a supreme court at Peking. These courts are to have officials with purely judicial powers. For the most part, the new courts have not been organised and justice is still locally administered by the *hsien* official. Military courts, too, have widely usurped the functions of the regular courts. Here and there, however, the new courts have appeared. There were, too, a good many modern prisons, the first one having been organised in Peking in 1912.

Defence.—As the result of the political disorganisation the Chinese Army, as a national defence organisation, practically ceased to exist, but the troops actually serving under one or other of the tuchuns are probably more numerous to-day than at any period of the Manchus' rule. The equipment and discipline of the troops have varied greatly, some armies being fairly well organised, as, for example, that of Feng Yu-hsiang, and others being little if any better than bandits. The transition from bandit to soldier has often been easy. No one knows the exact number in the various armies, but it is probably about a million.

Education.—Fully as significant and important as the political changes, and perhaps more so, has been the revolution in the realm of the intellect. This has been due primarily to contact with the Occident, a contact which has come through a variety of channels. Chief among these channels have been the extensive educational system conducted by missionaries, the migration—unprecedented for size in the history of the world—of thousands of students to foreign countries, the translation of a great many Western works, the writing of many books containing Western science and thought, and a new educational system built up by the Government and private individuals.

Probably the first of these chronologically has been the alteration in the educational system. When, in 1906, the ancient civil service examinations were abolished, the incentive for maintaining the older strictly classical type of education largely passed away. The new type of school which became popular usually taught some of the Chinese classics, but introduced so many "Western" subjects that the former were relatively neglected. The older classical scholarship was held in high respect and was in part perpetuated, but for a time it seemed in a fair way of becoming extinct. The new schools were conducted by various agencies—Christian missions (Protestant American ones leading), by Chinese in their capacity of private citizens and by the Government. In some fields of education missionaries led in efficiency, but as time went on the Government schools came to be more and more important. The educational institutions were of many kinds, primary, secondary and higher, with technical and professional schools. During the latter part of the period the most influential government institution was probably the National University of Peking, but there were others which attained prominence, notably the Southeastern University at Nanking, Pei Yang University in Tientsin, Nanyang University —largely for engineering—in Shanghai and Tsing Hua College at Peking for the preparation of students for the Boxer Indemnity scholarships in the United States.

Probably the most noted foreign-controlled institutions of

higher rank were the splendidly equipped Peking Union Medical College, maintained by Rockefeller money and setting a high professional standard for the new medical profession of China, Canton Christian College, St. John's University, the University of Nanking, Yenching (Peking) University, Shantung Christian University and West China Union University. The Chinese have had a traditional respect for education, and in their perplexity over the existing disorder, with almost pathetic enthusiasm and trust, thoughtful and patriotic citizens have turned to education as the door out of the nation's difficulties. In 1922–3 there were said to be in all grades and types of schools 6,819,486 students, of whom 6,601,802 were in elementary schools, 182,804 in secondary schools, and 34,880 in colleges and universities. Only a small minority of these students were in foreign schools. Although education had improved greatly under the Republic, both in quantity and in quality, it was badly handicapped both by a lack of experience in the new educational methods and by a paucity of funds. Given a Government with revenues already insufficient for its needs, and constantly drained by great armies, teachers were often unpaid and important forward steps could not be taken. Since the great masses of the nation have remained illiterate, there have been various projects for their education. One of the most recent has been a plan begun after the World War by Y. C. James Yen for teaching illiterates to read the most frequently used characters.

One of the outstanding features of the new educational system was the part that students took in school and national affairs. They often controlled the institutions in which they studied, and when dissatisfied went on strike. Student strikes, indeed, formed one of the fairly constant features of this period. Students were enthusiastically interested in politics, and from time to time organised for action on a national scale. Thus the anti-Japanese boycott of 1919 was in large part their work. They took an active share in the Shanghai disturbances in 1925, and in the same year showed strong Bolshevik tendencies in Peking. Since the number of university students was relatively small, the larger proportion of the members of the student unions were still not out of secondary school, although they were often directed by older men. Youthfulness combined with other conditions to make the students often turbulent and lacking in poise and judgment, but they were ardent in their patriotism and were resentful of any infringement on China's dignity or sovereignty.

Religion.—Changes in the field of religion between the beginning of 1910 and the close of 1924 were less marked than in some other phases of Chinese life, but they were by no means absent. The monarchy could not be destroyed without serious damage to the dominant religious-political system (known to Westerners as Confucianism) which was bound up with it. The imperial sacrifices to Heaven and to other divinities that for centuries had been a part of the nation's life were discontinued, to be renewed in part and for a brief term by Yüan Shih-k'ai and then again allowed to fall into abeyance. After the revolution Confucius himself was partially discredited in radical circles. The Confucian temples that were so prominent a feature of the cities tended to fall into disrepair. They and the ceremonies in them, however, were usually not abandoned, but were frequently maintained, often by Confucian associations made up of scholars, gentry and officials. Ceremonies in the schools in honour of Confucius tended to fall off, but were usually not entirely given up. A system that had so long moulded the life and thought of China was not to disappear either quickly or easily. The time-honoured local ceremonies to the gods recognised by the older official religion largely continued, the ancestral cult had apparently as strong a hold on the nation as ever, and the ethics of Confucius and his school remained on the whole the standards of conduct. Even in the first flush of the success of the Revolution, the power of old traditions was seen in the official announcement of the establishment of the republic before the Ming tombs at Nanking. There were various attempts to revive or reform Confucianism. Thus in Peking was founded a Confucian Association, and in the "model province," Shansi, Governor Yen established halls for the regular preaching of Confucian ethics and for meditation. All of these attempts, however, seemed singularly lacking in enthusiasm and vitality.

Buddhism fared somewhat differently in various places and times. In the early days of the revolution there seemed to be a reaction against it, but before the close of 1924 many temples were being repaired, many neophytes were being ordained in the monasteries, and especially in east central China there was a revival of interest with a new literature and the reissue of old books.

Taoism showed little if any new life, and the large Moslem groups for the most part continued their existence without either decay or much new interest. Quite a number of new cults appeared, most of them attempts to combine older faiths into one. Prominent among them were the Tao Yüan, the T'ung Shan Shih, the Tao T'ung I Hui and the Lu Shen Chen.

Probably the greatest religious change was in the growth of the Christian Church. Catholic missionaries had been in China continuously since the 16th century, and Protestants since 1807. Their communities had been increasing steadily for 100 years. After 1900, however, and especially for the first few years after 1911, the breakdown of resistance to Occidental civilisation and the popularity of things Western, together with a fresh influx of missionaries, had led to a rapid growth of the churches. In 1923 the number of Roman Catholic Christians was put at 2,208,800, an increase of 71% since 1910, of foreign priests at 1,481, of native priests at 1,071 and of bishops at 57. Protestant communicants in 1922 numbered 402,539, the total Protestant community was estimated at 795,075 and the total number of missionaries at 7,663. The number of Protestant communicants had increased 132% since 1910, and the Protestant community 167% in the same period. Although smaller, the Protestant groups were more noticeable than were the Catholic.

The Roman Catholics were touching the life of the nation through churches, schools and orphanages, and the Protestants through churches, schools, especially secondary and higher schools, hospitals, Young Men's and Young Women's Christian Associations and many kinds of philanthropic endeavour. A number of Protestant Christians were prominent in national affairs. This rapid growth of the Christian Church aroused the antagonism of some of the student class, and in the spring of 1922 there began a violent anti-Christian movement which protested against Christianity partly on the ground that it was superstitious and unscientific and partly on the ground that it was an agent of Western imperialism. In 1924 the movement revived, and in addition to its earlier criticisms protested vigorously against Christian educational institutions. It looked as though the Christian Church were for some time to come to have a less rapid growth. Within Protestant communions there was, too, an increasing demand for independence from the control of foreign missionaries and an impatience with what were deemed Western interpretations of Christianity.

Social Customs and Institutions.—Social customs and institutions could not escape the change taking place in other features of Chinese life. Many of the older elaborate forms of courtesy were abandoned by the younger generation. At the time of the revolution there was extensive cutting of queues, for this form of headdress was associated with subjection to the Manchus. For a time many Chinese affected foreign dress, but with the nationalistic reaction following the World War there was a tendency to return to native costume. Women often claimed and were given greater privileges. During the early years of the republic, for example, woman's suffrage was here and there granted. As the years passed, coeducation was introduced in many of the schools, including the higher schools, and in student circles the sexes, long so carefully segregated, mixed with much freedom. All this was, of course, a radical departure from the past, and in some cases led to moral shipwreck. The fundamental institution of Chinese society, however, the family, for the most part remained unshaken. Here and there it was threatened by the new customs, by life in the big cities and by the gathering of workers into the new factory communities, but for the most part it was unaltered.

III. FINANCIAL AND ECONOMIC HISTORY

The economic side of Chinese life was affected, on the whole, by three agencies: continued contact with the commerce and industry of the West, the World War and internal disorder. These agencies were helping to bring about the following changes: (1) a progressive disintegration of government finances in spite of attempts at budgets and the foreign supervision of some of the main sources of revenue; (2) an increase of the public debt, both foreign and domestic; (3) the continuation of chaos in the currency; (4) the growth of a Western type of Chinese bank; (5) the growth of chambers of commerce; (6) the beginnings of the industrial revolution, including the rise of modern factories; (7) a general increase of prices; (8) an irregular increase in foreign commerce; (9) the stability of agriculture, but certain modifications in it, especially the renewed cultivation of the poppy for opium; (10) a continuation of famines in various sections of the country; (11) the beginnings of modern forestry; (12) a slowing down of the development of mining; (13) a decline in railway building and the deterioration of many of the lines already constructed, but a growth in modern roads; and (14) a rapid increase in the telegraph and postal service. These will be briefly considered in the order given.

Finances.—The partial breakdown of the machinery of the central government at the time of the revolution led to trouble with finances. Order was in part restored by Yüan Shih-k'ai, but after his death much of the revenue that would ordinarily have gone to the central government was absorbed by the military leaders. The chieftains in more or less temporary control of a district or province often collected the land tax for several years in advance and transmitted little or none of it to Peking. Official peculation probably increased rather than declined. In the face of this disorganised revenue, the government needed increased sums, not only to maintain the immense and profitless armies of the tuchuns, but to meet such new expenses as those for education. The difference had to be met by loans. There were professed attempts at budgets, but these were not an accurate picture of the situation and had very little effect. The budget of the eighth year of the Republic for July 1919 to June 1920 was as follows:—

Revenue

I. Ordinary		II. Extraordinary	
1. Land tax	$86,845,388	1. Land tax	$3,703,399
2. Customs revenue	93,268,907	2. Customs revenue	695,749
3. Salt revenue	98,815,071	3. Tax on commodities	26,685
4. Tax on commodities including likin	39,224,837	4. Regular and miscellaneous duties	3,911,410
5. Regular and miscellaneous taxes	29,182,693	5. Income from government investment	31,522
6. Regular and miscellaneous duties	4,332,541	6. Miscellaneous income of provinces	293,037
7. Income from government investment	2,411,368	7. Income of central administration	3,519,838
8. Miscellaneous income of provinces	5,579,263	8. Income directly received by central government	17,451,910
9. Income of central administration	3,105,869	9. Miscellaneous income of central government	
10. Income directly received from central government	47,072,064	10. Loans	50,948,235
	$409,838,001		$ 80,581,785
Total Revenue			490,419,786

Expenditure

I. Ordinary		II. Extraordinary	
1. Foreign affairs	$ 4,807,336	1. Foreign affairs	$ 1,168,555
2. Interior	43,279,539	2. Interior	4,891,183
3. Finance	39,154,446	3. Finance (including loan service)	136,112,435
4. War	129,588,829	4. War	78,243,653
5. Marine	9,194,482	5. Marine	185,024
6. Justice	10,323,124	6. Justice	6,852
7. Education	6,058,723	7. Education	461,912
8. Agriculture and commerce	3,257,050	8. Agriculture and commerce	442,357
9. Communications	1,865,586	9. Communication	163,508
10. Mongolian and Tibetan affairs	1,318,842	10. Mongolian and Tibetan affairs	50,000
11. Central administration	22,441,350	11. Central administration	2,748,192
	$271,289,207		$224,473,681
Total Expenditure			495,762,888

In 1923 a commission for the readjustment of finance, under the chairmanship of Dr. W. W. Yen, was appointed. In a preliminary report it said that the income of the central government actually was only $148,000,000, that of this $141,000,000 went for domestic and foreign loans and military subsidies, leaving $7,000,000 to meet expenses estimated at $128,000,000. A general report by the Commission, submitted to Marshal Tuan Chi-jui in Feb. 1925, outlined a series of financial reforms, including the consolidation of national indebtedness, the reapportionment of national and political revenues, the enforcement of economy in national expenditure and the encouragement of industrial development, but in its final recommendations it added: "The key to the solution of the present situation is to be found in the reduction of military forces. Unless military forces are greatly reduced, the provinces will not be in a position to reduce their expenditures. If the provinces cannot reduce their expenditures, they will not be able to remit the entire collections of national revenues to the Central Government. If the Central Government be denied complete control of such national revenues, it will scarcely have sufficient funds either to meet its loan obligations or pay all the administrative expenses. If that should be the case, then China will not be able to maintain her national prestige abroad, nor can she effectively carry out the work of consolidation at home."

Customs Revenue.—The revenues collected by the Maritime Customs for the years 1916–20 were as follows:—

	Hk. Taels		Hk. Taels
1916	37,764,311	1921	59,007,129
1917	38,189,429	1922	59,359,194
1918	36,345,045	1923	63,378,000
1919	46,009,160	1924	69,550,000
1920	49,819,885		

sterling equivalent of the 1924 collection at the average exchange of the Haikwan or Customs Tael of 3/7 $\frac{13}{16}$ being £12,732,000.

The maritime customs, under its foreign leadership, continued to function for the entire country, but most of its proceeds were pledged to meet sums due abroad.

By an agreement concluded between the Allied Powers and China in the autumn of 1918, the import tariff was revised and new duties fixed at specific rates, calculated to produce an effective 5% *ad valorem* levy. There was an additional revision in 1922 by a commission authorised by the Washington conference.

Salt Gabelle.—In Jan. 1913, during negotiations for a loan from the group banks, it was decided that all salt revenues were to be held as a special account. The following figures show the net revenue paid into the group banks:—

1914	$60,409,675.75[1]
1919	80,607,000
1921	77,988,000
1922	85,789,049.57
1924	70,544,475.86

the decline in 1924 being mainly due to transport difficulties owing to the civil war.

China's Indebtedness.—With the revenues in such a deplorable condition and the government so disorganised, recourse was constantly had to loans. Some of these were obtained abroad, and the creditor usually insisted on fairly good security. Large amounts, however, especially those owing to Japanese, were not considered to be good risks, and by 1922 the foreign legations found much of their occupation in trying to wrest instalments of interest and principal from an impecunious government. Large loans were, too, floated in China itself. Sometimes the "loan" was to a chieftain in control of some city, and was merely a euphemism for an illegal tax levy.

The best report of late years seems to be that of Dr. Lo Wen-kan, made at the end of 1922. It showed the total indebtedness at the end of Sept. 1922 to be $1,726,400,000 (or less than $5 per capita of the Chinese population), of which $208,400,000 were domestic loans with security, $249,000,000 were domestic loans without security, $1,029,000,000 were foreign loans with security, and $240,000,000 were foreign loans (including interest in arrears) without security. In addition, unpaid military and civil expenses amounted to $180,000,000. This total indebtedness was not large when compared with the total wealth of the country and the debts of other nations. Given, however, a government whose income was constantly exceeded by its expenses, further loans were hard to obtain even at large premiums and high rates of interest. It must be added, however, to make the picture complete, that some loans, even some of those owed in China, have been repaid in whole or in part during the past few years. Some of the security, moreover, is excellent, including especially the maritime customs and the salt gabelle, which are collected under foreign supervision. Since, however, the fairly reliable sources of income have been so largely used to secure loans, the revenue available for current government expenses has been further reduced and further loans necessitated. The end of 1925 saw little if any prospect of relief.

Currency.—In the commercial treaty concluded with Great Britain in 1902 China undertook to create a uniform national coinage. In 1908, the government considered that the best solution of the matter would be a standard "tael," and orders were issued to

[1] Administrative expenses amounted to $4,897,054, or 9·7% of the revenue, while during the year $31,304,818.22 was released to the Chinese Government.

the provincial authorities accordingly. In 1910 this plan was abandoned and a 72 candareen dollar was adopted as the standard national coin. In April 1911 an agreement was concluded between the ministry of finance and the four-power consortium for a loan of £10,000,000 of which £8,500,000 were to be used for the reform of the currency. Owing to the outbreak of the revolution, however, the loan was not floated. In 1912 the establishment of a gold standard was discussed, but in March 1914 the silver dollar was definitely adopted, and in 1914 and 1915 coins bearing the effigy of Yüan Shih-k'ai were minted at Tientsin in large numbers. There had already been a considerable production of "standard" dollars by the mints at Nanking and Wuchang. A memorandum by the minister of finance in 1918 put the total coinage of new dollars (of 89% fineness) between 1914 and 1918 at 184,000,000, against which 52,000,000 of old coins were withdrawn from circulation. The currency law promulgated in March 1914 was intended to secure a limited coinage of dollars and subsidiary decimal coins of fixed values. Regulations to this end were adopted by a currency commission advised by Dr. G. Vissering, President of "De Javasche Bank," but the government authorities themselves failed to observe them and the output of the mints continued to be regulated by the necessities and opportunities of the officials concerned. The copper coinage, in particular, rapidly deteriorated. In Aug. 1918 the minister of finance (Tsao Ju-lin) proposed the issue of gold currency notes and the establishment of a currency department under the direct control of the premier. The president endorsed the scheme by mandate, but the opposition was so strong that it was indefinitely postponed. With the increased number of dollars minted in China the number of foreign dollars, especially the Mexican, has declined. Many Mexican dollars have been melted down and the bullion either reminted or exported.

The chaotic condition of the metal currency has been aggravated by the fact that numerous native banks and provincial governments have issued large quantities of bank-notes, in taels and dollars, for the most part unsecured by bullion reserves and circulating at varying rates of discount. During the revolution, moreover, military notes were indiscriminately issued. The government has since redeemed part of them. Now and then there has been an attempt to put some of the provincial notes on a specie basis, the old issues being redeemed at a discount, but as a rule efforts at reform have been transient. Many foreign banks having branches in China also issue bank-notes and these circulate freely in the treaty ports.

The currency, then, is in greater chaos even than under the Manchus. Dollars accepted at par in one city circulate at a discount in another; subsidiary coinage passes at various rates of exchange, and neither the copper ten-cash pieces nor the cash pieces are uniform. Paper money of various degrees of security and lack of security and many different kinds of taels help to make the confusion worse confounded.

Banks.—There had been, of course, foreign banks in China for many years, and the number increased during the republic, especially by the addition of Japanese and American firms. These were for the most part stable institutions, and the failure of the (French) Banque Industrielle de Chine in 1921 made quite a sensation. There continued to appear an increasing number of Chinese banks organised on Western models, some of them with governmental participation such as the Bank of China (organised 1911) and the Bank of Communications (established 1908), but most of them are purely private concerns.

Manufactures.—One of the marked developments has been the rapid growth of factories. These are still largely confined to the treaty ports and to northeast China and the lower and central parts of the Yangtze Kiang Valley. By far the larger proportion of Chinese industry is, as it has been in the past, in the handicraft stage and organised by guilds. However, in such centres as Shanghai, the Wu-han cities (Hankow, Wuchang and Hanyang), and Tientsin modern factories are important and seem to presage a beginning of a great industrial revolution.

In his report on trade for 1919, the statistical secretary (Inspectorate General of Customs) observed that there were then few foreign type articles of domestic use that were not made in China by factories on modern lines, the majority of them without foreign assistance. In 1906 there were 14 cotton-spinning mills in China, with a total of 400,000 spindles; in the *China Year Book* for 1919, the number given is 56. The *China Year Book* for 1924 gives the number at about 200 and takes 62 pages to list the various factories—and the list is admittedly incomplete. The most numerous of those given are albumen factories, canneries and biscuit companies, cement and brick works, cotton mills, distilleries, breweries and aerated water factories, dockyards, shipbuilding and engineering works, electric light and power plants, flour mills, ice and cold storage plants, iron and steel works, leather tanneries and factories, match factories, oil mills and bean cake factories, printing and lithographing works, rice-hulling and cleaning mills, silk filatures, soap and candle factories and tobacco factories. The great majority of these are operated by Chinese capital, although a good many important ones are owned by foreigners. With the shortage of raw materials and the growth of labour troubles in Europe Chinese capitalists, and the rich merchants of the treaty ports came to realise after the War how great and lucrative are the opportunities awaiting the industrial development of China, with its vast resources of cheap labour and raw materials, in competition with the manufactures of the West. Japanese capitalists and captains of industry showed themselves equally alive to the possibilities of the situation. As a result, the development of industrial enterprises of many kinds, but especially in textiles, in the period immediately following upon the Armistice was limited only by the impossibility of obtaining the necessary machinery. There came in time the inevitable reaction, and since 1922 nearly all factories have been working only part time or with greatly reduced forces.

The gradual industrialisation of labour has complicated the situation, particularly in regard to the employment of children, concerning which the Child Labour Commission appointed by the Shanghai Municipal Council issued a valuable report in July 1924. The industrial changes have also led to an increase in the number and activities of labour unions, particularly in the south, in Central China and in Shanghai; but owing to their tendency to work in the dark it is impossible to obtain reliable statistics. The most powerful union is that of the seamen, which organised the great strike at Hongkong. Serious strikes were those of the Chinese workers on Shameen (the foreign concession of Canton), the silk workers' strike in Shanghai in the summer of 1924, and the strike in the Japanese cotton mills in Feb. 1925. The Bolshevik propaganda in China is more political than economic, and is more successful among the students than the workers. Labour too is mobile, and when a Chinese artisan is dissatisfied with life in the city he can always return to his native village.

Prices.—One of the features of the late years has been a rise in prices, with a consequent increase in the cost of living. This was probably inevitable. Prices in China compared with those in the rest of the world were formerly phenomenally low, and increasing commerce with the West has tended to force them upward, particularly during and since the World War. No accurate survey has ever been made of cost of living and wage statistics throughout the whole country, but the following figures may serve to indicate the general trend. In Shanghai the wholesale index number of commodity prices for April 1923 was 157·7 as compared with prices for Feb. 1913 and 118·4 as compared with prices during Sept. 1919. This does not include the cost of rent. The cost of living of a middle-class family in Peking is reported to have increased from $77.50 in 1912 to $116 in 1922, and the following is a table of food prices in Peking:—

	1902 cost	1912 cost	1915 cost	1919 cost
Ordinary cloth (1 foot)	5	70	120	140
Rice (per catty)	40	80	90	100
Flour (per catty)	35	50	70	80
Pork (per catty)	70	200	220	230
Beef (per catty)	60	180	200	200
Mutton (per catty)	60	180	190	190
Cabbage (per catty)	2	5	6	7
Anthracite coal (per ton)	$..	$3	$12	$13

These prices, of course, are in cities directly in contact with foreign commerce. The increase in prices has probably not been as rapid in the interior. Whether the increase in wages has kept pace with the increase in prices is uncertain. The general level for skilled and semi-skilled labour has risen more rapidly than that for unskilled.

Agriculture.—The principal industry of China is agriculture. Probably from 70 to 80% of the population are engaged in it, and 73% of the exports of China are agricultural products. Since the revolution it has been remarkably stable, the farming population being less influenced by the changes abroad in the nation than any other class. There have been some modifications in the crops raised, however, which may affect the welfare of the country. Such new economic factors as the widespread revival of opium-growing (forbidden by imperial edicts and actively suppressed between 1907 and 1911), and the extension of the cotton-growing area due to the successful development of the spinning industry, probably involve a reduction of the home-grown food supply. These changes, unless accompanied by an increase of national wealth sufficient to replace it by purchases from abroad, may expose the nation to increased danger of famine in bad years.

According to the report on trade published by the statistical secretary of the maritime customs in April 1920, the cultivation of the poppy had been regularly resumed on a wide scale in several provinces, notably Szechwan, Yunnan, Kweichow and Fukien. By 1924 Anhwei, Honan, Hunan, Kansu, Kiangsi and Shensi were also reported to be cultivating the poppy extensively. This was at least partly due to military commanders who found in opium a convenient source of revenue and insisted upon the cultivation of the poppy in districts under their control. In 1925, however, there was evidence of a decline in opium cultivation except in Fukien and part of Szechwan, Yunnan and Kweichow due probably to economic disturbances. Between 1913 and 1918 the area under cotton cultivation steadily increased, in response to the growing demand of the spinning and weaving industries in Japan and at Shanghai, Hankow, Tientsin and other industrial centres, the chief producing areas being Chihli and Kiangsu. By 1919 China was third on the list of cotton-producing countries. By the close of 1921, however, there was a marked decline in the production of cotton. One estimate placed the crop at 1,002,000,000 catties in 1918, 931,000,000 catties in 1919, 675,000,000 in

1920 and 543,000,000 in 1921. The decline seems to have been due to internal war, brigandage and floods. The year 1922 showed an improvement, as probably did 1923. Other recent features of the agricultural situation are the rapid extension of the bean-growing area in Manchuria and the development of wheat cultivation (combined with a steady increase of the flour-milling industry) in North China and the central Yangtze provinces.

Famines.—Throughout her long history China has periodically suffered from famines, and with the disorganisation of the government which followed the revolution these naturally did not cease. A year seldom passes without one or more sections of the country experiencing an extreme dearth of food. In 1911 there was a severe famine due to floods in the Hwai river basin, and there was a serious one in North China in 1917 following floods. The most extensive and severe famine of recent years was in 1920 and 1921 in Chihli, Shantung, Honan, Shansi and Shensi, and was due primarily to prolonged drought in 1920 following a poor crop in 1919 and floods in 1917–8. Out of a population of about 50,000,000 nearly 20,000,000 were said to be destitute. Relief on a large scale was undertaken by the government and foreign and Chinese private agencies. Much of the foreign aid, especially that of the American Red Cross, was given in return for work done by those relieved, especially in the building of roads which would help to prevent future famines.

Exports and Imports

The World War and the years immediately succeeding it brought from abroad a great demand for foodstuffs and raw materials, and Chinese exports increased rapidly. The totals of imports and exports for the years 1918–23 were as follows:—

Year	Net Imports[1] Hk. Taels	Exports Hk. Taels	Total Hk. Taels
1914	569,241,382	356,226,629	925,468,011
1915	454,475,719	418,861,164	873,336,883
1916	516,406,995	481,797,366	998,204,361
1917	549,518,774	462,931,630	1,012,450,404
1918	554,893,082	485,883,031	1,040,776,113
1919	646,997,681	630,809,411	1,277,807,092
1920	762,250,230	541,631,300	1,303,881,530
1921	906,122,439	601,255,537	1,507,377,976
1922	945,049,650	654,891,933	1,599,941,583
1923	923,402,887	752,917,416	1,676,320,303

[1] Net imports, *i.e.*, the value of the foreign goods imported direct from foreign countries, less the value of the foreign goods re-exported to foreign countries during the year.

The following statistics show the amount of China's direct trade with the foreign countries concerned and indicate some of the important changes due to the War:—

Table I.

Imports from	1913 Hk. Taels	1919 Hk. Taels	1922 Hk. Taels	1923 Hk. Taels
Great Britain	96,910,944	64,292,239	145,292,550	120,397,229
Germany	28,302,403	368	24,744,130	3,735,472
France	5,299,517	3,375,809	4,555,510	7,548,654
Japan	119,346,662	246,940,997	231,428,885	211,024,297
U.S.A.	35,427,198	110,236,706	169,004,534	154,447,651
Hongkong (for transhipment)	171,366,099	153,631,544	239,347,671	248,083,456
British India	..	26,980,705	43,139,628	55,240,982
Korea	..	9,431,450	9,685,698	..
Russia (overland trade)	12,258,180	1,724,603	7,111,932	10,202,819[1]
Russia (Amur and Pacific ports)	..	12,323,532	7,129,539	..

Table II.

Exports to	1913 Hk. Taels	1919 Hk. Taels	1922 Hk. Taels	1923 Hk. Taels
Great Britain	16,346,413	57,186,242	38,507,874	43,207,130
Germany	17,025,224	163,886	9,804,806	11,914,718
France	40,749,782	34,285,989	40,755,834	39,577,659
Japan	65,544,186	195,006,032	159,754,351	198,517,546
U.S.A.	37,650,301	101,118,677	97,579,046	126,803,772
Hongkong (for transhipment)	117,128,661	131,495,296	169,995,691	175,796,249
British India	..	9,599,413	9,816,734	12,329,306
Korea	..	22,617,954	21,237,383	..
Russia (overland trade)	3,095,826	5,516,517	7,597,051	34,092,022[1]
Russia (Amur and Pacific ports)	..	15,770,598	31,646,422	..

[1] These figures include imports and exports *via* European ports, Russian Amur ports, Pacific ports and by the Siberian land frontier.

The major articles of import and export had varied somewhat, as is shown in the following table:—

Imports

	Opium	Cottons	Metals	Foodstuffs	Machinery and Vehicles	Kerosene	Tobacco
	%	%	%	%	%	%	%
1879	44·43	27·48	5·03	..	..	..	..
1899	13·5	39	3·5	16	..	5	..
1919	..	33	9	13	5	8	4
1922	..	27·56	5·28	19·01	5·23	6·71	4·40

Exports

	Tea	Silk	Sugar	Oilseeds, oil and oil cake	Cereals flour, etc.	Animal foodstuffs
	%	%	%	%	%	%
1879	46·03	39·60	3·07	..	..	..
1899	16	41·4	..	6	3	1·4
1919	4	22	..	24	6	5
1922	2·59	26·28	..	16·37	2·07	3·96

The returns of shipping entered and cleared at Chinese ports during 1919 show comparatively little change during and since the War except in 1924, when the Yangtze Kiang shipping was seriously affected by the civil war. The figures for the principal foreign nations concerned are as follows:—

Nationality	1913		1919	
	Vessels	Tonnage	Vessels	Tonnage
American	2,458	898,750	4,433	2,569,887
British	32,186	38,120,300	36,074	36,284,312
Norwegian	637	739,328	311	302,959
German	5,382	6,320,466	..	..
French	1,020	1,232,763	471	414,161
Japanese	22,716	23,422,487	27,182	27,532,449
Dutch	..	..	362	461,782
	1922		1923	
	Vessels	Tonnage	Vessels	Tonnage
American	4,670	4,846,437	4,994	5,968,261
British	40,075	47,698,139	44,055	51,965,230
Norwegian	699	959,463	588	848,138
German	126	447,050	364	1,369,016
French	1,707	1,626,586	1,948	1,839,731
Japanese	25,281	32,961,333	25,063	33,288,617
Dutch	502	1,487,121	525	1,644,279

In addition, it is well to note that Chinese vessels of foreign style, sailing under the Chinese flag, increased in number from 43,638 in 1918 to 52,146 in 1922, and in tonnage from 16,984,523 in 1918 to 28,644,588 in 1922. Vessels of Chinese type, built and owned by Chinese and cleared at the Maritime Customs, decreased in number from 87,164 in 1918 to 58,973 in 1922, and in tonnage from 4,798,181 in 1918 to 4,213,157 in 1922.

Forestry.—Scientific and careful work in forestry has long been one of the great economic needs of China, partly to provide needed timber and partly to regulate the flow of streams. Various attempts at a scientific forestry policy, all more or less abortive, have been made by the central government under the republic. A few of the provinces have been somewhat more successful, among them Kiangsu—its forest nursery near Nanking has a yearly output of 3,000,000 seedlings; and a number of private and semi-private companies, among them some of the railways, have undertaken reafforestation. Forestry schools have been founded, probably the best of which is that connected with the (Christian) University of Nanking, and there have been attempts at educating the public on the importance of forest conservation. The Tsingtao forest reserve, begun by the Germans and continued by the Japanese, is the most successful experiment of its kind in China, but the progress made in this direction has not been great.

Mining.—The mineral industry in China has advanced under the republic, but not as much as might have been expected. In 1913, inspired by a minister of commerce (Chang Chien) with some practical knowledge of modern industrial methods, the government of the republic took up the subject of mining regulations. The result was over 300 of these, issued under seven headings, at various dates between March 1914 and July 1915. By this code the government for

the first time asserted the claim of the state to dispose of all mineral rights, and "no longer to allow landowners to hinder mining development"; at the same time, it reduced the hitherto exorbitant rate of direct taxation levied on the industry. But it still left the miners' produce exposed to export duties and transit taxes amounting to over 10%, in addition to property tax, land tax and output tax. The unwillingness of Chinese officialdom under the republic to encourage any extensive development of mining enterprise by means of foreign capital has evidently been inspired, as it was under the monarchy, by fear that the employment of foreign capital and experts is likely to produce the extension of foreign influence. The chief of the Chinese geological department (V. K. Ting), writing on the subject in May 1917, declared that the chief obstacle to the rapid extension of mining operations by foreigners in China lies in the continuance of their claim to extra-territorial rights; that China cannot afford "to allow people who are outside Chinese jurisdiction to locate mining areas under the claim system." Quite a number of foreign mines have been developed, however, especially by the Japanese.

Coal mining is the most important of the mining industries of China. The supply was probably formerly overestimated. Late figures (those of the Geological Survey of China) give the reserve at 6,252 million tons of anthracite and 17,183 million tons of bituminous and lignite, and the reserve may total 40 or 50 billion tons. While at the present rate of production this would supply China for more than 2,000 years, consumed at the rate that prevails in America it would last only 70 years. The total production of coal in China was estimated in 1913 at 13,190,000 tons; two years later the estimate was 18,000,000, of which 8,000,000 came from mines equipped with modern plant and the rest from small native workings. In 1920 the amount produced was estimated at a little over 20,000,000 tons, and in 1922 at a little less than that figure. An increasing proportion was produced from modern mines. The amount of coal exported in 1918 was 1,708,149 tons; in 1919 it fell to 1,744,433 tons; in 1923 it rose to 3,108,682 tons. The most important coal-producing enterprises are the Kailan Mining Administration (an Anglo-Chinese co-operative company) in Chihli and the Fushun mines (Japanese) in Manchuria, both of which are rapidly expanding. The principal metals which China has so far been able to produce in quantities sufficient for export are antimony, tungsten (for these two metals and their ores China is the leading producer of the world), pig-iron, iron ore and copper. The trade in antimony was stimulated and the price advanced during the War, but in 1919 the demand had greatly diminished. The iron resources of China, like those of coal, were formerly overestimated. The amount of ore is probably about 1,000 million tons. The output in 1917 was 890,282 tons, and in 1923 1,150,828 tons. Much of this is shipped to Japan for smelting. Just how much petroleum is in the country no one knows. Great expectations were aroused by a concession to the Standard Oil Company in 1914, but after more than $2,000,000 had been spent in investigation, chiefly in Shensi, work was stopped, presumably because the supplies found did not justify further expense.

IV. COMMUNICATIONS

Waterways.—In Dec. 1913 a National Conservancy Bureau was established, under the presidency of the progressive minister of commerce Chang Chien, with Mr. Van der Veen as consulting engineer, to deal with irrigation and river conservancy matters. The conservancy of the Hwai river, with a view to the prevention of floods in Kiangsu and Anhwi, received special attention. In July 1914 this river was surveyed by engineers sent to China by the American Red Cross; their investigations were followed by an agreement between the American International Corporation and the Chinese Govt. for a conservancy scheme. As the cost of the proposed work necessitated the raising of a foreign loan, the scheme was perforce postponed upon the outbreak of the World War. In 1922 the Chinese Foreign Famine Relief Committee renewed the project by forming the Hwai River Conservancy Board. Conservancy operations were begun in 1916 to improve the bar at the mouth of the Liao river. The bar at the mouth of the Hai Ho, leading to Tientsin, has been dredged, and a little progress made toward regulating the streams of Chihli and the Yellow river. Much work has been done in canalising the Hwangpu (to Shanghai) and in improving the Min river below Foochow.

Railways and Roads.—The outbreak of war and the impossibility of raising further foreign loans resulted in the suspension of several railway enterprises, projected and commenced. Several important agreements had been concluded by the Chinese Govt. in 1913 and 1914 for the construction of new lines. Most of these were compelled to await the restoration of conditions favourable for financing these undertakings abroad. The railways for which preliminary or final agreements were thus concluded, included the following:—

Tatung to Chengtu (Franco-Belgian capital); approximately 960 miles. This line forms part of a general scheme intended to provide through communication betweeen French Indo-China and Kalgan, connecting with the Peking-Kalgan railway extension, with the Hukwang system and with a French line to Yunnanfu.

Yamchow (near Pakhoi) to Yunnanfu, and thence to Chungking (in the Yangtse Kiang basin) (French capital); about 1,000 miles.

Sinyangchow to Pukow (Kiangsi Province) (British capital). This is the final agreement (Nov. 14 1913) for a concession originally granted in 1898. Length of line, about 275 miles.

Shasi (Hupeh Province) to Singyi (British capital), a "construction" contract (Dec. 18 1913) for about 800 miles.

Nanking to Hunan (British capital), about 1,000 m. of line, via Ningkwo and Nanchang to Pingsiang.

In addition to these, agreements were made by the Chinese Govt. with the German and Japanese Govts. respectively for the construction of a number of railways in Shantung and Manchuria and Mongolia. (In Oct. 1918 the Industrial Bank of Japan issued a loan of 50,000,000 yen for the building of these lines, including two of the ex-German railway concessions in Shantung.) Two other important railway agreements were made by the Chinese Govt. during the War, namely, one (March 1916) with the Russo-Asiatic Bank, for a Chinese Govt. Railway from Harbin to Aigun, with several branch lines, and another (May 1916), with an American syndicate, for the construction of a number of proposed Railways, aggregating 1,500 miles. In 1919 and 1920 a contract was signed for the construction of 37 m. of additional line on the Taokow-Tsinghwachen line. In 1920 a contract was signed with Belgian and Dutch concerns for the construction of the Lunghai Railway.

The World War put an end to most construction work, although the line from Wuchang to Changsha was finished (on the Canton-Hankow road) and there was some work on the Peking-Kalgan line until the autumn of 1915. After the War, work was pushed on the Lunghai Railway and on the Kalgan line, and there was some work on the Peking-Moukden line. Financial conditions in Europe and political and financial chaos in China, however, checked construction. During 1924 the extension of the Lunghai Railway was carried on, and Wu Pei-fu interested himself in a number of new schemes.

Coincident with the government's adoption of the programme of active construction indicated by these concessions, the policy was definitely adopted of centralising control of the various provincial railway systems and unifying their accounts and methods of management. A commission was appointed for the purpose in 1913, under the presidency of Tih Kung-Chao (minister of communications, 1920), with the assistance of an American adviser. On Jan 1 1915 the unified methods came into operation, with the result that the annual reports on Chinese Govt. Railways, subsequently published by the ministry of communications, afford a comprehensive statement of the financial and general situation. The following figures are taken from the ministry's report for the year ending Dec. 31 1919:—

The total length of railway lines in China at the beginning of 1920 was 6,813 m. (10,963 km.), consisting of government and "concessioned" railways, as follows:—

	Km.	*Km.*
Government Railways—		
In operation		6,027
Operation by construction forces:		
Lunghai	368	..
Hupeh-Hunan	15	383
Total Govt. Railways	..	6,410
Provincial and Private Railways—		
Kwangtung	225	..
Kiukiang-Nanchang	136	..
Sunning	171	..
Swatow-Chaochowfu	42	..
Nanking City	11	..
Chung Hsien Mining Co.	52	..
Liu Chiang Coal Mine	12	..
Tayeh Mining Co.	30	..
Ching Hsing Mining Co.	15	..
Kailan Mining Administration	16	..
Tayaokow Mines	29	..
Tsitsihar City	29	..
Ma Chiapu Narrow Gauge	5	773
Total subject to control of the Ministry of Communications	..	7,183
"Concessioned" Railways—		
Chinese Eastern	1,722	..
South Manchurian	1,107	..
Shantung	451	..
Yunnan	465	..
Canton Kowloon (British section)	35	3,780
Total kilometres of railway in China (6,813 miles)	..	10,963

The Ministry's report for 1922 showed on government lines a surplus for the year of $29,584,800.49; the number of passengers carried, 35,600,834; and the number of ton kilometres, 3,981,534,813. The surplus in 1923 was $23,753,359 and in 1924, $22,641,643. Progressively during the past few years, however, rail service has been disorganised owing to internal strife. Contending generals have seized portions of lines, disarranged the schedule, mishandled the rolling stock, failed adequately to maintain the road bed, and appropriated much of the income. This disorganisation was especially marked after 1922.

Over most of the country, roads remained as they had been under the empire, in what in the Occident would be considered a wretchedly poor condition. In some few places, however, notably as the result

of foreign famine relief agencies, better and modern roads began to appear, some of them metalled. Considerable progress has been made in Kiangsu, Shantung, Shansi and Chihli.

Telegraphs.—In 1912 the head office of the Chinese Telegraph Administration, until then located at Shanghai, was transferred to the Telegraphic Bureau of the Ministry of Communications at Peking and a uniform scale of charges was introduced. In 1915, the total length of lines in operation was 42,518 m., with 710 stations. In 1921, the length of lines was 55,331 m. and of stations 909. There has been, as may be gathered from these figures, a marked increase in the use of the telegraph. Messages are transmitted either in foreign languages or in Chinese, the rate for foreign messages being 50% higher than that for Chinese. A beginning has been made in wireless communication. A few foreigners (Danes) are still employed in the administration, and a Danish adviser is attached to the telegraph departments of the ministry at Peking.

Posts.—It has been one of the anomalies and one of the encouraging features of the Chinese situation that, in spite of internal disorder, there has been a great increase in the postal service. Originally organised as a branch of the imperial maritime customs, the postal service was separated from that administration and placed under the ministry of posts and communications in May 1911. Under the republic it has remained a department of that ministry, but responsible for its own budget and organisation. Since 1911 the department has been controlled by a Chinese director general and a French associate director. Its activities extend not only over the 18 provinces, but through the New Dominion and Manchuria.

During the three years 1916–8, after the death of Yüan Shih-k'ai, postal operations and extensions in many provinces were seriously hampered by the depredations of bandits and lawless soldiery. In Shensi alone, 78 post-offices were looted in 1918. Nevertheless, in that year the number of district offices and agencies had increased to 9,367 (as compared with 5,357 in 1910), employing 27,000 Chinese, with a foreign staff of about 110. The growth of the service is shown by the following figures:—

	Offices and agencies	Articles posted	Parcels posted	Courier lines *li* (33 miles)	Steamer and boat lines *li*
1906	2,096	31,994,143	400,126	153,000	17,000
1911	6,201	116,748,914	954,740	319,000	45,000
1916	8,797	233,234,373	2,232,100	421,000	64,700
1920	10,469	400,886,935	4,126,220	603,300	74,600
1921	11,032	442,116,358	4,569,660	637,800	79,300
1922	11,306	426,363,616	4,791,420	658,400	82,900
1923	11,596	473,641,716	5,307,910	667,900	83,500

	Money Orders issued	Money Orders cashed
1904	$ 752,507.52	$ 749,773.69
1911	5,937,582.36	6,008,958.95
1916	15,965,588.76	15,787,069.94
1918	35,335,846.56	34,798,589.80
1920	58,923,606.12	58,409,255.11
1922	76,517,900.00	75,795,600.00
1923	95,993,800.00	96,021,200.00

The surplus of income over working expenses increased from $238,715.72 in 1915 to $4,456,823.94 in 1923. The staff increased from 8,863 in 1908 to 35,487 in 1924. Of these, 97 in 1908 and 115 in 1922 were foreign employees.

The Minchu or native postal agencies which had flourished before the organisation of the postal administration continued to exist, but with a declining importance.

China joined the Postal Union in 1914. In 1922 the foreign postal agencies in China ceased to operate, as provided by the Washington Conference. The number discontinued was ninety-two.

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CHINESE EASTERN RAILWAY (*see* 14.553).—In 1895 there was formed, under Russian charter, but with a predominance of French capital and with some capital owned by the Chinese Govt., the Russo-Chinese Bank. When, in 1896, Russia obtained from China permission to shorten the Trans-Siberian Railway by building a line across Northern Manchuria the Tsar's Govt. had already paved the way, by an agreement with the Russo-Chinese Bank, for the organisation of a railway company. Accordingly, in 1896, the bank formed the Chinese Eastern Railway Company. The statutes of this corporation were to be co-ordinated with those of the Russian railway companies. Only Russians and Chinese were to be shareholders, and a Chinese appointed by Peking was to be president. After 80 years the line was to revert to China free of charge, or the Chinese Govt. might purchase it at the end of 36 years. The original board of directors was entirely Russian in membership, and the capital stock was all owned by the Russo-Chinese Bank. In 1898 a convention between China and Russia provided for the construction by the company of the South Manchurian line of the Chinese Eastern Railway from Harbin to Port Arthur and Dairen (Dalny). The roads so provided for were completed in 1905 and for that purpose the Russian Govt. advanced about 800,000,000 roubles. In 1905, as a result of the Russo-Japanese War, the South Manchurian Railway south of Changchun passed into the hands of Japan. Such, in brief, was the history of the railway until 1910.

In 1910 the Russo-Chinese Bank was amalgamated with the Northern Bank to form the Russo-Asiatic Bank, and the new institution became heir of the Russo-Chinese Bank's interest in the Chinese Eastern Railway. The new bank had a Russian charter, but the majority of its stock was in French hands. The Chinese Govt. remained a part owner. In 1915 an agreement was formed for the operation by the Chinese Eastern Railway of the short private line connecting Tsitsihar and the main line, and in March 1916 an agreement was entered into by the Russo-Asiatic Bank and the Chinese Govt. for the building of a line from Harbin to Blagovyeshchensk with a branch from Mergen to Tsitsihar. In a treaty of July 3 1916 Russia ceded to Japan 60 m. of the Chinese Eastern Railway between Changchun and the Sungari river.

The Railway and the War.—The World War naturally brought a strain on the railway, owing to the heavy and sometimes interrupted traffic and the depreciation of the rouble. Then came the Russian revolution, the Bolshevik *coup d'état*, and disintegration in Siberia. The board of directors was scattered from Petrograd and the manager espoused the cause of Adml. Koltchak. With the disorder in Russia and Siberia, the railway's traffic and finances naturally suffered. The Russian Legation in Peking, which remained loyal to the old régime, caused the Russo-Asiatic Bank to call, in Peking, a meeting of the shareholders to elect a new board of directors. China had meanwhile (in the summer of 1917) entered the World War and in March 1918 had signed an agreement with Japan for military co-operation. In pursuance of this agreement Japanese troops appeared in the Chinese Eastern Railway zone.

The Chinese saw in the disturbed conditions in the north an opportunity to extend their control over the railway and in 1920 displaced Horvath, put Pimenoff in his place, and appointed three Chinese to vacant posts on the directorate. The Russo-Asiatic Bank protested against this action and was supported by the French Government. Negotiations between the bank and the

Chinese Govt. followed and an agreement was signed Oct. 2 1920, providing for temporary Chinese control of the railway under a directorate, five of whose members were to be elected by the bank and four by the Chinese Government.

The Chinese Eastern Railway came up for discussion at the Washington Conference in 1921–2, but the Chinese representatives could not agree with those of the Powers, and while all accepted a resolution (adopted Feb. 4 1922) stating that better protection should be given the railway, that the personnel should be more carefully selected, and the funds more economically used, the Powers other than China reserved the right to insist later upon the responsibility of China for the fulfilment of the obligations due to the foreign stockholders, bondholders and creditors of the railway. Under this reservation the consular body in Harbin interfered when in Aug. 1923 the Chinese attempted to seize the land department of the railway.

The 1924 Agreement.—When the Soviet Govt. began the resumption of Russian relations with China, the railway became one of the chief topics in the negotiations. The agreement of May 31 1924, by which normal diplomatic relations were restored between China and Russia, contained a long article which, among other things, had an assurance that China might buy back the railway, a provision for a conference to settle more definitely the future of the railway and a clause which stipulated that the future of the railway would be decided by the two contracting parties to the exclusion of any third party or parties. Simultaneously, another agreement was adopted for the joint administration of the railway by the two governments pending the final adjustment. Until this adjustment, too, the statutes of 1896 were to remain in effect. It is interesting to note that in 1924, in spite of unsettled conditions, the railway showed a profit in its operation of 7,365,000 gold roubles, and for the first seven months of 1922 of 3,560,594 gold roubles, as compared with 6,406,702 roubles in 1913 and 7,896,436 roubles in 1914.

Events of 1926.—Early in 1926 trouble arose between the Soviet Govt. and Chang Tso-lin over the transport of troops on the railway. In pursuance of a design, so it was alleged, for preventing an advance of the Manchurian troops into Chihli against Kuo Min Chun forces, M. Ivanoff, the Soviet general manager, closed the railway to the free use of the military. He was immediately arrested, along with three other Soviet directors on the instructions of Chang. M. Karakhan, the Soviet Ambassador at Peking, handed on Jan. 24 an ultimatum to Tuan Chi-jui, who of course had no control over Chang, demanding M. Ivanoff's release and the restoration of order on the railway. A copy of the ultimatum was also forwarded to Mukden. After some delay, M. Ivanoff was released and some kind of settlement patched up, but further complications are always possible, particularly as Chang is credited with a desire to secure complete control of the railway. (K. S. L.)

CHINESE LITERATURE (*see* 6.222).—The intellectual revolution of the present century displayed itself not only in education, but also in the language itself. Many new terms were introduced to express the new ideas, so that the vocabulary of the educated man was greatly altered.

Linguistic Changes.—An attempt was made to provide the country with a uniform spoken language to replace the numerous dialects which, especially in the south and southeast, have often been mutually unintelligible. To this end the Pekingese form of *Mandarin* was extensively taught in the schools as the *Kuoyu*, or national language. The written characters being numerous and at best rather difficult to learn, the effort to promote literacy led to the invention of a phonetic alphabet of 39 symbols, later increased to forty. In 1918 the Ministry of Education gave this official authorisation, but in 1925 it had not come into extensive use. More important was the production of literature in the spoken language. Formerly the great bulk of Chinese literature was in the classical style, and such literature as appeared in the vernacular was usually held in contempt by scholars. The classical style resembled the spoken language but was for the eye rather than the ear and was sufficiently different to make its acquisition a serious bar to universal literacy. About 1917, some Chinese students in America, among them Hu Shih, had the courage to challenge the supremacy of the classical language and began to produce literature in the *pei hua*, a purified form of *Mandarin* (which in one form or another is the colloquial tongue of most of Central and North China). When they returned to China they continued their efforts and there came a literary revolution which may prove as important and significant as that which occurred in Europe when the modern languages took the place of Latin as the medium of scholarship. Books and periodicals in the *pei hua* were soon issued in an increasing stream, all largely with the purpose of making literature and ideas more widely accessible to the public.

The break with the literary forms of the past probably aided in the revolt against tradition in other fields. After the World War, the intellectuals of the modern school began to question all accepted standards, Western and Chinese, of conduct and belief. The older orthodox forms of ethics, philosophy and politics, as well as those of literature were subjected to re-examination. Since the 17th century the spirit of criticism and revolution had been fostered by certain scholars who questioned the dominance of the great philosophers of the Sung dynasty, but their rapid increase and their scope were the result of the impact of the Occident. No custom, belief or institution, political, religious, economic, philosophic or social, foreign or Chinese, was too sacred or well-established to be challenged. The movement had its centre in the National University at Peking, and it was reinforced by the extended visits of such Western scholars as John Dewey and Bertrand Russell. The radical writers of the West were read with avidity and older Chinese philosophers, long condemned by the Confucian school as unorthodox, were re-examined.

The New Learning.—The new learning and the new ideas and questions were given wide circulation by a greatly increased output of newspapers, magazines and books. Under the Republic, newspapers multiplied rapidly. The vast majority were of rather low grade and they were often dominated by individuals or factions who used them for selfish propaganda and partisan attack, but here and there was one of better type. Magazines, too, were issued in large numbers. Many were short-lived, but they all bore witness to the intellectual ferment abroad in the land. Of books there were a great number—translations from other languages, new works in Chinese, text-books, essays, histories and political and philosophical treatises. Here and there an older writer, like Liang Ch'i Ch'ao, maintained his popularity and influence. Liang, indeed, wrote voluminously in the *pei hua* on many subjects—chiefly those connected with national and international affairs and philosophy and religion—and was probably the most widely read of modern authors. There were many younger writers, however, such as Hu Shih—with productions chiefly in the realm of philosophy, including a fresh study of the history of Chinese philosophy—and Liang Siu-ming—the author of two widely read books, *The Civilisations of the East and the West and Their Philosophies* and *An Introduction to the Philosophy of India*, and the student class seemed obsessed with the idea of expressing itself in print. The demand for the new literature gave rise to many publishing houses and the great Commercial Press, begun before the Republic, was the largest concern of its kind in the Far East.

This ferment of thought, with its revolutionary and critical attitude toward language and ideas and its vast output of literature, was so marked in the years just following the World War that it came to be known as the Renaissance, New Thought or, to use an expressive Chinese term, "New Tide" movement. It was intensely patriotic, and before the end of 1924 it had begun to react against the popularity which everything Occidental had had after 1911, and began to resent the aggressions of Western Powers, and was antagonistic to Christianity. Largely destructive in its criticism, and often immature, ill-informed, prejudiced and superficial, it was not without constructive features. Certainly it marked the greatest intellectual activity that China had known for many years, and may presage the dawn of a new culture. (K. S. L.)

CHIROPRACTIC, the name given to a method of healing employed in the United States, is based on the theory that most disease is the result of displacement of the vertebrae of the spinal column, resulting in abnormal pressure upon the nerves as they emerge. It is held that the articular joints are frequently thrown out of alignment, it may be only in slight degree, and the constricted nerves are thereby prevented from transmitting to the various bodily organs the mental impulse necessary for proper functioning. The human body has been charted, and it is claimed that the nerves emanating above each vertebra regulate particular organs; hence the cause of different diseases can as a rule be readily localised. Health is possible only when all the organs function harmoniously, and disease of one organ may affect some other. The chiropractor attempts to find the subluxated joint, and with the bared hand to adjust it. He never resorts to drugs or surgery; he merely tries to relieve the impinged nerve and leaves the rest to nature.

The first reported healing by chiropractic was made in 1895, when Dr. D. D. Palmer (b. near Toronto, Canada, March 5 1845; d. at Los Angeles, Cal., Oct. 13 1913), a "magnetic healer," in Iowa treated a man who had been deaf for 17 years. He claimed to have discovered that a displaced vertebra was pinching a certain nerve and that its adjustment was quickly followed by complete restoration of hearing. Little was done to work out a theory in detail until 1903, when Dr. B. J. Palmer (b. Sept. 10 1881), a son of the discoverer, began its formulation, resulting in the development of a well-defined system of articular adjustment with the hands. He established the Palmer School of Chiropractic (Chiropractic Fountain Head) at Davenport, Ia., which remained the best known, although later many others were founded in different parts of the United States.

The course of study extends over three collegiate years of six months each, and the subjects studied correspond with those of the usual medical school, materia medica alone being ignored. In 1926 there were about 25,000 graduate chiropractors to be found in some 40 of the United States of whom 15,000 were practising. In several states they were still debarred from practice, but 37 states had laws which accorded a measure of recognition to chiropractors and in others legislation was pending.

CHISHOLM, HUGH (1866–1924), editor of *The Encyclopædia Britannica*, was born in London Feb. 22 1866. He was of Scottish descent, the son of Henry Chisholm, who became warden of the standards in the Board of Trade. Educated at Felsted School and Corpus Christi College, Oxford, of which he was a scholar, he graduated in 1888 with a first class in *literae humaniores*. He then read for the bar, being called at the Middle Temple in 1892, but occupied himself also with occasional journalism and finally adopted that profession. From 1892 to 1897 he was assistant editor, and from 1897 to the end of 1899 editor, of *The St. James's Gazette*, and during these years he also contributed numerous articles on political, financial and literary subjects to the weekly journals and monthly reviews, becoming known as a literary critic and Conservative publicist.

On resigning the editorship of *The St. James's*, he became a leader writer for *The Standard*, and later, in 1900, was invited to join *The Times*, under whose management he acted as the responsible co-editor, with Sir Donald Mackenzie Wallace and President A. T. Hadley of Yale University, of the new volumes, constituting the tenth edition (1902), of *The Encyclopædia Britannica*, becoming in 1903 editor-in-chief of the eleventh edition. Throughout his editorship he worked in close co-operation with Horace Everett Hooper, publisher of *The Encyclopædia Britannica*, and manager of its sales and publicity. The alliance between the two men, based on mutual respect and confidence, was a very close one and productive of happy results, H. E. Hooper supplying the business ability and Hugh Chisholm the scholarship. Under his editorship the 11th edition of the *Britannica* appeared in 1910–1.

Rejoining *The Times* in 1913 as day editor, he became financial editor at the end of that year, and occupied this responsible position all through the momentous period of the World War, resigning his connection with *The Times* in March 1920, in order to reassume the editorship of *The Encyclopædia Britannica* and to organise the publication of the new volumes constituting the 12th edition.

As editor of *The Encyclopædia Britannica* Chisholm displayed remarkable ability. His gift for organisation, combined with his wide range of knowledge, enabled him to scheme out a subject, or an article, sometimes better than the expert whom he was inviting to write on it. He had an unusual power of visualising the right arrangement of details, and his letters to contributors, written always in his own hand, were practically a synopsis of the contents of the *Encyclopædia*. In politics he was a Conservative and Tariff Reformer with clear and definite views. In literature his taste was catholic and his judgment sound. As financial editor of *The Times*, Chisholm displayed great courage and remarkable quickness in grasping the financial situation. Bringing a fresh mind to bear upon the intricacies of the money market, he wrote with lucidity and authority, and contributed in no small degree to the maintenance of a high standard in financial journalism. His point of view was always that of a true patriot, and both privately and publicly he rendered very valuable services to the state in connection with the raising of the various war loans.

The influence which he had won in the City led to the offer of one or two directorships, and the last two years of his life were mainly devoted to developing his gifts as a financier. He was a keen freemason and a man of many friends, both in London and in New York. He had a retentive memory, and his general knowledge of public affairs, in Great Britain and also in the United States, qualified him in a very special degree for the editorial positions he occupied. He died in London Sept. 29 1924. In 1893 Chisholm married E. Beatrix Harrison, of Ardkeen, County Down, and had three sons. (J. E. C.)

CHIVALRY: *see* KNIGHTHOOD AND CHIVALRY.

CHLOROFORM: *see* ANAESTHETICS.

CHLOROSIS: *see* ANAEMIA.

CHOATE, JOSEPH HODGES (1832–1917), American lawyer and diplomat (*see* 6.258).—Upon the outbreak of the World War he ardently supported the British and Allied cause, and severely criticised President Wilson's hesitation to recommend America's immediate co-operation, but shortly before his death retracted his criticism. He was chairman of the mayor's committee in New York for entertaining the British and French commissions in 1917. His death, which took place in New York May 14 1917, was hastened by the physical strain of his constant activities in this connection. Among his last works were *Abraham Lincoln and Other Addresses in England* (1910) and *American Addresses* (1911).

See T. G. Strong, *Joseph Choate, New Englander, New Yorker, Lawyer, Ambassador* (1917); *Joseph Choate, a Great Ambassador* (1918); Edward Sandford Martin, *The Life of Joseph H. Choate* (1920).

CHOLERA (*see* 6.262).—During the period of 1910–25 cholera continued to be widely prevalent in India, and the recorded mortality exceeded 500,000 in both 1918 and 1919, when the disease was also epidemic in China, but, with the exception of moderate prevalence in eastern and southern Europe, including Italy in 1911, there has been little spread to Europe. Bengal maintains its unenviable reputation as the home of cholera, from which it extends over India, and no adequate attempt has yet been made to utilise the undoubted protective power of inoculation and good water supplies to prevent the disease being carried from Puri and other pilgrim centres in the endemic areas, and to lessen the danger of further world-wide pandemics originating somewhere in India.

Treatment.—Happily, during the decades 1905–25, important progress has been made in the treatment of cholera, which has robbed the disease of half its terrors when hospital accommodation is available. Leonard Rogers of the Indian Medical Service, as the result of his researches on the blood changes in the disease and of the action of permanganates in destroying the toxins formed by the cholera vibrios in the intestines, has established a system of treatment which has reduced the mortality in the Calcutta Hospital cases to about one-third of its former rate.

The great loss of fluid and salts from the blood, and the reduction of the alkalinity of that fluid are combated by the intravenous injection in severe cases of three to five or more pints at a time of the following solutions: (1) sodium bicarbonate grains 160 and sodium chloride grains 90 in a pint of sterile water, and (2) sodium chloride grains 120 and calcium chloride (as a cardiac tonic) grains 4 to a pint; one pint of the former alkaline solution and the remaining two to four pints of the second hypertonic saline being given whenever collapse occurs, or the blood is found to be concentrated by the specific gravity test; 20 to 30 pints being sometimes administered successfully in the course of a few days in very bad cases, while the alkaline solution is also given in half-pint quantities in enemata every two to four hours until the renal excretion is fully re-established.

In addition two permanganate pills of grains 2 each are given orally every 15 to 30 minutes during the stage of acute evacuations to destroy the toxins in the bowel. Kaolin, or fine China clay, has the power of loosely combining with cholera toxins and preventing their absorption from the intestines, so equal quantities of kaolin and water should be given to drink *ad libitum*. Pituitarin injections are of value to maintain the blood pressure and increase the renal secretion in the later stages, and injections of atropine in doses of $\frac{1}{100}$ grain twice a day are also of value as first suggested by Lauder Brunton. As the cramps and other symptoms are immediately relieved by the saline injections, opium is unnecessary and should never be given in any stage of cholera, as it strongly predisposes to fatal suppression of urine.

By these methods the mortality in over 1,000 severe cases in the Calcutta cholera ward over a number of years past has been reduced from 60% to 20% and equally good results were obtained in China in 1919. In the Bombay and Central Provinces the administration of large quantities of permanganate pills in outbreaks in villages remote from hospitals has reduced the death-rate one-half to one-third of that in untreated cases in the same epidemics, although the severest types require intravenous salines in addition if life is to be saved.

The great paucity of skilled medical men in Indian villages alone prevents greater saving of life by these methods, and prevention, especially by good water supplies and greater sanitary control of cholera-spreading places of pilgrimage within the endemic areas of the disease in Lower Bengal and southeast Madras, together with the compulsory inoculation against cholera of all pilgrims before being allowed to return to their homes from cholera areas, should be generally adopted without further loss of time if this very serious cause of mortality in India is to be reduced, as it well might be, and Europe saved from further pandemics of cholera. (L. Ro.)

CHORAL SINGING.—In Great Britain choral singing, from 1910 to 1925, falls into three periods—the splendid activity which was checked by the World War, the struggles during that dark period, and the efforts since 1919 to find the means of meeting the new situation. In the first period there was extraordinary vitality and much new impetus.

Some Notable Figures.—The old tradition of solid, square-toed choralism had been shaken to the roots by the personality of Dr. Henry Coward, the Sheffield chorus master. He had turned the big, heavy, unwieldy body of the provincial choral society into a living, sensitive, functioning organism, and his exploits had created a sensationsal interest in this form of art. Some of his disciples, no doubt, carried his ideas too far and lost sight of the end in exploiting the means. There were other notable workers in the field, with different aims, each contributing to the general good. Harry Evans, by his work in Wales and Liverpool, his keen personality and penetrating insight, made a great impression on the choral world. He was particularly successful in modern works for large choirs exploiting vivid colouring. His comparatively early death in 1914 was a severe loss.

Two other choirs, also under men of outstanding personality, were beginning to attract attention. Both were breaking away from the lines traditionally followed by the average British choral society. In 1904 Charles Kennedy Scott, an able and versatile musician, founded in London the Oriana Madrigal Society, a small body originally intended to arouse interest in the English madrigal school. It eventually widened its scope and devoted much attention to modern British unaccompanied choral works, and in the period in question it was becoming firmly established in public notice. The choice of programmes struck out new lines and gave fresh ideas to choral conductors all over the world.

In Glasgow an amateur musician, Hugh S. Roberton, was attracting attention by the skilled singing of his Orpheus Choir, a body of about 120 singers, concentrating mostly on Scottish song arrangements and unaccompanied works on a small scale. Dr. E. C. Bairstow, organist of York Minster since 1913, was proving himself one of the ablest choral conductors in the land.

An interesting episode in choralism was a world tour from March 17 to Sept. 30 1911, by a choir of 200 voices drawn from Sheffield, Leeds, Huddersfield, Halifax, Newcastle and other centres, under the direction of Dr. Henry Coward. In 1908 a similar tour had been taken in Canada and the United States of America, but that of 1911 was on a larger scale, and comprised, in addition to these, Honolulu, Suva, New Zealand, Australia and South Africa. The large works given were *The Messiah, Elijah, Gerontius, The Golden Legend,* Berlioz' *Faust,* Elgar's *The Kingdom,* Verdi's *Requiem,* Parry's *Blest Pair of Sirens,* Beethoven's *Ninth Symphony,* Bach's *Sing ye* and a number of madrigals, part songs, and humorous ditties.

The period under discussion was also remarkable for experiments in choral composition. The new technique acquired by large choral societies and the enormous strides made by choirs in touch with the competitive festival movement opened up new possibilities to composers. The most daring experimentalist was Granville Bantock, who, in 1912–4, wrote *Atalanta in Calydon* and *The Vanity of Vanities.* Entitled choral symphonies, they are divided into four movements on the lines of the traditional orchestral form, and are written for unaccompanied voices. The voices are disposed in 20 and 12 parts respectively, not with a view of polyphonic writing, but to obtain contrasts of colour on the lines of strings, wind and brass of the orchestra. Many highly original effects are obtained, and severe problems set for choir and trainer.

Pre-War Period.—During the War choral singing all but collapsed. Not only were societies robbed of most of their men, but public halls were commandeered, the energies of active people were deflected, and subscription lists fell rapidly. Many choirs were extinguished, others turned their attention to hospital, camp and charitable work. Some were suspended for the mistaken idea that people at home should not sing in times of trouble. At a later stage, however, the absurdity of this view was realised and societies began to struggle into existence again. Some mixed choirs resolved into female voice bodies; in other cases societies in one district agreed to sing the same works and pooled their male forces at each concert.

On emerging from the gloom, the task of reconstruction was even greater than had been anticipated. Traditions had been broken and the formerly constant supply of tenors and basses was not, and has not, been recaptured. Subscribers who had supported institutions for many years as a duty did not resume their help. The War, too, had accelerated a change of taste which had gradually been coming about. Standard societies had always been able to rely upon the popular oratorios of Handel and Mendelssohn to crowd houses and fill coffers. *The Messiah* had paid many and many a deficit. But, generally speaking, this is no longer the case. Moreover, costs of halls, orchestra, printing and advertising, are all higher, and in addition there is the entertainment tax. Consequently few societies can meet their expenses.

Competitive Festivals.—There has, however, been a new awakening in the direction of competitive festivals, which, firmly established before the War, have attained an extraordinary vitality since. Nearly 200 of these exist and at every one of them choral singing is an important, if not the most important, feature. The great value of this movement is that it affords a *raison d'être* for the existence of every kind of society, except the larger

choral bodies. Rural festivals bring into existence choirs in the smallest of villages, and the larger festivals stimulate the virtuosity of the leading bodies. Choirs connected with churches and chapels, women's institutes, guilds, boy scouts, all sorts of male, female and mixed organisations, are encouraged, improved and given a new outlook. In this way the problem of finding an audience for a concert and making ends meet may be avoided.

There has been a remarkable development of male voice choirs, mostly of working men, often connected with factories or works of various kinds and these have, to a certain extent, thinned the male ranks of mixed choirs. A much higher standard of music is now used through the influence of these festivals. The singing of madrigals has received an immense impetus. Choral arrangements of folk songs and compositions by the best of our modern composers are being brought within the ken of many thousands of people. For some festivals choirs prepare choruses from an important work which is finally given by combined forces. In this way tiny rural villages know their Bach cantatas and are even intimate with the B minor Mass and other large scale compositions.

A striking development is the growth of "works" choirs, some of which are very fine bodies. The Glasgow Police and Tramways Choirs and the L.N.E.R. Musical Society are examples. One interesting fact is being disclosed by this activity. It was thought that the best choral singing was to be found only in Yorkshire, and that other parts of the country could not hope to rival that county. But the opinion of most adjudicators is that first-rate work can be produced anywhere. Without doubt the most robust voices come from the county in question, and in other parts of the country the current quality is less adapted to powerful and brilliant results, but a good conductor can produce superlatively good results from material existing in any district in the British Isles. Adjudicators of the widest experience have found astonishing results in places which were supposed to be unmusical. The general consensus of opinion among critics at the Leeds festival of 1925 was that although vocally the choir there was perhaps the finest in the world, technically it was inferior to many bodies in other parts of the country. This change of centre foreshadows a new era in choral singing.

In London the Oriana Choir continues to do excellent work, forming a model for madrigal singing, and producing the latest works of modern British composers. In 1919 the Philharmonic Choir was formed in order that a large choral body might be affiliated with the Philharmonic Society. Kennedy Scott was appointed conductor, and he has proved as brilliant with a large choir as with a small one. Among the important works produced, in addition to classics, have been Bax's motets and the choral works of Delius. In particular, the performance of the *Mass of Life* in April 1925 reached a remarkable standard. London possesses, for the first time in its history, both a large and a small choir which can give performances unexcelled anywhere else in the kingdom. The Glasgow Orpheus Choir has reached a state of popularity unprecedented in the history of choral singing. It attracts numerous crowded audiences in Glasgow, gives concerts all over Scotland, and makes annual raids into England. It has done much to stimulate choral singing; its policy has been to afford opportunities for the training of conductors and to give advice and assistance on the question of formation of new choirs. It is probably the first time that any choir has undertaken missionary work on such a large scale.

One significant feature in recent years has been the decline of interest in Handel, or rather in one or two of his stock works, and an enormously increased interest in Bach. At the beginning of the century Bach was considered only suitable for the finest choirs and especially cultured audiences. His cantatas were almost unknown in Britain. Now large and small societies produce his larger works frequently, his church cantatas are becoming regular features in programmes.

A Newcastle Experiment.—Reference must be made in this connection to an experiment, the founding of the Newcastle-upon-Tyne Bach Choir in 1915 to perform the works of the master, not with the wrong proportions of an orchestra of 50 and a choir of 300, but with forces approximating to those used in his day. The choir, after a period of experiment, was fixed at 40, 10 to a line. The orchestra varies according to the work concerned; in some cases it is practically equal to the choir in numbers. Besides all the large works of Bach and the motets, 65 of his cantatas have been given. A three days' Bach Festival was given by the choir in London in Feb. 1921. British composers are also included in the scheme of work, over 60 having been represented. It gave in Newcastle Cathedral in 1924 the first known complete performance of Byrd's recently discovered *Great Service*, and the Carnegie United Kingdom Trust sent the choir to give three performances of it in St. Margaret's, Westminster, London, in November of the same year. Several choirs have been formed on its lines, and are helping to spread a knowledge of Bach unrivalled in any other country outside Germany. A Bach cantata club began operations in London in Feb. 1926, under the direction of C. K. Scott.

It is impossible in a short article even to mention all the manifestations of choral singing throughout the country. As a result of the competitive festival movement, new conductors of merit are appearing everywhere. Works which a few years ago were looked upon as extremely difficult, for instance, Elgar's *Gerontius*, are now sung in many small towns. The work in question will receive 50 or 60 performances every winter. To take a single example, an isolated town like Kendal, with a population of 14,000, can produce such works as Holst's *Cloud Messenger* and Vaughan Williams' *Sea Symphony*. In 1925 a movement for establishing community singing was inaugurated. Meetings are organised at which folk, national and simple classical songs are sung in unison, and easy rounds are rehearsed, the music being taught by pattern so that no technical knowledge is demanded from the singers.

Visits of continental bodies have been few. In 1919 the Choral Union of Moravian Teachers gave concerts in London. It made a great impression by its enormous rhythmic vitality and the dramatic quality of its consonants, features somewhat lacking in our native singing. In 1925 a Cossack male choir surprised London by its tremendous range of tone power and its fiercely dramatic methods.

Choirs in the Dominions.—The dominions bid fair to follow the good example of the mother country. Dr. Fricker, late of Leeds, is doing splendid work in Toronto. The Winnipeg Male Voice Choir, under Mr. Hugh Ross, impressed visiting adjudicators greatly. Possibly by virtue of its climate Australia produces splendid women's voices, which rather overweigh the men's. There is much choral activity in the main centres of that continent. *The Dictionary of Modern Music and Musicians*, ed. by A. E. Hull (1924), gives a list of the principal choirs in Europe, the United States and the British Dominions. (W. G. W.)

Choral Singing in the United States

United States.—Among the older choral organisations in the United States still active on a large scale are The Handel and Haydn Society, Boston (1815); Worcester Musical Festival (1858); The Apollo Club, Boston (1871); Cincinnati Musical Festival (1872); The Apollo Club, Chicago (1872); The Oratorio Society, New York (1873); The Cecilia Club, Boston (1874); The Choral Union and May Festival, Ann Arbor, Mich. (1878).

Choral singing in the United States is fostered as a social element rather than as an artistic force. There it may be said that practically every community, church and college maintains a group of singers either as a mixed chorus, a glee club of men's voices or a women's chorus. Large business houses have also found it a benefit to organise choral societies. Most of these choruses appear annually in three concerts and not a few have already availed themselves of the radio to enlarge their circle of listeners. Unfortunately, America has not yet produced a composer of outstanding choral works to add lustre to the festivals and concerts of these bodies.

The Vogue of the Negro "Spiritual."—During the first decade and a half of the present century, American singing societies,

discovering little in contemporary choral composition to attract them, turned their attention to the folk music of their own country. Indian music was found from the first to be unadaptable to choral forms and was discarded in favour of the undeveloped melodies of the negro slaves. This interest animated a revival of the negro "spiritual," popularised by the Fisk Jubilee Singers in 1871, replacing in part the Stephen Collins Foster type of plantation song and sweeping aside the negro minstrel chorus. By 1926 the negro spiritual had won an attractive place on the programme of almost every American choral society and had even crept into some churches, occasionally taking the place of the customary anthem in the service.

A second influence which left its impress on American choral activity was the introduction of Russian church music. The Aeolian Choir (Brooklyn, New York) under N. Lindsay Norden, the Russian Cathedral Choir (New York) under Ivan Gorokhoff and the Mendelssohn Club (Philadelphia), to which Mr. Norden later transferred his leadership, led the way to an American appreciation of the hitherto unknown musical treasures of the Russian Church. The influx of Russian singers and companies, notably the Russian ballet in 1916, gave a strong impetus to the movement.

When the World War drew the United States into the conflict, many choral organisations reduced their activities; some ceased altogether. Most of the German male singing societies (Gesangvereine) disbanded and in 1926 were but slowly returning to the field. Their place was taken, to a certain extent, by the college glee clubs and private male quartets. During the War the country's musical forces were organised to aid the cause of patriotism. Song leaders, as they were called, were attached to the army camps and singing became a feature of the military routine. Independent song leaders formed choruses in factories, mills and shops and in public squares. Community choruses, too, sprang into being everywhere.

Since the War, colleges in particular have done much to promote chorus singing. Many have been able to recruit much talent and have given creditable concerts in their auditoriums and local concert halls. Some have been so venturesome as to arrange interstate tours for their glee clubs. Annual competitions after the manner of the German Gesangvereine, which competed for the much-coveted Kaiserpreis, have been instituted. The third of these events occurred on Feb. 6 1926, under the auspices of a board called the Associated Glee Clubs. Twenty-five glee clubs, numbering 1,200 male voices, participated in a programme conducted by Walter Damrosch at the 71st Regiment Armoury in New York.

To stimulate greater interest in American choral composition, many choral organisations have offered monetary prizes to native composers. Four such prizes, totalling $1,200, were announced in 1925–6 for works in smaller forms. Whether the incentive thus given will be productive of significant results remains in the hands of the fates; in itself it is one of the signs of the growing desire in the United States to develop an American school of composers. (J. MAT.)

CHOSEN: *see* KOREA.

CHRISTCHURCH, New Zealand (*see* 6.274).—Since 1907, 12 outlying suburban districts have been included in its area, and the population in 1924 was 115,360. The city has extensive reserves and parks, totalling 7,071 ac., of which 3,200 are leased to farmers, and afforestation has been carried out in some parts. In 1922 the birth-rate was 19·7 per thousand, and the death-rate only 9·6. Buildings to the value of over £800,000 were erected in 1924, the house shortage having been previously very acute. The fine new municipal offices, on the site of a theatre burnt down in 1917 and including the old façade, were opened in 1924, and at the close of 1925 plans were being considered for a concert hall to be built adjoining. At the same time land reclamation work was in progress outside the west breakwater at Lyttleton; and a railway line was being extended to make the site available for factories. The water area of the harbour is 106 acres.

CHRISTENSEN, JENS CHRISTIAN (1856–), Danish politician, was born in North Jutland. The son of a peasant farmer, he was an elementary school teacher from 1877 to 1901. In 1890 he entered Parliament and eventually became leader of the Liberal party. In 1901 he was Minister of Education in the first Liberal government, and from 1905 to 1908 was Prime Minister. In 1909 he was Minister of Defence and in this capacity carried through the Army bill. From 1912 to 1913 he was Speaker of the *Folketing* (Lower House), from 1916 to 1918 minister without portfolio, and Minister of Worship from 1920 to 1922. He retired from politics in 1924. He has published a book, *Fra min Barndom og Ungdom* (1925).

CHRISTIAN X., King of Denmark and Iceland (1870–), was born Sept. 26 1870 at Charlottenlund Castle, near Copenhagen, the eldest son of Crown Prince Frederik, later King Frederik VIII. (1906–12), and Louise, Princess of Sweden and Norway. After matriculating in 1889, the prince embarked upon a military career, becoming chief of the royal guard, and attained the rank of major-general. He married, in 1898, Alexandrine, Duchess of Mecklenburg-Schwerin. In 1906 he became Crown Prince and in 1912 ascended the throne.

During the World War the necessity of friendly intercourse between the Scandinavian kingdoms resulted in several meetings between the three kings of which the first was held at Malmö in Dec. 1914. On June 5 1915 King Christian signed the new constitution of Denmark which extended the franchise to women. He signed, on Dec. 1 1919, the Federal Act whereby Denmark acknowledged Iceland as an independent kingdom and King of Iceland was incorporated in the King's title. In July 1920 he rode over the old frontier into North Schleswig, which had been ceded to Denmark by the Treaty of Versailles, and received an enthusiastic reception from the people. In 1921 the King and Queen and their two sons, Crown Prince Frederik and Prince Knud, journeyed to Iceland and the west coast of Greenland. King Christian, by moving freely among the people, increased his popularity with all classes.

CHRISTIANIA: *see* OSLO.

CHRISTIANITY (*see* 6.280).—In the 18th century, religion was taken to be a body of intellectual conclusions mainly about God, providence and immortality. Revelation was regarded as supernatural information supernaturally guaranteed. Religions were classified, with the utmost simplicity and definiteness, as true and false. Unless it were to be admitted that, where all others must be false, one alone could not be true, Christianity had to be defined as the one true religion with the one authenticated supernatural revelation, and defended as such.

The historical studies of the 19th century tended to obliterate such a distinction as true and false, and to reduce all religions to a process in which everything was linked together and all was temporal and relative. Much of this was due to the idea, which dominated the science as well as the history of the century, that if you could put things in a series you had explained their origin and guaranteed their progress. But there was also the discovery that the religions are not theories or information, and that, therefore, no question regarding them could be reduced to mere logical truth or falsehood. But this has not meant that there is no distinction in value between religions, or that value is determined by something different from correspondence with reality. Every classification which is not merely geographical is an attempt to arrange religions according to value.

In a general way most recent classifications follow Siebeck's: (*a*) The beginnings of Religion, (*b*) Religions of Morality, (*c*) Religions of Redemption. The last is taken to be the highest class, and Christianity the highest in it, because, while Buddhism and Neo-platonism are negative religions of redemption, Christianity is the sole positive. If redemption is the highest religious need and there is real provision for it, Christianity would still be the one true religion, only this would be understood in less intellectual terms.

Religion and Redemption.—But all religions are religions of redemption; and, only when we see this, do we understand how a religion differs from a body of intellectual opinions. All religions, even the lowest of what are called nature religions, are pessi-

mistic about the world on its face value, and in some way wish to find in it a better meaning, a greater security, a greater good. The problem of God is in a sense subordinate to this problem of the world. God is never a mere inference from the world, but He is the power needed to redeem the world, and is found according to the quality of the redemption sought, and verified according to the kind of victory it gives. In that case, religions are to be classified according to the kind of redemption they offer, though there goes with it the kind of God who so redeems. Thus the religion which is concerned only with the redemption of the natural life from trouble cannot reach beyond an animistic force, vaguely many and indefinitely one; yet even this is a power by which redemption is sought from the mere world of the senses. When the stage is reached that law is conceived as the exact equivalent of material good to moral good regarded as obedience to rules, a negative redemption like Buddhism, which seeks only escape from the world, means practically no God; whereas, a positive one like Zoroastrianism or ecclesiastical Judaism, which seeks victory over it, means a God much concerned about the clean and the unclean and a succourer of the good understood as the clean.

Christianity and Redemption.—In its general conception of redemption Christianity had a forerunner in the Hebrew prophets. The pessimism of both goes far deeper than Buddha's. Buddha's pessimism of the superior, sensitive class would have seemed a very thin-skinned affair to the robust Jewish peasant. The Prophets faced a doomed civilisation and inconceivable ruin and calamity, and Jesus faced a people who would crush themselves by the evil spirit with which they would crush Him. And the moral judgment was also deeper. The Prophets saw far beyond rules, and the virtues of Buddha are for Jesus mere respectable hypocrisies.

History as Progressive Revelation.—In the sense of something from which there can be no advance, history does not admit anything absolute, and if history is a necessary way of the patient working of God with His children, religion cannot admit it any more than history. The difficulty with infallible, final revelations is that, if at any point there were finality, history, as a progressive revelation, would be meaningless. Yet there is no meaning in progress were we not discovering absolute standards as well as applying them better; and it has been held that this alone remains when time which built is finished with destroying. Moreover, there are final methods which make other methods merely of antiquarian interest, and which, being right, do not themselves become antiquated. The question of the absoluteness of the Christian religion thus concerns the kind of redemption it has manifested, and the relation of Jesus to it. If this is at once our true dependence on our mortal experience and victory over it, and if Jesus manifested, in His perfect and creative dealing with it, God as the Father to whose rule we can be reconciled in spite of all the evil in the world, there is therefore an important sense in which we can speak, if not of the absoluteness of Christianity, yet of a finality of revelation and method, which as it works in all the historical forms of Christianity, can be distinguished as its true leaven from all it has absorbed in its journey through time.

The Personality of Jesus.—This, however, does not mean that any actual form of Christianity is more than a relative historical product. This problem begins with Jesus Himself. Criticism of the Gospels has been continued in recent years, and it has led farther and farther away from the Robertson and Drews view of a mythical Christ. Serious and competent students of the documents recognise some exaltation of miracle, but they are sure of a person of marked individuality in a certain and concrete historical situation. But this has, in recent years, raised sharply the question of the extent to which the idea of the Messiah and the Kingdom bore the contemporary Jewish form. The Apocalyptic School, of which Johannes Weiss is perhaps the most original representative, maintains that the Kingdom of God was the purely Jewish expectation of a visible rule to be introduced by the power of God, and the Messiah the head of this rule. The unique spiritual religion and an ethic identified with it cannot be wholly denied, but the attempt has been made to derive the idea of God as Father from this rule, with its morality as the high interim requirement in view of the immediacy of the Kingdom. That Jesus, in all He said and did, was a child of His time is the chief ground for believing in the reality of the narratives concerning Him; therefore, only enquiry can determine where this influence ended and His own admitted power and insight and originality began.

The Fatherhood of God.—Yet, however far it may have been clothed in contemporary forms, the Fatherhood of God is there, not merely in the abstract, but as interpreting nature, man, society, death and eternal life, and it is not easy to see how this could be a mere corollary of a visible apocalyptic kingdom. In a certain logical sense the Kingdom is first. It is the family which is essential to the understanding of God as Father. Precisely because it was reached in this way of finding in an evil world and evil men a world which is God's and in mankind His family, the monotheism of Jesus is not, like Mahomet's, a mere business of saying God is one, but rests on a victory over evil which does away with all final division in God's rule of the world, and makes religion and morality identical both in their sphere and in their power. And this is the unique, self-evidencing element, which we are sure came from none but Jesus, so that, so far as there may be crude material apocalyptic in Early Christianity, it may more easily be ascribed to His simple Jewish disciples than to Him. Moreover, the idea of the Father cannot really be derived from the Kingdom, because this is already pre-supposed in it, seeing that it is not because of what the world by itself could ever be, however much God changed it, but by the active purpose of God now in the world that life is turned from frustrated desire to blessed purpose.

Universalism in Judaism.—A universal conception, moreover, had abundant historical possibility in the Jewish outlook at that time, and the titles which connect Jesus with the Kingdom are very difficult to interpret except universally. They are Messiah, Son of Man, Son of God. Messiah, the one which had the most narrow Jewish association, He most avoided. An explanation of this is given, different from the old one that he wished to avoid the material Jewish expectation, but it is roundabout and not convincing. Paul at once universalised it as the "Christ," a thing only possible because of the outlook of Judaism as a world religion at that time. The Son of Man is only a poetic form for man, and Son of God had not the meaning it received in later theology, but surely the names universalise His vocation both toward man and God. Paul at least passed easily to this universalised meaning: and there is no hint that it was any part of the difference which arose between him and the immediate disciples of Jesus.

The Character of Christianity.—But the more important question concerns the abiding apocalyptic character of Christianity. This question also the events of recent years have raised more definitely than at any time since the 1st century. The Kingdom of God is not another name for the slow moral progress of the race, and the Father is not a mere name for the moral power that watches over this process. The first idea of the Church was the fellowship of this rule and not a useful institution to give shelter and continuity. All true morality is interim morality, a morality which lives in another order than the compromising present, and Christian morality does not strive or cry, but lives in a rule of God that is both present and to come. It is not a trust in safeguards, but a venture on the love of God as the power that is above all, valid for all. It is not yet manifested only because it is patient. Because God's rule is of the spirit, it cannot be displayed till idolatry vanishes from the heart of man and he worships the Father in spirit and in truth. But, then, it could come like a descent from Heaven. Because Christianity thus rests everything on the ultimate faith of the heart, it can regard God's action as a revolution, while still maintaining that the conditions of it are spiritual.

The Evolution of Catholicism.—Nothing, at least in the history of Christianity, has had such vast and manifest effects, especially in Europe, as the evolution of Catholicism from the religion of

Jesus. Yet there is no part of it about which we have fewer documents, or documents so difficult to interpret. The outside world gave no heed to the change, being unaware of its importance, and the Christians themselves were unconscious that it was change. They merely imported new meanings into old forms, without deliberate intention. Hence the great difficulty is to determine when the same terms cease to have the same meaning.

The Apostle Paul.—The sharpest difference of learned opinion on this point, in recent years, concerns the apostle Paul. That a large part of the process was the meaning given to his words has long been recognised, but this was usually ascribed to misunderstanding, due to the possibility of reinterpreting a phraseology, necessarily drawn from Greek religious expressions, back into its primitive meaning, by imperfectly Christianised converts who were ignorant of the apostle's Old Testament foundations and unable to rise to the level of his gospel free from the law. Thus legal, mystical, magical, hierarchical ideas and the conception of doctrine as dogma resting on authority, were reintroduced from Hellenistic Judaism and the mystical cults and Greek philosophical and political thought. But the modern school, of which Reitzenstein is perhaps the best known representative, finds the germ of it all in Paul, who is taken to have been influenced by those ideas through Hellenic Judaism. In spite of setting aside the Jewish law, Paul, it is said, by his Christ mysticism, opened the door to substitution and sacrifice, to officials, to mysterious doctrines and mystical sacraments.

Contacts with Heathenism.—That these ideas came in with the converts from heathenism, as they are doing in China to-day, is, in abstract probability, far more likely than that it was originated by this Hebrew of the Hebrews. His dominant thought is the Old Testament view of man as made in God's image, and from it he has Christ as the second Adam, and the new humanity in Him, while the natural interpretation of his favourite phrase "in Christ" is "in this new order," and no more mystical than "in Moses," while his insistence on all things being ours shows that redemption for him is essentially reconciliation. The Church also is a communion, a fellowship of the good news of the Kingdom of God, and in no form yet a present hierarchy; while a doctrine which was offered to the heathen, who acknowledged neither ecclesiastical nor biblical authority, could not have been Catholic in form.

The Influence of John.—In John it is easier to see that legal, sacerdotal, mystical and even imperial ideas were in the air, but it is still difficult to say how far the influence of John was by understanding or misunderstanding, because for him the Logos was still the revelation of the mind and purpose, and not of the omnipotence, of God, and eternal life a present and not merely a future possession, while the mixed society had not yet replaced the ideal Kingdom of God. This last change we find only in Matthew and the Pastoral Epistles. But it is there, so that, even in the New Testament, we find the first step from the Kingdom as an ideal, prophetic conception, which we enter as we are reconciled to the Father's purpose, to the Church as an ecclesiastical institution, which we enter as we accept its doctrine and obey its rules. This transferred the interest from a changed world by a changed loyalty, to a future life, into which the only way is the Church which possesses the correct doctrinal deposit safeguarded by its hierarchy and which has the proper rites effectively administered by a guaranteed sacerdotal succession. Then, alongside of redemption by reconciliation, we have all the other ways —sacrifice as propitiation, mystic rites, ascetic practices, etc.

Christianity and Other Religions.—Here we come to the crux of our problem, which is the place of Christianity among other religions. Is it this organised form of it, or something merely working in it that we are to consider? The view that the ecclesiastical institution itself is not merely relative to human progress, but that Jesus founded it, appointed the Apostles its rulers, settled its rites, gave it its doctrine, and guaranteed its fidelity, and that what it is it has been and will be, can only be maintained by making historical inquiry anathema. Last century this was modified into the view that what has grown to be the present Catholic doctrine and order, Christ planted only in germ. But even this is becoming increasingly difficult to maintain. Among those who differ only in detail about what happened, there are, however, diametrically opposite judgments of the value of the change. Liberal Protestant scholars, on the whole, regard it as the kind of corruption to which religions are always subject as they absorb alien elements with their only imperfectly instructed converts. They find the essential Christian element to be a power, shown by no other religion, first of elevating and spiritualising these alien elements and then of eliminating them. This they ascribe to the higher idea of redemption inseparable from the faith in Christ, which, however much overlaid, has always wrought like leaven, and to what goes with it—the revelation of the Father. Thus, for them, an essential quality of Christianity is its power to regenerate itself by a return to the Jesus of the Gospels. They would maintain that all other religions have their place, but it is as preparation, or, if their elements remain in Christianity, it is only as a temporary substitute for the true Christian redemption.

Syncretism in Christianity.—The Liberal Catholic scholars on the other hand regard it as the highest perfection of Christianity that it can thus syncretise what has appealed to human need in any religion, holding that, just by its comprehensiveness, Christianity was turned from an enthusiastic movement into a permanent and effective institution, with its bald Puritanism enriched in all kinds of profitable ways. If pagan mystical ideas were adopted, did they not meet a need? If Platonism was almost as dominant as Paulinism, was not Plato also inspired?

The Distinction of Christianity.—As a protest against the position which reduces the essence of Christianity to a mere doctrine of the Fatherhood, this position has value, for doctrines are life and life is doctrine, if either belong truly to religion. Yet we cannot thus deify history with its confusion of opposites and equalising of truth and error. Lower kinds of redemption may have to carry on till we are able to venture wholly on a higher, but no two forms are in the end compatible. Plato concerns himself mainly with safeguards, and Jesus wholly with venture: and Jesus does not rule where Plato does. Here is the essential part. All forms of ecclesiastical Christianity are largely concerned with safeguards. But the real challenge of the Cross is the high venture of living in a world not realised. It is this that distinguishes Christianity from all other historical forms of religion, this that is in some sense absolute in method, if not in any particular result. In any case, this seems to be the only aspect of it likely to be adequate to the thought and the enterprise of our time.

Yet the Catholic Church is there, with all its large variety, to remind us that this is no mere matter of intellectual conclusion, but is a victory of life only to be won in fellowship, and that there is no aspect of redemption we can abandon till its good is given in a better form by a higher. Yet it raises the question whether this fellowship should not be beyond any visible organised society, a question which is being raised acutely by the need of our time for a religious order in the chaos of our age, which, far beyond the political order, shall be able to embrace greater differences in a closer fellowship, for a higher and more permanent good. (*See* also ANGLICANISM; BAPTISTS; CHRISTIAN SCIENCE; CONGREGATIONALISM; LUTHERANS; METHODISM; ROMAN CATHOLIC CHURCH, etc.)

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CHRISTIAN SCIENCE (*see* 6.291).—In the history of Christian Science the year 1910 marked the beginning of a new era. Until Dec. 3 of that year, when she passed away, Mary Baker Eddy, the founder and leader of this religion, had taken the principal part in every step of its progress. Nothing had been initiated by anyone but her; nothing of moment had been done without her approval. Furthermore, although the organic law of the Christian Science movement, *The Church Manual*, applicable to The Mother Church and in many respects to its branches, conferred full and sufficient powers upon an administrative board, the Christian Science Board of Directors, yet until then this board had functioned under Mrs. Eddy's immediate supervision. Her demise, therefore, tested at once the adequacy of the Church Manual as an organic law and the loyalty of Christian Scientists to this law, in the absence of its author. In spite of doubts and predictions, in many instances concomitant with friendly interest, both the law of the Church and the loyalty of its members have fulfilled the most confident expectations. As developments have actually occurred, the 15 years from the end of 1910 to the beginning of 1926 have been the most fruitful and prosperous in the history of Christian Science.

Legal Difficulties.—By her last will, Mrs. Eddy devised the bulk of her estate as a charitable trust to be held and used for the purpose of promoting and extending the religion she taught. Thereupon, her next of kin began contests in the courts of Massachusetts and New Hampshire on the theory that a devise to promote Christian Science could not be a charity or charitable trust because Mrs. Eddy's teachings were so contrary to generally accepted beliefs and legally established practices as to be contrary to public policy. This contention, though argued ingeniously as a consequence from the tenet of Christian Science that all forms of evil are unreal, failed to impress the highest courts of these States, both of which dismissed the contests. The residuary estate thus devised consisted mainly of Mrs. Eddy's copyrights (valued at $2,500,000) which have yielded since her decease an income of even more than this sum (approximately $3,000,000).

This income has been expended by the trustees mainly as follows: (*a*) to put the Christian Science text-book, *Science and Health with Key to the Scriptures*, and other books by Mrs. Eddy, into public libraries throughout the United States, Canada, Great Britain and certain other countries; (*b*) to contribute toward the cost of public lectures on Christian Science in countries or places where this religion has few adherents; (*c*) to help branch Churches of Christ, Scientist, erect, enlarge or improve their church buildings; and (*d*) to assist them in their free distribution of Christian Science literature.

The Christian Science Monitor.—While *The Christian Science Monitor* dates from 1908, the development of this unique publication belongs essentially to the period 1910–25. For several years largely a Boston daily, later it dropped its local character and became, as it is, an international daily newspaper. It is read to some extent wherever English is spoken. Its circulation, while not great all told (100,000 or more), is almost as large in Chicago, San Francisco or London as in Boston. Never limited to Christian Scientists, *The Christian Science Monitor* now has a world-wide vogue among editors and public men. It is also said to have, of all daily publications, the largest number of readers for each copy, many copies being passed along by the original recipients to other readers.

Benevolent Activities.—During the period in question, Christian Science benevolences have been developed and systematised to an extent previously unknown. Funds provided by Christian Scientists have been administered by them for the purpose of relief in nearly all of the more important instances of great disaster or extensive destitution. The explosion at Halifax, the flood at Dayton, tornadoes in the Middle West, famine in the Near East, earthquakes in Japan and destitution in Europe after the World War, are among the occasions which can be mentioned in this connection. Christian Scientists also are doing an extensive missionary work among the inmates of penal institutions and among persons released therefrom. This work has been frequently commended, as being of exceptional value, by officers in charge of such institutions and by trained sociologists. Akin to this work was the extensive service rendered by Christian Scientists as chaplains and "camp welfare workers" among soldiers and sailors during and after the World War. In 1919 The Christian Science Benevolent Assn. opened a sanatorium in a suburb of Boston at a cost of $1,500,000, where persons may stay while having Christian Science treatment.

Deflections.—As in the earlier history of Christian Science, there occurred in the period under review a number of deflections from this movement. As founded by Mary Baker Eddy, the Christian Science movement consists of The Mother Church, The First Church of Christ, Scientist, in Boston, Mass., and of branch churches or local congregations wherever there are the requisite number of adherents. Each of them is designated as First Church of Christ, Scientist, of its locality, or as Second Church of Christ, Scientist and so on. Thus, the words Church of Christ, Scientist, furnish the distinctive part of the name of the Christian Science denomination as distinguished from several small and unrelated groups, which have adopted titles containing the words Christian Science.

Relations to Other Churches and to Medicine.—The successful application of Christian Science to the cure and prevention of disease has also produced some notable reactions in other communions and in the practice of medicine. In public addresses a number of prominent physicians have credited the practice of Christian Science with remarkable healings, while many others have commended as wholesome the habits of thought inculcated by this religion. On the other hand, many physicians have continued to deny or minimise the power of prayer or thought to effect cures in cases of organic disorder.

The reaction to Christian Science in the Anglican, Episcopal and Jewish communions has been most notable. In each of them, extensive inquiries have been made concerning the power of faith or prayer to cure or prevent disease, and in each of them methodical efforts have been made to employ mental and spiritual practices for this purpose. Christian Science, nevertheless, continues to make its distinctive contribution to the systematic application of theology to all human needs, including the cure and prevention of disease.

On June 8 1925 the total number of Christian Science churches ("branches of The Mother Church, The First Church of Christ, Scientist, in Boston, Mass.") was 2,202 (1,913 in the United States, 148 in England, 57 in Canada, 84 elsewhere). On Jan. 1 1920 the number was 1,804 (1,590 in the United States, 98 in England, 46 in Canada, 70 elsewhere). In 1910 the number was 1,201 (1,077 in the United States, 58 in England, 38 in Canada, 28 elsewhere). As a Christian Science church invariably has two readers—one to read the Bible, the other to read the text-book (*Science and Health with Key to the Scriptures*)—the number of readers in 1925 was 4,404; in 1920, 3,608; in 1910, 2,402. On June 8 1925 there were 7,828 recognised practitioners of Christian Science healing and 216 nurses. Statistics of membership are never given officially and estimates vary all the way from 300,000 to upwards of 1,000,000.

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CHURCHILL, WINSTON (1871–), American writer, was born in St. Louis Nov. 10 1871. He graduated from the United States Naval Academy in 1894. After brief service in the navy he resigned, and for a time was connected with *The Army and Navy Journal*. In 1895 he became managing editor of *The Cosmopolitan Magazine;* but in less than a year he retired in order to devote himself to writing. His first novel, *The Celebrity*, appeared in 1898. His next book, *Richard Carvel* (1899), had a

sale of nearly 1,000,000 copies. Its scene is laid in Maryland during the American Revolution. Then followed *The Crisis* (1902), the heroine of which is the great-great-granddaughter of his former hero, Richard Carvel; and *The Crossing* (1904). His other works are: *Coniston* (1906); *Mr. Crewe's Career* (1908); *A Modern Chronicle* (1910); *The Inside of the Cup* (1913); *A Far Country* (1915); and *The Dwelling Place of Light* (1917). All his novels treat of phases of American development, and form a sort of chronological sequence. Mr. Churchill took an active part in state politics. From 1903 to 1905 he was a member of the Legislature of New Hampshire, and in 1912 he was an unsuccessful candidate for the governorship as a Progressive.

CHURCHILL, WINSTON LEONARD SPENCER (1874–), British politician, the elder son of Lord Randolph Churchill and Jennie, daughter of Mr. Leonard Jerome, of New York, U.S.A., was born Nov. 30 1874. He was educated at Harrow and Sandhurst. Entering the army in 1895, his principal war service was with the Malakand Field Force, 1897, and the Nile Expeditionary Force, 1898; and on both campaigns he wrote books distinguished equally by ability and confident criticism. During the South African War, 1899–1902, he was correspondent for *The Morning Post*, London. He was taken prisoner by the Boers, but escaped.

As war correspondent, author, lecturer and politician he was indefatigable, and when elected conservative M.P. for Oldham in 1900 his personality, combined with hereditary interest, made him a fascinating figure in the new Parliament. His maiden speech attracted unusual attention. A slight defect of utterance was noted, and against this he had to struggle for many years. He excelled in the set speech elaborately prepared on the classic models, but was not at first a ready speaker, which led Lord Balfour to say of him once that he carried " heavy but not very mobile guns " and it was only very much later that he achieved distinction in the cut and thrust of debate. He had a filial reverence for the political memory of his father and his *Life of Lord Randolph Churchill* is one of the best political biographies in the language.

It was soon discovered that Mr. Winston Churchill was no more inclined than his father before him to tread the path of party docility. In his first session he opposed Mr. Brodrick's scheme of army reorganisation mainly on financial grounds and later Mr. Joseph Chamberlain's Tariff Reform Campaign afforded a great opportunity for his spirit of revolt. He threw himself into the ranks of the Free Traders with uncompromising vehemence. When he took the plunge and joined the Liberals his former political friends were very embittered. Returned as a Liberal for North-West Manchester at the general election of 1906, he became Under-Secretary for the Colonies in Sir H. Campbell-Bannerman's Govt., and the spokesman of his Department in the House of Commons. Even at the time of the South African War he had held liberal views about the treatment of the Dutch, and with Sir H. Campbell-Bannerman's policy of self-government for the Transvaal and Orange River colonies, leading up to the Federation of South Africa, he warmly associated himself. In 1908 he entered the Cabinet as President of the Board of Trade, where, and later at the Home Office, he developed an eager interest in social legislation, coming strongly under the influence of Mr. Lloyd George, whose National Insurance Policy he was to champion with great ardour. He himself carried a Trade Boards Act establishing a minimum wage in certain sweated industries, an Act setting up Labour Exchanges, and a Shops Act. The Old Age Pensions Act and other social measures appealed to him as creating the basis of a system that would give general security and comfort to the working classes.

By 1909 Mr. Churchill had become a great power in the Liberal party. His platform oratory had a vivacity, a boldness and an epigrammatic quality that stirred popular gatherings. Into the conflict that followed the rejection of the Budget of Mr. Lloyd George by the House of Lords, he threw himself with characteristic impetuosity and almost persuaded those Radicals who had been reluctant to believe in his whole-hearted conversion to their principles. As president of the Budget League he was a driving force in the campaign against the Lords' veto on finance. On the question of Irish Home Rule he had also made a definite advance.

But events on a larger stage were shaping themselves to give a new direction to Mr. Churchill's career. In July 1911 Great Britain came into dangerous contact with Germany over what was known as the Agadir incident. A conflict was avoided, but the German menace now presented itself as a reality to responsible British statesmen. Churchill was transferred from the Home Office to the Admiralty, with explicit injunctions laid upon him by the Prime Minister, Mr. Asquith, to " put the Fleet into a state of instant and constant readiness for war in case we were attacked by Germany "—a disclosure made at Dundee by Churchill in June 1915. The reason for Mr. Churchill's appointment to the Admiralty was that a serious disagreement had arisen between the War Office and the Admiralty concerning the strategy to be adopted in the event of war and Mr. Haldane had told Mr. Asquith that he would resign from the War Office unless the Admiralty worked in accordance with the War Office plans and a Naval War Staff was created. To that the existing Admiralty Board and Mr. McKenna were opposed and it was therefore one of Mr. Churchill's first duties to make a new Board. " He is knocking over the admirals like ninepins," it was said at the time. The formation of a naval war staff was less easy and years were necessary before it could do its work adequately. Later Mr. Churchill used to wonder whether, at the time of his own appointment, he would not have done well to bring Lord Fisher back to the Admiralty; he was, however, at this time, in constant though not always obedient consultation with the admiral.

It was now that the rift between Churchill and Lloyd George began, for Churchill was convinced that war was coming, whereas Lloyd George, despite his speech at the Mansion House on the Agadir crisis, was not. When war did come it found the Fleet, owing to the coincidence of the manoeuvres, on a war footing. Churchill had done important work in preparing the Fleet for war, but the operations of the navy in the first few months of the struggle suffered from the lack of clear and consistent direction which a naval war staff would have supplied. Mr. Churchill presently found himself the leader of a minority and opposition school of war strategy of which the Antwerp expedition and the Dardanelles enterprise were the main products. In both cases the strategical conception was not only sound but brilliant, but the forces against their success were too strong, and Churchill's own impatience contributed to their failure. Lord Fisher in particular, who had been recalled to the Admiralty, disliked the Dardanelles enterprise and his resignation in May 1915 was one of the causes of the downfall of the Liberal Govt., including Churchill who was succeeded at the Admiralty by Mr. Balfour. For a few months he remained in office as Chancellor of the Duchy of Lancaster, but resigned on Nov. 13 on the ground of his non-inclusion in the new War Committee of the Cabinet.

This step was followed by a lengthy and vigorous speech of personal explanation and vindication in the House of Commons, which was a performance of real power and made a great impression. Denying an improper usurpation of authority while at the Admiralty, Mr. Churchill described the Dardanelles adventure as a legitimate war gamble. He blamed Lord Fisher for not speaking out in the War Council if he did not approve the operation, declaring at the same time that he had not received from the First Sea Lord either the clear guidance before the event or the firm support after that he was entitled to expect. After this Mr. Churchill went on active service.

In 1917, on a ministerial reconstruction, he was again on the Treasury Bench as Minister of Munitions and became successively Secretary for War and Air Minister. He was Secretary for the Colonies when peace came. He directed the return of the army to a voluntary basis, but apart from his conspicuous part in the Irish settlement he was not in the inner counsels of Mr. Lloyd George's second Coalition and the close touch with Lloyd George, lost when Churchill went to the Admiralty, was

never afterwards renewed. Lloyd George disliked his Russian policy and the expensive campaigns conducted against the Bolshevists under his inspiration. The outward sign of this estrangement was the appointment of Sir Robert Horne instead of Mr. Churchill to the Chancellorship of the Exchequer left vacant by the retirement of Mr. Bonar Law. This was probably one of the greatest disappointments of Churchill's career. Out of favour with Lloyd George and still unpopular with the Conservatives, he was rapidly drifting into extreme insecurity and isolation.

The downfall of the Coalition which seemed likely to complete his political ruin was in fact his salvation. After his rejection by Dundee, Mr. Churchill had a period of retirement, during which he devoted himself to writing, painting and other pursuits. He now published the first volume of *The World Crisis*, a work which did much to dispel popular prejudices against his part in the War.

In March 1924 Churchill challenged attention by presenting himself as an independent anti-Socialist candidate at a by-election in the Westminster Abbey division. Backed by powerful Conservative support he polled heavily, but was defeated by the official nominee. The idea of a strong Centre Party, combining Conservatives and Liberals against Socialism, had appealed strongly to him, but in the following September he was adopted as Conservative candidate for the Epping division. Elected to the House of Commons he took his place as Chancellor of the Exchequer in the second Baldwin administration. On April 28 1925 he presented his first Budget, his proposals including a return to the gold standard, a new duty on silks, a reimposition of the McKenna duties, provision for pensions for widows and a reduction of the tax on earned incomes, but his ingenuity in the debate was more distinguished than the Budget itself. In 1908 Mr. Churchill married Clementine, daughter of Sir H. M. Hozier, K.C.B. (H. Si.)

CHURCH OF ENGLAND: *see* ANGLICANISM.

CINCINNATI (*see* 6.370).—During the period 1910–25 the area of Cincinnati was extended from 44 to 72 sq. miles. The population in 1920 was 401,247, an increase since 1910 of 10·4%. The official estimate July 1 1925 was 409,331. In 1925 the city possessed parks covering 2,725 ac., including the Mt. Airy forestry project which embraces 1,132 ac.; the Kessler plan was being carried out with further extension by utilising the boulevards and bluffs. The Parkway Boulevard covering the old Miami canal road-bed through the centre of the city and extending a distance of 4·6 m. was building at a cost of $3,330,000. The much discussed statue of Lincoln by George Grey Barnard presented to the city by Mr. and Mrs. Charles P. Taft was unveiled in Lytle Park in 1916. The rapid transit loop, at an initial cost of $6,100,000, encircling the city in connection with subway, surface and elevated railways giving access to inter-urban traffic, was nearing completion in 1925.

Manufactures.—In 1925 there were more than 2,350 manufacturing establishments in Cincinnati proper covering 90 industries, with capital of $600,000,000 and products valued at $750,000,000, employing 185,000 persons. The most important industries in the Cincinnati district were soap and soap products, $100,000,000; foundry and machine-shop products, $60,000,000; slaughtering and meat-packing, $40,000,000; clothing, $50,000,000; shoe and leather, $40,000,000; printing and publishing, $35,000,000. In 1924 the chief freight cargoes were coal, stone, sand, lumber, grain, metals and live stock.

Government.—A new charter was adopted in 1917 providing that the city "shall have all the powers of local self-government"; which, amended in 1924, effective in 1926, provides for a city manager form of government with a small council of nine including a mayor elected by proportional representation ballot. A city-planning commission prepared in 1925 a city plan controlling the future development and construction of streets, subways, bridges, playgrounds and parks, which has been enacted into law, the first of such comprehensive character in the country. An ordinance enacted in 1919 forbids the erection or maintenance of bill-boards within the residential blocks without written consent of property holders. The tax valuation for 1926 was $1,018,498,100. The municipally owned waterworks and the Southern Railway, also municipally owned, were more than self-supporting. As a result the net debt on Dec. 31 1925 was $42,480,600.

Education and Charities.—In the period 1910–25 extensive additions were made to the Jewish, Good Samaritan, Bethesda and Christ hospitals, and to the tuberculosis sanatorium. The General Hospital with its group of 24 buildings occupying 27 ac. and considered the best example of the pavilion type on the continent was finished in 1915 at a cost of $3,500,000, with a capacity of 850 beds. It is under the administration of the University of Cincinnati, whose new medical school adjoins it. Other new buildings and departments of the university (7,008 students) included the law school, the college of engineering and commerce, the college for teachers, nursery and health training school, school of household arts, household administration, applied arts, department of hygiene and physical education, new gymnasium and athletic field. The co-operative system, originated in Cincinnati, of supplementing college instruction by practical training in various shops and manufacturing establishments, was greatly expanded between 1910 and 1925.

Several new high-school buildings were erected, with improved facilities which enabled the student to pass at public expense from the kindergarten through the graduate schools of the municipal university. The Roman Catholic College of St. Xavier in 1919 moved its college department to a 26-ac. tract in the suburbs adjoining the newly-developed boulevard system of the city and constructed administration, science, library, dormitory and recitation buildings. The colleges of music increased in buildings and faculties, and in 1915 the Cincinnati Symphony Orchestra received an endowment of $1,000,000 as a bequest from Cora M. Dow. Of special importance was the establishment of the American House for the training of aliens for citizenship; and for social service work. The model town, Mariemont, with public buildings, banks, parks, schools, churches, athletic fields, hospitals, etc., constructed as an entirety, was nearing completion in 1925.

Between 1910 and 1925 among the new buildings were the Union Central Life of 34 storeys, 495 ft. high, the tallest building west of New York; the court-house in modern Ionic style, completed in 1919 at a cost of $5,000,000; the Dixie terminal for the Kentucky traction lines; a $2,500,000 storage warehouse; and several large clubs and hotels. (C. T. G.)

CINEMATOGRAPH: *see* MOTION PICTURES.

CIRCUS (*see* 6.390).—There are now three distinct types of circus. The British is a caravan, the continental a music-hall fitted with arena and stables, and the American a mobile arsenal of amusements. In none of these are the traditions of Philip Astley, father of the modern circus, strictly upheld. His amphitheatre, a combination of riding-school and music-house, retained much of the ancient dignity of horsemanship.

Since about 1920, interest in the circus has been re-awakened in several countries, including Russia, where the Soviet has permitted companies to be reorganised. In France, where the vogue took long to die, as the building of the handsome Cirque de Paris a few years before the War proves, the revival came quickly, partly because of the enthusiasm for the ring shown by the modern school of painters. This return to popularity was first marked by the redecoration of the Cirque Medrano in 1921; in the same year the Nouveau Cirque, which from 1914 had been an ordinary music-hall, was occupied by a menagerie, and, as the next step, the American bar was abolished so that the stables could be restored; the Cirque d'Hiver, the scene of Gémier's production of *Œdipe Roi*, in the season 1919–20 and afterwards a cinematograph theatre, once more became a circus in 1923–4; and this upward progression was crowned in 1923 when the French Minister of Public Instruction made the three Fratellini, the most popular clowns of France, officers of the Academy.

American Circuses.—Unlike the French circus, whose mainstay is the clown, the American three-ring exhibitions dwarf his antics into insignificance. The largest is the Ringling Brothers and Barnum and Bailey Circus, which was begun at Baraboo, Wis., in 1884, by five brothers. In 1907 they bought the Barnum and Bailey "Greatest Show on Earth" which they combined with their own "World's Greatest Shows" in 1919. After opening at Madison Square Gardens, New York, in the spring, this vast organisation set out in four or five trains on a seven months' tour of over 15,000 miles. Even before the union of the two concerns, the Ringlings' methods had revolutionised the American circus. When William F. Cody (Buffalo Bill) tried to renew his early successes by appearing before the public with Gordon

W. Lillie (Pawnee Bill) in a Wild West and Great Far East Circus from 1909 to 1913, his material had to be sold by auction to meet the heavy liabilities.

In Australia the Wirth Brothers have conducted a railroad circus on the American model for many years, but the mammoth show has yet to establish itself in Europe despite the success of Barnum and Bailey's visits between 1880–1900. In 1925, however, the Circus Krone aroused keen interest in Berlin as the only three-ring tent on the Continent, and three rings were installed in the stadium of the British Empire Exhibition, Wembley; but here the space was too large for the romantic smell of sawdust and tanbark to reach the audience.

International Circus.—Successful attempts to create an international circus have been made at Olympia, London. For the Christmas holidays of 1906–7, C. B. Cochran installed there a company from the Cirque de Paris with other acts; for the season of 1913–4 he brought instalments of the Hagenbeck Zoo from Berlin, thus introducing the idea of Mappin terraces into England, and engaged a German stud of 250 horses, besides an American trick rider, French clowns, and many other performers, mostly from the European continent. Each Christmas since 1920 there has been at Olympia an international circus managed by Bertram W. Mills. Otherwise the British circus is still a kind of large family party travelling from town to town in little cottages on wheels and congregating each Christmas at the Agricultural Hall, Islington, just as they congregated 100 years ago in St. George's Fields.

To-day they still perform the tricks that amused the country before the circus was invented. Thus, in 1925, dogs and monkeys were acting in Bostock's Royal Italian Circus a scene called *The Deserter*, ending with the execution of a Pomeranian by a monkey seated on a pony, which recalls the drama of *The Deserter* acted by dogs and a monkey at Sadler's Wells in 1785. After most of the buildings installed by Hengler, Sanger, and others, in the chief towns and cities of the United Kingdom had been put to other uses, the "tenting" companies became more like the old fair folk than Astley's performers. They exhibited personal skill instead of combining to present "equestrian dramas," of which the last relic was the Wembley stag hunt and Roman chariot races, two favourite circus items since Astley's was first built. Likewise the jester is disappearing, the fun now being provided mainly by silent clowns wearing the one-piece garment of the French "grotesque," the ill-fitting evening clothes of the "Auguste," or the costume of Charlie Chaplin of the films.

Entertainments of a character similar to the circus include the International Rodeo, held under C. B. Cochran's management at the British Empire Exhibition in 1924, which was a contest in steer-wrestling and buck-jumping between cowboys who were showmen in the sense that prize-money was their livelihood. In July 1925 a band of Cossacks gave an exhibition of horsemanship in London and Paris, including a dramatic spectacle enlivened by comic tumbles from horseback.

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CITY GOVERNMENT.—The authorities charged with city government are constituted upon one or other of the following principles: free local election of indigenous growth, as in Great Britain and as transmitted to her dominions overseas; a more or less complex mixture of free local election with central government appointment, as in most European countries; a somewhat intricate mixture of free local election with bureaucratic administrative method, exemplified practically throughout the United States. Recent change—for change there has been under every heading—has taken one or both of two directions: that of form or constitution and that of subject. The general tendency has been to broaden the scope of the admittedly legitimate activities of city government or to develop particular services already administered, though in the United States there has been at least for a period up to 1921 a tendency in the opposite direction.

The effect of the World War upon city government, at least in those countries which suffered most, has been to stimulate a communal sense. If progress is measured by approximation to "government of the people by the people for the people," this stimulation will in its turn make for the betterment of city government throughout the world. This, however, is a matter rather of administrative efficiency than of form or of subject.

I. THE ENGLISH SYSTEM

English city government is in form the least changed of any instrument of government in the world. Apart from measures of standardisation, such as the Municipal Corporations Act, 1882, the city governments of England are the same in form to-day as on this day 500 years ago. The municipal corporation, with its mayor, aldermen and councillors elected by the burgesses and its machinery of town clerk, surveyor and other paid officers is still to-day the staple form of authority by means of which an English city is governed; committees of elected members or councillors under whose orders the paid officers act are its medium.

Poor Law.—It is true that other agents exist. For poor law purposes boards of guardians are elected, also under a broad franchise. And to meet special needs there are specially constituted local authorities having duties of limited scope. Little has yet been attempted for the amalgamation under one administrative control of all the many subjects of city government, while in London a dual system of central and local authorities deliberately set up has been equally deliberately continued. The last great example of amalgamation of functions took place in 1902, when education was added to the roll of duties of city government as distinct from government by authorities *ad hoc*, and signs of renewed development in the direction of amalgamation are not wanting.

As a direct result of the suspension of building operations during the War, the responsibilities of city government in the matter of destroying slums and providing new houses were largely increased by special legislation culminating in the Housing Act, 1925. The net result of the housing activities of the civic authorities throughout the kingdom is that in England and Wales during the years 1920–5 no fewer than 190,000 houses have been added by civic enterprise to the houses available.

Housing.—The Housing Act, 1925, also deals with town planning. The duty of planning and controlling urban development, now freely recognised as a civic duty of first-class importance, was entrusted to civic authorities only in 1919. Since then civic authorities have thrown themselves whole-heartedly into a great and difficult task. Up to March 31 1925, schemes had been approved or were in preparation in no fewer than 281 urban districts, and in the larger cities the correlated problem of controlling redevelopment of areas already built up by some system of zoning is receiving careful attention.

Other Services.—Many other services, which a few years ago would by popular opinion have been unhesitatingly placed in the category of matters fit only for handling by private enterprise, are now treated as municipal services. Public health services are steadily enlarging to embrace treatment not only of material but of persons. Medical examination and treatment of school children are now municipal services, while tuberculosis and venereal disease are recognised, in addition to infectious disease, as evils for the prevention and cure of which all the forces of the civic authorities must be mobilised. Gas and electricity services, the first of which in London is still in the hands of companies and the second of which is just about to be dealt with by an authority constituted for the purpose, have, in Birmingham, Manchester and many other large cities, as well as in some of the metropolitan boroughs, long been within the acknowledged sphere of city government. Many of the larger cities, following the example of Glasgow and Manchester, regard the provision of traffic facilities in a broader sense than the mere provision of new or wider roads as of civic concern.

Spain.—The type of civic authority dealt with under this heading is not entirely confined to Great Britain. Spanish city

government has developed strongly upon these lines. Since 1890, communes have been administered by *ayuntamientos*, elected by registered male citizens above 25 years of age domiciled in the communes for at least two years, with a president or chairman (*alcalde*) appointed by the *ayuntamientos* from amongst its own members. It is true that there has always been a governor appointed by the state, who represents the state's authority in each province, but his duty as regards municipalities has been no more than to see that their actions do not overstep the powers granted to them.

In 1923 all *ayuntamientos*, together with the alcaldes, were abolished and replaced by associated councils of householders. In 1924 the *estatuto* municipal was passed giving communes through their *ayuntamientos* the right to choose whatever organisation best suits them. The statute also prescribes methods for determining the revenue and expenditure, as well as for the fixation of taxes, etc. Municipal accounts are not subject to approval by the state government, and ayuntamientos may form their own budgets.

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II. THE MIXED SYSTEM

Under the second heading fall the city governments prevailing throughout Europe (except Spain) and their derivatives (including Spanish) in Asia, Africa and North and South America. The outstanding feature of change in Germany, France, Belgium, Italy and the Balkan States is not a change in the form or constitution of the civic authority, but in the broadening on democratic lines of the basis upon which the free elective element is now chosen. The mixture of that element with the national government element is not affected, but the local franchise is extended. The most striking examples are perhaps to be found in Germany and Belgium, where since 1919 a municipal vote has been given to every citizen, male and female, over an age varying from 20 to 25 years. Of the second class—Holland, Norway, Sweden and the countries of European derivation in other continents—little change other than natural and normal growth can be postulated. City government in continental countries is summarised in rough outline below:—

France.—For local government purposes France is divided into departments, arrondissements, cantons and communes. The local affairs of the commune are managed by the municipal council elected by male (over 21) suffrage for four years, but many of its decisions and especially its budget must be approved by the prefect of the department, who is a political official nominated by the Minister of the Interior and appointed by the President. On the other hand, a *conseil gènèral* elected by male suffrage from business men in the cantons controls the departmental administration of the prefect. The municipal council elects from among its members a mayor who as executive head of the commune proposes the budget and supervises the police, revenue and public works, and appoints to or dismisses from communal offices. The mayor is also the agent of the government, and in his sphere of administration is charged with carrying out the laws of the country. Assistance is given to mayors by deputies (*adjoints*) elected by the municipal council and varying in number, according to the population of the commune, to not exceeding 12 (though in Lyons there are 17). The communal council draws up a list of *rêpartiteurs*, whose duty it is to apportion among the taxpayers the commune's share of direct taxes, but the actual selection from the list is made by the sub-prefect of the arrondissement. Direct taxes are imposed by the *conseil gènèral* on the district councils (*conseils d'arrondissements*) who allot to each commune its share of these taxes.

Germany.—Before the War, each state of the Empire regulated its own plan of municipal rule—there was, therefore, a lack of uniformity but nevertheless a closer approach to a single type of city government than in the United States. The dominating example had always been Prussia, and other states were falling into line except in adopting the three-class system of voting. On the formation of the Republic this system was abolished everywhere in Germany, and the disappearance of the autocracy and the extension of the franchise referred to above have increased the interest of the citizens in local affairs. City authorities are empowered to do whatever is deemed necessary in the interests of the city, subject to nothing being done which is prohibited either by law or by the veto of higher authorities. Speaking generally, the powers exercised by the German municipality correspond fairly closely with those exercisable by its English counterpart, with the important additions that poor law relief and all the public services of gas, electricity, water and tramways are almost universally included.

The general form of city government in Prussia and Hesse is by way of (*a*) municipal council, which elects a chairman, substitute chairman and secretary or clerk who may or may not be a member of the council, (*b*) *magistrat*—an executive board consisting of unpaid and paid members, the latter being usually expert officials. The head of the *magistrat* is the burgomaster, who is appointed by the council; he is usually an expert and has frequently been successful in a similar position elsewhere. Like the American city manager, the office of burgomaster provides a professional career.

The exercise of the powers of the municipality is restricted first by the overriding authority of the Minister of the Interior; secondly, by the intervention on occasion of the *oberpräsident* of the province. He, too, is appointed by the state and corresponds to the French prefect, as he is also the local agent of the national government.

A third form of control is by a district board (*Bezirksausschuss*) appointed by the provincial committee and composed of trained officials. They are a sanctioning authority and the arbiter between the municipal council and the *magistrat*. The part played by the state government as distinct from the national government is therefore considerable.

Italy.—Each commune has a communal council (*Consiglio Communale*), which is a deliberative and not an administrative body, and is elected for four years. Male persons over 21 years of age, and women over 25 years under certain conditions, are entitled to vote. The head of the administration is called the *Syndic* (*Sindaco*) and is elected, by secret vote, by the members of the communal council from among themselves; he is a representative of the state in the same way as the French mayor. The members of the communal council also select from among themselves a municipal council (*Giunta*), over which the *syndic* presides, which appoints officials, etc., and may be said to govern the commune.

Each communal council is supervised by the prefect or sub-prefect (state officials) and also mainly from a financial aspect by the provincial administrative *giunta*—composed partly of persons nominated by the government and partly of persons elected by the provincial council. The prefect has power to suspend the deliberations of the communal council and municipal council and to annul any action proposed by them when contrary to law or regulation. There is a right of appeal, however, to the government (Minister of Interior) by the communal council against the prefect and provincial *giunta*. Furthermore, the government can dissolve the communal council and appoint a

commissioner to act in its place. The system has been modified under a Fascist law, which abolishes self-government in the smaller communes with less than 5,000 inhabitants. There have also been drastic changes in the Govt. of Rome.

Belgium.—Municipal councils are elected by the qualified voters (of either sex over 21 years of age) for six years—half being chosen every three years. The burgomaster is appointed by the King in accord with the supposed wishes of the majority of the council, usually from among its members. Executive affairs are performed by *échevins* (échevinal college) holding office for six years and consisting of the burgomaster, aldermen elected by the council and the council secretary. The burgomaster is at once the servant of the commune and a representative in the commune of the executive power of the state. The office often descends from father to son. Provincial councils, the executive committee of which is known as the *députation permanente* and consists of six members, exercise a considerable measure of supervision over the actions of municipalities, and the state, too, through the provincial governor, but decentralisation is better realised in Belgium than in France.

Netherlands.—The municipal councils are elected bodies varying in numbers in accordance with size of towns. The mayor or burgomaster is appointed by the sovereign but in supposed deference to the wishes of the council. The councils are elected for a four-year term. Executive powers are given to *wethouders* (six in large towns) chosen by the council, and as such paid salaries. The police are under the burgomaster, who is an expert civil servant rather than a citizen magistrate, often holds his position for life, and is well paid. Municipal self-rule is more complete than in France, though budgets have to be approved by executive committees (" deputed states ") of provinces, and the " commissioner of the Sovereign " has also a controlling influence, corresponding to that of the French prefect, though not so powerful.

Norway.—Oslo and Bergen have a governor (*fylkesmann*) appointed by the state, as they rank with counties. Other cities and towns are administered by a town council (*bystyre*) elected for three years, and an executive committee (*formannskap*) of one-fourth the number of the council. The chairman of the council is elected by the members of the council from their midst. These chairmen, with the governor of the county in which the municipalities are situated, meet annually, and decide upon the taxes, etc., to be raised in the various cities and towns. There is also a burgomaster appointed by the council but his work is mainly secretarial.

Since 1910 women over 23 years of age have had the suffrage and are eligible for office under the same conditions as men.

Japan.—The larger cities have a municipal assembly (for administrative purposes) and a municipal council (for executive purposes, partly elective and partly nominated by the central government), the mayor, who is one of three persons elected by the assembly and approved by the Emperor, presiding over both bodies; towns have a municipal assembly presided over by a chief magistrate (headman), who is elected by the assembly and approved by the governor of the prefecture or province, who is himself appointed by the government. All male subjects of 25 years and over have the suffrage provided that they are resident in the city or town, and pay land tax or state tax of a certain amount. The main functions of the municipal authorities are concerned with finance.

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III. THE AMERICAN SYSTEM

Lord Bryce's *American Commonwealth* (1888) may be said to mark the turning point in the consideration of city problems in America. From the end of the Civil War in 1865 to 1888 the United States was engrossed in problems of readjustment, reconstruction, transport and internal development. Municipal affairs, where not wholly neglected, were at low ebb and in the hands of selfish political organisations, whose interests were wholly those of personal aggrandisement and profit. Lord Bryce's criticism stung the country into consciousness of the shortcomings.

Philadelphia Conference.—A national conference on city government was held in Philadelphia in 1894, out of which grew the National Municipal League. There was no regular form of American municipal government, and the greatest diversity of types. The general tendency, however, was toward a Federal plan modelled on that of the national Government with a division of functions (legislative, administrative and judicial). Out of the league's efforts grew a " municipal programme," the fundamental features of which were:

That every community should have the right of self-government in local affairs without the interference of outside governmental or party machinery;

That the city's public property in land, and especially its franchise rights, should be preserved unimpaired;

That all barriers should be removed which prevented the popular will from expressing itself freely and effectively;

That municipal administration should be conducted in the main by a class of public servants who by reason of experience and special training were particularly fitted for their official duties;

That official responsibility should be so placed, through simplification of governmental machinery and full publicity of accounts;

And that the people could hold their public servants to the execution of the public will with the least possible delay and uncertainty.

Example of Galveston.—In the year in which this programme was adopted (1900) the Galveston hurricane-flood nearly destroyed that city. Among other things swept away was the typical old-style mayor and council form of government, which was replaced by a commission of five men appointed by the Governor of Texas. This commission worked so swiftly and efficiently, and with so much less annual cost that, after the emergency passed, an attempt was made to continue it with a commission of five members, three appointed by the Governor and two chosen by popular vote. A court decision declared such appointments to be unconstitutional, and the entire commission forthwith became elective. To the surprise of most observers, no demoralisation ensued, and through successive elections changes in the personnel were slight.

In 1908 Des Moines, Ia., adopted the Galveston system, with the addition of the initiative, referendum, recall and non-partisan primary. This broader plan was even more widely copied than the Galveston plan. Among the larger cities (over 100,000 population) which adopted it are Buffalo; Newark, N.J.; New Orleans; Jersey City; Portland, Ore.; St. Paul; Oakland, Cal.; Omaha; Birmingham, Ala.; Memphis; San Antonio; Dallas; Houston, Tex.; Trenton; Salt Lake City; Reading, Pa.; Fort Worth; Spokane; Kansas City, Kan. Twenty-nine cities of over 50,000 population had adopted it by 1915; 67 of over 20,000; and 90 of over 10,000. Illinois leads in the number of commission-governed cities, followed by Texas, Kansas, New Jersey, Pennsylvania, Oklahoma, California, Michigan, South Dakota, Alabama, Louisiana, Tennessee and Florida.

City Manager System.—Few changes of importance were made in the Des Moines plan (except the preferential ballot first added by Grand Junction, Colo., 1909) until the appearance in 1913 of the modification providing for a city manager. Operating under an old form of government, the Council of Staunton, Va., appointed a business manager. Later Dayton, O., after a disastrous flood, adopted the commission-manager form of government, the essential feature of which was a small council of five, acting as a policy-determining body, and a city manager to be elected by the council to execute its policy. Out of this grew a city-manager form, which the National Municipal League recommended to charter-makers, then multiplying in great numbers

due to the growing dissatisfaction with existing conditions. A second "municipal programme" formally adopted by the National Municipal League in 1914, definitely embodied the city or commission manager plan and later recommended that the council or legislative body be elected on the principle of proportional representation.

The city manager movement is justly regarded as the ripest fruit of the movement for better municipal government. It embodies the short ballot, responsiveness to public opinion, concentration of executive power and responsibility, expert administration of city affairs and elimination of legislative control over the administrative: all essential principles of sound governmental practice. The success of the plan has been abundantly proved, although here and there expectations, because unreasonable, have not been met. Moreover, its application to an increasing number of cities is developing municipal policies as perhaps no other single factor has. City planning, zoning, budget making, improved personnel and administration, more effective purchasing, the preparation of adequate and carefully devised plans for transportation, intelligent housing—all have been stimulated by utilising experts in municipal affairs.

On March 1 1925 there were 352 cities and towns operating under a city manager form of government; 261 by virtue of charter provision, and 91 by virtue of ordinance provisions. These were distributed as follows: Michigan, 38; California, 33; Texas, 30; Florida, 26; Virginia, 23; Oklahoma, 18; Ohio, 16; Pennsylvania, 15; Kansas, 13; Georgia and North Carolina, 12 each; Iowa, 11; Illinois and New York, 7 each; Colorado, Tennessee and West Virginia, 6 each; Oregon and Washington, 5 each; 15 other states from 4 to 1 each. The cities over 20,000 population operating under this form of government are: Cleveland (769,841); Cincinnati (401,247); Kansas City, Mo. (324,410); Norfolk, Va. (159,080); Grand Rapids, Mich.; Dayton, O.; Fort Worth, Tex.; Knoxville, Tenn.; San Diego, Cal.; Wichita, Kan.; Sacramento, Cal.; Springfield, O.; Wheeling, W. Va.; Portsmouth, Va.; Berkeley, Cal.; Tampa, Fla.; Long Beach, Cal.; Roanoke, Va.; Niagara Falls; Jackson, Kalamazoo, and Bay City, Mich.; Pasadena, Cal.; Greensboro, N. C.; Lima, O.; Beaumont, Tex.; Kenosha, Wis.; Charleston, W. Va.; Stockton, Cal.; Dubuque, Ia.; San Jose, Cal.; Muskegon and Pontiac, Mich.; Auburn, N. Y.; Waco, Tex.; Newport News, Va.; Austin, Tex.; Columbus, Ga.; Lynchburg, Va.; Colorado Springs, Colo.; Muskogee, Okla.; Phoenix, Ariz.; Alameda, Cal.; Newburgh and Watertown, N. Y.; East Cleveland, O.; New London, Conn.; Middletown and Sandusky, O.; Durham, N. C.

Progress in Recent Years.—There can be no lasting improvement in the personnel of city officials until the short ballot becomes an established fact. This change will come less quickly than the others because of the "vested interests" of the great political organisations, which will yield with the greatest reluctance, for the short ballot means the substitution of citizen management for party organisation.

Prof. Frank Parsons, in summing up the municipal activities of American cities, declared the following subjects had been held to be proper public purposes and proper subjects of municipal ownership and control: "Roads, bridges, sidewalks, sewers, ferries, markets, scales, wharves, canals, parks, baths, schools, libraries, museums, hospitals, lodging-houses, poor-houses, police, jails, cemeteries, prevention of fire, supply of water, gas, electricity, heat, power, transportation, telegraph and telephone service, clocks, skating rinks, musical entertainments, exhibitions of fireworks, tobacco warehouses, employment offices."

According to the Federal Census of 1920, America had become preponderantly urban, over 50% of the population being reported as living in cities. The municipal problem is, therefore, an outstanding one, and questions of regional planning and city and county consolidation become of increasing importance.

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(C. R. W.)

CITY PLANNING.—In some directions the World War speeded up the work and achievements of city planning. The devastated areas in France and Belgium provided opportunities for applying new ideas with much wider scope than would have otherwise occurred; new societies, such as the Renaissance des Cités,[1] have prevented a repetition of the haphazard rebuilding that happened after the Great Fire of London. In Great Britain the War and the consequent housing shortage have produced an immense amount of municipal house building; houses by the thousand have been planned and built in complete new suburbs, exhibiting the looser method of suburban planning with about 12 houses to the acre (in place of the old 40 or 50) which was being timidly attempted before the War. Again, the large amount of unemployment caused by post-War trade depression has provided labour for an outburst of road construction that almost equals the work of the Romans in the British Isles. The new arterial roads round London, planned out and agreed to by a series of conferences before the War, have now nearly all been actually constructed, and the trees are already springing up along their routes.

But these pushes do not represent uniform and complete progress. There has been a tendency to slip back to old standards, on the score of the saving in finding immediate cash. It has always, however, been demonstrable that town planning is an economy in the long run. It is true that it will cost less to-day to construct a road 30 ft. wide than one 60 ft. (but not much, if the extra 30 ft. are only laid down in grass); but if in 20 years' time it is necessary to pull down the buildings which have been erected up to the 30 ft. road, widen it to 60 ft. and rebuild, then it would have been found considerably cheaper to make your road sufficiently wide at first. Town planning means the exercise of a little forethought, and using the skill of the designer to decide which roads will be eventually wanted at 66 ft. wide and which can remain at 30. Other questions require forethought. Zoning (a word that has come into common use) means deciding what is the best use to which land should be put and confining it, with of course reasonable elasticity, to that use. If a man now builds a house in a residential zone he knows that he will not wake up one morning and find a blast furnace started next door; if a certain town (as has happened in Sheffield) has a limited amount of land eminently suitable to industries, it may be necessary to prohibit houses being built there, in order to reserve the land for industrial expansion. In both cases it might pay for the moment to allow the blast furnace among houses and use up industrial land for residential; but in the long run the whole town suffers as well as the individuals; and in both cases the houses find themselves damaged by being mixed up with industrial buildings. Zoning, therefore, attempts to look ahead, and also gives a man a sense of security in his property; it stabilises rateable values.

City Planning in Various Countries

The following points from different countries will give some idea of the international character of the practice of city planning. Its theory is cosmopolitan, as the habits and customs of living in cities tend to approximate, with nevertheless an occasional sharply determinating factor which produces different effects, as, for example, the New York skyscraper and her elaborate height zoning regulations, necessitated by the fact of the business section being confined within a small island.

The British Isles.—In England town planning has been legalised by the Act of 1909, subsequently slightly enlarged in its

[1] Renaissance des Cités, Paris.

FIG. 1.—City of Dublin; development of central area.

scope and finally codified in 1925. Town-planning powers are still almost entirely concerned with suburban development on the outskirts of the great towns, though they are applicable equally to smaller isolated communities and even rural districts. All boroughs and urban districts with a population of over 20,000 at the census of 1921 must prepare a scheme for all land in their district which comes within the definition of the Act as land likely to be used for building purposes. This definition somewhat paradoxically includes open spaces, roads, parks and recreation grounds. Towns of historic or architectural interest may include their built-up areas if they can persuade the Ministry of Health that they are worth preserving in themselves. So far Oxford and Chester are the only ones that have taken advantage of this widening of the scope of the Acts. No fewer than 281 authorities had (by March 1925) presented schemes covering nearly 1,800,000 ac. of land thus under control; 17 schemes, prepared by 12 different local authorities, and covering approximately 28,000 ac., were finally completed and approved.

Regional planning may be said, so far as Great Britain is concerned, to have been practically invented as a definite policy during the period 1911–5. Towns, in attempting to plan out their future, found that in many cases it was essential to know what the neighbouring authority intended to do; at times in thickly populated districts such as southeast Lancashire, the west riding of Yorkshire and the neighbourhood of Birmingham one scheme insensibly merged into another. It was discovered that a group of authorities forming a natural unit might be well advised to combine together to produce a report and plan, in skeleton, for the whole region, thereby attempting to secure the best lines of development for main roads, zoning and other town planning purposes. One of the first regional plans of this nature was an unofficial one for London produced by the London Society during the War, and published in the form of a magnificent map as a development plan of Greater London. The object was to show the local authorities, from London county council to the smallest rural district within the metropolitan area, that their interests were inextricably bound up. It is significant of the difficulty found in dealing with capital cities that London is still without a complete regional committee, several small partial ones having alone been formed. The Doncaster scheme was the first regional plan to be prepared; others are in hand for regions of which the centres might be described as (1) Manchester, (2) Leeds, (3) Birmingham, (4) Newcastle, (5) Middlesbrough, (6) Chester, (7) Cardiff, Swansea and Newport; there are several others of less marked centralisation. In this direction England has been a pioneer. In east Kent, where an entirely new coalfield is being opened up, a far-reaching regional plan is prepared which it is hoped will inaugurate a new era in coal production, both as to the working of the pits and as to the creation of new towns, without impairing rural amenities.

The main lines of garden village design are by now familiar: the limitation of houses to 12 per acre, the sharp distinction between main roads and residence approaches, the retention of

natural features so far as possible in the layout and the importance given to grass, trees and open spaces. Many of the municipal housing schemes are models of layout and house design, and it would be invidious to pick out any for special comment.

The most important new departure since the founding of Letchworth on a single site has been the companion garden city of Welwyn, Hertfordshire. Both these are independent places, hence the use of the word " city," not " village "; but Welwyn is more in the nature of a satellite town to London—that is to

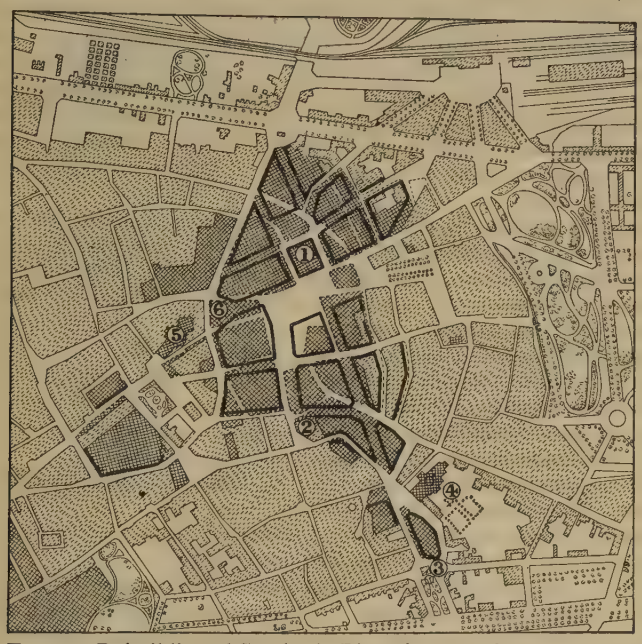

FIG. 2.—Rebuilding of Cambrai. Plan of centre of town. Hatched portion shows buildings destroyed by bombardment and fire. (1. Town Hall. 2. Beffroi. 3. Porte de Paris. 4. Cathedral. 5. St. Géry.) Heavy black lines show new City-Planning alignment of streets. The site of the British War Memorial is shown at 6.

say, its position was selected with a view to allowing a certain number of its inhabitants to go backwards and forwards. This satellite method of growth is one of the results of regional planning combined with the garden suburb planning of 12 houses to the acre, and is affected by improved train service and the increased use of motor-cars and buses. The question has thus arisen whether, instead of spreading the suburbs out continuously from the towns, it may not be better to start a new satellite further afield with a centre of its own, albeit dependent for its main nourishment on the parent body. The movement is only in its infancy, and would be facilitated by a better distribution of electrical power throughout the country. Welwyn must be regarded as a typical forerunner of the satellite town.

Several cities have put forward tentative suggestions for remodelling the centre of the town, and Birmingham has aimed at relating central improvements to suburban planning under the Acts and to the regional planning of the surrounding local authorities. Birmingham has schemes for buying up land wherever possible and re-laying it out in such a way that the city benefits as landowner for the newly planned area. The great contribution made by Liverpool during this period has been the construction of a magnificent series of external arterial roads, including an outer ring, known as Queen's Drive.

Another interesting direction of study is preliminary survey work, using the word in the widest sense of studying a place from every angle. Some valuable work was done under the auspices of the Royal Institute of British Architects during the War in London and at Manchester and other places as a centre. The object of these surveys is to familiarise the public, city councillors and officials with every aspect of the place, so that the town-planning proposals may really meet the needs and be in harmony with the character of the district. Perhaps the most detailed civic survey for an individual town was prepared by Sheffield, accompanied by a tentative plan of future growth.

Probably the biggest scheme (on paper) of general town planning (apart from urban schemes under the Act) has been produced for Dublin, as a result of a competition promoted just before the outbreak of war by the Marquess and Marchioness of Aberdeen. Other schemes, also not advanced in 1926 beyond the paper stage, were prepared for Bath, Plymouth, Kilmarnock, Northampton and Bolton.

France.—The importance of the French contribution to international town planning has hitherto been dominated by the achievements of the past, owing to the fact that a homogeneous and consistent architectural style had given continuity to the work of city planning and improvement from the reign of Louis XIV. continuously down to the end of the Second Empire. It must be remembered that, though the legal and utilitarian aspects of town planning are soon out of date, artistic achievement is perennial, even if the precise objects to be served may have changed. In France, city extension was being carried out before the War on what we should call town-planning lines as a matter of course. Gyratory traffic, introduced in 1926 into London, was being thoroughly studied as a practical proposition, and two interesting housing laws (1894–1906) giving encouragement to individual workmen to acquire their own houses had been passed. Since the War, as has been said, the whole energy has been directed to the restoration of devastated areas. Perhaps the two most spectacular events have been the passing of the law of March 14 1919, calling on every city, town and commune, of over 10,000 inhabitants to prepare a plan of extension, improvement and embellishment within three years' time; the other event, which indeed was concerned with it, was the great competition for the future of Paris, perhaps the largest town-planning competition ever held. The three special requirements asked for were (1) regional developments, (2) central improvements, (3) the existing fortifications, which latter it had been proposed to pull down just before the War. The scale of the work may be judged from the fact that the winning design (by M. Jaussely) was planned for a city that should contain 10,000,000 inhabitants.

Germany and Austria.—Germany before the War was in the full swing of city building. She was actually expanding more rapidly in her towns than any other European country. These were being systematically planned, and were in the majority of cases excellent examples of municipal foresight, but in two directions the work was not satisfactory. Artistically they were undistinguished, and as regards the health of the inhabitants the housing conditions left much to be desired owing to a still prevalent predilection for dwelling in tenements. The road planning was, within its artistic limitations, of a monumental and striking character, with great " places " formed at the railway stations and each important centre of the town; but this ample road provision was carried to excess when these big thoroughfares were provided also for residential streets, with the result in many cases of forcing up the value of land to very high prices.

An important competition was held for Berlin. The winning design, by Herr Jansen, contained among others two striking features: first, five great radial roads, whose object was to make the country round accessible in all directions; and, secondly, the knitting together of the fine woods and lagoons round Berlin into a great circular outer park belt, extending as far as Potsdam. Cologne has also produced a bold scheme of development and others are in prospect.

Vienna is naturally grouped with Germanic town planning, but resembles Paris in that its most remarkable achievements belong to an earlier period; but again its most important contribution to modern town planning is to be found in the girdle of wooded hills and meadows which it had completed shortly before the War. These comprise some 68,000 ac. of open spaces within the city boundary of the most varied topography, ranging from mountain slopes, rocky and wooded, to pleasant meadow lands and wide stretches of country and water lagoons in the neighbourhood of the old Danube bed and on the banks of the stream further down at Löbau.

Belgium.—Brussels during all this period has been in the throes of a reconstruction into which it was plunged by the ambitious schemes of Leopold II. The chief and still incomplete work was the creation of a great new central station in the midst of the old city: for this purpose a large part of the central area has been laid waste. This is the best European town in which to study the vexed problem of the single union through-station as against a series of terminals. The difficulties of the levels in central Brussels have complicated the solution; and this town-planning project became at an early stage an acute political issue. Contiguous to the station, but not theoretically connected, is the new garden which Leopold had constructed on the site of the old steep street, the Montaigne de la Cour; this is the best example of picturesque town landscaping carried out in recent times. Every other aspect of modern city planning may be studied in and near Brussels.

The rest of Belgium is naturally remarkable chiefly for the post-War reconstruction work, which has advanced very rapidly; the artistic policy adopted has been a re-creation of imagined 17th-century Flemish towns.

Italy.—As regards Rome, the great "Piano Regolatore" of 1908 was one of the biggest attempts of modern times at a city improvement and extension scheme; it remains in force with necessary modifications until 1933. Unfortunately, in spite of its boldness it is conceived in a somewhat hard and mechanical spirit, the remarkable topography of Rome not being allowed sufficiently to dominate the layout of the new streets. The main features of the plan are an immense encircling boulevard, "Avenue of Circumvallation," an archaeological zone, improvements to the ancient city centring on the Piazza Colonna and eight or nine large new suburban areas. Central improvements in the neighbourhood of the Capitol and the Victor Emmanuel monument are in hand. More normal examples of city extension are to be found at Milan, Turin and Florence: this work is still carried on under the Act of 1865.

Sweden, Denmark and Holland.—The extent of Swedish work in town planning was shown by the Exhibition and City Planning Conference, Gothenburg, in 1923. Whereas the previous town plans are of a hard and uninspired sort, the later work, which confesses a debt of acknowledgment to English planning, is extremely free and flexible, as may be seen at Stockholm, Gothenburg, Uppsala, Kalmar and other places. In a monumental direction the great new town hall at Stockholm stands among the first half dozen modern buildings.

Denmark, which in Copenhagen has always possessed one of the most charming and up-to-date capitals in Europe, has an interesting and progressive regional scheme of decentralisation and many charming examples of garden-suburban planning, founded possibly on English originals, but distinctive in architectural treatment.

Amsterdam possesses perhaps the most interesting town "Spider's-web" plan in Europe: the modern proposals are continued in the same spirit. Rotterdam, an uninteresting town plan, has some remarkable and completely planned suburban extensions and proposals for "gyratory" traffic places. No other continental country is so valuable to England as a field for the study of housing as Holland: modern methods of construction, traditional examples of design, brickwork, layout, etc., all may be seen in varying degrees of costliness and cheapness.

Finland.—The town plan of Helsingfors is a grandiose conception, and studies and models for the new suburbs have been made in greatest detail. The design for the study of Munksnas-Haga by M. Eliel Saarinen is a remarkable example of modern Finnish civic design.

Russia.—The most interesting piece of city planning in Russia is Moscow: the old capital has always been one of the foremost examples of instinctive "spider's-web" planning, caused by the successive walls of fortifications with the Kremlin at the centre. The extension plan carrying on the same type, with ring and radial roads, makes Moscow one of the largest and most marked examples of continuous-spreading towns, the reverse of the satellite method of growth.

United States.—Among the most marked features of the period in America has been the city-planning report which many towns have issued, not usually by official action, but as a result of the interest of the citizens at large and business men in the future of their city. Of the 43 cities in the United States with a population of 150,000 or more, only one has not had some sort or other of town-planning report prepared. The Chicago report, which appeared in 1909, was the first of these magnificent schemes to appear, in this case prepared for the Commercial Club, and presented to the city; and the main lines proposed have been adopted. Since then the San Francisco, Cleveland, Philadelphia, Boston, Rochester, Minneapolis, Pittsburgh, New Haven, New Jersey, Newark and many more reports have appeared, their tenor varying from monumental vision to severely practical and statistical suggestion.

The almost universal "gridiron" type of plan upon which American towns have been laid out has given a considerable degree of uniformity to many of these schemes, and has sharply cut them off from the normal European town plan. The aim of these plans has therefore been largely to cut diagonal lines through the square chequer board (the Fairmount Parkway has thus been thrust right through the very heart of Philadelphia at the City Hall); to create an encircling boulevard connection (as proposed for Chicago); to give the city a manifest centre, the gridiron being continuous and devoid of climax. These civic centres, in which were massed all possible public buildings with gardens and monuments, threatened at one time to become an obsession, but latterly have assumed juster proportions in the general scheme of things. San Francisco, St. Paul (Minnesota), St. Louis, Denver, Rochester and Springfield are among the more remarkable civic centres in course of realisation. Great attention has also been given to the railway station and its connection with the town; at Cleveland this is the key of the civic centre.

In the systematic provision of open spaces America has led the world: nearly all the statistical bases upon which parks and playgrounds are disposed in England have been founded on United States practice and experience. Small children's playgrounds, local gardens, connecting park strips, riverside drives and tree-planted boulevards, large parks and stretches of reserved country are all knit together into a continuous system which interpenetrates the town plan and in some places appears to be its guiding factor. The Boston and Metropolitan park system is the oldest, and is on a truly regional basis, as it embraces the areas of no fewer than 38 different local authorities who all contribute to its cost and upkeep. Other fine park systems are found at Kansas City, Cincinnati, Minneapolis, Philadelphia, Baltimore, Portland and Providence

The most characteristic city-planning term in use to-day in the United States is "zoning." This has been so enthusiastically taken up that zoning legislation and plans have been passed for cities, quite apart from other aspects of town planning. This is the exact converse of what has frequently happened in England, where main road plans have been prepared without any thought of what buildings are to face on them or occupy the districts through which they pass. Some 300 cities, towns and villages have passed zoning ordinances determining with some exactitude the character of every building to be erected in each district. This control of the use of land, density of population and height and bulk of buildings is administered directly by the courts under what is known as "police power," and not by the municipality under by-laws. Comprehensive zoning was first applied about nine years ago in New York; its growth and codification of practice took place in a decade.

New York, already zoned, is pursuing its city and regional plan. It is the biggest thing in city planning in the States, the area extending to 3,500,000 ac. and the population being about 9,000,000. Detailed monographs are prepared of all trades and their requirements; traffic and other data are collected and preliminary studies made. Rapid transit routes and freight distribution plans have been prepared in order to control the future spread of the population.

Washington, specially designed as a capital city, has been thoroughly overhauled by a commission and its original plan amplified; this was rendered possible by the reclamations from the Potomac river. The railways have been grouped together into a Union station facing down one of the avenues to the Capitol. The Mall, in front of the latter, has been cleared of blocking buildings and irregular gardening and is being restored as a great processional park leading up to the Washington monument; beyond this, the main axis is continued to the new Lincoln Memorial, and a bridge is planned across the river to the national cemetery at Arlington. The park system of Washington has been augmented by a series of magnificent riverside drives.

Other Examples of Town Planning.—The most remarkable city-planning study of Canada is that which has been prepared for Ottawa. Imposing plans have also been designed for Calgary and Vancouver.

Canberra, the Australian capital, is being built. The design was obtained by a competition, which was won by Mr. Walter B. Griffin of Chicago. Delhi, the monumental centre of British administration in India, is conceived on a scale of the greatest magnificence. Madras, Bombay and Lucknow have each of them great schemes in course of realisation.

International Organisations.—At Ghent in 1913 there was held the first international congress on town planning and organisation of

city life, on the occasion of the great exhibition. There was also the Cities Exhibition arranged by Professor Patrick Geddes. At this congress was founded the "Union Internationale des Villes et Communes," with its headquarters at 3, rue de la Régence, Brussels. This Union is intended to be the meeting ground of all cities for a discussion and comparison of problems concerning city life, of which town planning is one. The secretariat publishes a valuable periodical bibliography, "Tablettes Documentaires," which summarises international happenings in relation to civic life. Conferences are held from time to time, the last being in Paris in 1925.

Closely allied to the above, but dealing strictly with city and regional planning activities, is the "International Federation for Town and Country Planning and Garden Cities": headquarters, 3, Gray's Inn place, London. A very large number of technical and sociological organisations are represented on the council, and the leading technicians of the world belong to the society. The conference held in New York in 1925 was attended by representatives of states, affiliated societies, municipalities, technical bodies and individual members from 26 countries.

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CIVIL SERVICE (*see* 6.412).—This term usually refers to the officials of the central government only, but in France and certain other countries persons employed by municipalities and other local authorities are also civil servants.

GREAT BRITAIN

In Great Britain, in 1926, the Civil Service consisted of about 300,000 persons, of whom 187,500 were in the postal service. This excludes the industrial staffs of such services as admiralty dockyards. Of the total number 73,500 are women, of whom 50,600 are in the postal services. Of the men about 143,000 served in the armed forces in the World War.

The work of the Civil Service has not only increased since 1911; it has also in some sections changed in character. There are many more technical officials than there were, as the task of government has changed in regard to health, transport, etc. The machinery of administration is not very different in the various departments; but there are specialist functions performed by some officials: for example, the inspectors of the Home Office, the inspectors of the Board of Education, the employment exchange officials, etc. New departments have come into existence, *e.g.*, the Ministry of Labour (1917), which took over the "labour" divisions of the Board of Trade; the Ministry of Health (1919), which combined the work of the old Local Government Board with that of the Health Insurance Commissioners, etc.; the Ministry of Transport (1919), which took over some old functions of the Board of Trade and fulfils some new functions in regard to railways; the Ministry of Mines, combining some old work of the Home Office with some old work of the Board of Trade; the Dept. of Overseas Trade and the Air Ministry. The Ministry of Pensions deals with War pensions and may be regarded as a survival from the war period.

War Departments.—Some new departments created during the War, have ceased to exist: for example, the Ministry of Munitions (1916–20), the Ministry of Shipping (1917–20), the Ministry of Food (1916–21), the Ministry of National Service (1917–20) and the Ministry of Reconstruction (1917–20), and some sections of older departments, which grew up during the War, have also disappeared: as, for example, the postal censorship under the War Office, and the War Trade Dept. under the Foreign Office. During the War there were departments which hardly affected the character or functions of the normal Civil Service, such as the Ministry of Information, and these have disappeared.

Conditions of Entry.—The normal methods of entry to the Civil Service remain much the same as they were before the War. Examinations for entry are under the supervision of the Civil Service Commission; but this body has not the extensive powers of the United States Civil Service Commission. The Treasury is the co-ordinating authority for the British service. Under an order in council of July 22 1920, the Civil Service Commissioners issue regulations from time to time as to the conditions of entry and the subjects of examinations. Special arrangements were made in the years immediately following the War for recruitment; but all these have now come to an end. The special arrangements are recorded in the Reports of the Gladstone Committee (Cmd. 34, 1919; Cmd. 36, 1919; Cmd. 164, 1919) and of the Lytton Committee (1920, 1921, 1924).

Changes in Administration.—The organisation of the Civil Service has been considerably affected by the Reports of the Royal Commission on the Civil Service, especially the Fourth Report (Cd. 7,338, 1914). Again, a joint council for the Civil Service administrative and legal departments was established in July 1919. A joint committee of this council issued a report (Feb. 17 1920) on reorganisation, and the suggestions made in that report, agreeing with principles advocated by the Royal Commission, have been made the basis of the present organisation of the home service. The foreign services were reported upon by the Royal Commission (Fifth Report Cd. 7,748, 1914).

The general order in council of Jan. 10 1910 still remains the chief statement of the conditions of employment by the Crown. The present classification of the members of the Home Civil Service is as follows: an administrative class, concerned with the formation of policy, an executive class and a clerical class. Besides these there is a class of writing assistants in certain departments, for filling up forms, etc., and a separate section of typists and shorthand typists.

Pay and Pensions.—The pay of civil servants in Great Britain in permanent grades includes salary proper together with a bonus fixed in 1920 on the basis of a cost of living percentage of 130 above that of 1914. The bonus is given to all civil servants except those with salaries of £2,000 a year and over, but it is graduated so that the rate of bonus decreases as salaries increase. The bonus is subject to review every six months, when it is increased or decreased by 1/26th for every five full points by which the average of the official increased cost of living figures for the preceding six months rises above or falls below 130.

Disregarding the bonus, the pay of the principal classes of civil servants in London is as follows: the pay of those receiving more than £500 a year varies in different departments, but heads of departments receive in some cases £3,000 a year. Assistant secretaries receive from £1,000 to £1,200 a year and principal clerks £700 to £900. In accounting and supply departments the higher posts are usually paid on two scales, £550 to £700 and £850 to £1,000. Lower rates are at present generally fixed for appointments held by women.

Pensions and retiring allowances are granted to civil servants who retire on account of ill-health, age or because the office which they hold is abolished. No civil servant retiring before the age of 60, except for ill-health or on the abolition of his office, is eligible for any pension or gratuity. No civil servant with less than 10 years' service is eligible for any pension or gratuity. No civil servant with less than 10 years' service is eligible for pension, and the maximum number of years' service for which pension is granted is 40, or, for additional allowances, 45 years. But civil servants retiring for the reasons given above, with less than 10 years' service, are eligible for a gratuity. If a male civil servant dies in the service, a gratuity is paid to his estate equal to a year's pay, or the amount of the allowance which would have been due to him had he retired at the time of his death. Apart from pensions under earlier Acts, the Superannuation Act, 1909, which governs most of the cases, grants an annual pension to male civil servants of one-eightieth of the salary and emoluments for each year of service: there is also an additional allowance of a lump sum equal to one-thirtieth of the salary and emoluments for each year of service.

Position of Women.—The position of women in the Civil Service of Great Britain has changed considerably since 1914. At that date the divisions of the service known as Class I., second division and assistant clerks were not open to women. There were about 3,000 women in certain self-contained branches of

three or four departments, but most of these were in the General Post Office. There were about 500 women in the Labour Exchanges, some typists and shorthand typists and a class of female writing assistants numbering about 1,800. There were also some women inspectors for factories, health insurance, education, etc.

The Royal Commission proposed a large extension of these practices (Cd. 7,338, chapter x.); but it was the War which radically altered the situation. Men were needed for military service at the very time when the activities of the Civil Service greatly increased; and by July 1919, there were more than 115,000 women in the service. Evidence of their work is given in the Report of Lord Gladstone's Committee (Cmd. 164, 1919). The Sex Disqualification Removal Act, Dec. 29 1919, removed certain obstacles, and required that an order in council which might " prescribe the mode of admission for women to the Civil Service " should be laid before Parliament forthwith. The Reorganisation Committee of the Joint (Whitley) Council, referred to above, made detailed suggestions in regard to the employment of women in the Civil Service (Feb. 1920); and the House of Commons on May 19 1920 passed the following resolution:—

That it is expedient that women shall have equal opportunity of employment with men in all branches of the Civil Service within the United Kingdom and under all local authorities, providing that the claims of ex-service men are first of all considered, and should receive equal pay.

The Govt. refused to act on this resolution, but accepted a modified resolution of Aug. 5 1921, including the phrase:—

Having regard to the present financial position of the country this House cannot commit itself to the increase in Civil Service salaries involved in the payment of women in all cases at the same rate as men.

The employment of women has been curtailed owing to the necessity of finding places for ex-service men. Regulations in regard to the dismissal of women on their marriage were published on Aug. 26 1921 (E. 3,754/03): and further regulations reserved to men certain branches of the Civil Service (E. 3,242, in draft in Cmd. 1,244, April 11 1921).

Rights of Combination, etc.—The organisation of the Civil Service has been greatly affected by the adoption of the policy expressed in the Reports of the Whitley Committee of 1917, on the relations of employers and employed. The Govt. accepted the application of the principles of that report, and a joint council for the Civil Service, administrative and legal departments, was established in July 1919. This council consists of representatives of the Treasury and other departments, standing for the public as employers, and of representatives of the employees taken from associations and unions of civil servants. There are subordinate departmental joint committees. The central council produced, through an *ad hoc* committee, the plan of reorganisation of the Civil Service referred to above. There are also Joint Councils for industrial establishments under the Admiralty, Office of Works, War Office, Air Ministry and Stationery Office. Civil servants are organised on a trade union basis in certain sections: for example, the Civil Service Clerical Association has a membership of about 17,500, the Post Office Workers Union has a membership of about 80,000 and the Post Office Engineering Union, a membership of about 15,300.

A board of conciliation and arbitration in the Civil Service, established in 1917, came to an end in 1921; but in April 1925 new machinery for the same purpose was set up under the Industrial Courts Act, 1919. The Court of Civil Service Arbitration, described in the official letter of the Treasury (No. 6/25, March 14 1925), has power to deal with " claims affecting emoluments, weekly hours of work and leave of certain classes of civil servants." Claims of those classes receiving more than £700 a year will not be referred to the court except by the consent of both parties. Cases of individual officers are excluded from the competence of the court. The official announcement says that " subject to the overriding authority of Parliament, the Government will give effect to the awards of the Court."

The political rights of civil servants, *i.e.*, in regard to appearing on political platforms or standing for election to Parliament and local authorities, are defined by order in council. At present a civil servant is not allowed to criticise or express opinions publicly in regard to public affairs with which his own department is specially concerned; and with regard to candidature for Parliament, a civil servant is required to resign his post on the announcement of his candidature and has no right to reappointment even in the event of failure to be elected. A Treasury committee has reported upon this problem (Cmd. 2,408, 1925). The report contains information as to the existing regulations for parliamentary candidature of persons serving in the army, navy or air force as well as civil servants.

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Recent accounts are to be found in C. Delisle Burns, *Whitehall* (1921); *The Development of the Civil Service; Lectures*, prefaced by Lord Haldane (1922) and special studies of separate departments in the Whitehall Series, *e.g.*, *The Home Office*, by Sir E. Troup (1925), etc.; *The Reports of the Royal Commission on the Civil Service* (Cd. 7,338, 1913, etc.) are the most recent general reviews of the service.

THE BRITISH EMPIRE

In the Crown Colonies the Civil Service is frequently drawn from among residents in this or that colony, but the higher officials are appointed directly through the Colonial Office. In the self-governing Dominions the Civil Service is controlled by the Govt. of the Dominion in question.

Canada.—The " spoils " system was abolished and competitive examinations made effectual for the inside service by the Civil Service Act of 1908; and the same principle was established for the outside service by the Act of 1918. In that year a report was made by a body of American experts, on which a reclassification of the service was instituted and special examinations established for 1,600 different offices. The experts have thereby introduced two new conceptions; (*a*) that technical detailed knowledge of each office should be required of a candidate before entry, and (*b*) that there is no serious difference between routine and intellectual administration. The Act of 1918 contains most of the existing regulations in regard to political rights, promotion, dismissal, etc. (See R. M. Dawson, *The Principle of Official Independence* (1922), ch. iii., " The Civil Servant ".)

Australia.—The Public Service Act, 1922, governs the situation. The Act of 1902 was the first to regulate the Civil Service under the Commonwealth constitution; and under that Act a Civil Service Commissioner was appointed. The Royal Commission on Public Service Administration reported in 1919, and another commission reported on Economies in 1920. As a result the Act of 1922 was passed, which established a board of commissioners for the public service with extensive powers, similar to those of the United States Civil Service Commission rather than to those of the British system. The Arbitration (Public Service) Act, 1920, superseded the original Arbitration Act of 1911, and established a public service arbitrator, holding office for seven years, for giving awards on claims from associations of public servants; but this Act of 1920 appears to conflict in some particulars with the Act of 1922, in regard to the powers of the board. The decisions of the arbitrator have raised salaries by over £1,000,000 since 1913 without the board having any power to control such decisions. There is a system of contributions towards a superannuation fund. The number of civil servants in 1923 was about 202,476, of whom 26,277 were in the Commonwealth service. (*First Report of the Public Service Board of Commissioners*, Oct. 1924.)

New Zealand.—The Public Service Act, 1912, places the service under a commissioner and two assistants, appointed for seven years and responsible only to Parliament, but the Postal and Telegraph Act, 1918, excludes those services from the authority of the commissioner, except in regard to making appointments. There is a contributory superannuation fund under an Act of 1908 (*Year Book of New Zealand*).

Union of South Africa.—The Public Service Act, 1923, carries out the recommendations of the committee of enquiry which reported in 1920. Regulations have been issued in government notices under the 1923 Act. There is an advisory council representing associations of public servants which gives advice to the public service commissioners, when asked. The commissioners were appointed Nov. 27 1923, and have the extensive powers usual in the Dominions. The number of civil servants in 1925 was 26,612 (*Official Year Book of the Union*).

British India.—The situation is now governed by the Govt. of India (Civil Service) Act, Dec. 1925. The whole problem, however, is still fluid owing to the development of general policy in regard to the Govt. of India. The Islington Committee recommended certain improvements in the Civil Service in Aug. 1915,

but the report was only published in Jan. 1917. On Aug. 20 1917 the Secretary of State for India in the House of Commons announced that there would be " increasing association of Indians in every branch of the administration "; and in that year the enquiries began which led to the Montagu-Chelmsford report (Cd. 9,109, 1919) and the Govt. of India Act, 1919, the preamble of which allows for the Indianisation of the services. The MacDonnell Committee reported on difficulties of recruitment in 1922 (January) and the O'Donnell circular of May 30 1922, gave, in a letter to local governments, the arguments for and against drastic reduction of the number of Europeans. Finally, the Lee Committee reported on the superior civil services (Cmd. 2,128, 1924) and the Act of 1925 implements their recommendations.

The United States

The changes in the Federal Civil Service in the United States since the War are (*a*) an increase in the number of employees, (*b*) an increase in the proportion of women employed, and (*c*) modifications in the laws and regulations. In June 1914 there were 482,721 employees in the Federal Civil Service, of whom 292,460 had entered by competitive examination. In June 1923 there were 548,531 employees. During the War the number of women employed was increased, and since 1919 all the examinations under the Civil Service Commission have been open to women. In 1923 about 15% of the employees of the Federal Civil Service were women; and the greater number of these (41% as compared with 11% of the whole Civil Service) were in the District of Columbia, since outside that district the positions are such as are not usually sought by women (letter carriers, mechanicians, etc.). One member of the Civil Service Commission since 1920 has been a woman.

The statutes and Presidential rules affecting the Civil Service are printed in the *Report of the Civil Service Commission* for 1923. The chief new statutes and rules since the War are as follows: the Retirement Act, May 22 1920; the Classification Act, March 4 1923; a Presidential Order, March 3 1923, granting preference, under amended terms, to veterans, etc. The number of posts entered by competitive examination has been increased by the Presidential Order of May 10 1921, requiring examinations for the three superior grades of postmasters. The general tendency to abolish " political " appointments has been continued: but there are still about 15,000 positions filled by appointment by the President, besides 12,000 excluded by law from the classified Civil Service. The positions of deputy collectors of internal revenue are still regarded as " spoils " for the victors in political contests; and cases of illegal appointment for political reasons still occur and are dealt with by the commission. The Civil Service in the various states is developing along similar lines.

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The French Service

The number of civil servants under the Second Empire was 200,000 and in 1909 it was 757,678, not including workers on the state railways. These numbers, however, cannot be compared with those given for Great Britain, because in France they include local government officials and teachers, who would not be included as civil servants in Great Britain. The constitution of Feb. 25 1875, Art. 3, gives power to the president to nominate for all offices or posts in the service, and the conditions of entry, etc., are to be found in rules administered finally under the Conseil d'Etat. Examinations are held for candidates for most posts, and a university degree is in some cases necessary for entry. The organisation of the service in France is in three particulars strikingly different from that in Great Britain: (*a*) the Conseil d'Etat, (*b*) the cabinet of a minister, and (*c*) the position of the prefects and the connection between the central and the local administration.

The Conseil d'Etat, apart from its functions as court of appeal in cases of administrative law, is a central advisory body of permanent civil servants for assisting the Govt. of the day in its executive functions. The ordinary members of the conseil number 35; they must be at least 40 years of age and are partly officials who have had responsible positions elsewhere and partly chosen from among the 37 *maîtres des requêtes* who act as part of the conseil in preparing reports. The Conseil d'Etat discusses all matters of foreign policy, finance, police, education, etc., but its advice does not bind the Government.

The cabinet of a minister is a small body of officials chosen by a minister as a private secretariat to advise on policy. The law of July 13 1911, Art. 142, takes cognisance of the cabinet and prevents certain dangers of favouritism in the cabinet system; but the control over policy exercised by a cabinet naturally turns the rest of the officials in the ministry into mere instruments. A long controversy is connected with the right to trade union organisation among civil servants; and there seems to be an agreed distinction between civil servants who " give orders " (*fonctionnaires d'autorité*) and those who perform quasi-industrial services (*fonctionnaires de gestion*). The problem was discussed in the Senate and the Chamber in April and July 1919, but no solution was adopted. The present situation is that the law of 1884 does not allow trade unionism among civil servants, but that the laws of 1901 and 1920 are believed by some authorities to permit such trade unionism. In any case in practice *syndicats des fonctionnaires* are recognised and there is a powerful Fédération des fonctionnaires. (See H. Barthélemy, *Traité élémentaire de droit administratif*, 10th ed., 1923 ; J. Barthélemy, *Le Gouvernement de la France*, 1924.)

The German Service

In Germany the position of civil servants has been affected by the revolution and the Weimar Constitution of Aug. 14 1919, of which Articles 128, 129, 130 and 143 affect the Civil Service directly. The number of civil servants has increased since 1914 in spite of the loss of Alsace-Lorraine and although the Federal Post Office is to be conducted as a quasi-private undertaking. In spite of considerable reductions after the War, the number of full-time Federal civil servants in 1925 was about 94,300 as compared with 19,200 in 1913. But this has not decreased the number of civil servants in the various states; for example, in Prussia there are 11,500 more than in 1913, an increase of 10%, and in Bavaria the number has risen from 23,000 to 33,000, or nearly 44%. It is recognised that these numbers should be reduced, but as all these officials are pensionable, reduction of numbers would still leave a large expenditure necessary.

The chief increase of Federal officials is in the financial administration, in which there are now 73,200 persons. Before the War, taxes were levied by the states through the communes; but now, largely owing to the financial requirements of the Versailles Treaty, taxes are imposed and collected by the Federation, and, therefore, a large Federal organisation has been created, which is staffed by Federal officials. Women are eligible for any posts in the Civil Service, but in practice women are still excluded from judicial office. The political rights of civil servants have not been much changed so far as the letter of the law goes, since the War; but in practice civil servants used not to be free to engage in political activities, and particularly membership of socialistic parties was made impossible; and in this matter the Prussian administration was exceptionally strict. All this, however, is now changed, and civil servants are now as free politically as any other citizens. Freedom of combination is guaranteed by Art. 159 of the Weimar Constitution to all, and therefore to civil servants both in the states and in the Federation. There are several unions of officials. (See H. Oppenheimer, *The Constitution of the German Republic*, 1923.)

The League of Nations

An important development since the War has resulted in the establishment of an international civil service. It is true that ever since the middle of the 19th century, for example, in the

office of the Universal Postal Union since 1870, there have been small numbers of officials under authorities representing the joint action of sovereign states; but the establishment of the League of Nations and its International Labour Organisation has considerably modified the situation. There are now 475 officials of the league in Geneva and elsewhere and 360 officials of the Labour Organisation. Their work is partly to carry out the decisions of international councils, or committees, and partly to co-ordinate the activities of the governments of the states in the league. The league Civil Service thus forms an integral part of the whole machinery of government.

The Civil Service of each of the fully developed states is now in contact with the relevant services of the other fully developed states, since it is now recognised in practice that the work, for example, of public health organisation or education cannot be effectual unless there is co-operation between states. The league officials therefore are a necessary inter-connection of the parts of modern administration. Appointments are generally made after competitive examinations, which are held periodically. But apart from competence, some regard is paid to nationality. In 1925 there were 34 different nationalities in the League Secretariat. Of the 475 officials, 161 are British (including the Dominions), 93 French and 101 Swiss.

See *Annual Reports* on the Budget of the League and of the Director of the International Labour Organisation. (C. De B.)

CLARETIE, JULES (1840–1913), French man of letters (*see* 6.436), completed *La Vie à Paris* in 1913, later published in 21 vol. in 1914. He retired from the Théâtre Français in 1913 and died Dec. 23 of the same year.

CLARK, CHAMP (1850–1921), American politician, was born in Anderson Co., Ky., March 7 1850. He first entered Kentucky University but finished his course at Bethany College in 1873. The following year he was elected president of Marshall College, West Virginia, and one year later was admitted to the bar. After 1880 his law office was in Bowling Green, Missouri. He was city attorney for Louisiana, Mo., and for Bowling Green from 1878 to 1881; and was prosecuting attorney for Pike Co. 1885–9, and then for three years was a member of the Missouri House of Representatives. He was a member of Congress from 1893 to 1895, and from 1897 to 1919, being Speaker from 1911 to 1919. At the Democratic Convention for the nomination of a presidential candidate held at Baltimore in 1912, he led on 27 ballots and on 8 had a clear majority, but not the necessary two-thirds. He was finally defeated by Woodrow Wilson of New Jersey. He died in Washington, D.C., March 2 1921.

CLARKE, THOMAS SHIELDS (1860–1920), American artist (*see* 6.447), died in New York City Nov. 15 1920.

CLASSICAL EDUCATION.—In the principal secondary schools in Great Britain, classical studies are not losing ground (*see* Public Schools). As historical links exist with university foundations, the great public schools conserve the best traditions of classical scholarship. The introduction of modern methods, together with the development of interest in local and general archaeology, serves to maintain these studies in a position of basal importance. As characteristic of new methods the following account of an interesting and successful experiment in classical education deserves notice:—

The Direct Method.—The direct method of teaching foreign languages aims at teaching by use. It connects the foreign word, phrase or sentence directly with a thing, or an act or thought, without the intervention of English words. When a certain number of words have been learned, new ones are explained by a paraphrase in the same language; and in the final stage, the literature is read and discussed in the original.

This has long been recognised as the proper method for modern languages; and a working system has been devised by which it can be applied to Latin and Greek. Time is saved, because the whole lesson is taken up with the language, instead of its being largely occupied with English explanations; attention is kept, because the language used expresses what we do or think, and it is real to us instead of artificial; understanding is easy, because what we do or see, explains what is said. In proportion as we exclude English words from our minds, we come to think in the language, and a feeling for its idioms and turns of speech is soon developed. Idiom is usually the last thing to be learned, and then only by the select few; with this method, it is the first thing, and it is learned by all. Since the vocabulary used is simple and deals with every-day and familiar life, the attention can be exercised on the novelties, that is, the peculiar inflections which distinguish the ancient languages.

Grammar is learned as much on the direct method as on any other; but it is learned after use, not before, and is therefore less irksome. Short exercises are also used, if necessary, to illustrate grammar; they do no harm if they come in their proper place (after use) and in due proportion (not excessive).

With the reading book, from the very first all is read aloud and explained in the same language, the explanations being written and learned. English is never used unless it cannot be helped, and then with a kind of apology. The less English we use, the more Latin or Greek we shall learn. When the pupils are fit to read an author, they know enough to dispense with English altogether or nearly so. Formal translation from English into Latin or Greek, the most difficult of all exercises, is reserved for the last two years of school life. Whoever does not understand must ask. No one is blamed for not understanding; all are blamed, and punished if necessary, for not asking.

The reading lesson is the most important part of the direct method. Every line of the matter is read aloud; and very often the mere manner of reading shows at once whether the text has been understood, and if it has not, it can be explained simply by correct reading. By reading the memory is filled, the ear is taught, the taste is trained; the language, in short, is learned in the most effective way. So much so, that verses of all sorts, lyrics included, are written with ease by imitation. But the real merit of this method lies in its effect on the learner. From the first stage to the last, the learners are willing to learn, and happy in learning; their attention is kept without trouble and discipline is easy. (W. H. D. R.)

Universities.—In the universities archaeology, anthropology, numismatics, epigraphy, psychology, philology and geography are recognised as essential to the classical scholar who would understand and describe clearly conditions of life in the ancient civilisations. Western Europe has learned to realise the measure of its debt to Greece and to estimate the nature of the legacy it has received from Imperial Rome. To the Greeks modern science owes much—the spirit of ceaseless enquiry; from Rome come political ideas and methods as yet unexhausted. The precision of classical literature leads to a sense of proportion, a standard of values, a respect for the truth of words, and accuracy of thought—qualities of abiding worth in the turmoil of public life or in the contests of scientific debate.

France.—In France during the greater part of the 19th century, the position of classics in secondary schools was supreme. They alone led to the baccalaureate;—sole entrance to the universities and the liberal professions. Towards the end of the century, a strong movement in favour of modern languages and science arose. In 1898 a parliamentary committee was appointed to inquire into the subject. They reported in 1899, but it was not till 1902 that their conclusions were embodied in the establishment of four alternative courses, a full classical, a Latin-modern languages, a Latin-science and a purely modern course, all of which led to the university. These courses remained unchanged for nearly 20 years, and during that period the classical candidates for the baccalaureate, who in 1904 numbered 3,337, fell to 2,775 in 1924. The Latin-modern rose from 1,217 to 5,964, the Latin-science from 2,229 to 5,241 and the science-modern languages from 2,742 to 5,241. Thus, while Greek declined, the students taking Latin increased more than twofold and amounted to over 70% of the candidates.

The war brought its aftermath of discussion. In 1922 M. Bérard, the Minister of Public Instruction, proposed to make Latin and Greek obligatory in the earlier stages, and to cut down the courses to two (classical or modern). A bitter struggle followed, in which the majority of expert opinion was against

him. None the less, in May 1923 the President of the Republic issued a decree embodying the proposals of M. Bérard, and requiring a certificate of proficiency in Latin and Greek from all future candidates for the baccalaureate. A year later the Ministry fell and was replaced by a Radical one. The two courses have been maintained, but Classics are no longer obligatory for all, though as the curricula of the girls' schools have now been assimilated to those of the boys, a classical education is equally open to the former.

Germany.—In Germany up to the end of the 19th century, Classics were likewise supreme. The full classical school, the Gymnasium, was with one or two exceptions the sole avenue to the university and liberal professions. In 1890, at the instance of the Kaiser, a conference was called in Prussia. Its conclusions, largely embodied in the curricula of 1892, reduced the number of hours given to classics and dethroned the latter in favour of the mother tongue, while the universities were thrown open to pupils from the Realgymnasium (Latin-Modern School) and to a large extent to those from the Oberrealschule (Modern Studies School). Similar reforms had already been adopted by other German states. The next outstanding feature was the founding of Reformgymnasia, where the first language was French, Latin not being introduced till the fourth and Greek till the sixth year, both being taught intensively. This type was largely adopted in Prussia before the war. Classical studies have been open to girls since 1904, but the number taking them has not been very great. For education since the war, no statistics are available, but according to one authority, "the desertion of schools with Latin as a central subject is general." Others are less pessimistic and the prevailing opinion seems to be that the Reformschulen will ultimately be the future type of German classical education.

Italy.—Of the other European countries, the most interesting one from the classical standpoint of view is Italy. Here, thanks to the reforms of Gentile, there has been a strong reaction in favour of classics, and by the royal decrees of May and Nov. 1922, classical studies have been strengthened in the Higher Schools not only of the purely classical but also of the scientific type. Latin in fact is now obligatory in all secondary schools. Room for this increase has been found by cutting down the number of subjects and reducing the time given to mathematics; the main object of the reform being to replace the former encyclopaedic aim of the school by a cultural one based on direct knowledge of the classics. Latin is also a principal subject in the girls' high schools.

Belgium.—In Belgium again the position of classics appears to have improved. A committee was appointed after the war to consider the reform of the school syllabuses and the position of Greek. As a result, classics have been maintained in the Athénées Royales (High Schools) and further Greek and Latin can be studied in those *écoles moyennes*, which are not within convenient distance of an Athénée.

Norway.—In Norway, likewise, the classics have recovered ground. In 1896 Greek was entirely banished from secondary education; to-day it is included in one section of the higher schools (Gymnasia), and can be studied by girls as well as boys.

Czechoslovakia.—The republic of Czechoslovakia has largely maintained the previous types of education, which were on German lines and as the system is co-educational, classical or Latin studies are equally open to girls.

Sweden.—In Sweden classics seem to have somewhat lost ground. The pupils following a full classical or Latin course, who ten years ago were in a majority, are now outnumbered by those taking modern studies.

To sum up: In Italy classics are supreme. In Spain Latin is obligatory for all university entrants. In France, while Greek is on the wane, Latin forms part of the education of at least two-thirds of the secondary pupils. In Germany for the moment Latin is losing ground, but in the new Reformschulen classical pupils still abound. In Sweden classics appear to be slightly losing popularity; in Czechoslovakia the old forms of classical education have been preserved. In the other European countries, where classics have been ousted from intermediate education and confined to one or more sections of higher education, they are apparently either holding their own, or have recovered some of the lost ground, as in Norway and Belgium. (C. Bre.)

In the United States

United States.—The limitation of the Latin vocabulary required in the secondary schools to the words of greatest value for further study of Latin was modified by a study of the Latin words most important for the correct use of English, and a definite place in teaching was assigned to the derivation of English words from Latin. Greater attention was paid to the historical, political, social and literary values of the authors read, and less emphasis was laid on the formal side of the language. The Direct Method, demonstrated by Dr. W. H. D. Rouse in New York in 1912, was found ill adapted to the inelastic programmes of the large public high schools, but its influence was seen in the greater provision for oral Latin in new textbooks.

In 1920 the General Education Board arranged with the American Classical League to conduct an investigation of the Classics (chiefly Latin) in American secondary schools. This investigation was carried out by experts and extended over a period of three years. The results were published in 1924 in the elaborate General Report, Part I. This covered statistical information, chapters on the aims of Latin teaching, the curriculum, the methods of teaching, etc. The aims as organised were, in order of importance, to read and understand Latin; to increase the pupil's ability to understand the Latin element in English, and to read, speak and write English; to develop historical and cultural background, correct mental habits and right attitudes toward social situations; to increase the ability to learn foreign languages; and to give an elementary knowledge of the principles of language structure. The chapter on curriculum recommended a graded restricted vocabulary organised largely with reference to English derivatives; an elimination of the unusual syntactical constructions from the early work; an increase in the amount of easy reading; less attention to Caesar, Cicero and Vergil; a wider range of selection in authors; and an extensive use of collateral reading illustrative of the civilisation of Greece and Rome. In the chapter on method a functional rather than a formal approach was suggested, with careful attention to the transfer of training, a large use of oral Latin, including reading aloud with proper expression, and the employment of translation rather as a sure training in English than as a means of testing comprehension of the text.

The suggestions of this report have been received with general approval and bid fair to be widely adopted. The College Entrance Examination Board has approved them, and textbooks are being modified to meet the new demands. (G. L.*)

CLAUDEL, PAUL (1868–), French poet, dramatist and diplomat, was born Aug. 6 1868 at Villeneuve-sur-Fin. He was educated at the Lycée Louis-le-Grand, and entered the consular service in 1892. The early part of his diplomatic career was spent in the East as consul at Foochow, Shanghai and Tientsin. As first secretary at Peking he gained a valuable acquaintance with Chinese life and thought. In 1921 he was made French Ambassador at Tokyo after a series of European appointments and three years in Rio de Janeiro. He was one of the earliest contributors to the *Nouvelle Revue française*, founded in 1908–9, but as early as 1900, he was recognised by the discriminating few as a writer of the first rank. His works and especially his plays are definitely Catholic in inspiration; they are, however, often marred by a vague mysticism tending to obscurity.

Among his works are *Connaissance de l'est* (1900; Eng. trans. by T. Frances and W. R. Bénet, *The East I Know*, 1914); *L'échange, La tête d'or, La jeune fille Violaine* (1901); *Cinq grandes odes* (1910); *L'otage* (1911; Eng. trans. by Chavannes, 1917); *L'annonce faite à Marie* (1912; Eng. trans. by L. M. Still, 1916); *Deux poèmes d'été* (1914); *Corona* (1915); *Poèmes de guerre* (1915). He was also responsible for translations of the Agamemnon and the Eumenides of Aeschylus (1920).

CLAUS, ÉMILE (1849–1924), Belgian painter, was born at Vive Saint-Éloi, Flanders, on Sept. 27 1849. Receiving early training at the Antwerp Academy of Fine Arts, Claus began as

a traditionalist. His early works are genre scenes and portraits, correctly drawn and painted in a stereotyped manner and showing no originality. Soon, however, he came under the influence of certain French painters who had determined to break from the rut, and he completely changed his style, in spite of the fact that he had achieved a certain reputation and his work was remunerative. He started to paint in high lights by the juxtaposition of pure colours. He settled at Astène, in a house on the banks of the Lys, which he called *Zonneschijn*. There he began to paint that beautiful series of views of meadows, gardens, fields, streams, roads, seen at every time of the day, at every moment of the season. He became the painter of the sun and of the moonlight, of the blue or of the grey sky, of rain, of wind, of mist, of snow, of dew, of fog, rather than the painter of earth, trees, cottages, cattle or human beings in the open fields, which appear to be his subjects.

During the World War Claus resided in London, and from the windows of a house on the Victoria Embankment painted views of the Thames, showing the changing effects of the light and the weather. In 1917 he accompanied the Queen of the Belgians to La Panne, and visited the devastated regions. In 1920 he returned to Astène and worked there until his death, on June 6 1924. He was a member of the Belgian Royal Academy, Commander of the Order of Leopold and the recipient of numerous Belgian and foreign honours. He is represented in the Luxembourg, Paris, and in galleries in Venice, Brussels, Antwerp, Ghent and Liége. His works are also found in numerous Belgian and foreign private collections. (P. L.)

CLEANING: *see* DRY CLEANING.

CLEMENCEAU, GEORGES (1841–), French politician (*see* 6.482).—In 1911 M. Clemenceau entered the Senate and went on the Commissions for Foreign Affairs and the Army. He could have had no better position for surveying European fluctuations and German activities; or for inquiry into the real condition of French armaments—this last his dominant concern. Convinced that Germany meant war, and was organising war, he was haunted by the fear that again France might be caught unprepared. Significant was his speech in the Senate, Feb. 10 1912, on the Franco-German Convention (of Nov. 4 1911). "Germany relies above all on force . . . her whole thought is how to utilise that force. I see it constantly stated in the German papers that she intends to invade France, and extract from us an immense indemnity. All her newspapers are insisting that France shall be made to pay the costs of the new German fleet."

The Senate, however, gave little opportunity for sounding the alarm. Accordingly, on May 5 1913 appeared a new daily paper, *L'Homme Libre*, its editor—Georges Clemenceau. In its pages he waged daily battle for security and liberty. The issue of May 5 contained the following: "Our past defeats have exposed us to a perpetual menace from the most formidable army that ever was. We must live; and the nation has the right to insist that the maximum of efficiency shall be obtained from its manpower." Though *L'Homme Libre* dealt every day with home politics and social problems, it returned always to the terrible theme of the German menace.

The following extracts are from articles which appeared in 1913: "The issue of this appalling conflict will be nothing less than the life or death of France." (May 25); "Germany has but one aim—to wipe out France." (June 14); "Only an absolutely determined Government can ensure our being prepared for war." On March 6 1914 he wrote: "Let Germany choose her own time; she will soon learn how much can be accomplished by the moral force of a good cause backed by courage and full preparation." To stir the nation by his urgent appeals this ardent controversialist seized every pretext: Alsace-Lorraine, the Zabern affair, the illusions of French pacificists, the vain attempts at a Franco-German rapprochement, the imprisonment of Hansi the Alsatian caricaturist by the Germans. In the spring of 1913 the question of restoring the three years' term of conscript service suddenly arose. Would France make this mighty sacrifice in view of the German peril? M. Clemenceau took an impassioned part in the debates on armaments. The Minister of War admitted that France had allowed herself to be outstripped by Germany in the production of scientific means of warfare, but he added: "Moral force is supreme. With its aid inferior weapons can deal splendid blows." "Why don't you buy crossbows then?" cried M. Clemenceau from his seat in the Senate.

Then came Aug. 1914 and the War. M. Clemenceau was living in the rue Franklin at Passy, in a three-roomed flat crammed with books. The flat was on the ground-floor of a five-storied building, on the far side of the courtyard. At the back, on a terrace overlooking the boulevard Delessert, was a small garden planted with rose-bushes and Japanese dwarf-trees. During the first three years of the War, M. Clemenceau's day was spent as follows: He rose at one or two in the morning, lit his lamp, and worked intensely for three to four hours on the daily article of two columns for his paper. Sometimes this long article was written straight off at one heat; at other times it was worked out after many alterations and erasures. At six or seven o'clock he breakfasted, did physical exercises and received his daily flow of visitors. Next he coped with his correspondence—one to two hundred letters from all parts of France, enabling him to keep his finger on the national pulse. After a hasty lunch of perhaps a cutlet and some fruit, he used to face the two formidable commissions of the Senate, where the ministers of national defence had to appear. After these sittings, M. Clemenceau quitted the Luxembourg to drive off immediately into the heart of Paris. At his newspaper office in the rue Taitbout he went through his article, conferred with his subeditors and political correspondents, read the evening papers. At eight o'clock he returned home, dined and went to bed. This was the average working day of M. Clemenceau, who in 1914 was already 73 years old.

But at the hands of the Censor *L'Homme Libre* soon suffered for M. Clemenceau's plain speaking. He knew that the war problem was complex, and was determined to insist on all the vital needs. The whole youth of France must be mobilised. He denounced the shirkers, demanded that technical efficiency raised to the highest pitch must become worthy of the outpouring of blood. He attacked all incompetency, red tape, inadequate munition factories, with their shortage of guns and rifles, and badly-run hospitals. He made war in short, upon all who failed to realise that this was a conflict of supplies and organisation, and upon every kind of apathy and feebleness. The civil and military officials were staggered. M. Clemenceau had actually dared to say that all was not well, and that peace habits must cease when the nation was fighting for life. The result was that in Sept. 1914 *L'Homme Libre* was suppressed. Two days later, however, it reappeared as *L'Homme Enchâiné*, but wore its fetters lightly. For three months—until M. Clemenceau came into power—there was a daily struggle with the Censor. Which would tire first? For some time not a week passed without articles being mutilated, but M. Clemenceau won. His hammer hit the nails on the head. The Censor relaxed more and more until excisions became very rare. Meanwhile in the Senate, M. Clemenceau agitated for more and still more guns, munitions, soldiers. He pleaded for a judicious use of the available man-power, for a better medical service.

But above all he strove to create the indomitable and desperate "will to victory." He was supported by other members of the Army and Foreign Affairs Commission, like MM. Jeanneney, Chéron, Doumer, Humbert, Berenger. The War dragged on; weariness, slackness and pacificism began to appear. M. Clemenceau was the first to draw public attention to that growing peril; he now felt that his warning must be more resounding; that neither the columns of his newspaper nor the secrecy of the commissions gave him scope enough. He first spoke behind the closed doors of the Senate, but it was at a public debate there on July 22 1917 that he sounded a clarion call which rang through France. At this time M. Malvy, who had been Minister of the Interior since 1914, was Chairman of an important Committee in the Chamber; and probably even his warmest admirers would admit that during his term of office he had not treated revolutionaries with a firm enough hand. His justification, it

is true, was that he desired to " gain the confidence of the working-man "; but M. Clemenceau retorted that there was no comparison between those working-men who were loyally doing their duty to their country and a number of abject " defeatists." In vain the Minister of Justice declared that crimes had been punished and precautions taken; M. Clemenceau denounced the measures as inadequate. " We are at war," he said, " the Germans are at St. Quentin: the morale of the country has been shaken. Yet all you do is to quibble about legal forms and talk about fines of 15 to 300 francs! . . . What we must have is order within, that the army with peace behind it may face its task of war."

Four months later M. Clemenceau came into power. He had never sought office and he knew that his task meant victory or death. It is significant to recall the state of France when Clemenceau became premier. Although some maintained that all was going well, and that victory was in sight, the situation in reality was miserable. The morale at the front was bad, and at home even worse. Resources were nearly at an end, and except in the flowery speeches of officials, no solution whatever could be discerned.

At this point M. Poincaré sent for M. Clemenceau; not because he loved him: it would be hard to imagine two men with less in common than the impetuous, explosive Vendean, and the cold precise Lorrainer. But M. Poincaré realised that of all men M. Clemenceau was the impersonation of the idea of war to the death. In his new Government M. Clemenceau himself took the portfolio of Minister of War. He was not altogether a favourite with his colleagues in Parliament; for hitherto he had been chiefly a fighter, giving and taking hard blows. His warnings had been harsh; his candour scathing. But now they welcomed him. One ministry after another had been dismissed. The last, that of M. Painlevé, had fallen amid feelings of doubt and anxiety. A War Minister was needed who would carry on the struggle without flinching or respite. Such a leader was found in M. Clemenceau, who was then 76 years of age. He formed his Victory Cabinet on Nov. 16 1917 and was destined to see Germany defeated on Nov. 11 of the following year. On Nov. 20 1917 he made the following declaration: " Pacificism must go; no more German intrigues; no more treason or semi-treason. War, and nothing but war!" Thenceforward till Nov. 11 1918, Clemenceau did in fact concentrate on war only. But first he made it clear that France was bent on absolute victory and would brook no half-measures. Those who spoke of wavering or yielding were immediately silenced; any one who obstructed the path to victory was ruthlessly removed. By these means Clemenceau restored the nation's self-confidence, and with it the conviction that its long-drawn out martyrdom would not be in vain. No one who was in France at that time will ever forget that extraordinary resurgence of hope and resolution transforming the French people.

The soldiers at the front redoubled their efforts; in vain the Central Powers alternately brandished the sword and held out the olive branch. The whole nation was solidly united by the will to victory. In March 1918 the Anglo-French line was broken through; Clemenceau joined in organizing the unity of command with Foch at the head. In April the Austrian Minister Czernin proclaimed that France was ready to negotiate. M. Clemenceau merely replied: " Il y a des consciences pourries." In May came the disaster of the Chemin des Dames; the French troops were driven back on the Marne, while the commander-in-chief was criticised. " Our soldiers," said M. Clemenceau, " have officers who are in every respect worthy of them," and three months later he made Foch Marshal of France. During that long year of ceaseless effort M. Clemenceau's resolution remained unshaken. France was determined on victory, for he had infused into her the temper of fine steel. Every night German aviators raided Paris, demolishing whole blocks of houses and dropping bombs even on the Ministry of War itself. " Big Berthas " fired on churches and the hospitals of the Maternité and Saint-Gervais were both struck. Whole towns and districts were wrapped in mourning; but resistance only stiffened. Conviction strengthened that the Germans were being beaten. On Nov. 8 1918 Erzberger was already in the train of the Commander-in-chief of the Allied Armies. On the 11th the guns roared for the last time; the nightmare was over.

From Nov. 11 1918 to June 28 1919 M. Clemenceau devoted himself to the international settlement. The Peace of Versailles was in preparation, and this necessitated strenuous days of work and delicate negotiations. Up till now M. Clemenceau had merely had to contend with his enemies; now his task was to reconcile the interests of France with those of her friends. He defended her cause with enthusiasm and conviction, forcing his view alternatively on Mr. Lloyd George and President Wilson. Meanwhile Germany was disarming, and M. Clemenceau took care to supervise that disarmament. But the French Parliament began to grow restless, for it saw itself put to one side in the peace negotiations. It therefore no longer regarded M. Clemenceau as indispensable. The great patriot, who was anxious to finish the work he had begun, did his best to smooth matters over. Momentous problems had to be solved; demobilisation had to be faced, a general election was looming ahead, and the questions of Alsace-Lorraine and the liquidation of war stocks had to be settled. M. Clemenceau decided to deal simultaneously with these questions as of equal importance.

Peace was signed on June 28, and on Nov. 11 the new chamber was elected. M. Clemenceau counted on its support; for he believed that its members, many of them ex-soldiers, would have profited by the lesson of the War. Although he never stood as a candidate—it is certain that he would have been ready to give the last years of his life by taking M. Poincaré's place at the Elysée. And thus outside and above the changing Governments, he could have secured continuity in political action by a strict application of the 1919 treaties.

M. Poincaré left the Elysée . . . but M. Deschanel was elected President of the French Republic. And without doubt the electors, under the cloak of the ballot, had voted according to their hearts. M. Clemenceau had saved his country, but members could not forgive the fact that he had excluded them from the final work for victory. During the War he had undoubtedly worked alone; he felt that large assemblies were not made for action. Probably he would have admitted the Commissions to the deliberations on the Treaty of Versailles if diplomatic obstacles had not intervened to prevent it. M. Clemenceau had also to face—both in the Chamber and in the Senate—the hostility, not only of the clerical party of the Right who suspected him of indifference to the Vatican, but also that of the extreme Left, who were alienated by what they considered to be his militarism. Clemenceau thus met the fate which overtook other War Ministers and on Jan. 20 1920 his cabinet fell, M. Deschanel being summoned to office. He had earned the gratitude of his country and returning to his beloved books, might well have sought repose; instead he sailed for India. There he was able to study an ancient civilisation, whose splendours had always fascinated him. " The Tiger " hunted the tiger; and his English friends welcomed him magnificently. He travelled over the whole country, and retained a vivid impression of the Ganges and the temples of Benares in particular. In Paris *L'Echo National* of André Tardieu carried on the fight for the Treaty of Versailles. M. Clemenceau returned to the rue Franklin and to his books. Once more he was able to enjoy his Aeschylus and the roses in his garden.

But it now appeared that the United States was endeavouring to dissociate herself from European affairs. Though she had fought to win the War, she would not help to win the Peace. M. Clemenceau was now 81 years old, but he sailed at once for America at the end of 1922. From town to town he carried the message of France to the citizens of the Union. He had no official mission, for he had neither asked anything nor received anything from the French Government. His progress was none the less triumphant. Once more he returned to the rue Franklin, but not to rest. Life and work with him were synonymous, and by the end of 1925 he was already writing two books; one on philosophy and the other on Demosthenes. What better subject

for the French patriot than the great Athenian who would not have his country false to itself. (J. Mt.*)

CLÉMENTEL, ÉTIENNE (1862–), French politician, was born March 29 1862 at Riom and educated there. He was elected a deputy in 1898 and became Minister for the Colonies in Rouvier's Cabinet, in 1905, afterward occupying ministerial posts in departments where his knowledge of economics could find full play: the ministries of Agriculture, Colonies, Finance, Public Works and Marine. His collaboration was particularly valuable in organising the supply of raw materials for the Allied Armies between 1914 and 1918. By effecting the agreement for the establishment of the Inter-Allied Wheat Executive (*see* CONTROL, INTER-ALLIED) with Mr. Walter Runciman in Nov. 1916 Clémentel helped to tide over a difficult situation. The creation of the Inter-Allied Maritime Transport Council was due in great part to his energy, for, as early as Aug. 1917, he had occupied himself with drawing up a general inventory of his own country's requirements, an initiative quickly followed by the Allied Governments. After the Armistice, M. Clémentel was chosen " Président fondateur " of the International Chamber of Commerce. His work at the London Conference of July 1924, which he attended as Minister of Finance in the Herriot Cabinet, was eminently appreciated. He was elected Senator for the Puy de Dôme in 1918. Among his writings may be mentioned: *L'Âme celtique* (1899) and *Un drame économique* (1914).

CLERMONT-GANNEAU, CHARLES SIMON (1846–1923), French orientalist (*see* 6.498), died Feb. 13 1923.

CLEVELAND (*see* 6.503), the largest city in Ohio and the fifth in the United States, had in 1920 a population of 796,841, a gain of 42·1% for the decade. In 1924 the population was estimated at 902,457. The area in 1925 was 69·154 sq. m. as against 41 sq. m. in 1910. Of the three new viaducts across the valley of the Cuyahoga river, the noteworthy one is the High Level Bridge with a central span of 591 ft. in length and 96 ft. above water. The total length, with approaches, is 5,630 ft., the cost $5,407,000.

The centre of retail trade has moved steadily eastward, crowding out the large houses with spacious grounds which had made Euclid avenue famous. New residential sections were developed, especially near Wade Park and on the heights east of the city. Noteworthy buildings added include the County Courthouse, the City Hall, the Public Auditorium and the Public Library (of the uncompleted " group " plan); the Union Trust, the Engineers Bank, the Federal Reserve Bank and Hanna buildings; *The Plain Dealer* newspaper building; the Cleveland Trust Co's. Bank; the Museum of Art and the Church of the Covenant (Presbyterian), St. Agnes (Catholic), The Temple (Jewish) and the Amasa Stone Memorial Chapel of Adelbert College.

Education.—The schools were reorganised in 1917 as a result of a survey. Significant features were the development of junior high schools, of which there were 19 in 1925, and the establishment of departmental supervision. The Normal School, now the Cleveland School of Education, was affiliated with Western Reserve University. To the university group was added a night college called Cleveland College. In 1924–5 the university had 514 instructors and 3,410 students. The most important addition to the educational and artistic life of the community was the Museum of Art. The building, of classical design, was completed in 1916. Its directors have succeeded, through classes, lectures and special exhibitions, in making it a power in popular education. Another valuable influence has been the Museum of Natural History opened in 1922. The musical development of the city was stimulated by the creation of a symphony orchestra and a school of music.

In its charities Cleveland has carried far the principle of co-operation, seeking to obviate through a welfare federation the waste in soliciting contributions. The Cleveland Foundation was created in 1914 to enable a competent commission to institute inquiries on the best methods of furthering the interests of the community, and, when the funds entrusted to it become large enough, to apply the income directly to schemes of betterment.

Cleveland is the seat of a Federal Reserve Bank. Its two largest banks in 1925 were the Union Trust Co., formed in 1921 by the consolidation of several older banks, and the Cleveland Trust Company. The Brotherhood of Locomotive Engineers Co-operative National Bank, the first labour bank in the United States, organised in 1920, had resources in 1925 of $28,082,840. The city's manufacturing enterprises expanded steadily during the period 1910–25. The increase in automobile production was among the most striking. The harbour facilities were developed by the completion of the government breakwater, 5¼ m. long. The city still retained its position as the greatest ore market in the world, and led also in the manufacture of many steel products.

In accordance with the authority conferred by the home-rule amendment of the state constitution, a charter, submitted by a special commission, was accepted by the citizens on July 1 1913. This reduced the number of elected officers to the mayor and 26 councilmen. By an amended charter, which took effect on Jan. 1 1924, the manager system was introduced. The council of 25 members was chosen by districts, four in number, instead of by wards. The president of the council was called the mayor, but full administrative authority, with the duty of choosing heads of departments, was entrusted to the manager, elected by the council and holding office at its pleasure. Subordinate officials were appointed according to the merit system. The city added to its waterworks a filtration plant for its western section, with a capacity of 150,000,000 gal. a day, and a high-level reservoir for the eastern section, and in connection therewith a filtration system with a capacity of 166,000,000 gallons. (H. E. B.)

CLIFFORD, JOHN (1836–1923), British Nonconformist divine (*see* 6.507), died Nov. 20 1923.

CLIMATE AND CLIMATOLOGY (*see* 6.509).—Climatology is largely a science of the future. The full value of much of the great mass of data already collected and now being collected will really not be reached until the averages, the extremes and the variability of the different climatic elements can be based upon longer series of records than most of those now at hand. The essential facts concerning the climates of most of the world, although not yet known as completely or as accurately as is desirable, or as will eventually be possible, are nevertheless sufficiently well ascertained to meet ordinary needs.

General Climatology.—The third edition, in three volumes, of Julius von Hann's *Handbuch der Klimatologie* (Stuttgart, 1908–11) constitutes the one indispensable handbook for all who are in any way concerned with the study of climate. In them, a summary of what is known concerning the climate of every part of the world may be found. The climatic pictures are made notably complete and accurate by means of vivid descriptions of weather types; by frequent references to the effects of climate upon vegetation, crops and human activities and by well-chosen quotations from the writings of residents and of travellers who are familiar with the climates concerning which they have given accounts. Temperature, rainfall and other essential data for large numbers of stations are in many cases here worked out in detail and summarised for the first time. Kendrew's *The Climates of the Continents* (Oxford, 1922) is the first comprehensive survey in English of the climates of the land areas of the world. Tables of monthly average temperatures and rainfalls for more than 400 stations, and numerous maps and diagrams, are included. A vast amount of information is here available, in one volume, in convenient form for ready use.

Wladimir Köppen's *Die Klimate der Erde* (Leipzig, 1923), after a general discussion of the principles of climatology, gives a description of the essential features of the world's climates. This description ignores political boundaries, using instead a series of climatic provinces, distinguished from one another by certain critical values of the essential climatic elements. A brief, simple scheme of two or three reference letters or numbers (climatic formulae) is used for the characterisation of each province. Eckardt's *Grundzüge einer Physioklimatologie der Festländer* (Berlin, 1922) is original in title as well as in method of treatment. It deals with the climatology of the continents, but dispenses with all tabulations and contains very few numerical data. The changes in seasonal pressures are taken as the fundamental controls of climate. These three volumes are valuable supplements to von Hann's standard work.

Local Climatology.—Many recent publications deal with the climate of individual countries or of smaller areas as given in the classified *Bibliography of Meteorology* issued semi-annually (since Sept. 1920) by the Royal Meteorological Society (London), or in the bibliography regularly published in the *Meteorologische Zeitschrift.*

United States.—Especially marked progress has been made during the past decade in the scientific investigation of the climatology of

the United States. The preparation of a section on climate for a new *Atlas of American Agriculture* (1918 and later years) marks an important advance in the accurate charting and discussion of many of the essential features of the climatic conditions of this large area. This atlas will, for many years to come, be the standard authority on all the subjects with which it deals. The data used in the construction of the large series of maps relate to temperature, precipitation, humidity, frost, sunshine and wind all cover a uniform period of 20 years or longer, or have been reduced to that period. Many details are further set forth by means of special diagrams and graphs. All the essential facts regarding the climatology of the United States are cartographically shown in this new atlas with a detail not hitherto attained in any other area of equal size in the world. The text accompanying the charts, while brief, is adequate in calling attention to the more important facts.

In *The Climates of the United States* (Boston, Mass., 1925) R. DeC. Ward has given a compact general description and explanation of the essential characteristics of the climatology of the United States, fully illustrated with charts and diagrams, and based on all available information. Full bibliographies are included on each topic, and special attention is paid to the economic and other human relations of climate.

Australia.—Australia is another large area, a knowledge of whose climatology has advanced very rapidly. The Australian Commonwealth Bureau of Meteorology has issued an unusually valuable series of reports, dealing especially with rainfall, but also presenting many other essential facts concerning the general climatic characteristics of the country. These studies are clear and concise in treatment, and emphasise the practical economic aspects of the subject. A report on the climate and weather of Australia (1913) is one of the best available discussions of the meteorological and climatic conditions of any part of the globe. The main thesis of these monographs is the climatic limitation and control of agriculture and of stock-raising. The results will be of practical value in the future development of Australia. The extreme importance of rainfall is emphasised, not only of the annual amounts but also of the season at which the rain falls, and of its reliability.

Latin America.—The climatology of Latin America is receiving increased attention. The establishment of the new Directoria de Meteorologia (1921), in Brazil, has already resulted in an increase in the number of observing stations, and in the publication of important climatic data in the regular bulletins of that service.

For Mexico there is a very complete study of the temperature conditions, equal to that available for many other countries.[1] New rainfall maps of Latin America have been constructed.[2] The scattered data for the several countries of Central America have been compiled in convenient form,[3] and a useful annotated bibliography of South American climatology has been published.[4]

It is significant that, with the increasing accuracy of climatic data resulting from the availability of records covering longer and longer periods of time, there is a marked tendency to publish these data in cartographic rather than tabular form. They thus become available for easier and more effective use. Hellmann's *Klima-Atlas von Deutschland* (Berlin, 1921); a new edition of Mohn's *Atlas de Climat de Norvège* (Christiania, 1921); Angot's monographs on the rainfall of France (Paris, 1913, etc.); Gorczynski's new isothermal and isobaric charts of Poland, Europe and the World (Warsaw, 1917–8) may be noted here. Mention should also be made of a very complete discussion of the rainfall of the British Isles, based on all available data, by Salter.[5]

Arctic Regions.—While the meteorology of the Arctic has made relatively little progress in recent years, the Antarctic has been visited by a large number of expeditions, most of the results of whose scientific work, as well as some of the results of work done prior to 1910, have been published in the last decade or so. These discussions include those relating to the British expeditions of 1901–4, 1910–3 and 1914–7; the Australian expedition of 1911–4; the Norwegian of 1910–2; the German of 1911–2, etc. Meteorological observations are now available for complete years, made at fixed land stations; on board vessels drifting slowly in the ice, on sledge journeys, and from the upper air by means of kites and balloons. The material is, however, still too scattered and incomplete to give an accurate and satisfactory picture of Antarctic climate. Most of the discussions concern the physical problems of Antarctic meteorology.

In all studies of the controls of the seasonal weather conditions, and hence also of climates, the *Réseau Mondial* is practically essential.[6] This is a compilation of world data by 10° squares of latitude and longitude based on observations at land stations averaging two for each square. Monthly and annual summaries of pressure, temperature and precipitation are included.

Climate and Crops.—Recent studies of the larger controls of climate over crop distribution, and of weather factors which most affect the critical periods of growth and of yield of field and garden crops, have brought out much information which will prove of importance in the advance of agricultural climatology. The geographic origin of the world's food supply and of other essential agricultural products, and of the climatic and other factors which control the present distribution of the world's crops and livestock, are discussed in the *Geography of the World's Agriculture.*[7] In this atlas the essential climatic controls in the case of the important crops in all parts of the world are briefly stated. Another publication, also of wide interest, deals with cotton.[8] The climates of all the cotton areas are discussed, detailed consideration being given to the United States. The facts here given are of practical value in the selection of the most favourable climates for future cotton growing. An outstanding publication whose aim is to elucidate the methods that may be used in studying the aetiology of plant distribution, and to give the essential climatic data necessary for carrying out such work in the United States, has been issued by the Carnegie Institution of Washington.[9] This is the most notable investigation of its kind for any area of comparable size. J. Warren Smith's *Agricultural Meteorology: the Effect of Weather on Crops* (New York, 1920) is a serviceable guide to the use of correlations and of similar processes in the study of climate and crops, and also summarises results already achieved.

Climate and Health.—The intimate study of solar radiation in relation to health (*see* HELIOTHERAPY) is making very rapid progress. At Davos, Switzerland, Dorno has made himself the recognised authority on solar and sky radiation.[10] He has there measured the light, heat, chemical and bactericidal effects of radiation which is found to vary widely in its ray elements, even at the same station, the same solar altitude and under a clear sky. The results are of great importance in medicine and in biology, recent medical researches having shown the value of certain of the finer rays in the treatment of tuberculosis, rickets and other diseases. The essential facts on open-air and sunshine in relation to health and diseases are given in a popular handbook by Dr. Leonard Hill,[11] and in A. C. Rollier's *Heliotherapy* (London, 1923). It appears that in the use of climate for medical purposes the variable quality of sunshine must be known, and not merely its duration.

Physiological Climatology.—It has for some time been recognised that conditions which are best for human beings are moderately cool and moderately moist air, in motion, together with a reasonable variability of temperature. (*See* PUBLIC HEALTH.) Dr. Leonard Hill has devised a so-called "Katathermometer" (*q.v.*) which indicates by the rate of cooling of wet and dry bulb thermometers, heated to about the surface temperature of the human body, the combined effect of temperature, humidity, wind evaporation, etc., in a way comparable with the experience of a human body.[12] Several investigators have sought to determine, in actual numerical values, the most favourable atmospheric conditions for man. Dr. Griffith Taylor, using wet bulb temperatures and relative humidities, has worked out the criteria of a suitable climate for Anglo-Saxons in the tropics.[13] This study suggests, as representing ideal conditions, a wet bulb reading of 62° F. and relative humidity of 68·5% in summer, and 37° F. and 81% in winter. Köppen gives 64·4° F. (18° C.) as the temperature of greatest comfort.

Climate and Civilisation.—Using statistics of the efficiency of factory operatives, students and others in the eastern United States, Huntington has determined what he calls the "Optimum" temperatures for man's greatest efficiency.[14] These are outdoor temperatures of 60°–65° F. for maximum physical efficiency and 40° F. for maximum mental efficiency. Beneficial stimulating effect was found in a certain moderate degree of temperature variability associated with storm controls. The different parts of the world are graded according to their approximation to such a climate, and the civilisations of those areas are also graded. A close agreement is found between the results. The conclusion is reached that a certain special combination of climatic conditions prevails to-day where high civilisation is found, and that past climatic fluctuations which brought a similar type of climate were associated with corresponding periods of high civilisation. Criticism of these far-reaching conclusions has been based on the insufficiency of the data upon which the study rests; a lack of any general agreement as to the facts concerning the distribution of civilisation and the occurrence of special climatic types in past times, and upon the fact that the controls over human development and historical events are far too complex for any simple evaluation.

Variations of Climate.—The whole question of climatic variations is still under active debate, both as to the occurrence,

[1] The references refer to the Bibliography at the end of the article.

characteristics and frequency of any such "changes," and also as to their possible causes. Dr. Ellsworth Huntington has been a prolific writer on this problem. His investigations, which began in central Asia, have been extended over parts of western Asia, Palestine, the Libyan Desert, the south-western United States and portions of Central America.[15] From an examination of a large body of evidence—archaeological, physiographic, historical, including the rings of the giant *Sequoias* of California and of other trees, the conclusion is drawn that from the beginnings of human history a gradual change from moister to drier climates has been going on. This process has, however, not been steadily progressive, but has taken place in a more or less irregular, pulsatory fashion, drier and moister epochs alternating, without definite periodicity, as subordinate irregularities on the general curve of desiccation. The major fluctuations are believed by Huntington to have been essentially synchronous, and of the same general character under similar geographic conditions, in central and western Asia, in the Mediterranean area and in North America. These pulsations are further believed to have been potent factors in bringing about certain great historical migrations and events, such as the decay of Rome, the rise and fall of the Central American civilisations, and so on.

While much evidence in favour of changes of climate in historic times has been brought forward, the opinion is quite widely held that a good deal of this is not wholly trustworthy. Much of it is so distinctly contradictory that in certain cases nothing less than a complete deadlock exists. Further, a considerable number of meteorologists think that much of the evidence seems to have been interpreted without due consideration of controls other than climatic fluctuations. In cases where careful examination of the evidence has been made by experts in archaeology, botany, geology and history, there has usually been hesitation in ascribing the facts solely, or often even partly, to fluctuations in climate. At the present time, the opinion of the majority of the most competent authorities seems distinctly to be that there is not sufficient unimpeachable evidence to justify a belief in any permanent progressive change of climate within historic times. That there are certain fluctuations in the values of the climatic elements is, however, a well-established fact. The so-called Brückner period, averaging about 35 years in length, is generally recognised. No definite or universally accepted conclusion has yet been reached regarding the existence of other longer periods. A period of about 11 years in temperature, rainfall and certain other meteorological phenomena has been made out by several investigators, but on the whole the variations in the values of these elements appear to be very slight, and the results are often debatable, if not contradictory. Köppen has greatly extended his investigations of sunspot controls over temperatures, begun some 30 years ago, and has found that the 11-year periodicity appears to be somewhat less marked but more regular than he at first thought it to be.[16] (*See* ATMOSPHERIC ELECTRICITY; METEOROLOGY.)

Douglass has for some 25 years been studying the evidences of climatic fluctuations given by tree rings in California and elsewhere.[17] Some of his conclusions have been used by Huntington and others in their investigations of climatic fluctuations. Douglass believes that a close relation exists between the thickness of tree rings and the annual amount of precipitation, and finds evidence of periodicity over large areas, in agreement with the sunspot cycle or multiple of it. A 100-year cycle also appears very prominently in the 3,000 years of *Sequoia* record and in the 500 years of the yellow pine. The climatic chronology based on the tree rings has also been studied in the tree trunks and beams discovered in the ruins of prehistoric dwellings in the south-western United States.

Causes of Climatic Fluctuation.—There is not yet any agreement as to the causes of climatic fluctuations. Very important work on the variations in the intensity of the sun's heat has been carried on during the past two decades by Dr. C. G. Abbot, and his associates of the Astrophysical Observatory of the Smithsonian Institution. The sun is a variable star. There are variations associated with the sunspot period of about 11 years, and there are also variations in shorter intervals, of the order of a few weeks or even days. There has been much discussion, but there is no unanimity of opinion, as to just how such variations in the amount of solar radiation will affect conditions on the earth's surface. Instead of being higher at times of greater solar activity, temperatures over most of the world are slightly lower. A highly complex train of effects must obviously result, in which temperature, pressure, evaporation, cloudiness and rainfall are all concerned, and in which readjustments in the general circulation of the atmosphere play an important part. The varying strength of the atmospheric and oceanic circulations, and the resulting effects upon the development and location of the great "centres of action" and of the wind and rain belts, seem to many writers competent to account for any climatic variations which may have taken place in historical times. In one of the outstanding publications of the past decade, Helland-Hansen and Nansen, in their study of North Atlantic temperatures, conclude that variations in the supply of solar energy, acting through the atmospheric circulation are the initial cause of temperature changes on the earth's surface.[18]

So far as changes of climate during the geological past are concerned, there has been a decided tendency towards seeking an explanation in factors which are recognised as being effectively at work in determining present-day climates, and a lessened appeal to purely astronomical causes, which in the past were most widely advocated. E. Huntington and S. S. Visher in *Climatic Changes, Their Nature and Causes* (New Haven, Conn., 1922), however, incline to the view that variations in solar activity may arise from some effect induced by the approach to the solar system of some of the greater stars. Such variations in solar energy, acting on storms and on the position of storm tracks on the earth's surface are believed to have been concerned in the climatic changes or fluctuations of the past. W. J. Humphreys, who may perhaps be taken as most emphatically advocating terrestrial as opposed to extra-terrestrial or cosmical controls, believes that past climatic fluctuations were due to changes in topography, in the distribution of land and water, in elevation of the land, in atmospheric and oceanic circulations, in volcanic dust, etc. In other words, the same controls over climate were at work in the past as are observed to-day, only in different combinations.[19] In *The Evolution of Climates* (London, 1925), C. E. P. Brooks holds that past changes of climate, such as the glacial periods, were mainly due to changes in the extent and elevation of the lands, especially in the higher latitudes.

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CLYNES, JOHN ROBERT (1869–), English politician, was born at Oldham, Lancs., March 27 1869, of working-class parents, and worked himself as an artisan for many years. He was active in the trade-union movement, and eventually became president of the National Union of General Workers, and chairman of its executive council. He entered Parliament as Labour member for Northeast Manchester (Platting Division) in 1906, when the Labour party was returned for the first time in numerical force, over 50 in all; and he has sat uninterruptedly for the same constituency ever since.

It was not, however, till the World War that he attracted general attention. He protested, in Feb. 1915, on behalf of his party, against the rise in prices, which he attributed mainly to contractors and dealers exploiting the needs of the people. In 1917 he was appointed parliamentary secretary under Lord Rhondda soon after the latter accepted the position of Food Controller. In the arduous and successful work of that office he took his full share, and, when his chief died in June 1918, he succeeded him to the general satisfaction. He gave special encouragement to the creation of national kitchens, the number of which had grown by the end of August to over 600, and he set up, inside the Ministry, a food council to consider questions of policy, and to co-operate with other bodies dealing with food problems. Public appreciation of his admirable work in the War was shown by the honorary degrees conferred upon him in 1919 by the universities of Oxford and Durham. In consequence of the decision of the Labour party to terminate its support of the Coalition Govt., he resigned office in Nov. 1918, just before the general election.

At the beginning of the session of 1919 Clynes was elected vice-chairman of the party, and since then he has been reckoned among its principal leaders. He was chosen chairman in 1921, but after the election of 1922 the Labour party at Westminster elected Mr. Ramsay MacDonald. Mr. Clynes became deputy chairman, and in that capacity moved on Jan. 17 1924 the Labour amendment of want of confidence in Mr. Baldwin's Govt. which brought that Govt. down and put the Labour party in office. He became Lord Privy Seal and deputy leader (in the necessary absences of Mr. MacDonald on Foreign Office business) of the House of Commons. Whether leader, or deputy leader, of his party, Mr. Clynes always spoke in the House of Commons with a moderation and appreciation of the standpoint of other classes not always manifested by Labour members. He showed himself opposed to "direct action," and has treated a capital levy as a suggestion rather than a definite proposal. Though a very lucid and respected speaker, he never attained great parliamentary power. He left office in Nov. 1924.

COACHING.—The London meets of the Coaching Club are fairly well attended, seven or eight members generally putting in an appearance at the Magazine in Hyde Park at the two or three meets which are held every year. This number is supplemented by coaches sent from the Royal Artillery (Aldershot) and the Royal Artillery (Woolwich) and sometimes by a coach from the Army Service Corps.

At the Richmond Show in June 1925 there were 21 entries for the Coaching Marathon. Of these 12 were private coaches, seven road coaches and two military coaches, and the full number did not exhaust all the coaches which were then seen about London. There were also Marathons at Olympia and at one or two other shows in 1925, and, though some of the road coaches which took part in these events were infrequently seen on the roads, two at least had a long and regular season. One coach ran regularly in the north of England during part of the summer.

Driving.—As regards the driving of single-harness horses, the dog-cart, gig, buggy and governess cart are still found in fair numbers, more particularly perhaps in countries where there are many lanes and by-ways and no great amount of traffic on the main roads. Welsh farmers, for example, use a dog-cart more frequently than a car, the approaches to many of the hill farms being almost impossible for a car. In this single-horse traffic the cob is favoured rather than the horse, and for the pair there is almost no demand. The teams which have been seen in and about London during the 20th century are better looking and have better action than their predecessors of two or three generations ago, and the improvement in horseflesh applies in a considerable degree to all breeds of light horses and has come at a time when, except for hunters and polo ponies, the demand is smaller than it has ever been in modern times. (C. Ri.)

COAL (*see* 6.575).—A considerable advance was made during the period 1911–25 in the scientific knowledge of coal, and the production and distribution of coal were largely changed by the World War and other circumstances.

I. COMPOSITION AND CHARACTER

Research work as to the composition and character of coal has been greatly intensified in Great Britain, being carried out particularly in the provincial universities and other educational institutions. The coal owners themselves have promoted it; and, in 1916, the Government set up the Fuel Research Board which since has engaged upon important investigations, more especially in regard to the low-temperature distillation of coal. In Germany, France, Canada and the United States much important work on coal and lignite has been carried out. Nevertheless little more has been discovered as to the chemical composition of coal than was known in 1900.

Coal, being a complex colloidal organic substance, of high molecular aggregation, requires for the elucidation of its chemical constitution the application of the best trained minds in organic chemistry. Again, coals are so varied, from both the chemical and physical standpoint, as to constitute a very wide field for investigation. For years the ordinary black bituminous coal of commerce has been known to be made up of layers of "bright coal" (the *Glanzkohle* of Germany) and "dull coal" (*Mattkohle*), the layers being divided by an amorphous powdery substance known as mineral charcoal. Of late years, and for no very obvious reason, it has become customary to designate these varieties as "vitrain" and "clarain" for the bright coal, "durain" for the dull coal, and "fusain" for the mineral charcoal. The exact origin of these substances, which vary in composition, is not quite clear.

Composition.—Coal is made up of various constituents: (*a*) woody or xyloid substances which are so characteristic of lignite or brown coal, called by some "anthraxylon," from *anthrax* coal and *xylon* wood; (*b*) canneloid material, consisting largely of the spores of cryptogamic plants, of which cannel coal is chiefly composed; (*c*) resinous matter, occurring largely in lignites but rarely in cannels; (*d*) macerated material mixed with woody matter and best described as débris, as it contains all the previous mentioned substances; (*e*) the "fundamental matter" of White and Thiessen, which is the colloidal ground mass in which the other constituents are embedded and which is composed chiefly of the more readily decomposable parts of the vegetable matter. The vegetable constituents of coal are therefore cellulosic and resinous.

Chemists employ three experimental methods for the investigation of the coal substance: (*A*) thermal decomposition, (*B*) fractionation by a sequence or combination of solvents and (*C*) oxidation of the coal, hydrogenation, halogenation, etc. The principal facts which have been established by these methods are:—

(*A*)—M. J. Burgess and R. V. Wheeler (*Chem. Soc. Trans.*, vol. 97, 1910; vol. 99, 1911; vol. 105, 1914) by thermal decomposition applied up to a temperature of 1100° C. determined:—

(1) That the decomposition of the coal substance commenced at about 350° Centigrade;

(2) That in respect of the coals examined, whether bituminous, semi-bituminous or anthracitic, there is a well-defined critical temperature between 700° C. and 800° C. which corresponds with a marked and rapid increase in the quantity of hydrogen evolved; and

(3) That the evolution of methane and other paraffin hydrocarbons almost entirely ceases at about 700° Centigrade.

They concluded that the coals examined by them contained two types of compounds of different degrees of stability, viz., the "resinic" or less stable, which on thermal decomposition yield principally paraffins and no hydrogen; and the "cellulosic," which yield principally hydrogen. The facts hold good, but the interpretation of them as given above is not universally accepted. For instance, Messrs. H. C. Porter and G. B. Taylor, who have carried out researches on American coals (*Proc. Amer. Gas Inst.*, vol. 9 [i.], 1914), repudiate the suggestion that the "resinic" constituents of coal would be less than the "cellulosic" and attribute the great increase in the evolution of hydrogen between 700° C. and 800° C. to secondary decomposition, and they found that more than two-thirds of the organic substance of coal is decomposable below 500° Centigrade. Their views about the composition of coal are best expressed in their own remarks:—

"All kinds of coal consist of cellulosic degradation products more or less altered by the process of ageing, together with derivatives of resinous substances, vegetable waxes, etc., in different proportions, more or less altered. They all undergo decomposition by a moderate degree of heat, some, however, decompose more rapidly than others at the lower temperature. The less altered cellulosic derivatives decompose more easily than the more altered derivatives, and also more easily than the resinous derivatives. The cellulosic derivatives decompose so as to yield H_2O, CO_2, CO and hydrocarbons, giving less of the first three products the more matured and altered they are. The resinous derivatives, on the other hand, decompose on moderate heating so as to yield principally the paraffin hydrocarbons, with probably hydrogen, as a direct decomposition product. The more mature bituminous coals, having good coking properties, contain a large percentage of resinous derivatives and their cellulosic constituents have been highly altered. The younger bituminous or subbituminous coals are constituted of cellulosic derivatives much less altered than those in the older coals. They undergo a large amount of decomposition below their fusion point, and possibly for that reason many of them do not coke."

Professor W. A. Bone points out (*Soc. Chem. Ind.*, June 19 1925) in his paper on the "Constitution of Coal," that in most recent coal research work little, if any, importance appears to have been attached to the nitrogenous constituents of coal, and there seems to be at least some room for doubt whether the supposed "resinic" constituents of coal have been rightly so called. He is inclined to think that our whole coal-nomenclature might be overhauled with advantage. Though there may be some doubt as to the feasibility of drawing a sharp line between the evolution of the various gaseous products in the case of a highly matured type of coal when under thermal decomposition, it is otherwise in the instance of an immature brown coal or lignite, as Bone's work has shown. The results being: (*a*) that up to a certain temperature (in the case of a dried sample of brown coal, from Morwell, near Melbourne, 375° C.) the only gases expelled from the dried coal are steam and oxides of carbon, which evolution continues right up to (and perhaps beyond) 700° C.; (*b*) that at a somewhat higher temperature range (in the case of the Morwell coal 375°–500° C.) methane and other hydrocarbons (without oxygen) appear; and (*c*) it is not until the temperature exceeds 500° C. that hydrogen appears among the products.

(*B*)—1899, Bedson discovered the solvent action of pyridine on coal, and much later, A. H. Clark and R. V. Wheeler (*Chem. Soc. Trans.*, vol. 103, 1913) fractionated coal substance into three parts by first dissolving it with pyridine, then treating the pyridine extract with chloroform. The coal substance was divisible into: (1) that insoluble in pyridine, (2) that soluble in pyridine but insoluble in chloroform, (3) that soluble in both pyridine and chloroform. These fractions are frequently referred to as *alpha*, *beta* and *gamma* constituents respectively, as though they were distinct and definitely separate chemical substances, which is unfortunate seeing that they all contain carbon, hydrogen, nitrogen, oxygen and sulphur—in fact, nearly the same percentage of nitrogen and sulphur in each fraction. In the extraction of coal substances by benzene under pressure, Bone's work is of great interest. He employs benzene in a special form of extractor on the Soxhlet principle at pressures between 500 and 700 lb. per sq. in., and at temperature 260° to 285° C., and afterwards fractionates the extract by a suitable solvent treatment. He and his co-workers have by this means obtained four distinct benzene soluble fractions (*Proc. Roy. Soc.*, 105, Ser. A., 1924).

The result is shown diagrammatically in the next column.

When working on a coking coal it was found that fractions 1 and 2 could be disregarded from the point of view of containing substances of a "binding" character. With regard to fraction 3, Professor Bone says "the amount of this fraction was always very small, ranging between 0·3 and 0·8% only of the whole coal substances; so that, although it has good 'binding' properties, and therefore would be to some extent a contributory factor, it cannot be considered as the chief cause of the coking properties of the coals."

Concentrated benzene solution of crude extract poured into light petroleum (b.p. 40°–60°)

Soluble		Insoluble	
Benzene-free light petroleum		Ethyl Alcohol	
Soluble	Insoluble	Soluble	Insoluble
Fraction 1	Fraction 2	Fraction 3	Fraction 4
Non-nitrogenous heavy oil	Red brown solid softening point about 25°	Non-nitrogenous brittle resinous red brown solid softening point about 60°	Nitrogenous amorphous brown solid softening point 180°–230°

The substances contained in fraction 4 were different from the so-called "coal resins" and seemed to be rather of the "humic" type. Their chemical nature has not yet been finally established, but they constitute from 4·6 to 7·0% of the parent coal substance and have very pronounced "binding" properties, so that the relative coking properties of bituminous coals run nearly parallel to their yields of this fraction. These may therefore be considered as the chief cause of the coking properties of coals.

F. Fischer, H. Broche and J. Strauch (*Brennstoff-Chem.*, 1925) in an account of similar experiments made upon German bituminous coals some little time after the appearance of Bone's paper, divided their crude benzene extract into two fractions only, which probably explains the apparent discrepancy in interpretation of the results. The benzene extracts from a brown coal are chemically different from those yielded by sub-bituminous or bituminous coal. It would seem that the coking quality of a coal is the result of the maturing of coal and is a product of age, for in black lignite there is evidence of the incipient formation of substances closely resembling the coking constituents of the more mature coals.

(*C*)—Recent chemical research on the character of coal includes the work of Dr. Bergius, the German chemist, during the period 1915–25. By subjecting coal to the influence of hydrogen under heat and pressure, he saturates the hydrocarbons in the coal, converting them and, it is claimed, some portion also of the fixed carbon, into saturated hydrocarbons, thus achieving the liquefaction of coal, the objective of chemists for many years. The process has not yet emerged from the laboratory stage, but should it prove a commercial possibility, the results on industry would be far-reaching indeed.

Classification.—Frequent attempts have been made towards a scientific classification of coal, the broad division of anthracite, bituminous coal, and lignite and brown coal, not having been deemed sufficient. Perhaps the best is that adopted by the International Geological Congress held at Toronto in 1913. Coal were then divided into four main classes and three subclasses, letters instead of names being used, and the fuel ratio is taken as the basis of classification:—

$$\frac{\text{Fixed carbon}}{\text{Volatile matter}}$$

and, in the cases of B_3, D_1 and D_2, the split volatile ratio of

$$\frac{\text{Fixed carbon + volatile combustible}}{\text{Hygroscopic moisture + } \frac{1}{2} \text{ volatile combustible}}$$

The classes were as follows:—

Class A

(1) Burns with short blue flame; gives off 3 to 5% volatile combustible matter.
Fuel ratio 12 and over.
Calorific value 8,000 to 8,330 calories or 14,500 to 15,000 B.T.U.

Mean composition—

Carbon	93 to 95%
Hydrogen	2 to 4%
Oxygen and nitrogen	3 to 5%

(2) Burns with slightly luminous short flame and little smoke, does not coke and yields from 7 to 12% of volatile matter.
Fuel ratio 7 to 12.
Calorific value generally 8,300 to 8,600 calories or 15,000 to 15,500 B.T.U.

Mean composition—

Carbon	90 to 93 %
Hydrogen	4 to 4·5%
Oxygen and nitrogen	3 to 5·5%

Class B

(1) Burns with short luminous flame and yields 12 to 15% volatile matter; does not readily coke.
Fuel ratio 4 to 7.
Calorific value generally 8,400 to 8,900 or 15,200 to 16,000 B.T.U.

Mean composition—

Carbon	80 to 90%
Hydrogen	4·5 to 5%
Oxygen and nitrogen	5·5 to 12%

(2) Burns with luminous flame and yields from 12 to 26% volatile matter; generally cokes.
Calorific value 7,700 to 8,800 calories or 14,000 to 16,000 B.T.U.

Mean composition—

Carbon	75 to 90%
Hydrogen	4·5 to 5·5%
Oxygen and nitrogen	6 to 15%

(3) Burns freely with long flame; withstands weathering but fractures readily and occasionally has moisture content up to 6%; volatile matter up to 35%; makes porous, tender coke.
Fuel ratio (split volatile) 2·5 to 3·3.
Calorific value 6,600 to 7,800 calories or 12,000 to 14,000 B.T.U.

Mean composition—

Carbon	70 to 80%
Hydrogen	4·5 to 6%
Oxygen and nitrogen	18 to 20%

Class C

Burns with long smoky flame and yields 30 to 40% volatile matter on distillation, leaving very porous coke.
Fracture generally resinous.
Calorific value 6,600 to 8,800 calories or 12,000 to 16,000 B.T.U.

Class D

Contains generally over 6% of moisture; disintegrates on drying; streak brown or yellow. Cleavage indistinct.

(1) Moisture in fresh mined, commercial output, up to 20 per cent.
Fracture generally conchoidal.
Drying: cracks irregular, curved lines.
Colour generally lustrous black, occasionally brown.
Fuel ratio (split volatile) 1·8 to 2·5.
Calorific value 5,500 to 7,200 calories, or 10,000 to 13,000 B.T.U.

Average composition—

Carbon	60 to 75%
Hydrogen	6 to 6·5%
Oxygen and nitrogen	20 to 30%

(2) Moisture in commercial output over 20%.
Fracture generally earthy and dull.
Drying: cracks generally separate along bedding planes and often show fibrous (woody) structure.
Colour generally brown, sometimes black.
Calorific value 4,000 to 6,000 calories or 7,000 to 11,000 B.T.U.

Average composition—

Carbon	45 to 65%
Hydrogen	6 to 6·8%
Oxygen and nitrogen	30 to 45%

This classification, giving names to the letters, may be interpreted thus:—

A_1 corresponds to anthracite.
A_2 corresponds to semi-anthracite.
B_1 corresponds to semi-bituminous coal (in this class would be included the so-called smokeless steam coal of South Wales).
B_2 corresponds to bituminous coal.
B_3 corresponds to bituminous coal of low fixed carbon content.
C corresponds to cannel coal.
D_1 corresponds to sub-bituminous coal or compact black lignite.
D_2 corresponds to lignite or brown coal.

Bituminous coal is divisible into gas, coking, house, manufacturing and steam coal.

II. THE WORLD'S COAL

The International Geological Congress also made an estimate of the world's resources of coal, for which purpose they took as the minimum thickness of seams, workable to a depth of 4,000 ft. from the surface, 1 foot, and between depths of 4,000 ft. to 6,000 ft., 2 feet; 6,000 ft. being regarded as the limit in respect of workable depth. The figures are given in millions of metric tons. (A metric ton = 2,204·6 pounds.)

Continent	Anthracites including dry steam coals	Bituminous coal	Sub-bituminous coals, lignite or brown coals	Total
Europe	54,346	693,162	36,682	784,190
Asia	407,637	760,098	111,851	1,279,586
Africa	11,662	45,123	1,054	57,839
America	22,542	2,271,080	2,811,906	5,105,528
Oceania	659	133,481	36,270	170,410
Total	496,846	3,902,944	2,997,763	7,397,553

In 1926 coal mining is being carried on to a depth of 4,000 ft. (in Belgium), and the mining of mineral deposits to a depth of 6,000 ft. (in Brazil) from the surface. The working of coal at great depths is, however, more difficult than the extraction of ore from a metalliferous vein at like depth, for, whereas in the latter case the plane of the deposit is, as it were, on edge reaching to the surface, in the former case it is, usually, more or less flat lying at great depth from the surface, the whole of the coal being derived from, approximately, the same depth, and it is very doubtful whether it will ever prove commercially possible to produce coal from a depth greater than 5,000 feet. On the question of supply, it is not so much the duration of the world's ultimate resources of coal that matters, but how long will the better and more cheaply got coals last. European countries are rapidly exhausting their supplies of readily available coals, and, if the present relative rates of exhaustion are continued, the period of their complete exhaustion will arrive long before that of Asia and the New World.

In available resources of coal the American continent far exceeds the rest of the world. In North America there are 5,073,431,000,000 tons; and in South America there are 32,097,000,000 tons; of all individual countries the United States of America takes first place, her resources, for example, being considerably in excess of those of the whole of the British Empire. At the present rate of output the North American resources, more especially those of the United States, will outlast all other countries, and will probably suffice for 2,000 years. Great Britain's supplies at the present rate of consumption will not suffice for more than 600 years at most, and if we take into consideration the coal existing to a depth of 4,000 ft. (the limit taken by the British Royal Commission on Coal Supplies of 1905) they will only last for 450 years. Germany, before the ceding to Poland, after the World War, of a part of her Silesian coalfield, and to France of her Saar and Lorraine fields, had resources of coal sufficient to last at the pre-War rate of output for 1,000 years, but much of her remaining coal is lignite which is of much lower calorific value than true coal. France will have to live on imported coal much sooner than Great Britain or Belgium. The latter country has supplies sufficient for nearly 500 years. Switzerland could mine all her resources in a few years.

The most important of all classes of coal is that which is termed bituminous, for not only does that coal provide the gas, the coking, the house and manufacturing, but many of the steam coals also. It is, too, from this class of coal that we obtain our coal derivatives, *e.g.*, tar, pitch, sulphate of ammonia, paraffin hydrocarbons, benzene, toluene, dyes and some medicines. It is fortunate, therefore, that nearly 4,000,000,000,000 tons, or more than half of the world's coal reserves, are bituminous coal.

Coal Production.—The following statement shows, in comparative form, the production in long tons, of coal by continents for 1913 and for 1924:—

Country	Production	
	1913	1924
North America	531,600,000	525,400,000
South America	1,600,000	1,700,000
Europe	730,000,000	710,000,000
Asia	55,000,000	82,000,000
Africa	8,300,000	12,500,000
Oceania	15,000,000	16,000,000
Entire World	1,342,300,000	1,340,000,000

About 90% of the world's coal is derived from the coalfields of the United States of America and the coalfields of Europe (see fig. 1). The War wrought great changes in the coal-mining industry of the chief coal producing countries of the world and it is of value, in view of recent events and from the point of view of the future, to compare the economic position of the industry

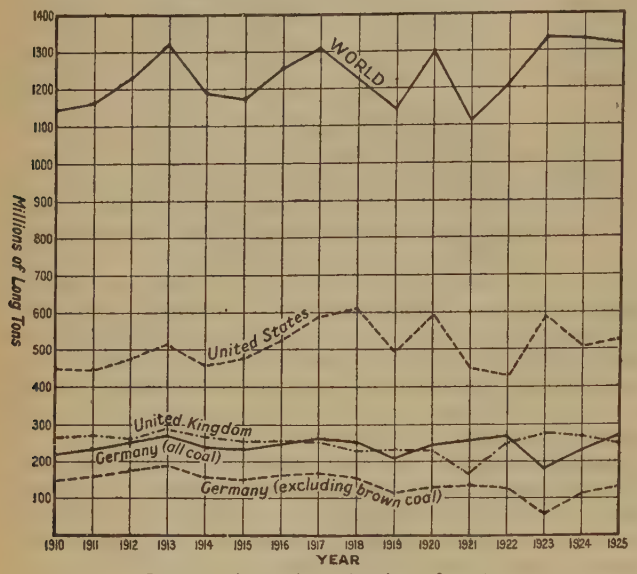

FIG. 1.—Annual production of coal.

as existing at the outbreak of war and in 1925 more particularly as regards production and distribution.

III. GREAT BRITAIN'S COAL TRADE

Of all the industries that contributed to the successful issue to the Allies of the World War, the coal industry was perhaps the most important. In 1913 Great Britain contributed 21·7% of the world's output, and in that year there were 1,110,884 persons employed in about 3,000 coal mines which were worked as about 1,500 separate undertakings. The coal properties, or royalties, as they are called in the industry, were vested in about 4,000 owners. Various estimates of the amount of capital invested in the coal mining industry have been attempted, that by Sir Josiah Stamp, £135,000,000, based on the output of five years preceding the War, being perhaps nearest the mark.

Production and Prices.—The estimated cost of production and of profit to the coal owners arising from the sale of the coal may be taken to have averaged as follows:—

	s.	d.
Wages	5.	6
Stores and pit wood	1.	0
General expenses, inclusive of everything, except depreciation and interest	1.	3
Total	7.	9
Profit	2.	5
Grand total	10.	2

The average royalty rent payable to the owners of the coal averaged about 6d. per ton of coal raised.

For some years the selling price of coal had been on the upgrade, and it has been estimated that during the period 1897–1910 the pit head price had advanced no less than 38%, but during 1914 the tendency of selling prices was downwards, especially in regard to industrial coal, due to the fact that the iron, cotton and other staple industries were in a somewhat depressed state. In fact, when war broke out, trade in Great Britain was on the eve of one of those cycles of depression which are the aftermath of periods of inflated trade and temporary over-expansion.

There was at this time comparative peace in the coal mining industry as between employers and workmen. The year 1913 had been a good year, and wages were high. The settlement of disputes regarding wages was dealt with through the medium of district joint boards or representatives of colliery owners and workmen, presided over by independent chairmen. But there was a movement amongst the advanced or extremist wing of the Miners' Federation in support of national, in preference to district, settlements of wages, and towards nationalisation of the industry. With a view to determining how the available coal supply could be best distributed to meet the national interest in the best possible way, the following comparison as between the years 1903 and 1913 was arrived at:—

	1903	1913
Total output	230,334,469 tons	287,430,473 tons
Reserved for home consumption (not including bunker coal for foreign trade)	166,529,120 tons	189,092,369 tons

The balances were devoted to export and bunkers.

The average pit head value of a ton of coal in 1913, all kinds included, was about 10s. 2d. Of the home consumption it was estimated that at least 80,000,000 tons were absorbed in the production of power, inclusive of railways. The following table shows for 1903 and 1913 the uses to which the coal was put:—

	1903	1913
	Tons	Tons
Railways	13,000,000	15,000,000
Coasting steamers (bunkers)	2,000,000	2,500,000
Factories	53,000,000	60,000,000
Mines	18,000,000	19,000,000
Iron and steel industries	28,000,000	31,000,000
Other metals and minerals	1,000,000	1,250,000
Brick works, potteries, glass works and chemical works	5,000,000	5,750,000
Gas works	15,000,000	18,000,000
Domestic	32,000,000	35,000,000

Effect of the World War.—The immediate effect of the War on the coal trade of Great Britain was to close several important foreign markets. Transport facilities, by reason of the diversion of rolling stock and shipping to military purposes, was also impeded. The result was that there was a temporary glut of coal at the collieries for home consumption. The Allies, especially France and Italy, became largely—the latter country entirely—dependent on Britain for their supplies of coal. France's demands were soon double that of the normal importation. The great expansion in the manufacture of the munitions of war at home greatly augmented the fuel requirements of the iron and steel works and on top of all this the war requirements made a constant drain on the staff of young miners. Up to the end of March 1916, no less than 282,200 men from the coal mines had voluntarily enlisted in the fighting forces. So that, although the decline in exports of coal and coke during the year 1915 amounted to about 14,000,000 tons, this was more than balanced by decreased output, amounting to nearly 12,500,000 tons, and increased demands for home consumption. The average pithead price of coal rose from 9s. 11·21d. in 1914 to 12s. 4·8d. per ton in 1915.

The Coal Mining Organisation Committee, consisting of representatives of the colliery owners and miners, presided over by the chief inspector of mines, was set up by the Government in Feb. 1915 to organise the industry to the best advantage to meet the exigencies created by the War. It had no plenary powers; it could only investigate, report and arbitrate. It continued in almost constant session until the financial control of the industry by the State in 1917, and but for the very strained relations between the colliery owners and workmen in South Wales, which culminated in a complete impasse at the close of 1916, it is probable that the Committee could have functioned successfully right through the War. Two other committees dealing with coal problems were established on the advice of the Coal Mining Organisation Committee, viz.: the Coal Exports Committee, under whose control was placed the whole of the export trade of the country in coal, and the Coal and Coke Distribution Committee, which dealt with the inland distribution of the coal and coke supplies.

In 1916 the output of coal showed an increase of over 3,000,000 tons on the previous year, and the average pithead price had risen to 15s. 2·57d. per ton. Exports still further decreased, but this was occasioned by the unavoidable restriction which had to be imposed to meet home requirements, due to the starting of munition factories and the extensions of works. On the advice of the Coal Min-

ing Organisation Committee the Government instituted the Price of Coal Limitation Act which became law as from July 29 1915, and remained in being until the end of March 1921, being repealed when Government control ceased.

The coal trade had reached a purely artificial state which continued onwards throughout the War, the natural laws governing supply and demand being largely disturbed by Government control of prices and of export. The limitation of the price of coal, which was in the nature of a self-denying ordinance on the part of colliery owners and the miners, constituted one of the chief events in the history of the coal mining industry of Great Britain. It was almost the first attempt at a statutory limitation of the price of an essential commodity and, on the whole, it achieved a remarkable success. By the Act certain maximum pithead prices for the sale of coal for inland consumption were fixed, the coal owners being left free to obtain the best possible price for coal for export, with the exception of a limitation in the case of coal sold to the Allies. Thus at one time the price of the same coal was for home consumption 16s. 6d. per ton and for export 60s., 62s. 6d. and 65s., and after the Armistice, but before the repeal of the Limitation Act, the same coal actually reached 140s. a ton for export.

Government Control.—Owing to the wage disputes in South Wales terminating in an impasse, the Government took possession of the coal mines in Wales and Monmouthshire as from Dec. 1 1916, with the object of eliminating war profits, the avoidance of industrial disputes, and of securing the best results from labour in the mines during the War. In Feb. of the year following it was succeeded by a more stringent control by Government, which was extended to include all coal mines, the three Advisory Committees mentioned above being merged in the control. An agreement arrived at between the Controller and the coal owners as to the compensation to be paid to the latter under the control, was confirmed by an Act of Parliament on Feb. 6 1918.

The management of the collieries remained with the owners, and a profit standard was fixed in respect of each undertaking based on any one of the three years preceding the War which the owner chose to select, such profit being guaranteed to him during the period of control provided he worked up to a standard output. Eighty per cent of all the profit over and above the guaranteed profit was paid to the inland revenue as in the case of the excess profits of other concerns. Of the remaining 20% the Coal Controller took 15%, which went to form a pool from which he met deficiencies that arose in respect of the guaranteed profits of any of the undertakings, the colliery owners receiving the remaining 5%.

Perhaps the two most important actions taken by the Controller of Coal Mines were those in respect of the transport and rationing of coal. On Sept. 8 1917, the Transport of Coal Order was issued, under which Great Britain was divided into 20 areas, shown on maps accompanied by a table indicating the area to which coal produced in each of the production areas might be forwarded by public railway for inland consumption for (1) steam and manufacturing purposes, (2) gas and coking purposes, and (3) domestic purposes. It was estimated that, on the basis of the year 1917, the scheme would effect a saving in transport of rail-borne coal of 700,000,000 ton-m. per annum: though it is doubtful whether the saving effected actually reached this figure. The rationing of domestic coal first applied to London under the Household Coal Distribution Order of Aug. 10 1917.

The Distribution Order, 1917.—Three principal objects were aimed at by this order: (1) the establishment of minimum stocks of coal to be held in reserve throughout the winter; (2) a priority in distribution of any available stocks of coal, in case of shortage, to be conferred on consumers requiring or taking supplies in quantities not exceeding 2 cwt. per week; and (3) restriction in the consumption of coal where it was in excess of the normal average requirements of houses of different sizes. In July 1918 compulsory rationing in respect of domestic coal was made applicable to the whole of England and Wales, and in Oct. 1918 to Scotland also.

Certain advances in wages had been given to the miners during the War and a state of peace reigned in the industry for two years of the control. But at the conference of the Miners Federation of Great Britain at Southport in the summer of 1918 a programme was decided upon which included:—A National wage-board in substitution of district wages boards; a five-day working week; a six-hour working day; and alliance with the railway men and transport workers in order to enforce their demands.

The Sankey Commission.—Active agitation towards securing nationalisation of the mines commenced. The year 1919 was largely one of labour difficulties. To the demands specified above was added one for a 30% advance in wages, and other items. The Government appointed the Coal Industry Commission (known since from the name of its Chairman, Mr. Justice Sankey, as the Sankey Commission), to report, by March 20, as to wages and hours. Unanimity was not secured. There were three reports, that signed by the chairman and three other members of the committee being accepted by the Government. The chief recommendations were, that as from July 16 1919, the hours of underground workers should be reduced from eight to seven, and that, as from Jan. 9 1919 (when the demands of the union's executive were first formulated) workers over 16 years of age should receive an increase of wages of 2s. per shift worked and those under 16, 1s. per shift worked. These recommendations were carried into effect. On June 20, the Sankey Commission, though not unanimously, reported in favour of nationalisation. The measure was not acceptable to the Government, but a stoppage of work was averted.

End of War Time Control.—The financial control of the coal mines was terminated by the passage, on March 31, of the Coal Mines (Emergency) Act 1920, which specified that it should be deemed to have ceased as from April 1 1919. In Aug. 1920, the Mining Industry Act was passed, under which a separate Department of Mines was set up. Although the mines were still under Government control, a national strike of the miners took place in Oct. 1920, and lasted for 12 days. They had received a 20% advance in April (including "war wage" and "Sankey wage") and they now sought a further advance and a reduction in the price of coal. They obtained a settlement on the basis of a temporary scheme put forward by the Government.

The financial decontrol of the mines took place on March 31 1921. As the temporary scheme was drawing to a conclusion, the representatives of the owners and workmen met in order to work out a permanent settlement. Their efforts failed, and, on April 1 1921, another national strike took place; it lasted until July 4, when a settlement was arrived at embodying for the first time the idea of profit-sharing.

The coal mines of the country were divided into 13 districts, each district constituting a unit for the ascertainment of wages. A standard wage was to be paid, being the existing basis rates plus the percentages which were payable on basis rates, in July 1914, in each district. These were to be a first charge on the industry. After deduction of standard wages and costs of production other than wages, the surplus was to be divisible in the proportion 83% to wages and 17% to profits. The standard wages, and the share of the surplus apportioned to wages, were added together, and the sum expressed as a percentage on basis rates, which percentage constituted the rate of wages payable during the next period. In no case could wages fall below a point 20% above the standard wages. Thus was created a national board and district boards to effect a national agreement. In 1924 the agreement was modified, the standard profits to the owners being 15% in relation to the standard wages. Of the gross profits remaining after the deduction from the gross proceeds of costs other than wages, standard wages and standard profits, the workmen received 88%, the minimum percentage on standard wages being 33⅓%.

Depression in the Trade.—Complicated though this agreement was, and therefore not very intelligible to the miners, it could undoubtedly have worked well had the industry continued in a normal state; but the selling price of coal fell considerably, and though it had not reached an economic basis by the end of 1924, it was, by reason of the high cost of production, too low to enable the collieries to be carried on at a profit under the conditions imposed by the agreement. The depression in the coal trade was world-wide. The United States and Germany, great competitors in the coal industry, were in very much the same plight as Great Britain, for the demand was not equal to the supply. In July 1925 the Government decided to make to the coal industry a financial subvention as from Aug. 1 to April 30 1926, by which wages could be paid at the current rate. By March 31 1926 this subsidy had £19,000,000. In the meantime a royal commission was appointed to enquire into the industry

in order to find a way out of the impasse. The chairman was Sir Herbert Samuel, who had just returned from Palestine.

The 1926 Report.—The report of the Commission, which was unanimous, was issued on March 10 1926. It showed that, excluding the subsidy, 73% of the coal was produced at a loss. It condemned the principle of a subsidy. To meet the immediate problem it considered a revision of the "minimum percentage addition to standard rates of wages" fixed in 1924 as indispensable in order to save the industry from immediate collapse. This, however, could not prevent the closing of a number of uneconomic collieries, the labour employed at which should be transferred to the "economic" collieries, while the Government should prepare plans for, and assist financially in, the transference of the labour. The wage arrangements were to be governed by "an economic wage determined from time to time on ascertained facts as to the economic condition of the industry in each district, and that of a minimum wage settled for each district on principles approved nationally." The Commission recommended the maintenance of the standard working day, which averages 7½ hours, but an optional redistribution of hours within the present weekly total over a week of five days instead of six, and the expansion of the multiple-shift system.

The industry should be continued under private enterprise, but state ownership by purchase should be effected of the minerals (royalties) where they have a market value, and by a declaration of state ownership in the case of unproved coal, or coal at deep levels, which has now no market value. Efficient organisation demanded amalgamation of small units of production. Large financial advantages might be gained by the formation of co-operative selling agencies, which in particular are needed in the export trade, and in co-operation and combination, with allied industries. Local authorities should be empowered to engage in the retail sale of coal. Larger mineral wagons should be used and a greater concentration of ownership of wagons instituted, a standing joint committee of the Ministry of Transport and of the Mines Department being set up to promote this improvement.

They favoured augmented provision for research in order that coal may be used more scientifically. If processes of low temperature carbonisation of coal were perfected, great national advantages would ensue because a smokeless fuel would be produced for domestic and industrial use and there would be provided large supplies of mineral oil from the country's own resources. The state should give financial support to the further experiments, on a commercial scale, which are necessary. Methods of payment should be devised in respect of the workmen not employed at the face which would induce a direct interest in output and measures were recommended having for their object the improvement of the economic interests of miners by family allowance schemes, and copartnership which should be made obligatory. The schemes and suggestions made in the Report involved the creation of a permanent coal commission, a national fuel and power committee and joint pit committees, as well as legislation of a far-reaching character.

Although the owners, under pressure, accepted the report in principle, it was rejected by the miners and on Saturday, April 29, the men ceased work. To support them a general strike was ordered (*see* STRIKES), but in a few days this was abandoned. The miners, however, remained idle throughout May and June and the attempts made by the Prime Minister and others to bring about a settlement of the dispute were unavailing. A meeting between the parties, called by the owners early in June, failed, like the debates in the House of Commons, to bring about a return to work. The miners persistently refused to consider any extension of working hours or any reduction of wage rates, while the owners adhered to their view that without these concessions they could not continue in business. Meanwhile, unemployment was growing, railway and other services were restricted and other industries were suffering in an increased degree from the shortage of coal. In June the government introduced legislation into Parliament to carry out the recommendations of the Samuel commission.

IV. THE TRADE OF OTHER COUNTRIES

United States.—The output in the United States rose rapidly during the War years, attaining the enormous figure of 605,546,343 tons in 1918. After that it was subject to great variations, due principally to industrial unrest resulting in strikes of the miners; the production for 1925 being 522,474,999 tons. But the productive capacity of the United States coal mines is far beyond the actual output.

Germany.—Like Great Britain, the year 1913 marked a record with 187,054,115 tons of "black" coal, or including brown coal, 272,885,210 tons, one ton of "black" coal being equal to 2·8 tons of brown coal in point of heat value; and, when the brown coal is converted into briquettes, which is done to a considerable extent, to 1·4 tons of briquettes. Although her Saar and Lorraine coalfields passed to France in 1919, and part of her Upper Silesian field to Poland in 1922, yet Germany's output of "black" coal has suffered less than might have been expected. A heavy fall took place in 1922, due to "passive resistance" upon the occupation of the Ruhr by the Allies; recovery set in later, the output for 1925 reaching to 130,595,951 tons or, converting brown coal into terms of "black" coal, 174,127,935 tons.

Taking the whole of Germany and comparing pre-War and post-War results, the following figures show the relative outputs exclusive of brown coal:—

Germany's Production of Coal

1913	Tons	1923	Tons
Ruhr	112,695,000	Occupied Territory	33,552,000
Upper Silesia	43,097,000	Unoccupied Ruhr Mines	7,863,000
Lower Silesia	5,438,000	German Upper Silesia	8,604,000
Saxony and Lower Saxony	5,872,000	Lower Silesia	5,223,000
Aix-la-Chapelle	3,212,000	Saxony	5,214,000
Lorraine	3,735,000	Aix-la-Chapelle	984,000
Saar Area	13,005,000		
Total	187,054,000	Total	61,440,000

The table below shows the export trade in coal of the three great coal producing countries in 1913 and 1924.

World's Coal Export Trade (in Millions of Long Tons)

(Including coal shipped as bunkers by vessels engaged in overseas trade, and also coal equivalents of brown coal, coke and briquettes)

Compiled from Coal Tables, 1924, issued by the Mines Dept. of Great Britain

Country	Quantity		Per Cent of Total	
	1913	1924	1913	1924
Great Britain	98·3	82·0	49·8	51·2
Germany, including reparation deliveries[1]	47·4	25·1	24·0	15·6
United States	23·6	19·8	12·0	12·4
Total of above	169·3	126·9	85·8	79·2
The World	197·3	160·2	100·0	100·0

[1] Coal equivalent of brown coal briquettes delivered on reparation account is included here.

These figures show that Great Britain had improved her position in point of her percentage of the world's export, but inasmuch as the total amount of coal exported from all countries had declined, the weight of coal exported by Great Britain had also declined (see figs. 2 and 3). The year 1925 showed a further decline of nearly 11,000,000 tons, and Great Britain's figures for 1926 were seriously affected by the strike.

Germany.—The total home consumption of coal and lignite in Germany during 1924 was as follows:—

	Tons
Coal from home sources	118,828,644
Lignite, home sources (converted ⅓)	41,453,276
	160,281,920
Plus imports	15,240,108
	175,522,028
Less exports	4,358,568
	171,163,460
Less reparation deliveries	19,680,243
Net consumption	151,483,217

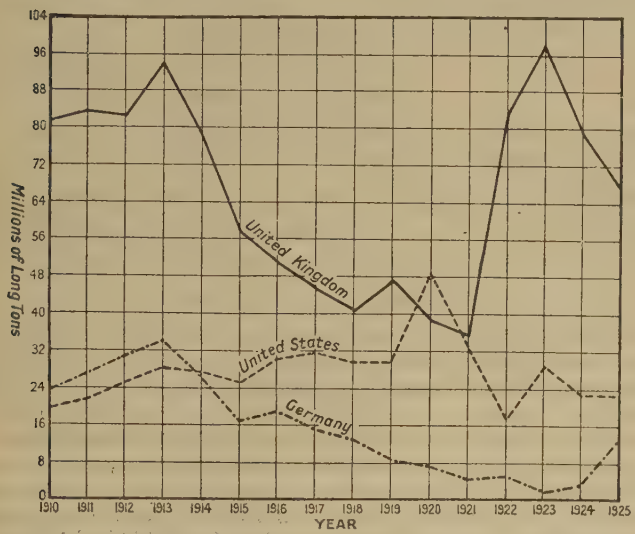

FIG. 2.—Domestic exports of coal of all kinds, including coal shipped as bunkers for use of steamers engaged in overseas trade. Note the steady decline in British exports during and after the War, and the great increase in 1923 and 1924 during the occupation of the Ruhr by the French.

The German exports of coal for 1925 rose to 13,500,000 tons. Taking the frontiers in 1925, the consumption in 1913 was 156,000,000 tons, which is not far short of the British home consumption in 1913 of 189,000,000 tons, and points to the increased industrial activity of Germany. The chief consumption of lignite was in the generation of electrical energy. In 1913 lignite was the source of 23% of the power generated in Germany, and in 1922 of 41·2%; the generation of electric power more than trebled in the 10-year period 1913–22, amounting in the latter year to 7,200,000,000 kw. hours. Increased saving in fuel consumption in large power plants and increased use of lignite in the generation of power have liberated a greater quantity of high class "black" coal for export, which competes with British coal in European and other markets.

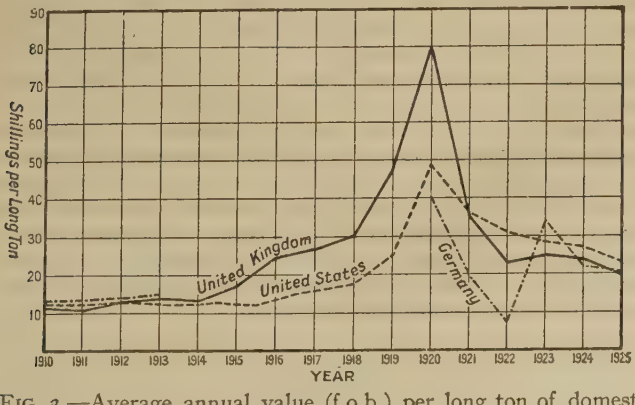

FIG. 3.—Average annual value (f.o.b.) per long ton of domestic coal exported. Note the great increase in value, particularly of British coal, during 1920.

United States.—The coal produced in the United States of America was estimated in the year 1922 to be distributed as follows:—

	Per Cent of Production
Domestic consumption	13
Railways	28
Power utilities	12½
Iron and steel industry	15
General manufacturing	19½
Export and bunker trade	12
	100

Consumption per Head of Population.—The comparative apparent coal consumption per head of population as between Great Britain, the United States, Germany, France and Belgium for the years 1913–24 inclusive, is shown in the following table:—

Apparent Coal Consumption per Head of Population
(*Long Tons per Annum*)

Country	1913	1914	1915	1916	1917	1918
United Kingdom[1]	4·22	4·08	4·48	4·76	4·81	4·45
United States	4·98	4·44	4·48	4·94	5·35	5·52
Germany[2]	3·08	3·34	3·27	3·49	3·68	3·70
France[3]	1·44	1·04	0·98	1·03	1·17	1·06
Belgium	3·44	(4)	(4)	(4)	(4)	(4)
	1919	1920	1921	1922	1923	1924
United Kingdom[1]	3·96	4·07	2·77	3·52	4·00	4·18
United States	4·44	5·08	3·90	3·78	5·00	4·31
Germany[2]	3·06	3·66	3·86	4·18	3·35	4·15
France[3]	1·04	1·23	1·14	1·29	1·54	1·69
Belgium	1·98	2·96	2·73[5]	3·03[5]	3·53[5]	3·78

[1] Figures for 1915–8 are based upon populations consisting of English and Welsh civilian populations only, Scotch population making no allowance for movement of Scottish troops overseas, and Irish population allowing for movement of military forces. Figures for 1923 and 1924 refer to Great Britain and Northern Ireland.
[2] Including brown coal.
[3] Excluding Saar.
[4] Information as to trade is not available.
[5] Belgium-Luxembourg Economic Union.

Germany's Selling Methods.—In Germany the colliery owners must by law sell through syndicates arranged according to districts. A severe penalty is imposed on any owner selling coal outside the syndicate of the district in which his colliery is situated. The syndicates, which are not worked in order to make profit, determine the output of each colliery and fix the selling price of the coal, all coal being divided into classes, *e.g.*, gas coal, coking coal, steam coal, etc. There is one price only for any given class, except in respect of coals grading from steam into anthracite, intermediate of "dry" steam coals; in these "border-line" cases here may be more than one price. The syndicates are as follows:—

A. Black coal (German "Stone coal").—1. Ruhr, 2. Aix-la-Chapelle, 3. Hanover, 4. Saxony (Zwickau), 5. Lower Silesia and 6. German Upper Silesia.
B. Some Black coal but chiefly Lignite (Brown coal).—7. Bavaria.
C. Lignite.—8. Cologne, 9. Saxony (Halle) and 10. East of Elbe (Berlin).

All of these syndicates are combined into the Reichskohlenverband over which is a coal council composed of representatives of the coal owners, workmen and consumers' associations, termed the Reichskohlenrat, which has conferred upon it, by government, power to make laws and regulations for the control of the coal mining industry, subject, however, to a power of veto vested in the Minister of Economics (Reichswirtschaftsminister). There are at least 100 members of the Kohlenrat, 25 of whom are appointed by the management, 25 by the miners and 10 by the Reichstag, and the rest—of whom not more than one-third may be officials—by the President of the Reich.

Output per Man and Hours of Work.—The output per man per shift has of late years shown a decline in Great Britain. The annual average quantity of coal in long tons raised per person employed under and above ground in the countries named over the period 1910 to 1924 was as follows:—

Year	Great Britain	United States	Germany (d) (excluding brown coal)	France (e)
1910	256	618	242	192
1911	259	614	252	193
1912	243	660	282	200
1913	259	681	286	(a)
1914	(b) 238	601	260	182
1915	(b) 269	648	302	182
1916	(b) 260	731	311	179
1917	(b) 247	768	291	170
1918	(b) 229	794	275	153
1919	(b) 195	637	174	122
1920	(b) 187	749	181	120
1921	(c) 144	549	165	130
1922	217	504	184	137
1923	220	693	103	134
1924	220	654	209	143
1925	225	(a)	(a)	(a)

(a) Information not available.
(b) These figures refer to the United Kingdom.
(c) Low figures due to coal strike, which lasted for three months; comparable annual figure = 192.
(d) From 1912, inclusive, figures are based upon numbers of insured workers.
(e) Excluding Saar district.

These figures have been obtained by dividing the annual output by the number of persons employed, and, for comparative purposes

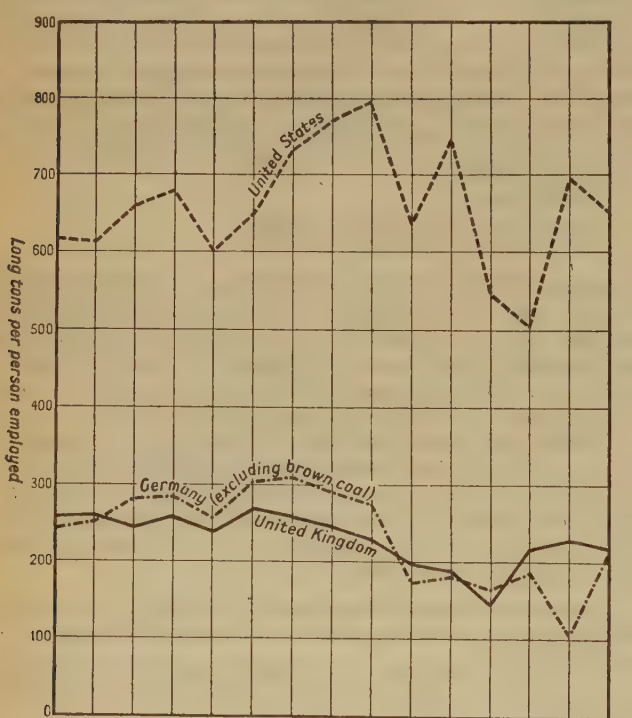

FIG. 4.—Annual average quantity of coal raised per person employed under and above ground.

as between countries, are vitiated by the fact that the same number of days and hours may not have been worked in each country in respect of any given year: nor are the natural conditions with which the miner has to contend the same in each country—for instance, the conditions prevailing in the United States are perhaps the best in the world. On the average the seams are thick with good roofs, and lying at shallow depths from the surface. In respect of the black coal of Germany, the conditions are somewhat more difficult than in Great Britain. Making the fairest comparison, namely that of output per shift, calculated over all persons employed that for Great Britain is at present about 17·85 cwt. as against 19·5 cwt. for the whole of the Ruhr coalfield. In the latter field the rise in production per man per shift has been on the up grade. The output per shift in Germany of lignite is very considerable, much of it being quarried "open-cast." In Great Britain the hours of work of the underground miner are 7 hours exclusive of winding time, say, on the average, 7 hrs. 37 minutes. In Germany (Ruhr) they are 8 hours inclusive of one winding time, so on the basis of the same length of winding time as in Great Britain the average time below ground is 8 hours.

In France the working time is 8 hours inclusive of both winding times, so that miners actually work less time than in Great Britain. In the United States the time is 8 hours, exclusive of both winding times, but as in the majority of the mines the inlet is by way of adit or day-drift, the actual time below ground is probably on the average more than 8 hours, though, from the report of the recent United States Coal Commission, the miners would appear to go into the mines and come out pretty well as they like, so long as they do not exceed the time during which the mine is open.

Cost of Working.—The cost of working in Great Britain and the Ruhr may be stated thus:—

	Great Britain—Quarter ending Sept. 30 1925		The Ruhr Year 1924
	With subvention	Subvention deducted	
Cost of working portion	s. d.	s. d.	s. d.
Proceeds of working portion	16 7·57	17 11·64	15 1·50
Loss	16 4·75	16 4·75	14 2·75
	0 2·82	1 6·89	0 10·75

V. STATE COAL MINES

In Great Britain and America there are no state-owned mines. The German State formerly owned a large number of collieries. The Prussian State owned and managed three large coal mines in Upper Silesia, now in Polish territory, three lignite mines and eight bituminous coal mines in the Ruhr, together producing about 9,500,000 tons per annum. Prussia also had control of the Hibernia coal mines, which, however, were run on the lines of a private company. In 1924 all these mines were denationalised, though the state continued to hold all the shares and other capital, the only difference being that, though the directors are appointed by the state, the officials and control generally of the mines are not under the state.

Russia.—All the collieries in Russia, once privately owned, are under the Soviet. Figures based on returns by the Soviet—the latter likely to be favourable than otherwise—present a very bad comparison with pre-War conditions. A considerably reduced output has been obtained and that output only with the aid of important state subsidies. In the fiscal year ending Sept. 1924, the coal mining industry received subventions in cash amounting to 24,800,000 chervonetz (1 ch. = £1 1s. 0d.) and a credit of 50,000,000 ch. in addition. The industry is greatly in arrears with payment of taxes. The position of the miner is far worse than before the War: in the Donetz basin he received, in March 1924, 15 gold roubles compared with 36·8 gold roubles in 1914, calculated upon the index cost of living. The output in 1913, exclusive of the area assigned to Poland, was 28,990,000 tons, whereas in 1924 it was only 14,580,000 tons; the country cannot even absorb this greatly diminished output. In 1913 the output per man per annum was 149·4 tons; in 1924 it was only 86·8 tons.

Holland.—Holland has some state coal mines, the production from which in 1924 exceeded that from the privately owned mines for the first time. The state-owned mines produced 2,912,899 tons out of a total for the country of 5,787,020 tons. The gross working profit from all the state mines in 1924 was 7,320,000 florins as compared with 8,340,000 florins in 1923.

British Empire.—In the British Empire there are several cases of state ownership of collieries on a very small scale, *e.g.*, the Udi Mine in Nigeria, the Mount Mulligan Mine in Queensland and the James and Liverpool Collieries in New Zealand, but all of them are very small concerns.

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COAL-TAR PRODUCTS (*see* 6.595).—Many attempts have been made since 1910 to effect the low temperature carbonisation of bituminous coal commercially, in which process a coal-tar is obtained, differing materially from that produced by carbonisation of such coal at high temperatures. It is therefore usually distinguished as low-temperature coal-tar, or in Germany as *Urteer, i.e.*, primary tar. This low-temperature coal-tar represents approximately the mixture of such primary decomposition products of the coal as are liquid at the ordinary temperature. It is always also first formed even when the coals are carbonised at high temperature, but these primary products then, by the further action of heat, undergo secondary changes, resulting in the production of a different liquid product and the conversion of much of the primary tar into permanent gas.

Low-Temperature Coal-Tar.—The low-temperature coal-tar produced from bituminous coals containing 28–35% of volatile matter at temperatures not exceeding 600–650° C. is usually a brownish-black liquid, less viscous than the high-temperature tars obtained from the same coal; the yield is usually from 8–10% by weight of the coal, or approximately double the amount obtained from the same coal at high temperatures (900–1200° C.), and the specific gravity of the low-temperature coal-tar from such coals is mostly between the limits 1·02 and 1·07. Hitherto the amount of such low-temperature coal-tar produced has been small in proportion to the output of high-temperature coal-tar in gas-works and coke-ovens, the highest production having been in Germany. Smaller amounts have also been produced in Great Britain and in the United States.

Variations of Analyses.—A number of analyses of such low-temperature coal-tar have been published. The results of these analyses are, in detail, in some respects contradictory, due largely to the fact that the composition of the tar obtained varies with the kind of coal carbonised, and to the fact that, even with the same coal, the composition of the tar alters with variation in the temperature reached in the carbonisation, and in the length of time during which the vapours first produced are exposed to that temperature. Broadly, the results so far obtained may be summarised as follows:—

Tar Acids.—Very characteristic of these tars is the high proportion of tar-acids, or phenolic bodies, present, which may form 30% or more of the whole. The lower-boiling products obtained by distillation of the tar, up to about 200° C., consist chiefly of hydrocarbons, but the higher fractions usually contain 25–50% of tar-acids, the proportion rising with increasing percentage of oxygen in the coals. Only a portion of these phenolic bodies, usually less than half, consists of true homologues of phenol, the remainder being complex acidic bodies of as yet unknown constitution. Phenol itself, the lowest member of the true phenol series, is either absent, or present in small amount only, but the three cresols, the xylenols and higher homologues are always present. The tar also contains up to about 1% of nitrogenous bases, which have not as yet been closely examined, but it appears that derivatives of aniline, pyridine and quinoline are all present.

Residues.—After removal of the tar-acids and bases, the residual neutral oil consists to the largest extent of hydrocarbons, but contains in addition considerable quantities of neutral carbon-hydrogen-oxygen compounds, the nature of which is hardly known. Whereas the hydrocarbons in high-temperature coal-tar consist for the most part of members of the aromatic series, those in the low-temperature tar belong mainly to the aliphatic group, true aromatic hydrocarbons being present in small proportion.

The aliphatic hydrocarbons present partly belong to the saturated series including both paraffins and naphthenes, and the higher-boiling fractions often deposit paraffin wax on cooling, the amount of the latter being sometimes sufficient to cause the tar to "set" at the ordinary temperature. Considerable quantities of olefines are present, and the low-boiling fractions include an amount of dienes which is much higher than in the corresponding fractions of high-temperature tar. If the temperature of carbonisation is kept as low as possible, the amount of the true benzene homologues is very small, but tends to increase with increasing temperature; as with the phenols, the lowest member of the series, benzene, is even then only present in small quantity, the higher members, toluene, xylene, etc., being chiefly formed. Naphthalene and anthracene themselves are absent or present in very small amounts, but small quantities of their higher homologues have been isolated, and derivatives of hydrogenated naphthalene, anthracene, etc., are also present.

Pitch.—The proportion of pitch in low-temperature tar is much less than in high-temperature tar, being only about one-third of the tar as compared with two-thirds for high-temperature tar, and the physical properties of the low-temperature residue differ considerably from those of high-temperature coal-tar pitch. The low-temperature tar also contains very much smaller amounts of the so-called free carbon or suspended solid matter, the quantity present being from 1 to 4%.

Up to the present, owing to the limited quantities of the material available, no extensive working up of the low-temperature tar into refined products has taken place. Commonly the lighter fractions are distilled off and after refining are employed as motor spirit, the residual oil being used as oil fuel with or without the previous removal of pitch by distillation. Owing to the large amount of tar-acids and other oxygen compounds present, such crude oil has, however, a distinctly lower calorific power than the corresponding crude petroleum oils.

Crude Oils.—Low-temperature crude oils are also obtained by the similar distillation of cannels, lignites, etc., but these are more nearly allied to shale oil.

Coal-Tar from Gas-Works.—In the period since 1910, the average quality of coal-tar produced in gas-works has altered, due to the increased substitution of vertical retorts for horizontal retorts in gas-making. Although the carbonisation temperatures in the former are at least as high as with horizontal retorts, the carbonisation conditions are such that the primary tar-vapours are less subjected to the action of heat, so that the resulting tar has a character intermediate between that of high- and low-temperature tar. The vertical-retort tar, therefore, contains a higher proportion of aliphatic compounds than the former and a lower proportion of "free carbon"; it still, however, remains predominantly aromatic in character and is worked up along with horizontal retort and coke-oven tar. Vertical-retort tar has a specific gravity of from 1·07 to 1·10, and its yield is from 5·5 to 6·5% of the coal, as compared with about 5% from the same coals in horizontal retorts.

Road Tar.—In the working up of coal-tar, the chief change in

recent years has been in the production of treated tar for road preparation. To this purpose a large proportion of the total tar output is now devoted. Such tar may be prepared simply by distilling off the water and light spirits from the crude tar, leaving a dehydrated tar which is employed direct. The quality of such a product varies however greatly, according to the composition of the crude tar employed, and a much better and more uniform refined tar is produced by first carrying out the full preliminary distillation of the crude tar, and then suitably blending the pitch and distillates to produce a tar of the qualities required for different purposes in road construction.

In the distillation process itself and the preparation of such tar products as is normally carried out in tar-works, few fundamental changes have taken place in recent years. An increasing number of continuous distillation plants have been erected, some working under vacuum; and larger and more efficient stills for the production of benzene, toluene, etc., and for the separation of the phenols have been set up. The demand for anthracene has greatly diminished and comparatively little of this is now recovered; vertical-retort tars and many coke-oven tars are quite unsuitable for its production as the anthracene from these is very impure.

Resins.—Among the newer products obtained from coal-tar may be mentioned the coumarone and indene resins. The fraction of coal-tar naphtha boiling from 165–185° C. contains considerable amounts of coumarone and indene, and when this fraction is treated with suitable agents such as concentrated sulphuric acid, these undergo polymerisation, forming resins which remain behind on distilling off the unaltered hydrocarbons and are employed as artificial resins in industry.

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(H. G. C.)

COAST DEFENCE (*see* 6.599).—The War of 1914–8 has naturally caused changes in the realm of coast defence, as it has in every branch of the military art.

Effect of New Weapons

Opinions have been expressed to the effect that Great Britain's whole scheme of coast defence must be changed, owing to the introduction of new weapons, of which by far the most prominent is the use of aircraft. Against this it is contended, on general principles first of all, that history has shown that a new weapon has never caused a revolution in the art of war. Naturally a new effective weapon will cause a change; and the introduction of aircraft has caused a change, but it is not a revolution. It will be found that the new weapon or the fresh invention takes its place in the armoury of war alongside of, but not at first, and sometimes never, in place of what has gone before. Before dealing with this suggested fundamental change it will be well to glance at the occasions on which coast defences were brought into play during the World War. These were not numerous.

Practically the first one was the German raid on the Yorkshire coast on Dec. 16 1914. During this the "Seydlitz," "Moltke" and "Blücher," mounting 64 guns altogether, from 11-in. down to 6-in. bombarded Hartlepool for nearly an hour. The only guns on shore were three 6-inch. Of course a large number of casualties were caused among the civil population, but no damage was done to the shore battery or its garrison of Durham Territorial Artillery. Later on the Germans admitted the loss of 10 killed on the "Blücher," while it was plainly visible that the upper works of the ships were suffering from the battery's fire, which was sufficiently annoying to draw off the enemy's attention from a small naval vessel which had emerged from the harbour and had been suffering loss. During the War a long series of engagements took place between British ships and the numerous batteries erected by the Germans on the Belgian coast. Admiral Bacon's book on the Dover Patrol mentions at least 40 of these engagements, and yet no gun, mounting or magazine of these batteries was ever hit.

Dardanelles and Zeebrugge.—In the naval operations in the Dardanelles, on March 18 1915, a deliberate action was fought between the main batteries of the Turks at the Narrows and 16 British and French battleships at the comparatively short ranges of from 14,000 to 10,000 yards. The Turkish batteries and guns were old, their sites were ill-chosen, as a rule close to the water, and their high traverses and deep embrasures rendered them very conspicuous. The batteries were, however, helped by the existence of mines, the position of which was imperfectly known to the ships. At the end of the day three battleships had been sunk by mines, and three others so badly damaged by shell fire as to necessitate their immediate withdrawal to a dockyard. The damage to the batteries was very small. For instance, the Hamidieh I. battery near Chanak, which contained three 14-in. and six 9·2-in. guns, had one of the latter put out of action and suffered some losses in its garrison. A war-time battery of five 6-in. guns at Dardanos, skilfully sited near the top of a conspicuous hill some 150 ft. high and in advance of the Narrows, received a large amount of attention from the fleet, not only during the main action, but for some days previously, but the only result was that splinters made three dents on the gun-shields.

The most spectacular action of the War between ship and shore was the successful blocking of the Bruges ship canal on April 23 1918 by Sir Roger Keyes's ships. This operation had been tried at Santiago de Cuba by the Americans and several times at Port Arthur by the Japanese; in both cases the attempts were unsuccessful. The success at Zeebrugge is an excellent instance of the fact that a fleet which is fully determined to come to close quarters with coast defences will most surely find out any weak spots. And there were weak spots at Zeebrugge. Most of the German guns were sited as if they were meant to defend the water outside the Mole and none seemed to have been allotted to deal specifically with block-ships, although the Germans quite realised the possibility of such an attack. The search lights especially were poorly sited; there was no concentration of illumination at the zone where the guns would have been most effective. On the other hand, the flanks of the canal entrance were crowded with machine-guns, trench-mortars and rifles. These weapons were useless for stopping the ships themselves, but were admirably placed for killing the crews, especially when the latter were leaving the ships. That the losses among the crews of block ships and motor boats were small can only be put down to the theory that "Fortune favours the brave."

Value of Aircraft.—Coming now to the action during the War of aircraft in the realm of coast defence the instances are few, and practically none are recorded of such action against coast defences. Attempts were made to bomb the "Goeben" in Jan. 1918, when she made a sortie and grounded on Nagara Point, remaining there for six days, but the results were practically nil, as she was only once hit, on a funnel, in a series of over 200 flights.

There was also the case of the German cruiser "Königsberg," laid up in a river in East Africa. She was bombed by two seaplanes, one of which was brought down by her gunfire and the other of which did her no harm. The ship was finally destroyed by indirect gunfire from two monitors, the fire being controlled by seaplane observation. Admiral Sims, in his book *Victory at Sea*, recalls the fact that although the U.S. Navy had 500 planes, a large number of which were operating over the North Sea, Irish Sea, Bay of Biscay and the Adriatic against submarines, only one boat was destroyed by direct bombing and one was "probably damaged."

In action against a ship, aircraft are heavily handicapped compared with a gun ashore. Aircraft really provide a form of long-range bombardment, in which the aircraft's engines take the place of the propellant charge in the gun. But every bomb

that is dropped is a trial shot and no information gained from the first bomb is of any use for correcting the dropping of the next. No gun commander, ashore or afloat, expects a hit with his first shot, but he uses it to correct the fire of his next. But with aircraft, every bomb is a "first shot." There is no intention here of decrying the value of aircraft in its main sphere of observation; the only contention is that aircraft cannot take the place of artillery in coast defence.

Deliberate trials have taken place since 1918 to ascertain the effect of aircraft against ships. The most important of these were made in the United States in 1921. Two old warships, the "New Jersey" and the "Virginia," were anchored and exposed to aerial attack. Although 75 planes were used against them it was 9½ hours before the ships were sunk. Other trials have been made, but the results were no more favourable to the aircraft.

Since the War, aircraft have been designed to carry torpedoes for the attack of ships and great results have been expected from them. Hitherto they have been in the trial stage only, but they have the disadvantages that they must descend to from 10 to 15 ft. from the water before releasing their torpedoes and must get within some 1,000 yards of their target, thus rendering themselves peculiarly vulnerable to every kind of fire from a ship.

Taking into account all the experiences gained in the late War, and fully weighing what aircraft can do in their present stage of evolution, it is firmly contended that the basic principles underlying the British idea of coast defence before the War are still thoroughly sound, and that, it is correct policy to regard the gun as the main weapon for use now against an enemy's fleet.

Guns and Batteries

On the assumption that the gun is still the main weapon of coast defence, it will be well to consider in what way the differences of the conditions under which the shore gun and the naval gun carry out their work have altered since 1914.

(1) The fact that ranges have greatly increased has affected the question in several ways:—

(*a*) The handicap against the naval gun, in being on a platform which is not immovable, has been accentuated, since the longer the range the greater will be the distance any movement of the ship, however small, will throw the shell off its intended target.

(*b*) Guns are not mathematical instruments. Their shooting is affected by very slight variations of propellant charge in quality and quantity, of weight of projectile, of the distance by which the latter is rammed home in the bore, and by the wear of the gun itself, not to speak of change of atmospheric conditions. Increased range magnifies the inaccuracies caused by these factors and necessitates a greater number of rounds being fired to produce a given effect than was the case with shorter ranges. The amount of ammunition in a ship, especially for heavy guns, is not large, and it is far less easy to replenish this afloat than it is for the gun ashore with all the resources of the land.

(*c*) Increased range is more helpful in rendering a shore gun inconspicuous than it is as regards a ship. Probably, too, heavy guns will be sited behind low hills so that they are invisible from the sea.

(2) The methods adopted and under trial for range-finding and the control of fire have made greater advances ashore than afloat. This is owing to the inherent inferiority of ships in this respect, compared with guns ashore, since all arrangements to this end are restricted to the dimensions of the ship and its masts, whereas the shore gun has the whole coast within the limits of vision at its disposal and will often have the advantage of using commanding heights. In this connection, too, the shore gun may be able in the future to make use of sound-ranging, which proved so useful on land in the World War. This would be especially valuable for dealing with a ship which protected itself by a smoke screen. This form of ranging is denied to a ship, since a long base is necessary.

Aerial Observation.—Both sides can make use of aerial observation of fire, but, in addition to the use of smoke screens, which is also available to both, it will be possible to take other steps to render the elements of a coast battery indefinite objects when regarded by the eye of an aerial observer. This is a measure which is impossible to a ship which, apart from smoke screens, must always be a well-defined object on a flat surface. As regards aerial observation, the possibilities of jamming the wireless of spotting aircraft by either contestant have not yet been fully explored. The Americans have done some experiments in this direction and, if this should prove possible, the value of aerial observation would largely disappear.

It may be argued that if ships find that, in the attack of coast defences, they are too greatly handicapped by long ranges they will close in to shorter ranges and endeavour to overwhelm batteries by their superior volume of fire. This manoeuvre, however, would be the means of giving the superior instrumental system of control of fire possessed by the shore gun the very chance of proving that superiority, as it is at the very long ranges that all instrumental observation, ashore and afloat, is weakest. And shorter ranges would give lighter guns their opportunity.

At present (1926) there seems a disposition to ignore the damage that can be done by medium and light guns to heavy ships, but the fighting efficiency of a ship can be greatly impaired without penetrating its armour. So that it is quite possible that this view is overdone. The 6-in. guns at Hartlepool were hopelessly outclassed in number and size by those of the German, yet they took their toll of their powerful opponents and came off scatheless. The dispatches of the Admiral in command during the Dardanelles operations often refer to the great annoyance caused to his ships, armoured and otherwise, by two 6-in. batteries, Messudieh and Dardanos, while Admiral Lord Wester Wemyss, in his book, refers to the "Prince George," an old battleship, being hit by a 6-in. shell, taking a list and having very shortly to be withdrawn to a dockyard on account of the damage done.

Size of Guns.—The heaviest British pre-War gun was the 9·2-in., firing a 380 lb. projectile to a range of some 17,000 yards. It is now necessary to have a longer range weapon. To obtain this it is not really essential to have a gun of much larger calibre, although the life of a large long-range gun is longer than that of a smaller one of equal range. But against capital ships now it is necessary to have a projectile with greater power than that of the 9·2-in. and such guns as the 12-in. or upwards are required.

It has often been advocated that guns on railway mountings should be used for coast defence,[1] as they can be moved from place to place as the situation demands, while their appearance would be unexpected. But the railway mounting is most unsuitable for use against moving targets since it does not give sufficient traverse, as it can be fired only a few degrees off the axis of the railway. For larger variations a railway gun has to be on a curve and move along it as required to alter the line of fire. This is much too slow for coast defence purposes. Also, modern arrangements for control of fire demand fixity of position, while from the point of view of training the detachments, especially with local forces, it is vital to have the gun always on the spot. Finally, a railway mounting is more expensive than a fixed one. For these reasons its use is not advocated.

Design of Batteries.—As regards heavy guns, when the long ranges now required are considered and the great improbability that ships will come close in, there are many advantages to be gained by siting the guns behind features of the ground, so that they are unseen altogether from the sea. In any case, such guns would have to be controlled by some form of position-finding instruments, so that nothing is lost in this way. The advantages gained are increased protection from hostile fire, much greater latitude in choice of sites and probably easier communications up to the battery. The disadvantages are a small loss of range, an area of dead water owing to the shell having to clear the intervening higher ground and the difficulty of fighting the guns if the communications of the control of fire system be damaged. The loss of range is generally immaterial, the dead-water, even assuming that it is navigable, can generally be covered from another battery, while adequate protection for the communications, with possibly their duplication, would reduce the third disadvantage to a minimum. All the heavy German guns on the Belgian coast were sited for indirect fire.

The actual design of batteries can be considerably simplified. In this the guiding principles may be said to be that everything

[1] The Ordnance Department, U.S. Army, has designed railway mounts (the largest being for a 14-inch gun of approximately 40,000 yards range) in which this difficulty has been overcome. The design permits of rapid emplacement on a prepared base and ensures the same all round traverse, and speed and accuracy of fire, as obtain for the gun on a fixed mount. (Ed. *E.B.*)

must be done to facilitate the service of the guns, while protection from hostile fire will be sought for by dispersion of the vulnerable points, *e.g.*, magazines, and not by giving them thick material cover. The guns will still require their solid concrete platforms, but parapets are unnecessary. Ammunition will be distributed in small expense stores at some distance apart, and these will not be shell-proof but only weather-proof and splinter-proof. It will be useless for a ship to aim at a battery as a whole; each element of it, gun or expense store, will form a separate target.

Batteries for use against cruisers and light craft, mounting medium and light guns, say 9·2-in. and 6-in., will still be sited for direct fire, and so will be visible from the sea. The same guiding principles will apply to them as in the case of the heavy batteries, except that special care must be taken to render them difficult targets for ships at sea. The guns must have a background close behind them and the ways of communication, from the ammunition stores up to the guns, must be kept out of view from the sea, as well as the stores themselves.

Air Attack.—The War introduced this new feature which must be reckoned with. As already mentioned, aircraft can and will be used for controlling the fire of both shore and ship guns. But aircraft can also act offensively against coast defences by dropping bombs. The best protection of batteries against aerial attack will be in the use of counter aircraft and of anti-aircraft guns. Even with the latter only—and their action is becoming more and more effective—hostile aircraft will have to keep high up and the accuracy of their aim in bombing will thus be greatly impaired.

The largest vulnerable element of a coast battery will be the gun and its emplacement, which will not exceed 20 yd. diameter with the heaviest guns. If an aeroplane were travelling at a speed of 120 m.p.h., in order to get a direct hit on the emplacement the bomb must be released at an exact third of a second, and if there is any wind this must be allowed for. These conditions are very difficult to fulfil conjointly, but practically direct hits are necessary to put out of action any of the elements of a battery, whether guns or stores. It is also easy to erect traverses round the vulnerable elements which would guard against bombs dropping close by. As a rule, every battery will be within the region of anti-aircraft guns.

Land Attack.—This has very often been the most effective form of attack on a coast fortress, but it is a branch of land warfare and cannot be dealt with here.

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COAST PROTECTION (*see* RECLAMATION 22.954).—There is a difference of opinion about the value of much of the works for coast protection, and in the opinion of some, money expended thereon does not give an adequate return. Even in Holland, whose existence depends on the maintenance of its sea walls and defences, authorities are divided on many important questions both of principle and practice. Since 1910 there has been remarkably little development in the means adopted to combat coast erosion, and, generally speaking, the methods of construction which still find favour, not only in Great Britain but also abroad, are the same in principle as those which have been used for generations previously. The Royal Commission on Coast Erosion, appointed in 1906, whose final report was issued in 1911, collected and placed on record much useful information on the subject of coast erosion, protection and reclamation, not only relating to the United Kingdom but also in reference to foreign countries and in particular Holland and Belgium.[1]

The recommendations of the commission regarding the control of the foreshore of the United Kingdom and the constitution of a central sea defence authority have not yet been given effect to by legislative enactment. The report, however, has served to dispel certain erroneous ideas, particularly as to the extent of the loss of land due to erosion in the United Kingdom, and proves conclusively that the expense of protecting purely agricultural land is out of all proportion to the value of the land thereby saved from destruction.

Subsidence and Upheaval of the Earth's Crust.—It has been sometimes asserted that the continuous loss of land on the south and east coasts of England is partially due to subsidence of the earth's crust, but there is no evidence to show that either upheaval or depression has, during historic times, affected the encroachment or recession of the sea on the coasts of Great Britain, and it may be safely asserted that the whole of the changes in the coast-line since the dawn of history have been due either to accretion or denudation.

Physical Causes of Sea Encroachment.—The encroachment of the sea on the coasts is due to the erosion of the cliffs and shore material. Of the detritus derived from such erosion a portion is carried along shore by the combined action of wind, waves and tides, remaining in a state of more or less constant movement until it is finally deposited to swell some accreting sand or shingle bank or is driven against some natural or artificial barrier, where it lies and is perhaps buried under subsequent deposits. The travelling shingle and sand or "littoral drift" is the principal source of the beach materials which form, and make good the wastage from, the foreshores of the coast. In the course of this lateral travel the particles, large and small, forming the detritus are still further disintegrated. The lighter material is carried off in suspension by the sea and ultimately finds a resting place on the ocean bed at a level below the influence of wave action or tidal scour. The remaining portion of the solid materials derived from the destruction of the cliff or shore is immediately transported into deep water, the finer particles being rapidly swept away by the current until finally deposited on the sea bed, and a certain proportion of the larger material too heavy to be carried in suspension for any considerable distance, is drawn down the foreshore and the bed of the sea by the undertow of the waves and ultimately makes its way by gravitation into deep water, where it finds a resting place.

River Detritus.—The amount of solid matter thus finding its way into the ocean is vast and is increased by the addition of detritus brought down by rivers and derived from the land surface. River detritus, on reaching the sea, shares much the same fate as the material derived from the coast line. A part finds a resting-place in sand banks and alluvial deposits at the mouths of rivers and estuaries, the remainder spreading itself over the deep-sea bed.

Relation of Littoral Drift to Eroded Material.—It is impossible to form any exact estimate of the relative proportions of the material more or less immediately carried away to the deep sea and that other part which we may call littoral drift. In the case of chalk cliffs and foreshores it is probable that the immediately removed material amounts to nearly 90% of the whole, while alluvial cliffs and those consisting of boulder clay or other similar material may yield 20% to 30% of solids not at once carried away from the foreshore into the deep sea. Gravel and rock cliffs naturally yield a higher proportion of heavy and harder particles. On the whole it is unlikely that on the average more than 20% of the solid material falling on to foreshores and derived from the decay of the coast line remains above low-water mark for any length of time.

Deep Sea Erosion.—The process of erosion and littoral drift is not confined to the foreshore and beach above low-water mark. Such changes are continuously in progress below low-water mark where wave action or tidal scour is capable of affecting the sea bottom. These agencies and the gravitating tendency of the particles continue at work until a condition of equilibrium of the opposing forces is reached. It has sometimes been asserted that material is derivable from the deep sea for the replenishing of foreshores. Fragments of rock, boulders and flints dislodged from the sea bed in comparatively shallow depths below low water are sometimes cast up on the foreshore, but such instances are exceptional and cannot be taken as evidence of

[1] See *Reports and Evidence: Royal Commission on Coast Erosion;* particularly final report, Cd. 5,708 (1911).

the supply of any considerable volume of material from the deep sea bed. Undoubtedly material lying on the sea bed below low water and in shallow depths is, under certain conditions, driven back on to the foreshore, but this is merely a temporary phase in the progress of littoral drift. With change of wind or tide the conditions may be reversed.

Effect of Protective Works on Adjoining Coast-Line.—In order to increase the extent of any foreshore or to maintain it even in its existing condition, the natural and incessant losses must be made good by accretion or the trapping of material derived from other parts of the coast. This may be done in favourable circumstances by the construction of groynes or other works similar in effect, but the accretion through their agency is in every case accomplished to the detriment of neighbouring foreshores. Thus the large groynes at Brighton trap for the time being the greater part of the shingle travelling from west to east, and very little passes on to the foreshore to the east of Brighton, which, in consequence, has become denuded.

Conditions Affecting Littoral Drift.—The direction of the prevailing littoral drift is in general governed by the direction of the flood tide, the prevailing winds, and the shape of the coast. Authorities differ as to the relative effect of the tide and wind, and although the direction of drift is at times varied by the wind direction and the consequent wind waves, most competent authorities agree in the opinion that, in the case of England, at any rate, the prevailing drift coincides with the set of the flood tide. On the English coasts the direction of the flood tide does, in fact, in general coincide with the direction of the prevailing winds. On the east coast the drift is from north to south and on the south coast from west to east, both in the direction of the flood tide and prevailing wind.

Where a coast-line is broken up by deep bays and indentations no continuous drift can take place, each bay retaining its own characteristic material, which is prevented from leaving it by the projecting headlands extending to low water or beyond and forming natural groynes. Numerous examples of these conditions are found on the south coast of Devon and Dorset. The direction of the flood tide is also in many cases altered locally by the configuration of a bay, *e.g.*, the deflection of the tide along the shores of the bay in a direction opposite to that of the normal coastal current. In cases where a coast-line is broken up by estuaries or rivers the results are variable, depending upon the continual struggle which takes place between the opposing forces affecting littoral drift and the tidal inflow and outflow of the river, the latter sometimes aided to a material extent by the addition of large volumes of fresh water.

During strong winds in a direction contrary to the set of the tide the normal travel of drift may be nullified or even reversed. The accumulation of material on a foreshore is generally brought about by tidal action in calm weather. A beach which has been depleted during a long spell of heavy weather usually makes up again, at any rate to a partial extent, on the occurrence of calm sea and the cessation of wind. This replenishing is due to the return of a portion of the material previously drawn down into shallow water below low-water mark. Generally speaking, on-shore gales result in the drawing down of the beach material and its gravitation towards the deep sea. Off-shore winds, on the other hand, frequently lead to the accumulation of material on a foreshore.

Effect of Pier Works and Other Artificial Projections.—The construction of solid piers or other similar obstructions at an angle with the general shore line and projecting into the sea is, when occurring on a coast-line subjected to erosion, almost inevitably followed by serious depletion of the foreshore to leeward. The solid projection, which in many cases is carried sufficiently far in a seaward direction to reach comparatively deep water, effectually hinders the passage of littoral drift from its windward to its leeward side.[1] Thus the erosion of the lee shore is accelerated by the loss of the travelling material which under natural conditions makes good to a partial extent the ravages of the sea. Instances of such stoppage are numerous on the English coast. The Folkestone harbour pier has arrested the travel of the beach from the westward, and led to the accumulation of a large bank on that side and the denudation of the foreshore to the east of the harbour and towards Dover. The construction of the harbour works at Dover has stopped the eastward drift at that point and accelerated the destruction of the cliffs in St. Margaret's Bay. At Lowestoft the construction and subsequent extensions of the harbour pier and other works which project at right angles to the coast-line at the sea outlet of Oulton Broad have resulted in the accumulation of a bank of shingle to the northward and serious encroachments on the town frontage to the south of the harbour.

[1] The terms "windward" and "leeward" are used in the sense understood by engineers engaged in coast protection work, viz., "windward"—the direction whence the prevailing littoral drift proceeds; and "leeward"—the direction towards which such drift takes place.

Sea Walls.—The conditions affecting the design of a sea wall differ so materially that every case must be considered on its merits and provided for accordingly. Sea walls may be divided roughly into two classes, sloping and upright, each class having its advocates among engineers. Generally speaking, walls having a sloping face are used in Holland and Belgium, whilst a vertical or nearly vertical face is more common in Great Britain. The immediate effect of the construction of a wall is detrimental to the beach in front of it, although affording protection to the cliff or banks behind. Thus, the construction of a sea wall on a sand or shingle foreshore is in itself calculated to bring about the denudation of the beach and the wall may become before long the agent of its own destruction. Whilst the wall will prevent erosion by the sea of the cliffs in rear of it, the beach in front of the wall must be protected and conserved by the construction of groynes. Many walls have failed through the displacement of the filling behind them by wave action; the provision of a substantial and wave resisting surface or paving behind the wall is, therefore, of great importance, and has been too often neglected. Suitable provision for the drainage of the cliffs, where they exist at the back of sea walls, is also a matter of high importance, which has often been neglected with disastrous results.

Much can undoubtedly be done by draining, sloping and planting, to preserve and protect cliff faces, and these works ought to proceed simultaneously with the carrying out of sea-defence undertakings, when the cost of the latter is justified, to protect the foot of the cliff. Sea walls subjected to abrasion by shingle are, if faced with concrete, very liable to progressive and serious damage. In such positions a concrete wall is frequently protected by a facing, at any rate over that portion subjected to abrasion, of hard stone or flints. For this reason also reinforced concrete is unsuitable for use in the face work of walls on a shingle beach, as the abrasion of the concrete surface soon results in exposure and deterioration of the steel reinforcement.

Groynes.—However effective they may be in collecting travelling material, groynes will not in all cases prevent the waves reaching the toe of a cliff or bank and eroding it to a greater or less extent. A combination of the two forms of protection—groynes and wall—is frequently desirable, but groynes alone have on many low-lying foreshores, particularly where there are no cliffs, proved successful and efficient without the construction of sea walls or protected banks, as for instance on the four miles of shore between Worthing and Shoreham. In some cases protection of the crest of a beach above high water has been secured with success by the construction of a timber barrier or wave screen formed of piles spaced apart and driven parallel to the line of shore.

Groynes may be divided into two main classes: (1) high and substantially built structures of timber or other material; (2) low groynes of inexpensive and light construction usually placed at short intervals apart. In general, low, light groynes are suitable on flat sandy foreshores which are not exposed to sudden and extensive changes of level. In any case it is undesirable to build up the planking of a groyne to a considerable height above the foreshore level existing at the time of construction, and it is preferable to raise the groyne by the addition of planking to

keep pace with the accretion of beach material. The use of reinforced concrete for the construction of groynes has frequently been advocated, but is unsuitable on shingle beaches on account of the rapid abrasion of the thin concrete coverings of the steel reinforcement.

Groynes, speaking generally, to be of maximum efficiency should be at distances apart about equal to or little more than their length. They should extend continuously from the shore or work to be protected to the vicinity of low water of spring tides. There is much diversity of opinion and practice with regard to the direction in which groynes should point. Some authorities advocate their direction at right angles to the shore line, others pointing slightly to windward, and some authorities advocate a leeward direction. No general rule can be laid down and a plan suitable for one locality may prove a failure in another. The opinion of most authorities, however, appears to favour a direction pointing slightly to windward.

Removal of Shingle.—Beach material is too often limited in quantity and the question arises whether its removal for commercial purposes should be allowed. The results of natural erosion and denudation are, in many instances, aggravated by this practice. The powers possessed by the Board of Trade provide for the issue of prohibitory orders and in certain circumstances where the removal of beach or sand can be shown to be injurious, such orders have been frequently made.

Relative Extent of Loss and Gain of Land.—The evidence as regards the total superficial area gained and lost in recent years on the coasts and in the tidal rivers of Great Britain shows that far larger areas have been gained by accretion and artificial reclamation than have been lost by erosion. Evidence laid before the royal commission by the Ordnance Survey Dept. in 1907 showed that within a period, on the average, of about 35 years, about 6,640 ac. had been lost to the United Kingdom, while 48,000 ac. had been gained. Most of the gain has been in tidal estuaries, while the loss has been chiefly on the open coast. Moreover, the gain has been due in the main to the deposition of sediment brought down by rivers and to artificial reclamation. It is, however, probable that the land lost has been more than compensated for by land naturally accreted. The report of the royal commission contains the following statement:—

> The erosion . . . would have been far more serious if extensive works of defence had not been constructed by local authorities, railway companies and others, at a great cost, though, on the other hand, such works in many places have been responsible for erosion of the neighbouring coasts by interfering with the normal travel of the beach material. On the whole we think, however, that while some localities have suffered seriously from the encroachment of the sea, from a national point of view the extent of erosion need not be considered alarming.

Cost of Coast Protection.—The cost of construction of groynes varies very considerably with the design and local conditions. Before the World War light low groynes might be constructed at a cost of from 10s. to £1 per foot lineal, and groynes of more substantial construction at from £1 to £3 per lineal foot, while some of the large concrete and masonry groynes of the type frequently constructed at Brighton and Hastings cost as much as £7 or £8 per lineal foot. The initial capital cost of protection per mile of shore was seldom less than £4,000, even when no sea wall was constructed. Under present conditions these figures should be nearly doubled. The annual charge for repairs, interest on capital, and replacement may be put at not less than 10% of the original capital cost.

The cost of protecting purely agricultural land which is subject to erosion must of necessity, under the conditions which usually prevail, be considerably in excess of the value of such land. Protection under such conditions is only justified when agricultural land is in the vicinity of towns and its erosion, if it be not stopped, is likely to lead to those towns being outflanked by the sea, and in situations where the works have as their object the preservation from inundation of areas of low-lying land of considerable extent. It is not desirable, even if it were practicable, to prevent erosion of all parts of the coast, as the waste of the cliffs provides the greater part of the beach material which acts as the most valuable agent of protection.

The expenditure incurred in the construction of sea defences by many of the coastal towns of England in recent years has been very considerable and in some cases has imposed a heavy burden on the inhabitants. As an instance the case of Sidmouth, a seaside town on the south coast of Devon, having a population of about 6,000, may be referred to. As a result of exceptional gales the sea defences of the town over a frontage of under half a mile were seriously damaged and undermined between the years 1917 and 1925 and the construction of new sea walls and groynes, completed in 1926, entailed an expenditure of over £100,000.

Sand Dunes and Alluvial Flats.—The preservation of sand dunes is most important along certain parts of the coast where they afford protection to low-lying areas behind them, and they should in these cases be maintained and fostered by the encouragement of the growth upon them of marrum and other grasses, which help to bind the sand together. Where drifting of blown sand occurs much may be done to check it by the fostering of such grasses. The process of natural accretion on alluvial flats has been hastened in many cases by the planting of suitable vegetation such as rice grass (*spartina*), and in this way land may in time be reclaimed by entirely natural means.

Conditions in Holland and Belgium

A large part of Holland and some portions of Belgium are below the normal sea level and are protected from inundation by artificial embankments (dikes) or by narrow belts of sand dunes. The foreshore works on the coast of Holland and Belgium, although of great interest and attended with considerable success, do not afford examples to be followed as affecting the sea defences of the United Kingdom and other countries exhibiting physical characteristics similar to those of the latter. The protection works in such cases as Blankenberghe, Heyst ,Scheveningen, Kallantsoog and Petten are of great magnitude and the engineers responsible for these works, particularly in Holland, have at their command the accumulated experience of centuries of sea-defence work. The local conditions with which these works have to conform, viz.: low flat foreshores consisting entirely of sand, are wholly different from those generally associated with sea-defence works in England. The large expenditure involved is justified by the necessity of securing the safety, not only of the sea-board, but of large tracts of the countries themselves. Investigations in Holland are said to indicate a continuous subsidence of the land of that country relative to the sea level, amounting to about 15 cm. per century.

The North Sea foreshores of Holland and Belgium consist for the most part of fine sand; similar deposits border the lower portions of the numerous river estuaries which penetrate far inland, but in the higher parts of these the foreshores are generally composed of fine sand covered with clay or mud. The foreshores of the North Sea between high and low water have an average gradient of about 1 in 45 and the shores above high water normally slope at about 1 in 25. Submerged sand banks more or less parallel to the shore are a characteristic feature of the North Sea and estuary coast lines of Holland and Belgium. These, where they exist, afford considerable protection to the sandy shores during on-shore gales. In calm weather and with off-shore winds sand accumulates on the foreshores.

The two most important forms of sea-defence works in common use in Holland are (*a*) groynes, (*b*) fascine-mattresses with stone ballasting. Groynes are usually constructed at right angles to the shore line and are maintained as a rule at a small height above the average foreshore level. On those portions of the North Sea coast which are most exposed groynes are placed about 250 metres apart and are extended out beyond the low-water line. Many of the groynes on the Dutch coast are constructed of layers of fascine mattresses covered by heavy stone, having their crests almost flat or turtle-backed with side slopes of 1 in 2, or flatter. The fascine or brushwood mattresses are held together and pinned down by rows of piles. Wide brushwood aprons, with heavy stone covering forming flat slopes, are constructed on either

side of the groyne in order to protect the flanks against scour. The groynes are carried up above the line of high water to meet the base of the sand dunes or the protecting dikes. These groynes, inclusive of the side aprons, are often of considerable width, sometimes as much as 30 metres at their deepest and widest parts. The cost of groynes built in Holland has varied from £4,000 to £11,000 each.

The underwater banks of some of the estuary channels and sea inlets on the coast of Holland frequently stand at a steep slope with deep water alongside. Under these conditions there is serious liability to erosion and it is usual to protect the banks both above and below water by artificial means. For many years fascine mattresses have been used for this purpose. These are made up on a convenient sandy foreshore, covered at high tide and when completed are towed to the place where they are to be used and sunk on the sea bottom by ballasting with stone. They consist of two layers of grids of brushwood, each built up of crossed rows of parallel brushwood ropes, 0·4 metre circumference, and spaced 0·9 metre apart centre to centre, bound together with a filling of brushwood in three layers between them.

On the top of the upper brushwood grid some open-work partitions are formed for the reception of stone ballast. Formerly, clay mixed with a little stone was used for ballasting, but in modern practice stone alone is employed, the mattresses being weighted to the extent of 1,000 kg. per sq. metre. The cost of continuous protection of the steep banks of the estuary channels where the depth of water alongside is sometimes as much as 30 metres, is very considerable, amounting in some cases to as much as £100 per metre run of bank. In some localities the cost has been reduced by the construction of intermittent mattress work, leaving short unprotected stretches of bank between projecting spurs which serve to deflect the main current away from the unprotected embayments. In cases where the sea bed of the deep channels consists of clay, erosion is not so uniform as that of sandy bottoms and the side slope is sometimes almost vertical. In such situations rubble stone ballasting or surfacing of the bank is preferred to the employment of mattresses. The protection of the shore lying between the steep submerged and partially submerged banks of the channels and the base of the dike or wall, which forms the immediate protection of the land behind, is usually effected by means of groynes. These shores, which are sometimes of considerable width above the level of normal high water, have in most cases flat gradients.

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COATES, JOSEPH GORDON (1878–), New Zealand politician, was born at Matakohe, the son of a farmer. He was elected M.P. for Kaipara in 1911, and favourably impressed his leader, Mr. W. F. Massey, with his solid, if not brilliant, qualities. From 1917 to 1919 he served in France with the New Zealand Forces, in which he attained the rank of major and gained the military cross. Shortly after his return home, he was invited to join the Cabinet, and, as head of the Public Works, Railways and other departments proved himself a capable administrator. His energy and sincerity amply compensated for any lack of eloquence, and when Mr. Massey died in 1925 he was his obvious successor. As Prime Minister the chief aim of his domestic policy was the consolidation of the primary industries of New Zealand, thus paving the way for a development of secondary industries. In overseas affairs he was a staunch Imperialist.

COBLENZ, GERMANY (*see* 6.612), had in 1919 a population of 57,393. New law courts, churches and a theatre were built after 1910. Coblenz was bombed by the Allies in 1917 and 1918. After the Armistice the town and bridgehead were occupied by Allied troops under the Treaty of Versailles, Art. 429–432, Coblenz forming the second zone to be evacuated after 10 years, should Germany fulfil her obligations (*see* RHINELAND). Coblenz was the seat of the Rhineland high commission, and was first occupied by American troops, becoming General Pershing's headquarters. On Jan. 10 1923 the American troops were withdrawn and replaced by French. On Oct. 21–26 1923 Separatists carried out a coup, proclaimed a Rhineland Republic, and declared that they had been recognised as a *de facto* Government by the French high commissioner. The Separatist leaders quarrelled among themselves, and the movement had collapsed by Feb. 1924.

COCHERY, GEORGES CHARLES PAUL (1855–1914), French politician (*see* 6.619), died in Paris Aug. 8 1914.

COCHIN, DENYS MARIE PIERRE AUGUSTIN (1851–1922), French politician (*see* 6.619), joined the Briand National Defence Cabinet on the outbreak of the World War as a minister of state and was sent on a diplomatic mission to Greece. He died in Paris March 24 1922.

COCOA (*see* 6.628).—The moderate prices of cocoa in 1925 were largely due to the development of cocoa-growing in British West Africa. In 1905 the world's production of raw cocoa was 141,000 tons, of which 23% was grown in the British Empire; in 1913 255,000 tons were produced, of which 35% was British; and in 1925 the world's production was about 500,000 tons, of which 60% was produced in the British Empire.

Gold Coast.—In 1922, out of a total world output of 403,000 tons, 159,000 tons were grown on the Gold Coast. There were no organised plantations, the trees being cultivated around the native villages. The crop is gathered, fermented and dried and brought in in small but very numerous consignments to the river and rail collecting stations, whence it is shipped down to the warehouses at Accra. The bean is not of the highest quality, being flat in shape and somewhat bitter in taste, owing to imperfect methods of native cultivation and preparation. But it is the most important cocoa available in bulk and at a low price, and forms a basis for all cocoa and chocolate productions, at its best readily blending with any other sorts. Dangers to further development of production on the Gold Coast are the felling of the forests, causing the climate to become drier and the country more exposed to winds; and the multiplication of pests and diseases. These matters are carefully watched and dealt with by the Department of Agriculture and by the Gold Coast Agricultural and Commercial Society.

Other Producing Areas.—Nigeria presents conditions which make possible a production equal to that of the Gold Coast; 37,192 tons were exported in 1924. Other important producing countries, and their approximate production in 1924, are: Brazil, 70,000 tons; Ecuador and Trinidad, 30,000 tons each; Santo Domingo and Venezuela, 25,000 tons each; and San Thomé, 20,000 tons. The bulk of high grade beans, to which the flavour and richness of good cocoa and chocolate are due, comes from Trinidad, Venezuela, Grenada and St. Lucia; and these, with the small quantity from Ceylon, of the plantation variety, fetch the highest prices on the London market. The entire crop of Java beans, which are comparable with those from Ceylon in quality, is shipped to Amsterdam and is sold there by auction six or seven times a year.

During the World War, Hamburg lost its position as the largest cocoa market: most of the Gold Coast crop was landed at Liverpool and London, which handled more cocoa than Hamburg during the post-War period. London has a public auction, the prices at which cocoa changes hands being wired all over the world and forming the basis of negotiation. In 1918, prices at which the various kinds of raw cocoa should be sold in Great Britain were fixed, Accra being quoted at 65s. per cwt. and Ceylon Plantation, Java and Samoan at 100 shillings. In 1919, when control was abolished, the price rose rapidly, and by Feb. 1920 Ceylon was 200s., with that of other sorts in proportion; but by 1921 the price had fallen to the normal level of 80 shillings.

(C. L. T. B.)

CODY, WILLIAM FREDERICK (1846–1917), American scout and showman known throughout the world as "Buffalo Bill" (*see* 6.637), died in Denver, Colo., Jan. 10 1917. He was buried in a tomb which was blasted from solid rock on Lookout Mountain, 20 m. from Denver.

CO-EDUCATION (*see* 6.637).—Co-education as an administrative procedure of assembling the two sexes in the same educational institution for purposes of instruction under like auspices has made steady progress since 1910. This has been due to a number of causes. Women have taken an ever-increasing share in commercial and industrial activities and as a result have demanded and secured opportunities for training that fits them for these activities. Economic pressure has operated to consolidate the educational activities of communities, especially where communities are small.

It was undoubtedly the frontier conditions in the middle and western sections of the United States which led to the widespread establishment in these regions of co-educational schools. Like economic limitations are leading to the establishment of co-educational schools in the countries of Europe where segregation was common in the past. Further, there is appearing everywhere in the world, especially in the Occident, a disposition to accept social equality between the sexes. This has broken down the barriers in schools as well as in other institutions. Social freedom was greatly promoted by the World War, during and after which women took over many forms of industrial and professional service which earlier had been monopolised by men. The social consequences of this radical change are obvious.

Internal Separation.—While administrative co-education has been steadily increasing in Europe and the United States, a tendency has appeared toward separation of the sexes within co-educational institutions. Women and girls, having secured the right to enjoy educational opportunities equal to those offered to men and boys, are now beginning to specialise more than ever before and are found in increasing numbers in classes where they are pursuing courses regarded by them as appropriate to their sex, even though these courses are administratively conducted by an institution that provides instruction also for men and boys. Co-education being administratively established, differentiation in electives is producing a new type of segregation.

Statistics.—The high school of the United States is very generally committed to the policy of co-education. The extent to which the high schools of the United States are co-educational is shown by the fact that in 1910 there were only 34 public high schools exclusively for boys and 26 for girls. The corresponding figures for 1920 and 1922 are 39 and 37 special schools for boys, 37 and 42 for girls. The situation with regard to private high schools is somewhat different as the following figures show:

Number of Private High Schools of Various Types in the United States at Different Periods

	1924	1920	1910
For boys only	403	385	348
For girls only	739	728	511
Co-educational	982	980	922

When both private and public schools are considered, it is evident that the secondary schools of the United States are in the main co-educational.

The aggregate attendance of girls is greater than that of boys in both groups of schools according to the latest statistics.

	Public High Schools			Private High Schools		
	1922	1920	1910	1922	1920	1910
Boys	1,033,739	822,967	398,525	100,116	84,222	55,474
Girls	1,195,668	1,034,188	516,536	116,406	99,931	61,926

Girls in general have somewhat greater leisure and consequently a larger opportunity to secure a high-school education than boys have.

Subjects Chosen.—The two sexes do not take advantage in equal degree of the various elective opportunities offered to them. The process of distribution of the pupils of the two sexes is taking place along lines which comport with their social and occupational interests. That this is a progressive tendency is shown by such facts as that in 1910, 3·78% of the pupils in high school elected home economics, while in 1922, 14·29% registered in this subject. During the academic year 1921–2 the registration in certain selected subjects was as follows:—

	Boys	Girls
Home Economics	2,572	304,982
Biology	88,955	100,333
Agriculture	75,859	35,383
Physics	112,747	79,633
Algebra	444,499	421,016
Trigonometry	27,733	8,197

Institutional Variation of Choice.—The fact that separation of the sexes is going on along lines of special interests is further shown by an examination of the registrations in different types of institutions. The normal schools and teachers' colleges of the country are professional schools devoted chiefly to the preparation of teachers for elementary schools. The student body in these schools is very largely made up of women, although men are admitted. The facts are as follows:—

Registration in Normal Courses in American Normal Schools and Teachers' Colleges at Various Periods

	1921–22	1919–20	1914–15	1909–10
Men	32,694	19,110	19,978	19,746
Women	161,840	116,325	80,347	68,815

There is a very marked departure here from complete co-education in the administrative sense. Corresponding figures from the other professional schools show a preponderance of men. In schools of law, medicine and engineering, women constitute but 2 to 5% of the total registration.

The separation of the sexes by subjects of instruction rather than by institutions is a natural consummation of the movement for complete equality of educational opportunity. In the United States the vigorous discussions of the wisdom of co-education which were carried on during the first five years of this century closed the theoretical argument. After those discussions it was conceded that women shall have an education equal to that offered to men and the right to choose their subjects. The latter right to natural election is now being exercised in increasing measure with the results noted.

General Conditions.—So far as the rest of the world is concerned, women have been conceded the right to attend universities in all European and colonial countries and they have taken advantage of this right on a large scale. Co-education in the elementary schools has been common in small communities in all countries. It has also been practised in an increasing measure in larger communities in the northern countries of Europe and in Australia and South Africa. It has been, and is still, avoided in France, Italy, Spain and South America wherever communities are large enough to support separate schools.

In the secondary schools of countries other than the United States, co-education is less common than in the elementary schools and the universities. The history of secondary education in Europe and in countries which have borrowed their educational systems from Europe, inhibits the adoption of a policy of co-education. Girls did not enjoy opportunities of secondary education in former generations except as this was administered in the strict privacy of the home. Even now, when the right of higher education is generally conceded, there is reluctance to disturb the traditions of the secondary schools which were established for boys. The conservatism of tradition shows some signs of weakening. In the new republics of Europe co-education in secondary schools is commonly practised. In newer countries on other continents it is not uncommon.

The Orient.—The statements made above do not apply to the Orient. The oriental attitude on the matter of the social and economic status of women is in general too fixed to be overcome even when the examples of America and Europe are fully understood. Mission schools and native schools in oriental countries maintain in general a strict separation of the sexes, except in a few of the lowest primary schools. Furthermore, the extent to which girls receive any education is very limited.

Separate Institutions.—The discussion of co-education would not be complete without explicit reference to the fact that, along with the general tendency to organise public education on a co-educational basis, there is still a disposition in some quarters to favour separate institutions for the two sexes. The presence of such a disposition is seen in the large registrations in the women's colleges and in the relatively few surviving men's colleges in the United States. The older foundations in England allow women to attend lecture courses given by men and primarily organised for men. These survivals of an earlier type of educational separation are usually favoured by those communities and social classes which are beyond the reach of the economic motives which dictate the consolidation of educational opportunities. As long as the two sexes are to participate in equal degree in the advantages of education, it is much more economical and probably more efficient to conduct all instruction under the same auspices. Social traditions of exclusive rearing, as well as favourable economic conditions, are to some extent recognisable in those institutions where separate education is still practised. On the whole, however, the tendency in Europe, and to a greater extent in America, is increasingly to disregard social traditions and to establish a single system of institutions for the two sexes, allowing such separation as is to take place to appear within the institutions. (C. H. J.)

COFFEE (*see* 6.646).—During the post-War period, Brazil and British East Africa commanded most attention as coffee-producing countries: Brazil because of her control policy and its effects in the United States, and British East Africa because of the rapid growth of coffee planting in that area.

Brazil.—The importance of Brazil in coffee production is shown by her production in 1924–5, which was about two-thirds of the world's supply. In that crop year over 5,000,000 ac. were planted with coffee; 13,721,000 bags of 130 lb. net were produced and 13,682,000 bags exported. All other countries produced 6,762,000 bags and exported 6,824,000 bags. The protection of the crop is under the control of the São Paulo institute for the permanent defence of coffee, the Federal Govt. having relinquished in its favour all rights conferred by law.

The law of the State of São Paulo provides that the chairman and the vice-chairman of this body shall be its ministers of Finance and of Agriculture respectively, the three remaining members of the governing body being elected by the two associations of planters and the commercial association of Santos, subject to the approval of the president of the State. The powers of the institute include the regulation of the amount of coffee to be retained in the official warehouses through which all coffee produced in the interior must pass; 10 of these had been erected throughout the coffee-growing districts of São Paulo and one in the State of Rio, their total capacity being 11,500,000 bags per annum. Other powers of the institute extend to the amount of coffee to be exported, the making of agreements with other producing countries for the protection of coffee, the concluding of financial arrangements, the levying of an export tax on coffee, and the establishment of an agricultural loan bank. To obtain funds for the institute £4,000,000 of 7½% bonds were issued in London and £1,000,000 in Holland and Switzerland in Jan. 1926. Interest on this capital is to be raised by a transport tax of one gold milreis (2s. 3d.) levied on each bag of coffee grown in and transported through the State of São Paulo.

The effects of the "permanent defence of coffee" in the United States, Brazil's greatest customer, were higher prices and reduced consumption. In June and July 1925, a mission from the United States, consisting of three representatives of the trade in coffee, visited the institute and the producing centres in Brazil. After conference, the following measures were agreed: the daily regulated entry into Santos of coffee for export in accordance with the crops and the needs of consumption; the maintenance of a stock in Santos of never less than 1,200,000 bags, to facilitate the buyers finding the qualities required; the constant attendance of American buyers on the Santos market; full publication of statistics and of data relative to crops, stocks, etc.; and the resumption of coffee-propaganda in the United States. It was also arranged that similar conferences should be held in 1926 and annually thereafter. (*See* BRAZIL.)

Colombia.—Next in importance to Brazil as a coffee-growing country, Colombia showed signs of following her example. A law providing for the establishment of coffee bonded warehouses and the official classification of coffee, with the issue of negotiable bonds, was passed, but the declared policy of the Government was to help the industry without interfering with prices.

East Africa.—Coffee growing under British auspices in Kenya Colony and Protectorate has rapidly developed. In 1920 there were 27,813 ac. under coffee; on June 30 1924 there were 60,054 ac. an increase of 7,805 ac. over 1923. The production in 1923–4 was 144,952 cwt. The exports from Mombasa in the same year were 186,081 cwt. valued at £636,744. The colony also had 27,883 ac. planted with trees less than three years old, which had not come into full bearing. On the London market Nairobi and Uganda coffees now appear as Kenya.

The annual British consumption of coffee remained stationary at 7 lb. per capita. British taste in coffee is satisfied largely with the produce of the Central American Republic of Costa Rica; the demand for the produce of Kenya Colony is increasing. In Sept. 1915 the import duty on raw coffee was increased from 14s. to 21s. per cwt. and again to 42s. in 1916. On Sept. 1 1919 the duties became 42s. on foreign grown, and 35s. on that from British possessions. Later changes were: in 1922, 28s. and 23s. 4d.; and in 1924, 14s. and 11s. 8d. Annual consumption in the United States rose from 11 lb. *per capita* before the War to 12·4 lb. in 1923: in 1925 it had fallen to 11·09 lb. About two thirds of the imports in 1925 came from Brazil and the greater part of the remainder from Colombia.

The following table shows the exports of coffee from the principal producing countries from July 1 1924 to June 30 1925:—

	Lb.
Brazil	1,778,660,000
Colombia	273,984,139
Dutch East Indies[1]	145,850,108
Venezuela[2]	102,366,000
Salvador	72,007,584
Haiti	67,687,620
British India	32,280,640
Costa Rica	31,617,040
Nicaragua	21,729,185
Kenya Colony	20,841,072
British West Indies	12,973,389
Guatemala	7,275,247

[1] 1925 estimated.
[2] 1923–4.

(C. L. T. B.)

COHAN, GEORGE MICHAEL (1878–), American actor, author and producer, was born at Providence, R.I., July 4 1878. His parents were of the theatrical profession, and at an early age he appeared with them in juvenile parts, subsequently taking comedy rôles in vaudeville and on the legitimate stage. His first appearance in New York was at Keith's Union Square Theatre in 1893. Since that date he has been continuously engaged in writing and producing plays and musical revues, in the majority of which he also acted. Among his productions may be mentioned *The Governor's Son* (1901); *Forty-five Minutes from Broadway* (1905); *The Talk of New York* (1907); *Get-Rich-Quick Wallingford* (1910); *Broadway Jones* (1912); *Seven Keys to Baldpate* (1913); *Musical revues* in 1914, 1915 and 1916; *The Tavern* (1920); *The Song and Dance Man* (1923); *American Born* (1924). In addition he wrote numerous musical numbers and songs, one of which, *Over there*, acquired an international vogue during the World War. He wrote also an autobiography, *Twenty Years on Broadway* (1924).

COHN, GUSTAV (1840–1918), German economist (*see* 6.652), died at Göttingen Sept. 20 1918.

COINAGE.—The World War of 1914–8 placed an unprecedented strain upon the monetary system of both the belligerent and neutral nations. How the various systems endured the strain is discussed fully in the article on CURRENCY; the following article deals with one aspect of the problem, namely, the question of coinage and the provision of small change in the various countries concerned.

Great Britain.—The sudden change of circumstances produced less confusion in Great Britain than in any other country involved. To provide for the quick production of small change, before the Mint could get to work on a large scale with the coinage of silver, postal orders were made legal tender for all amounts during the early months of the War. But by the beginning of 1915 the subsidiary currency was being coined freely, and the circulating power of the postal order was abolished. The Treasury Notes issued in 1914 did not at first supersede the use of gold. The Royal Mint coined £15,000,000 worth of sovereigns and half-sovereigns in 1914 and over £21,000,000 in

1915. It was not till 1916 that the public was asked to pay in gold to the banks, while the banks were prohibited from paying it over the counter to those who demanded it. In 1916 and 1917, only something over £1,000,000 of gold money was struck in each year, and this was ear-marked for regions such as Arabia, where subsidies to the rulers of the Hejaz and Nejd continued to be paid in gold. Stringent legislation was framed against those who tried to take gold money out of the realm, or offered to pay a larger sum than £1 in Treasury Notes for the sovereign.

Meanwhile the issue of silver money for small transactions was portentous and unprecedented. The Mint in the years immediately preceding the War had been putting out silver to the net value of under £1,000,000 on the average. But in 1914 over £5,000,000 in silver was minted in the last six months, after the declaration of war, and in 1916, 1917 and 1918 over £7,000,000 in each twelve-month. By the end of the War there was twice as much British silver circulating within and without the realm as there had been in 1913. Silver bullion for a few months in 1920 rose to the unprecedented price of 82 pence an ounce, a figure which so terrified the then Chancellor of the Exchequer, Mr. Austen Chamberlain, that he insisted on the passing of a measure which introduced 50% of base alloy into the silver currency. The bill was wholly unnecessary, as silver fell to 40 pence per ounce before the end of 1920, and to 32 or 33 pence by 1921, so that coinage on the old scale of alloy could have been continued at a good profit. The new base money was so unskilfully compounded that its first issue turned brown or green after a little wear, or even came to pieces from inadequate mixing of the good and bad metal.

Germany.—At the outbreak of the War the Imperial Govt. did not have to improvise everything as the British Govt. was bound to do. It had collected much treasure by means of the forced loan of 1913, and it had ready for war emergency the long-hoarded military chest stored in the castle of Spandau, where a large proportion of the gold paid in the French War indemnity of 1871 had been kept intact for more than 40 years. This was used freely in the autumn of 1914 for German purchases abroad. But gold money, despite all preparation, disappeared more quickly in Germany than in Great Britain, and from the first days of the War the internal currency was paper. Silver, which never failed the British public, disappeared in Germany at an early date in the struggle. By 1915 of the old currency only the minute copper 1- and 2-pfennig pieces remained in circulation, and these too disappeared later.

To replace the nickel 5-, 10- and 20-pfennig pieces, withdrawn for military purposes, the German Govt. issued from 1916 onward immense quantities of iron and zinc coins, reproducing the old types: but both these metals proved unsatisfactory substitutes, being prone to rust and decay. The government issues proving insufficient for trade necessities, many municipalities and *Kreises* followed the Imperial lead and produced in 1917 and 1918 not only paper money but zinc and iron 10-pfennig, 5-pfennig and occasionally 20-pfennig pieces. They generally bore the town coat-of-arms or badge on the obverse, and a large figure of value on the reverse. It was apparently only after the Armistice of Nov. 1918 that a few towns put out small change of more unusual material—porcelain in some cases, wood in others. But these were very exceptional freaks.

The year 1922 found republican Germany issuing metallic subsidiary coins from its mint, but now made of aluminium and bearing on one side the accepted republican eagle, on the other a strongly conventionalised sheaf of grain. Coins of 1, 2 and 5 marks denomination were added by the end of the year. The same year saw some transitory private issues of banknotes printed on aluminium foil. With the introduction of the Rentenmark standard in 1924–5 came an issue of more durable subsidiary coins of that standard and by the close of 1925 the coinage of silver 1-mark pieces had been resumed.

France and Belgium.—The history of the French War coinage presents many similarities to that of the German, but the chaos at the beginning of hostilities was rather worse. All gold disappeared at once into the proverbial "stocking" of the thrifty peasant or bourgeois, and much silver also. But for some little time there was an endeavour to keep up a silver currency: the dies and presses of the Paris mint were moved in Aug. to the remote town of Castelsarrasin, close under the Pyrenees, and there remained to the end of the War, striking in 1914 5-franc and 2-franc pieces. They are only to be distinguished from Paris-struck money by a small capital "C" under the value on the reverse. As the French exchange grew worse, there was a steady migration of silver 5-franc pieces to Switzerland. As they were, and had been for many years, legal tender in Switzerland, the Berne Govt. had scruples about demonetising them, and they were only denied currency after the War had ended, when a vast quantity of them were recoined into Swiss 5-franc pieces.

Since the French Govt. had made no preparation to face a dearth of small change, its provision fell, far more than in Germany, into non-governmental hands. At first the situation was quite chaotic; not only municipalities but chambers of commerce, associations of merchants and shopkeepers, companies of all sorts, private firms and even individuals not engaged in trade, put out paper or metallic token-money of the most varied shapes, sizes and materials. The most characteristic pieces of the time were the *carton* (cardboard) sou and two-sou tokens. They were simply pieces of thick cardboard printed on both sides, generally with the name of the issuing town, firm or person on one side, and the value in large figures on the other. They were of all sizes and shapes and all degrees of thickness. Some, on very thin cardboard, were provided with a metal rim, to prevent them from creasing or breaking. Others were made inordinately thick for the same purpose. A very few municipalities, particularly in the south of France, tried countermarking old or foreign copper coins with a superimposed stamp, the name of the town and the value, 5 or 10 centimes, obliterating the original type.

From 1915 onward local metallic currency began to appear, superseding in most places the fragile and rubbishy cardboard. These sou, two-sou and 25-centime pieces were generally of aluminium or zinc, occasionally of iron or copper. They were in many cases very neatly struck, with simple heraldic types. Metallic tokens were issued not only by chambers of commerce and large industrial firms, but by tramway companies, electricity supply companies, military and civil clubs, the *Union des cafétiers* of Toulouse, the bakers of Nantes in syndicate and thousands of private shopkeepers. Late in the War this maddening situation led to the creation of both paper money and aluminium small change for federated towns or districts of the same region. For example, the chambers of commerce of Marseilles, Nice, Avignon, Arles and Toulon, issued zinc sous and 10-centime pieces which passed current in all five places.

In northern France and Belgium the invader, after seizing all the legitimate currency on which he could lay hands, organised a new circulating medium. The Belgian fractional currency, all nickel, was requisitioned for military purposes. To replace it the intrusive administration at Brussels coined zinc 5-, 10- and 20-centime pieces in great profusion. They imitated in general appearance the old national small change, having the lion and the large figure of value, but the inscription *Royaume de Belgique* and the king's monogram were suppressed, and the bilingual inscription was only BELGIQUE-BELGIE. In northern France there was no such metallic substitute for the small change, and the result was the issue of very small-denomination paper money, either in cardboard or in note form on ordinary paper. The round or polygonal cardboard sou, so common all over uninvaded France, was rare in the region of German occupation, though it existed in the cities of Lille and Ghent. The town of Ghent seems to have been unique in issuing a metallic currency of coins of considerable denomination. It put out a handsome gilt-bronze 5-franc piece, with subsidiary 2-franc, 1-franc and 50-centime pieces, in the same metal but of a square form.

Other Countries.—On the other side of Europe, in the enormous belt of Polish and Lithuanian territory which the Germans overran in 1915–6, a zinc fractional currency in kopeks was issued for small transactions. The Austrian War currency was in most respects a mere reflection of the German. There was a com-

paratively small amount of metallic (zinc or iron) fractional currency, and one or two examples of strikings in a sort of amalgam or earthenware material. Issues by private firms or individuals also existed, but not in such profusion as in France. Czechoslovakia issued a handsome nickel crown in 1922.

In Italy gold had been almost unknown before the War, though silver was circulating: the bulk of the fractional currency was in bronze, which did not disappear so quickly as the nickel pieces of Germany, Belgium or Austria. But the *ventino* or 20 centesimi piece of nickel, vanished for military reasons. Despite the continued existence of the bronze soldo, there was an acute lack of small change, for which *experto crede* such odd substitutes as postage stamps, cigarettes and tramway tickets were substituted. Even government packets of matches were sometimes given as change to the spender of a lira note.

In Russia, a country already using paper for all purposes during the first year of the War, the only currency problem which seems to have caused some trouble was the deficiency of small fractional change, which was in some degree met by issuing cardboard money, composed of the dies of postage stamps struck off on very thick paper. The stamps of 1, 2 and 3 kopeks replaced copper coins; those of 10, 15 and 20 kopeks had printed on their backs a notice that they were equivalent to, and were to be taken for, government fractional silver coins. In 1925 the victorious Soviet, throwing over the problem of how to deal with incalculable masses of worthless paper, started striking silver coins equivalent to a rouble, and even gold money, of the so-called *chervonetz* type.

European neutrals were somewhat affected in their currency by the nickel-famine, caused by military demands, which prevailed among all combatant powers. Finding their own small change surreptitiously departing to the seat of war, Denmark, Norway and Sweden all issued iron pieces of 1, 2 and 5 öre, and Switzerland brass 5- and 10-centime pieces. These last had all disappeared by the end of 1925, and the familiar and handsome Swiss nickel currency was once more employed. (C. W. C. O.)

COKE: *see* FUEL PROBLEMS.

COLAJANNI, NAPOLEONE (1847–1921), Italian author and politician, was born at Castrogiovanni (Sicily) April 28 1847. In his youth he followed Garibaldi, and was once deported and once imprisoned for his republican activities. After graduating in medicine, he studied social science, and in 1892 was appointed professor of statistics first at the University of Palermo, and subsequently at Naples. He published many books and essays on social and political problems. For many years he edited *Rivista popolare*, by means of which he strove to improve the moral and intellectual standard of the masses and combat all forms of intolerance and hypocrisy. He began his public career as a municipal councillor in his native town in 1872, and in 1890 was elected deputy for the same place. In Parliament he sat as a Republican with Socialist tendencies. He was a strong opponent of Crispi's somewhat autocratic policy (*see* 15.79). Though he had always opposed militarism, on the outbreak of the World War he became a warm supporter of Italian intervention. After the Armistice he conducted a campaign against the bolshevism of the Socialist party. He died at Castrogiovanni Sept. 2 1921.

COLBY, BAINBRIDGE (1869–), American politician, was born at St. Louis Dec. 22 1869. After graduating from Williams College in 1890, he studied at the Columbia Law School and the New York Law School and began to practice in 1892 in New York. He was a member of the New York Assembly, 1901–2. He supported Theodore Roosevelt for the Republican presidential nomination in 1912. Following the split in the Republican party he became one of the founders of the National Progressive party. He was a member of the American Mission to the Inter-Allied Conference at Paris in 1917, a commissioner of the United States Shipping Board, and a member of the United States Shipping Board Emergency Fleet Corp., 1917–9. He was Secretary of State in President Wilson's Cabinet March 22 1920–March 4 1921. On leaving office he resumed private practice.

COLBY, FRANK MOORE (1865–1925), American editor, was born at Washington, D.C., Feb. 10 1865. He was educated at Columbian University, Washington, and Columbia University, N.Y. (receiving a degree of A.B. in 1888 and of A.M. in 1889). He was acting professor of history at Amherst College (1890), instructor in history and economics at Columbia University (1891), and professor of economics at New York University (1895–1900). In 1893 he joined the editorial staff of *Johnson's Universal Cyclopaedia*. In 1895 he became editor of *The International Cyclopaedia* and *The International Year Book*, and from 1900 he was editor of *The New International Encyclopaedia*. He was also editor of *The Bookman*, 1904–8. He died in New York City March 3 1925. He wrote, among other works, *Imaginary Obligations* (1904); *Constrained Attitudes* (1910); and *The Margin of Hesitation* (1922).

COLD STORAGE: *see* REFRIGERATION.

COLLINGS, JESSE (1831–1920), British politician, was born at Littleham, Exmouth, Devon, Jan. 9 1831. He was educated at home and at Church House School, Stoke, near Plymouth. In 1866 he settled in Birmingham, where he founded the mercantile firm of Collings and Wallis, and had a highly successful business career. Entering municipal life, he was intimately associated with Joseph Chamberlain, and in 1878 was elected mayor of Birmingham but retired from business in 1879. In 1880 he entered Parliament as Liberal member for Ipswich, and became prominent as an advocate of the Radical land policy, associated with the phrase, "three acres and a cow." In 1886 he became Parliamentary Secretary to the Local Govt. Board, but resigned with Chamberlain over Gladstone's Home Rule policy. In 1895 Collings became under-secretary to the Home Office, retaining the post till 1902. He resigned his seat in Parliament in 1918. He was the founder (1872) of the Rural Labourers' League, and also of the Exminster Industrial school. In 1906 he published *Land Reform;* in 1914, *The Colonisation of Rural Britain* (2 vol.); and his *Autobiography*, written in conjunction with Sir J. L. Green, appeared in 1920. He died at Edgbaston, Birmingham, Nov. 20 1920.

COLLINS, MICHAEL (1890–1922), Irish politician, was born near Clonakilty in County Cork, the eighth child of John Collins, a prosperous farmer who, as an old bachelor of 62, married Kate O'Brien, his junior by 40 years. Michael Collins entered the second division of the British Civil Service and went to London as a junior postal clerk in 1907. After two years he left the Civil Service to be clerk in an accountant's office. His life in London was spent mostly among Irish people interested in the Gaelic League and in distinctively Irish sports—such as hurling. During this period he joined the Irish Republican Brotherhood, or Fenian Society.

At the beginning of 1916 Collins and several other young Irishmen of similar views, being opposed to conscription, returned to Ireland and took a hand in the rising which by that time was expected in extremist circles. He joined the Irish Volunteers in Dublin and was one of those who fought under Pearse in the General Post Office during Easter week. He escaped being taken under arms, but later was arrested and sent with the great body of suspects to the detention camp at Frongoch. Released with the rest in July 1917, he became conspicuous in the movement by his energy, and at the general election in Dec. 1918 he was returned as Sinn Fein member for County Cork. Out of 73 elected only 29 were present when they met in the Mansion House and declared for the Irish Republic. Mr. de Valera, their elected president, was in gaol, so was the vice-president, Arthur Griffith. All effective decisions were taken by the men who were clever enough to avoid arrest. These were Collins, Cathal Brugha and the headquarter staff of the Irish Volunteers. In actual practice Collins was dictator.

Brugha (Charles Burgess), as Minister of Defence in Mr. de Valera's Republican Ministry, was head of the Irish Volunteers, known later as the I.R.A. (Irish Republican Army). In this military organisation Collins was head of the Intelligence Department. But, in the administration as a whole, he was Minister of Finance. In this dual capacity Collins controlled the entire correspondence of the movement. All enterprises were considered, financed and many were carried out by him. In March

1919 he and Harry Boland arranged the escape of Mr. de Valera from Lincoln gaol; and it is claimed that he directed the campaign waged at this time against the more active members of the Dublin secret service police. How far he was responsible for the spread of the guerilla war cannot now be ascertained. Dan Breen in *My Fight for Irish Freedom* traces its beginning to the spontaneous action of a small group of volunteers in Tipperary, which was disapproved of at first by the Dublin headquarters. Breen says, however, that Collins was the man from whom they received most encouragement; and that in one of the projected attacks on Lord French, Collins was among the men in ambush.

By 1920 his name, first gradually, and then universally, had become known as that of the man most wanted by the British authorities. A reward of £10,000 was offered for his arrest, and pictures of him were published. Yet letters addressed to him through Sinn Fein channels were promptly delivered and immediately answered. He used no disguise, went about Dublin alone on a bicycle and frequently made appointments for an interview in the public streets. He succeeded in completely demoralising and dislocating the British secret service and in creating a most effective spy system of his own which ran through the whole British administration.

At the close of 1920 important secret negotiations, conducted through the Australian Archbishop Clune, were held with Collins, who afterwards maintained that all the concessions obtained six months later could have been secured then but for the action of a county council which called for cessation of hostilities. This, he held, encouraged the British to insist on a surrender of arms, upon which demand the negotiations broke down.

In July 1921 when the truce with Britain was proclaimed, Collins for the first time became directly known to the Irish public. No other figure was so popular. When the negotiations between Mr. de Valera and Mr. Lloyd George failed to reach any conclusion, Griffith, Collins and three others were appointed to renew the attempt. Collins, by his genial personality, undoubtedly smoothed over many of the difficulties and though in principle a republican, he had the instinctive sense to know when the utmost possible had been gained. Griffith alone could not have forced the Dail to accept the treaty against Mr. de Valera's opposition; this achievement was mainly due to the magnetic personality of the younger man.

When the result of the voting showed the narrow margin of seven for acceptance, Collins instantly rose and gravely warned the assembly of the anarchy that might follow dissension. He proposed a joint committee of public order, but the proposal was rejected. In the debate he had declared that he accepted the treaty as a stepping stone to a republic but he was careful both in his speech and his published volume, *The Path to Freedom*, to disavow any desire to force a separation which would injure Britain or leave her exposed. In his opinion, the Dominions were destined to detach themselves naturally and without a wrench, like ripened fruit.

The first result of the Dail's decision was confusion. Griffith was elected president, not of the Free State but of the Irish Republic. He met the situation by appointing a provisional government to carry on the administration till the Free State was legally created; and Collins was appointed chairman of this body. But administration in the ordinary sense was impossible. Civil life had been destroyed in the guerilla war; the police were now necessarily disbanded since the struggle had left a blood feud between them and the people; the British garrison was evacuating the country, and the Irish Army, still considered the Army of the Republic, was deeply disaffected.

Collins had two main objects. The first was to reach a settlement with Ulster, where a state bordering on a war of religion existed. To succeed in this would have helped him with his main purpose, the peaceful establishment of the Free State. He therefore entered into personal negotiations with Sir James Craig, Prime Minister of Northern Ireland. But no settlement was reached, largely because of the evident imminence of civil war in the South. Mutiny broke out in the army and Collins, hoping against hope to avoid civil strife, refrained from drastic action. He was instrumental in postponing the general election (stipulated for under the treaty) and when at last a date for it was fixed in June, he entered at the eleventh hour into a compact with Mr. de Valera by which he and the Republican leader agreed to appeal for the unopposed return of candidates jointly nominated by them. This would have given a very large representation to opponents of the treaty. But when independent candidates were put forward, Collins at the last moment advised his countrymen to vote as they wished. This he knew would mean the acceptance of the treaty. At the elections the republicans were heavily beaten and the Irish Govt., challenged by force even in the capital, decided to use force in return.

Civil war began; and Collins, assuming chief command, flung himself into the struggle with all his energy. Opposition was crushed in Dublin and all the large towns. Suddenly, on Aug. 12, Griffith fell dead and Collins became at once head of the state and of the army. The newly enrolled forces needed impetus and he went down to give it to them by his presence in Munster where the chief resistance lay. On Aug. 22 1922, motoring with a strong escort from Skibbereen to Cork, his party was ambushed, and in the skirmish he was shot through the head. No man since Parnell had so caught the imagination of Ireland. Perhaps the moment of his death was fortunate, for he died when victory was more apparent than real, and he was spared the task of executing those who had been his comrades. But his work stands, and he emerges from the struggle with a reputation less tarnished than some of his contemporaries. (S. G.)

COLLOIDS (*see* DIALYSIS 8.157).—In the course of investigations (1861–4) on the diffusion of substances in solution, T. Graham, professor of chemistry in University College, London, and Master of the Mint, found that certain substances, *e.g.*, sugar and common salt when in solution, can pass through or diffuse through a membrane of parchment paper, whereas other substances, *e.g.*, starch and gelatin, cannot do so. Since the substances which could pass through the membrane were such as generally crystallise well, whereas those which did not pass through were, as it was thought, non-crystallisable and of a gelatinous nature, Graham divided substances into crystalloids and colloids (from the Greek κόλλα, glue).

Although this distinction was for long maintained, more recent investigation has shown that Graham's classification is unsuitable; and the terms crystalloid and colloid are now no longer employed to connote different kinds of substances but only different states or degrees of sub-division of matter. In a solution of cane sugar, for example, molecules of sugar are distributed homogeneously throughout the solution, or, as it is said, the sugar is molecularly dispersed. In the case of gelatin and other so-called colloids, the substance does not exist in the molecular but in a coarser state of aggregation. The particles, however, are too small to be seen by the ordinary methods of microscopic examination. In short, the term "colloid" or "colloidal state" is now used to connote a state or range of sub-division of matter lying between the limits of the microscopically visible and the molecular states. These limits may be taken as, approximately, one ten-thousandth of a millimetre (0·1 μ) and one-millionth of a millimetre (1 $\mu\mu$).

Although Graham's classification of substances into crystalloids and colloids was imperfect, the process of dialysis which he introduced gave a means, still universally employed, of distinguishing between molecularly dispersed matter and matter in the colloidal state. By a refinement of the process, it is possible, using collodion membranes of varying permeability, to separate colloids of different degrees of dispersity.

General Properties.—Since the peculiar and characteristic properties of the colloidal state do not depend on the physical state of the finely sub-divided matter or of the medium in which the matter is dispersed, colloidal properties are exhibited both by colloidal suspensions and emulsions (solid particles and liquid droplets dispersed in a liquid medium), and by smokes and mists (solid particles and liquid droplets in a gaseous medium), foams (gas bubbles in a liquid dispersion medium), and so on.

Whilst it could be inferred from the experiments of Graham

that the colloidal systems, although apparently homogeneous like a solution of sugar, are nevertheless heterogeneous or contain particles which have a magnitude greater than molecular, the actual existence of such particles is rendered evident by the scattering of light which they bring about (the so-called Tyndall effect). The introduction of the ultramicroscope by Siedentopff and Zsigmondy enables the eye to detect the presence of particles of a magnitude of about six millionths of a millimetre, about sixty times the dimensions of a hydrogen molecule.

Dispersion of Light.—In the scattering of light by finely divided particles, the light of shorter wave length is scattered most, and the light which reaches the eye is therefore blue or bluish in colour. Consequently, a system containing colloidally dispersed particles, when illuminated from the side and viewed against a dark background, will appear blue. As Leonardo da Vinci suggested long ago, we can, in this way, explain the blueness of the sky as due to the scattering of the sunlight by finely dispersed particles in the atmosphere; or, as is now thought, by the molecules of the atmospheric gases themselves, the background being the blackness of infinite space. The blue colour of the eye and the colour of many feathers also find their explanation in the scattering of light by finely dispersed matter.

Surface Changes and Adsorption.—Since the colloidal state is a state of very fine sub-division, the extent of surface exposed is very large relatively to the total volume of the matter. Surface forces, consequently, play a predominant part and bring about changes in the distribution or concentration of matter at the surface of the particles. This change of concentration at a surface, brought about by surface forces, is spoken of as *adsorption*, a phenomenon readily observed in the decolourisation of liquids and the removal of noxious or obnoxious gases by the very porous, and therefore surface-active, material, charcoal.

In the production and characterisation of colloidal systems, adsorption plays a part of the highest importance. By the adsorption of ions from the dispersion medium or from electrolytes present in solution, the colloid particles acquire an electric charge. Adsorption of the dispersion medium as a whole may also take place to a greater or less extent, whereby variation in the general behaviour of colloids may be brought about. In the case of the so-called suspensoid or hydrophobe (or, generally, lyophobe) colloids, the dispersed particles may adsorb none or practically none of the dispersion medium; and they exist, therefore, in suspension as non-hydrated or non-solvated particles, the stability of which is due mainly to their electric charge and to their Brownian movement. In the case of the so-called emulsoid or hydrophile (lyophile) colloids, such as solutions of gelatin or of starch, adsorption of the dispersion medium itself takes place, and the stability and properties of such a colloidal solution (colloidal sol), are due to the adsorbed dispersion medium as well as to electric charge on the particles. The greater the extent to which the adsorption of the dispersion medium takes place, the more will the stability and properties of the colloid be dependent on the adsorbed medium and the less will they depend on the electric charge.

Electrolytes.—If the electric charge on a suspensoid colloid be neutralised, agglomeration of the particles followed by precipitation takes place, and this neutralisation of the electric charge can readily be effected by the addition of electrolytes. Negatively charged colloid particles will preferentially adsorb the positive ions of the added electrolyte, and positively charged colloids will preferentially adsorb the negative ions, the charge on the colloid being thereby neutralised. Although multivalent ions are, in general, more effective in producing precipitation than are univalent ions, recent investigation shows that there is no exact relationship between the valency of an ion and its precipitating power, and that the adsorbability of the ion may exercise an important influence.

Natural Electrolytes.—The precipitation of fine particles by electrolytes is well illustrated on a large scale in nature, the finely divided clay carried by many rivers being caused to deposit when the river water mingles with the sea. In this way the silting up of river mouths and the formation of deltas, as in the case of the Nile and of the Mississippi, are brought about.

The electrical charge on a colloid particle may also be neutralised by another colloid carrying an electric charge of opposite sign. Colloids of opposite sign may mutually precipitate each other and give rise to "adsorption complexes" which simulate chemical compounds. Purple of Cassius, for example, is an adsorption complex of stannic oxide and colloidal gold.

Action on Solutions.—In the case of solutions (or sols) of hydrophile (lyophile) colloids (*e.g.*, gelatin), the stability of the colloid is due mainly to adsorbed water or other dispersion medium, and consequently such solutions are not so sensitive to added electrolytes. Even though the addition of small amounts of an electrolyte may produce changes in the amount of water adsorbed by the colloid, actual precipitation does not take place until the concentration of added electrolyte is relatively large.

The relatively great insensitiveness to electrolytes which is shown by hydrophile colloids may be transferred to hydrophobe colloids or suspensoid colloids. When gelatin, for example, is added to a colloidal gold sol, the gold is adsorbed by the gelatin and a much greater concentration of electrolyte is required in order to precipitate the gold than is necessary in the absence of the gelatin. The gelatin is said to protect the gold, and this so-called protective action, which varies greatly in the case of different hydrophile colloids, is of much importance in many directions (*see* ELECTRO-METALLURGY).

Gelatin Types.—Many colloids of the hydrophile type exhibit, when cooled, the property of passing into a jelly by a coalescence of the hydrated colloid particles. The jelly so formed may be dried to a more or less hornlike material, such as ordinary dry gelatin. These jellies have the important property of taking up or imbibing water, even against very great pressures. The amount of water imbibed is greatly affected by the presence of electrolytes, being increased by acids and alkalies, up to a certain concentration; but the increased swelling produced by dilute acids is diminished by the addition of salts.

The properties of colloid matter play a part of the greatest importance not only in physical but also in biological science. In agriculture, the presence of colloids in the soil is of importance by their water-retaining power and by their power of adsorbing salts and plant foodstuffs and of retarding the washing away of these materials by rain.

Colloids in Industry.—Adsorption, also, plays an important part in the dyeing of textiles and the staining of animal tissues. The negatively charged colour ion of the acid dyes will be predominantly adsorbed by a positively charged fibre, and a positively charged dye (basic dye) will be predominantly adsorbed by a negatively charged fibre. After the dye has been adsorbed, secondary changes may take place, leading to the formation of a more stable adsorption complex (*see* DYEING).

By the use of "protective" colloids, sparingly soluble substances produced in chemical reactions can be kept in a colloidal state and so prevented from undergoing flocculation and sedimentation. In the production of the photographic plate, the silver bromide, formed by mixing silver nitrate with potassium bromide, is prevented by the gelatin from forming a precipitate of coarse particles unsuitable for photographic purposes, and is kept in a finely divided form. In normal bile, the bile salts, albuminoids, etc., act as protective colloids which keep the sparingly soluble substances, such as cholesterin and the calcium salt of bilirubin, in the colloidal state and so prevent their deposition; but when a reduction of the amount of protective colloids is brought about by pathological conditions, deposition of the sparingly soluble substances takes place in the form of gall-stones (*see* BIO-CHEMISTRY).

Colloids in Milk.—The nature of the curd which separates from milk and the readiness with which it is formed are greatly affected by the presence of protective colloids. In cow's milk there is a relatively large amount of casein and a relatively small amount of the protective colloid, lactalbumin. Cow's milk, therefore, readily curdles. In human milk there is a smaller proportion of casein and a larger proportion of lactalbumin; the casein is therefore more effectively protected and curdling takes

place less readily. In asses' milk, the relative proportion of protective colloid is highest of all and curdling takes place with greatest difficulty. The digestibility of asses' milk is consequently greatest. By increasing the amount of protective colloid in cow's milk through the addition of gelatin or white of egg or of barley water (starch), curdling is caused to take place less readily and the digestibility of the milk is increased.

The living protoplasm (*see* CYTOLOGY) of the animal or vegetable cell, finally, is a complex system of colloids in which there occur processes of adsorption, changes of dispersity, alterations in the distribution of water between the colloidal particles and the dispersion medium, a system in which the mutual relations between the colloids are in a constant state of flux. Only in such a colloid system is it possible to have the flexibility and adaptability to the varying requirements of what we call life and growth. Moreover, the many diverse chemical reactions involved in breaking down complex foodstuffs into simpler substances and building up again these simpler compounds into the complex proteins of the protoplasm are accomplished in the living body under the catalytic activity of the enzymes, and these are themselves colloidal. The living organism, therefore, is a vast colloidal community, the diverse members of which are held together in common service by surface forces and by mutual actions and reactions of electrical charges. In this community the colloidal workers are engaged in carrying out the multifarious and complex chemical operations on which the life and the health of the community depend. (A. FY.)

COLLYER, ROBERT (1823–1912), American divine (*see* 6.694), died in New York City Nov. 30 1912.

COLMAN, SAMUEL (1832–1920), American landscape painter (*see* 6.695), died in New York City March 27 1920.

COLOGNE (Ger. KÖLN *see* 6.697), the third city of Germany, had a population in 1925 of 693,266, including Mülheim, Meiheim and Worringen (with a population of 84,000) incorporated in the city in 1914. Cologne is an important commercial centre and is the retail town for the industrial cities of the Rhineland and Westphalia. The first international Cologne fair was held in 1924. The city is now visited again by numbers of tourists. Cologne was one of the chief military centres of Germany during the World War, and was bombed in 1917 and 1918. The Allies occupied the city and a bridgehead of 18 sq. m. on the other bank of the Rhine under the terms of the Armistice. The Cologne zone was to be evacuated after five years if Germany fulfilled her obligations under the treaty. It was formally entered, in Dec. 1918, by Sir. H. Plumer's army, and formed the headquarters of the British army of occupation. The evacuation was postponed owing to the report of the Inter-Allied Commission of Control that Germany had not fulfilled her obligations with respect to disarmament, but it was finally evacuated on Jan. 30 1926. The great bell of the cathedral, weighing 27 tons, was melted down during the War, and a new one was dedicated in 1924 (*see* also RHINELAND).

COLOMBIA (*see* 6.700), a republic in South America and a member of the League of Nations. Its area is 462,024 sq. miles. At the census of 1918 the population was 5,855,490. In 1925 it was estimated to be 6,617,833, about half being whites or of mixed blood.

I. POLITICAL HISTORY

On Aug. 3 1909, Gen Ramón González Valencia was elected by Congress to serve as President for one year in place of Gen. Rafael Reyes. The latter's dictatorial rule had aroused popular indignation, and after two terms as President he left the country. González-Valencia found the country suffering from bad administration, and still feeling the disturbing effects of the civil war of 1899–1902, and the secession of Panama. On July 15 1910, Dr. Carlos E. Restrepo was inaugurated as President, after a formal election, and more stable conditions prevailed. The law of 1906 for the representation of minorities in Congress and other public bodies came into effect, and its application, even to the appointment of judges and other office-holders, led to the co-operation of all parties in the pacification and good government of the republic. The law of 1898, guaranteeing the liberty of the press, had been disregarded under the régime of Gen. Reyes, but after 1910 it was rigorously observed. The movement toward currency reform and financial stability was also begun, and further efforts were made toward a settlement of differences with Panama and the United States arising out of the secession of the former from Colombia and its constitution as an independent republic. Relations between the three countries had long been delicate. The visit of Gen. Reyes to Washington had proved futile, and the treaty negotiated in 1909 between Colombia's envoy, Enrique Cortés, and the U.S. Secretary of State, Elihu Root, did not prove acceptable to Colombia.

At the regular presidential election in Feb. 1914, Dr. José Vicente Concha, the Conservative candidate, was returned. He had the support of the Liberal party, and in the formation of his Cabinet he filled some of the offices with Liberals, thus inaugurating a coalition form of government and fulfilling the spirit of the minority representation law. During 1914 renewed efforts were made to adjust Colombia's differences with Panama and the United States, and on April 6 a treaty was signed by Thaddeus A. Thompson, U.S. Minister at Bogotá, and Francisco J. Urrutia, Colombian Minister of Foreign Relations. This treaty was ratified by Congress on June 9 1914, but did not obtain approval by the U. S. Senate till seven years later, nor come into final effect without prolonged negotiations. President Concha was installed in office on Aug. 7 1914. Apart from fiscal and diplomatic problems inherited from his predecessors, he had to face new difficulties created by the outbreak of the World War. The neutrality of the republic was proclaimed, and to ensure its observance Suárez, the Foreign Minister, addressed a circular letter to the newspaper editors throughout the country on Nov. 27, exhorting them to be strictly neutral in their comments on events. Colombia passed through the War period without any diplomatic difficulties arising.

The Panama Settlement.—In Feb. 1918 Marco Fidel Suárez was elected President, and took office on Aug. 7. On Nov. 3 1919 Congress authorised Colombia's adhesion to the League of Nations, but served notice that her acceptance of Article 10 of the Covenant did not imply her acknowledgment of Panama as an independent nation. Two delegates attended the Assembly of the League at Geneva in 1920. The old trouble arising from the secession of Panama again absorbed attention, and the terms of its settlement excited political feeling. The Thompson-Urrutia Treaty, as originally drafted, had been ratified by the Colombian Congress, but the U.S. Senate proposed several drastic modifications. One of these involved a pledge on the part of Colombia of her recognition of the independence of Panama. The privileges allowed to Colombia in the use of the Panama Canal were also somewhat reduced. The treaty stipulated that Panama should accept as her southern boundary the line sketched in a Colombian law of 1855. Of the indemnity of $25,000,000 for the loss of Panama it was further provided that $5,000,000 should be paid within six months of the treaty coming into force, and the balance in four annual instalments. Because of the factious opposition in the Colombian Congress to these modifications, President Suárez resigned his position on Nov. 11 1921 and was succeeded by Gen. Jorge Holguín. On Dec. 22 1921 the Colombian Congress ratified the modified Thompson-Urrutia Treaty, which had been adopted by the U.S. Senate in April, and two days later it was approved by President Holguín. On Feb. 12 1922 Gen. Pedro Nel Ospina, candidate of the Conservative party, was elected President, and was installed on Aug. 7 1922.

Questions of financial reform came under review early in the régime of Gen. Ospina, and at the invitation of the Government a commission, headed by Prof. Kemmerer of Princeton University, arrived in Colombia in March 1923, to undertake the task of introducing greater financial efficiency and establishing an effective gold standard. In May 1924, at the instance of the United States Govt., the envoys of Colombia and Panama in Washington signed an agreement which provided that each government should designate a Minister to the other contracting party and thus formally establish normal diplomatic relations

between the two states. On Aug. 1 1924 Nicolás Victoria, the Minister of Panama, was received at Bogotá, and Colombia's representative to Panama was duly accredited. A mixed commission was appointed to survey the boundary between the two countries. In Feb. 1926 Dr. Miguel Abadia Mendez, Chancellor in the Cabinet of Gen. Ospina, was elected President for the term 1926–30.

Constitutional Changes.—In the period 1910–25 important modifications of the constitution of 1886 were made. A law of June 6 1910, provided that in case of vacancy in the presidency, two persons selected by Congress were temporarily to exercise the powers of the president in a designated order. It was also provided that no person could be re-elected for a second term as president. On Oct. 31 1910 another law made important constitutional amendments, among which was a provision that only male citizens who were able to read and write and either owned real estate or had an income, should be allowed to vote in congressional and presidental elections. The method of constituting the Senate was also altered by providing that its members should be chosen by the assemblies in the different departments into which the country is divided. The Supreme Court was empowered to determine whether or not a law should be enforced if the national Government, or a citizen, denounced it as unconstitutional: in the exercise of this power certain concessions, originally granted to Colombians and then transferred to foreign corporations, were held to have been unconstitutionally granted, and as the terms had not been fulfilled, were cancelled. During the administration of President Concha, Congress enacted a law providing for the re-establishment of the council of state, which was to act as an advisory body to the president.

Defence.—In 1925 Colombia had a defence force with a peace establishment of about 5,000. The system of compulsory military training was nominally in force, the conscripts undergoing six months training. Actually exemption from service is freely granted. In 1924 arrangements were made with the Swiss Govt. to send out a military mission of five officers, besides aviators, to introduce the Swiss system of training and organisation. The infantry is armed with the Mauser rifle and the artillery has Schneider-Creuzot guns. Expenditure on defence amounted in 1924 to $2,648,300.

Education.—There are primary, secondary, professional, industrial and art schools in Colombia, as well as the University of Bogotá (founded in 1572) and the four provincial universities of Cartagena, Popayán, Medellín and Pasto. Education is under the control of the Ministry of Public Instruction, but the Church has wide powers, and so far as direction and supervision go, dominates the entire scholastic system. The industrial and art schools are mostly directed by the religious orders. Primary education is free. In 1924 a German commission of three members began to advise the Colombian Govt. on educational matters, and aided by a council of three Colombians, headed by Dr. Tomás Vargas, took in hand the modernisation of the system. In 1924 there were in Colombia 6,674 primary schools having on the average only one teacher each. The attendance at these schools was 417,054. The vote for public instruction in 1923 was $1,108,190, and in 1924 the actual expenditure under the heading of " Instruction and Public Health " was $2,234,672. In addition departments and municipalities spend money on education.

II. ECONOMIC HISTORY

Staple Products.—The principal industry of Colombia is the production of mild coffee, in which the expansion has been remarkable, the value of exports rising from $18,369,768 in 1913 to $53,630,661 in 1924, dropping through crop shortages to $42,968,544 in 1925. The country is the second largest world producer of bananas. Cattle breeding has also been developed as the result of the clearing of forests and the sowing of imported grasses. In 1921 there were estimated to be 8,000,000 head of cattle, a figure which increased to 9,000,000 in 1925. The carrying capacity of the cattle lands is estimated to be 50,000,000 head. Cocoa, sugar, tobacco, balata, pita fibre, ivory nuts, sisal-hemp, silk, tropical fruits, wheat and maize and cotton are the staples of agricultural produce. In 1925 arrangements were made for a British expert commission to visit the country and report on the development of the cotton industry, which is increasing in importance. The mission arrived in Colombia on Feb. 27 1926. Medicinal plants such as cinchona, ipecacuanha, sarsaparilla, etc., are also grown. The forests are valuable chiefly for the production of cedar and dyewoods. Rubber grows in most of the departments. On the coasts there are valuable pearl fisheries.

The republic is famous for emeralds and platinum. Other mineral products of importance are gold, silver, copper and iron, while a small amount of coal is produced. Asphalt is also being worked and there are large salt deposits under state control. Of recent years the country has been vigorously prospected for oil, and rich fields have been tapped by British and American companies. Colombia has been classified by the U. S. Geological Survey as the largest potential oilfield in the world. The Tropical Oil Company has a big concession in the Department of Santander, and at the end of 1925 was producing 20,000 bbl. a day. To convey the oil from the Santander fields to the point of shipment the Andean National Corporation, under a contract with the Government, laid down a national pipe-line, the first section of which (240 m.) was under construction at the end of 1925.

Encouraged by high protective tariffs, manufacturing industries progressed considerably after the War. The development of cotton growing, sheep raising and silk production assisted the growth of the textile industry, and factories were erected at Barranquilla, Medellín, Bogotá and Cartagena. The manufacture of Panama hats, and the export of the finished product, greatly increased in the post-War period. The country's industrial development, however, is still greatly retarded by inadequate means of transport.

Foreign Trade.—Colombia's foreign trade, which had previously shown only a slight annual increase in volume, was seriously checked during the World War. Since then, however, it has greatly increased.

	Imports	Exports		Imports	Exports
	$	$		$	$
1913	28,535,779	34,315,251	1921	33,078,317	63,042,132
1915	17,840,619	31,579,131	1922	44,148,024	53,816,331
1918	21,783,002	37,443,991	1923	57,783,798	60,257,172
1919	47,451,724	79,010,983	1924	52,347,914	70,615,819
1920	101,397,906	71,017,729	1925	57,783,796	60,115,435

With the exception of 1920, when there was a " boom " in imports to replenish stocks depleted during the War, a favourable balance of trade was maintained. The main item of exports was coffee, the volume and value of which rose from approximately 450,000 bags, worth $18,369,768 in 1910, to 2,500,000 bags, worth $42,968,544 in 1925. Other important exports were bananas, platinum, hides, tobacco, cattle and Panama hats. The export trade was largely to the United States, Great Britain, Holland, Mexico, Germany and Belgium. Imports mainly comprise railway material, locomotives and rolling stock; engineering, road-building and general construction materials; agricultural and other machinery; commercial vehicles, hardware, jute bags, cutlery, crockery, wines and spirits, drugs and chemicals and provisions. In 1925 the chief countries from which imports were received were the United States, Great Britain, Germany, Italy, France, Spain and Holland.

National Finances.—There was a great improvement in the national finances in the period 1910–25, and particularly in the two years immediately following the adoption of fiscal and other reforms recommended by the Kemmerer Financial Mission. This body spent six months in 1923 in investigating the entire system of national accountancy, revenue and expenditure, banking and the monetary system. Drastic reforms followed, the results of which are admitted to have placed Colombia among the most healthy and stable of Latin American countries so far as public finance is concerned. A proper valuation of the national assets was made and a system of independent audit of accounts introduced. In the same period the payment of the instalments of the indemnity for the loss of Panama helped to strengthen the

financial position of the republic. The first instalment of $5,000,000 was paid on Dec. 7 1922 and was used the following year to establish the central bank as recommended by the Kemmerer Mission. Three subsequent payments were made before the end of 1925, and there was a gain to the republic on exchange.

In 1910 the revenue of Colombia totalled $10,827,569, and the expenditure was $11,501,442. In 1924 the ordinary revenue amounted to $33,458,053, to which was added extraordinary revenue (mainly the instalment of the American indemnity) of $6,391,982. Ordinary expenditure (national services) amounted to $32,024,244, while that on extraordinary account was a further $6,899,693. On both accounts the year closed with a surplus of $926,097. The year 1925 closed with total receipts of over $40,000,000, not including the quota of the indemnity, and the biggest surplus that had been known in the history of the country was realised.

On Dec. 31 1910 the public debt was $17,495,127, consisting of external obligations of $14,839,000, and internal debts of $2,656,127. At the end of 1924 the gross debt was $36,716,827, the external debt being $19,293,862 and the internal $17,422,965. During 1924 the gross indebtedness was reduced by $6,049,984. Colombia's credit stands very high abroad owing to the regular fulfilment of the debt services and the steady amortisation of the loans. The main operations after 1910 were the loan of £1,500,000 at 6% obtained in London in 1913, and that of $5,000,000 (U.S.) raised in the United States in Oct. 1922, with interest at 6½%, these and other loans carrying a sinking fund of 1%. Long credits have been obtained for the purchase of railway and other material. Owing to the reorganisation of the finances and administration, and also to the influx of money in the form of the Panama indemnity, no further effort was made by the Central Govt. to float foreign loans.

Money and Banking.—The monetary unit is the gold peso ($) worth $0.975 United States currency, and four shillings English. The five peso gold piece has the same weight and fineness as the English pound, which is also legal tender in Colombia. The peso is divided into 100 cents. The currency consists of nickel coinage of 1, 2 and 5 cents; silver for 10, 20 and 50 cents; notes for 50 cents, 1, 2, 5 and 10 pesos, and gold coins for $2.50 and $5. Before 1910 the paper peso had dropped to a value of one cent, and all foreign coinage was allowed to circulate. The Government of the day exchanged one gold peso for every 100 paper pesos. From 1910 the money in circulation was restricted to a total of about $10,000,000.

The whole question of the currency system was reviewed by the Kemmerer Mission. Among the proposals adopted in 1923 were those for a new banking system embodying the creation of a central national bank, and the reformation of the currency. While the mission was at work the collapse of one of the biggest of the local banks threatened to precipitate a commercial crisis. The Banco de la Republica was hastily established, with the sole right to issue notes based on a minimum gold reserve of 60%, supplemented by short-dated commercial paper. At the same time arrangements were made to reduce the circulation of old notes issued by other banks. In the first year of its existence the Banco de la Republica stabilised the currency on an effective gold basis, reduced the discount rate, increased the gold reserve against the legal requirement, and generally restored complete confidence. Against the total note issue of $33,555,890 in circulation on June 30 1925, there was a gold reserve of $26,286,703. All local and foreign banks in Colombia are under the control of the law through a state banking superintendent. During 1925 an agricultural mortgage bank was established to afford credits for the agricultural development of the country.

Communications.—The main approach to Colombia from Europe and the United States is, on the Atlantic side, through the port of Cartagena, and on the Pacific, through Buenaventura. Vessels of the United Fruit Company call at Cartagena, Puerto Colombia and Santa Marta. The Harrison, Leyland and Horn Lines maintain services from Europe, and other companies, using the Panama Canal, serve the Pacific ports. Colombia can also be reached through Venezuela, *via* Lake Maracaibo. Inland traffic from the Atlantic to the capital of Bogotá mainly follows the Magdalena river, which is navigable for some hundreds of miles. Short railways exist in various parts of the republic and the policy of the Government is to link them up and form three grand trunk systems, one connecting the capital with the Magdalena, the second from Cartagena through the Cauca valley southward to the frontier of Ecuador, and the third eastward from Buenaventura to Bogotá. Colombia's railway policy is to construct, own and operate her own lines. The director general of railways reported at the end of 1925 that the state operated 517 m. of line and had under construction, or had planned, a further 370 miles.

Colombia devoted most of the Panama indemnity to public works, including the construction or purchase of railways. A vigorous programme of road building was also adopted in 1925. The republic possesses the longest aerial ropeway in the world, and in 1925 the construction was begun of a ropeway for passengers and goods from Gamara on the Magdalena to Cúcuta, a distance of 105 miles. Aviation services have proved very successful, especially for shortening the time of travel between Cartagena and other Atlantic ports and Bogotá. Aerial services are operated over a distance of 1,000 miles. Telegraph lines exceed 15,000 m. in length, and there is wireless communication with the United States and Europe. Cable communication is maintained *via* Colon with the United States, and direct with Europe.

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(W. S. Ro.; L. Ma.)

COLOMBO, Ceylon (*see* 6.713), had, in 1921, a population of 244,163, which includes Parsees, Tamils, Malays and a number of people of mixed Portuguese and Dutch descent. In 1921 the birth rate, 25·8 per 1,000, was the highest for 14 years. The death-rate was 25·2 per 1,000. An ambitious drainage scheme for an area of 10 sq. m., taken in hand by the municipality, was modified for financial reasons, and the reduced scheme, with main works at Madampitiya, was brought into use in 1921. In that year a university college was founded, and the college building and laboratories were erected in 1922. The harbour, with a water area of about 600 ac., has fine accommodation for large vessels since the extension of the southwest breakwater in 1911. A dredger is regularly at work in the harbour. Communication has been established between Colombo lake and the harbour, and a railway built to connect with the main line. Oil depots have been established at Blomendhal and Kolonnawa.

COLORADO (*see* 6.717).—The estimated population of the state in 1925 was somewhat in excess of 1,000,000. The census of 1920 showed 939,629; in 1910, 799,024, an increase of 140,605, or 17·6%, as compared with 48% in the preceding decade. In 1919, 83·8% of the population were native-born, 98% being whites. Negroes and Indians numbered 12,935, and there were 3,736 Chinese and 2,300 Japanese. The density of population increased from 7·7 persons to the sq. m. in 1910 to 9·1 in 1920

	1920	1910	Increase per cent
Denver	256,491	213,381	20·2
Pueblo	43,050	41,747	3·1
Colorado Springs	30,105	29,078	3·5
Boulder	11,006	9,539	15·4
Greeley	10,958	8,179	34·0
Trinidad	10,906	10,204	6·9

and to about 9·8 in 1925. The decay of mining towns altered the balance between urban and rural population. In 1920 the urban population was 48·2% of the whole, the rural 51·8%. The table on the preceding page shows the comparative population figures for the six largest cities.

Agriculture.—During the decade 1910–20 agriculture displaced mining as Colorado's most important industry. The number of farms increased 29·8% to 39,934; their area 80·8% to 24,462,014 ac. and their average size 39·2% to 408·1 acres. The value of all farm property increased 119·1% to $1,076,794,749. Land values were estimated at $763,722,716, buildings at $102,290,944, implements and machinery at $49,804,509 and live stock at $160,976,580. Reports for 1924 indicated increased acreage in cultivation, but decreased numbers of farms, capital valuations and values of products, due to post-War price adjustments.

The farm crops (partly estimated) in 1924 were:—

Crops	Acreage	Production	Value
All crops	6,427,215		$132,015,097
Cereals, total	3,915,000	51,587,000 bus.	55,435,000
Corn	990,000	9,900,000 "	9,000,000
Oats	260,000	6,500,000 "	3,770,000
Wheat	1,457,000	21,030,000 "	24,815,928
Barley	340,000	8,160,000 "	5,875,000
Sorghum grains	308,000	3,050,000 "	5,817,600
Beans, dry	290,000	986,000 "	3,057,000
Sugar beets	229,000	2,548,000 tons	20,868,120
Hay and forage	2,475,000	4,250,000 "	45,400,000
Vegetables	146,000		13,200,000
Orchard fruits		4,520,000 bus.	6,250,000
Misc. fruits			550,000

The irrigated area was 2,792,032 ac. in 1909, 3,348,385 ac. in 1919, while acreage under all irrigation enterprises, whether completed or not, had decreased from 5,917,457 to 5,220,588 acres. Organised drainage enterprises, most of them having been rendered necessary by faulty irrigation, had affected 171,656 ac. at a cost of $1,081,875. In 1924 county assessors reported in the state 290,323 horses, 35,325 mules, 972,828 range cattle, 149,421 milch cows, 809,761 sheep, 246,206 swine, 16,819 goats, 211,490 dozen poultry and 53,990 stands of bees.

Mining.—As in the case of agriculture, the mining industry in Colorado has been depressed by post-War adjustments, but a revival of production under more favourable conditions began in 1923. Radium and tungsten production almost entirely ceased in 1921. In 1924, with an output of $8,447,900, the state ranked second among the states in gold mining. It was seventh for silver, with an output worth $3,286,996, and ranked fifth for lead and zinc, of which it produced 50,982,000 lb. and 59,200,000 lb. respectively. Coal mined in 1923 was 10,336,735 tons. Petroleum production had fallen to 67,000 bbl. in 1923. Exploratory drilling in 1924 developed several new petroleum fields which promised to be of great value.

Forests and National Parks.—A marked influence on Colorado's economic life is found in the existence of large forested and mountain areas, and the consequent establishment of forest reserves and national parks. The forest acreage in 1925 was 13,280,000 ac. in national forests and there were two national parks and three national monuments. Timber supplies, grazing for stock, irrigation and hydroelectric power are important. The tourist business is a leading industry of the state.

Manufactures.—From 1900 to 1920 the number of manufacturing establishments in Colorado nearly doubled, the number of persons engaged more than doubled and the capital invested increased 225%. State authorities estimated that in 1924 there were 2,750 manufacturing establishments, employing 36,663 persons, with products to the value of $375,000,000. Beet-sugar manufacture has been the leading factory industry since 1914. There were 16 operating plants in 1924, which manufactured sugar valued at $45,000,000. Slaughtering and meat-packing products amounted to $45,000,000. Flour and mill products were valued at nearly $20,000,000. Butter, cheese, condensed milk, crackers, candy, cement, steel and machinery were important products.

Education.—In 1924 there were in the state 1,944 school districts, with 3,243 schools and 3,635 buildings. There were 1,336 male and 7,263 female teachers. The school population was 297,934, and the enrolment in the public schools 249,813. The income of the permanent school fund, derived from Federal land grants, is annually apportioned among the districts. In 1924 there were 180 consolidated rural schools teaching combined high and grade classes of 33,000 pupils. Enrolment in secondary schools had increased from 24,404 in 1920 to 48,559 in 1924.

Finances.—The bonded indebtedness of the state in Dec. 1924 was $10,536,500, excluding $6,700,000 for the Moffat Tunnel district and $3,600,000 for the Pueblo Conservancy district. There were outstanding county bonds amounting to $3,662,630, municipal bonds of $47,895,100 and school district bonds of $20,854,470. The general assessment valuation of taxable property in 1923 was $1,543,211,892, on which there was a state levy of $4,480,000. The tax revenue of the state in 1923 was $6,080,798, of counties $8,710,145, of municipalities $7,954,168, of school districts $19,493,711.

History.—A constitutional amendment adopting initiative and referendum was ratified in Nov. 1910. In the same year a primary election law provided for direct nominations by the people of candidates for the U.S. Senate, representatives in Congress and all elective state, district, county, ward and precinct officers, as well as members of the state legislature. This Act provided for party assemblies, at which party candidates might be designated to seek nominations in the primaries, every candidate receiving 10% or more of the votes of the delegates to the assembly being certified by the assembly as a candidate to enter the primaries. It was also provided that persons not entering the assembly might become candidates for any of the offices above mentioned by petition, the number of signers required being 300 for any official who is to serve any political district in the state greater than a county, and 100 for other officials. The expense of candidates in such primaries was limited by the Act and severe penalties were provided for violations.

In 1911 an Act was passed providing for registration of voters for all elections to be held in the state except school elections, and providing severe penalties for false registration and other violations of the Act. In Nov. 1912 the people approved amendments to the state constitution providing for the recall of elective officials and, in certain cases, for the recall of judicial decisions. An Act, proposed by initiative, was passed at the same time, providing for a ballot without party headings. The voters adopted in Nov. 1914 an amendment to the state constitution prohibiting the sale and manufacture of intoxicating liquor, which became effective Jan. 1 1916; and the prohibition amendment to the Federal Constitution was ratified by the Colorado Legislature in regular session Jan. 15 1919.

The Legislature in 1919 passed an Act providing for a budget system in making appropriations and creating a state budget and efficiency commissioner. The first budget prepared under this Act was presented to the Legislature in 1921. In 1920 the voters adopted an initiated constitutional amendment raising the limit on state tax levy from $4,000,000 to $5,000,000, the additional $1,000,000 to provide buildings for educational institutions. In 1921 a proposed amendment to extend the tenure of office of state and county officers and a proposal for a convention to revise the state constitution were defeated. The Legislature in that year revised and strengthened inheritance tax laws by raising the rates thereof. Persistent advocacy by the governor secured the passage of laws for the re-establishment of a national guard and for a Dept. of Safety, with a force of rangers as a state police force. A special session of the Legislature in 1922 passed laws for a bond issue of $6,700,000 to finance the construction of a tunnel through the mountains northwest of Denver, and for a bond issue of $3,600,000 to finance a flood control district on the Arkansas river for the protection of Pueblo. In 1923 laws were passed to facilitate co-operative marketing of agricultural products and to grant compensation to veterans of all wars beginning with the Civil War. Condemning the maintenance of a state police force as violating rights of local self-government,

the new Democratic governor in 1923 secured the disbanding of the state rangers. In 1924 referendum votes on several constitutional amendments defeated the proposals. Issues raised by the Ku Klux Klan were politically prominent in 1924–5. Many men favourable to the Klan were elected to municipal, county and state offices, including the governor and a U.S. Senator.

There were a number of serious labour disturbances between 1910 and 1920, some of them marked by violence and virtual insurrection which had to be put down by the military. A notable contribution to better relations between capital and labour was the industrial representation plan put into effect by John D. Rockefeller, Jr., in the properties of the Colorado Fuel and Iron Co. in 1916. Employees, by districts and classified groups, elect representatives who have the right to confer with executives on all questions affecting wages, conditions of employment and operation and general welfare. The system has had a marked influence on similar large industrial organisations elsewhere, but it has been opposed by labour unions.

In 1910 the state administration was in the hands of the Democratic party, with Joseph H. Shafroth as governor. The Democrats again elected a governor in 1912, Elias M. Ammons, a result largely due to the split in the Republican party throughout the nation. In 1913 George A. Carlson, Republican, was governor. He was succeeded by Julius C. Gunter, Democrat, elected in 1916. A reunited Republican party, profiting by popular reaction on World War issues, elected Oliver H. Shoup governor in 1918, and re-elected him in 1920 with an increased majority and a Legislature almost completely Republican. The Democrats elected William E. Sweet governor, and Mary A. Bradford superintendent of public instruction in 1922, although Republicans mostly elected their candidates for other offices. In 1924 C. J. Morley, Republican, was elected governor.

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COLORADO RIVER (*see* 6.724).—The Colorado river, with its drainage of 250,000 sq. m., its 7,500,000 acres of irrigable land, its annual flow of 18,000,000 ac.-ft. of water, its capacity to develop more than 5,000,000 continuous H.P., and its devastating floods reaching 240,000 cu.ft. of water per sec., is a vexatious problem. The immediate danger of inundation of the great Imperial Valley, which has been impending since the disastrous break of 1905, has been lessened by the diversion of the river into the Pescadero Channel and the completion, in 1922, of a substantial levee. The relative security attained remains uncertain, however, as long as occasional extraordinary floods might undermine or overtop existing levees; while nearly 5,000,000,000 cu. ft. of silt brought down annually to Yuma produces dangerous meandering in the leveed section and builds up the delta channels causing the river to seek new outlets. These conditions necessitate large expenditures for revetment and the raising of the levees to prevent disaster to the rich irrigated lands of the delta region.

To ameliorate these conditions and to increase the low water flow for further irrigation, Congress has been urged to provide for the construction of Boulder Canyon reservoir to be formed by a dam 605 ft. high in Black Canyon, east of Las Vegas, Nevada. Such a dam would store 34,000,000 ac.-ft. of water and would provide for the reduction of floods, the regularisation of the stream flow, the interception of silt and the development of 650,000 continuous horsepower. The cost of the dam is estimated at $50,000,000, while the power development, including transmission lines to southern California power markets, would add $80,000,000, a total of $130,000,000.

Besides securing flood protection, three large irrigation developments, Palo Verde, Yuma and Imperial Valley, would utilise the regulated flow to increase their 700,000 ac. of irrigated land to about 2,000,000 acres. Since one-third of the irrigated lands of the Imperial Valley and much of the main irrigation canal lie in Mexico, the agitation for the Boulder Canyon dam has been accompanied by a demand for the construction of a new canal entirely on American territory. Opposition to these projects has been based upon two principal grounds: they are not the best means of accomplishing the results desired, and the projects should not be financed and built by the national government.

Developments in the lower basin having appeared likely to acquire water rights that might prevent future developments in the upper basin, a commission, with a member from each of the states of Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming and one from the United States, prepared, in 1922, a plan for the distribution of the waters, giving 7,500,000 ac.-ft. annually to the upper states (Colorado, New Mexico, Utah and Wyoming), and 8,500,000 to the lower states. This plan, known as the Colorado river compact, requires ratification by each state and subsequently by Congress. Arizona having failed to ratify the compact, the Federal authority has been withheld, in order to await an adjustment of the conflict of interests. (H. T.*)

COLOUR (*see* 6.728).—The sensation of white light is caused by electromagnetic waves of a certain wave length impinging on the retina of the eye. The sensation of colour is produced by the absorption of one or other of the coloured components of white light when the light strikes some suitable surface or passes through a suitable medium—the light reflected from the surface or transmitted through the medium consequently conveying to the retina a sensation of colour complementary to that absorbed.

General and Selective Absorption.—Many substances do not absorb any definite portion of the visible spectrum—the name applied to the range of colours into which white light can be resolved—but give *general* absorption throughout the range.

Such substances appear, therefore, colourless both by transmitted and reflected light and it is only those materials which cause selective absorption, that is which absorb some definite portion of the visible spectrum, that appear coloured. It follows, therefore, that there must be some special property possessed by substances which produce the sensation of colour which distinguishes them from other substances that appear colourless.

Physical and Chemical Colour.—As a matter of fact it is quite easy to detect the causes leading to the main underlying difference between the two types, for they may be divided into two classes which, for the sake of convenience, may be named the physical cause and the chemical cause; and, in the first instance at any rate, the reason for production of colour is quite clear and it is a comparatively simple matter to reproduce the effect mechanically. For example, white light is resolved into its component colours when it is allowed to impinge on a glass surface which has been ruled with a number of fine lines, and there are a number of other ways by which the sensation of colour can be imparted by purely mechanical means.

Subjective Colour.—As a matter of fact many natural objects, especially in the animal kingdom, owe their colour to the physical cause. The vivid green of certain beetles, the colours of the peacock's feathers, the colours of butterflies' wings and the colour of blue eyes are all produced in this way, the colour effect being caused by the interference of white light through the agency of minute excrescences or fine filaments on the surface of the objects that appear coloured. The colour effects in such cases are, therefore, subjective and it would be just as reasonable to attempt to extract a coloured substance from the peacock's feather as it would be to do so from the rainbow.

Chemical Colour.—On the other hand there are a great number of substances the colours of which must be ascribed to the second or chemical cause. These occur both naturally and artificially and are distinguished from those of the first or physical section by reason of the fact that the coloured substances in them can be extracted from the coloured materials and, when extracted, are found to be definite chemical compounds which owe their colour to their chemical constitution.

The Colours of Flowers.—In nature such coloured substances are to be found mainly in the vegetable kingdom, in the colouring matters, for example, of the flowers and of green grass or leaves. Moreover, it is easy to distinguish by a practical test between the two types because if a peacock's feather is viewed by transmitted light the brilliant colours will disappear, whereas, if a red rose leaf is treated in the same manner no change in colour will be noticed.

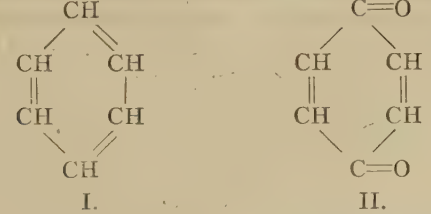
Intermolecular and Intramolecular Interference.—Nevertheless, it is only reasonable to suppose that the two types of phenomena are of the same order and that whilst the physical or subjective colour is due to the *intermolecular* interference of white light, the chemical colour is due to *intramolecular* interference, or, in other words, white light is "filtered" through the molecular structure of the chemical substance, leaving a "portion" behind in its passage. The colour is therefore dependent on the chemical composition of the particular compound. It remains then to compare those chemical compounds which produce colour with those that are colourless so as to reach some conclusion as to the influence of molecular structure on colour production. In the first place, however, it is necessary to attempt to arrive at some definition of what is meant by colour in a strictly scientific sense.

The Visible Spectrum in the Range of Electromagnetic Vibration.—The range of the visible spectrum which is produced, for example, when a beam of white light passes through a quartz prism, represents a range of electromagnetic vibrations of wave lengths between 4,000 and 8,000 Ångström units. This is, however, only one octave in the range of 62 octaves of wave lengths from 0·01 to $3{\cdot}5\times10^{16}$ Ångström units which has been investigated. It is clearly, therefore, scientifically illogical to restrict the term "coloured" to those substances which cause absorption only in the short region capable of detection by the eye, because a substance which produces selective absorption in any other region of the electromagnetic range is also "coloured" although such colour requires the aid of some external influence in order that it may be detected.

Visible and Invisible Colour.—It is necessary, therefore, to distinguish between *visible* colour and *invisible* colour and to describe those substances which give selective absorption in the visible region as visibly coloured and those which give selective absorption in other regions as invisibly coloured.

Infra-red and Ultra-violet Regions.—It is fortunate that the photographic plate is more sensitive to waves immediately outside the visible region of the spectrum than is the eye, for by its aid it is possible to detect selective absorption in those regions immediately outside the visible spectrum, which are known as the infra-red and the ultra-violet, and thus to show that many substances which appear colourless to the eye possess nevertheless intense invisible colour. Moreover, it is possible by simple chemical reactions to transform compounds having this invisible colour into those having visible colour or, in other words, by a change of structure, to throw the absorption from the invisible region into the visible region. In this way it is possible to correlate structure with visible colour.

Invisible Colour of Benzene.—For example, the hydrocarbon benzene (C_6H_6) appears colourless to the eye both by reflected and transmitted light, nevertheless when its spectrum is photographed marked selective absorption in the ultra-violet region

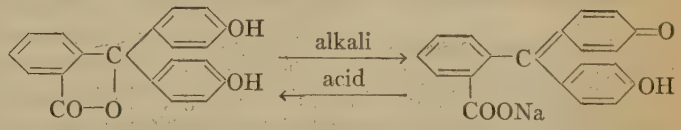


I. Benzene (invisibly coloured)

II. Quinone (yellow)

is manifested. Benzene is, therefore, a substance having a strong invisible colour. By a simple series of reactions it is possible to transform benzene (I.) into quinone (II.) and by so doing to shift the absorption from the invisible to the visible region of the spectrum, thus obtaining visible colour (yellow).

The Shift of Absorption.—This change, in the case of many derivatives of benzene, takes place with remarkable ease and with astonishing rapidity, thus the change from phenol-phthalein (III.), the benzenoid or invisibly coloured form, to the sodium salt (IV.) the quinonoid or visibly coloured form, by the action of alkali, and the reverse change which is effected by the action of acid, is so rapid and sensitive that the substance is used as an effective indicator in alkalimetry.



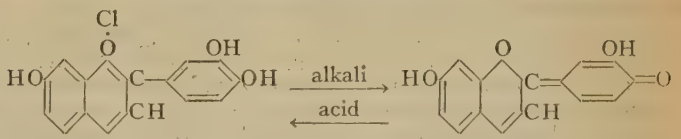
III. Benzenoid form (invisibly coloured)

IV. Quinonoid form (red)

The hydrocarbons naphthalene ($C_{10}H_8$) and anthracene ($C_{14}H_{10}$) provide further examples of the same kind and, in fact, the occurrence of colour among organic compounds which has led to the foundation of the coal-tar colour industry is based mainly on this change.

It is also possible to start with a benzenoid derivative which by reason of its structure is visibly coloured and by a simple chemical change, such as that illustrated above, to throw absorption from one end of the visible spectrum to the other and thus to transform a red substance into a blue one.

Red and Blue Flowers.—As a matter of fact Nature has utilised this method to produce her red and blue flowers:—



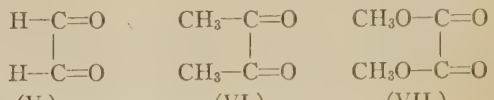
Red (rose)

Blue (cornflower)

The red flowers are those in which the cell sap is acid, the blue those in which it is alkaline. If the cell sap is neutral the flowers are purple.

It would appear, therefore, that the occurrence of visible colour is mainly adventitious and depends on molecular conditions which are subject to control. It happens to be a property of the quinone ring because the parent substance benzene possesses the power of causing absorption just outside the visible region. Even so, the formation of the quinone ring may not shift the absorption of benzene far enough to bring it within the visible region, and there are thus derivatives of quinone which have no visible colour. On the other hand the shift of the bands may be caused by other structures and there are, in consequence, derivatives of benzene such as azobenzene, $C_6H_5{-}N{=}N{-}C_6H_5$, to which no quinone structure can be assigned, yet which possess strong visible colour.

Infra-red Absorption.—If the wider definition of colour be accepted it is probable that there is no such thing as a colourless material, because it is likely that every substance gives selective absorption somewhere within the range of electromagnetic vibrations. It appears to be in the power of many substances belonging to the aliphatic series of organic chemistry to give selective absorption in the infra-red region of the spectrum. Visibly coloured substances in this portion of organic chemistry are not of frequent occurrence, but when such colour occurs it is always associated with the presence of what is known as the conjugated system of double linkages; thus glyoxal (V.) and diacetyl (VI.) are yellow:—



(V.) (VI.) (VII.)

Methyl oxylate (VII.) is, however, visibly colourless and it must be assumed that in this case the infra-red absorption has not been thrown into the visible region. It is of interest to note that the same system of conjugated linkages is present in the conventional formula for benzene (I.).

The Definition of "Colour."—It is also significant that visible colour is shown only by unsaturated carbon compounds and that in no case has a visibly coloured saturated compound been prepared. It follows therefore:—

1. That both visible and invisible colour are associated with unsaturation.
2. That they are associated with the occurrence of selective absorption either outside or within the visible region of the spectrum, the former causing invisible, and the latter visible colour.
3. That occurrence of this absorption is bound up with the presence of a system of conjugated double linkages within the molecule.

Colour in Inorganic Chemistry.—The causes leading to the production of visible colour in inorganic compounds will not be clearly understood until more is known about the molecular structures of such substances. It is obviously due, initially, to the presence of a colour-producing element such as copper, chromium, cobalt, etc. The cause of colour in these elements is probably molecular, as instance the change in colour iodine undergoes when heated. Nevertheless the structure of the salt must also play a part as is shown, for example, in the disappearance of the blue colour of hydrated copper sulphate when it loses part of its water of hydration. In any case the causes of visible colour in this section of chemistry are not so clearly defined as they are in the organic section, and no useful purpose would be served by dealing with them in the present state of our knowledge.

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(J. TH.)

COLOUR AND RACE, PROBLEMS OF.—The narrowing of the world by improved transport, the levelling of mankind by the spread of education, and the increase of wealth and rise in social position of coloured peoples are bringing the races into relationships which may provide the most difficult problems of this century. The progress of civilisation is threatened by the serious danger of racial conflict and the still more serious evil, the demoralisation caused by inter-racial and colour prejudice.

I. PRIMARY RACES

Mankind, according to most authorities, includes three primary divisions or races which are as difficult to delimit as the breeds of dogs. According to some authorities the three races are so different that they should be regarded as distinct species; but the fact that all their members can interbreed and produce fertile offspring is weighty evidence of their specific unity. In opposition to the view that the human races are specifically distinct is the claim that there is no real difference between them, and that the apparent distinctions are no more significant than those variations in complexion, head form and size, that occur between members of the same family. That claim is based on the differences between the extremes of any one race being greater than the difference between the races. This overlap, however, no more proves the invalidity of racial distinction than the fact that a bee has more points in common with mankind than it has with a barnacle is evidence that man is an insect.

The characteristic which seems to be most constant and useful in the classification of man is the hair, which marks off three primary races: in Cymotrichi (wavy-haired), Leiotrichi (smooth-haired), Ulotrichi (woolly-haired). The division into these three races is now generally accepted. Apart from the hair the physical characters of each of the races vary so greatly that their definition is difficult. The main distinctions are remarkably stable, for the negro and the Caucasian are clearly represented in early Egyptian pictures, and the three races were probably distinct in the Stone Age.

As Haddon points out, "the Ancient Egyptian artists who decorated the royal tombs at Thebes in the XVIII. Dynasty distinguished between four races: (1) The Egyptians, whom they painted red; (2) the Asiatics or Semites, who were coloured yellow; (3) the Southerners or negroes, who naturally were painted black; and (4) the Westerners or Northerners, white. We ourselves speak loosely of white men, yellow men, black men, red men and brown men." The correspondence between colour and races founded on hair form is not complete. The negro has woolly hair, the straight hair belongs to the Mongolians, while the Caucasian peoples have wavy hair. The negroes vary in colour from chocolate hue to a brown which is so dark that it is often called black; the hue of the American section of the Mongolian race differs so much from the typical yellow that the American aborigines were called the Red Indians. The Caucasians include the whites of Europe, the brown races of Asia, North Africa and Australia, and some of the blackest of the African tribes.

Characteristics.—The social and intellectual differences are well marked, though in these respects the races overlap. As regards courage, endurance and self-sacrifice the three races are not unequal. The brown people have contributed to progress most of the chief handicrafts and the founders of all the chief religions—Buddhism, Confucianism, Hinduism, Islam and Christianity. The Mongolian is characterised by steady industry, high skill in craftsmanship and habitual self-surrender to his community. The negro, on the other hand, has a strong individuality which is less adapted to political stability and social coherence; he generally lives in village communities, which, except where ruled and organised by non-negroes, have never united into a powerful or wide-ruling nation. The Caucasian race is not a political unity; for it is divided into the white section or European, including therein the white settlers in the other continents and the brown Caucasians, who are grouped with the Mongolian and the negro as the coloured section of mankind.

The European people have shown the greatest capacity for initiative, combination and subdivision of work, and have thereby subdued the forces of nature, achieved the infinite complexity of organisation required for success in industry on a great scale and yoked the powers of steam and electricity. The European in administration has by his success rendered inevitable a readjustment between the white and coloured sections of mankind. The white nations during the past four centuries, owing to the mental alertness due to their superior education, have gained world-wide supremacy—commercial, political, military and intellectual. They have established their dominion and direct rule over eight-ninths of the habitable land of the earth. Yet they number only one-third of its inhabitants. The recognition of European superiority in some respects and the benefits received from the European's skill in administration have made many Eastern and African people accept his help and even his rule.

The Ballads of Bengal, recently collected and published by Dines Chandra Sen, show that in the 16th century northern India under its Mogul rulers was in appalling disorder. British rule has contributed to the country's prosperity and peace, and European influence has frequently had that effect elsewhere. The European commercial pioneers were either preceded or followed by missionaries who often gave important secular help and faithfully upheld the interests of the native population when they tended to clash with those of the trader. Hence the growth of European influence was often welcomed. The Chinese, for example, appreciated not only the work of the early Jesuit mis-

sionaries, but the help of the European staff in its Imperial Customs Service. The eastern people also prized the benefits of European trade; but they could not have had much share in it without giving European capital and traders the security of extraterritorial privileges, which lapse as the necessity for them disappears. In time, however, the material disadvantages of foreign control, the galling symbols of inferiority, religious fanaticism and the mistakes of government have led to reaction.

Reaction.—The control of the world by the European peoples is a comparatively recent development and may be only temporary. The uprising of national sentiment since 1900 has already lessened the European domination. The most important single factor in this change was the Russo-Japanese War of 1904. Japan, alarmed at the attempts to exclude her or her influence from the adjacent parts of the mainland of Asia, attacked Russia, and by brilliant victories secured control of Manchuria and struck a resounding blow at European prestige. In India the rise of the professional class with the spread of western education, the irritation of some genuine grievances and the stimulus to Indian nationalism by the Japanese success led to the establishment of partial Indian self-government by a measure which contains the machinery for its further extension. The establishment of a republic in China with its remarkable development of scientific and educational activity among the intellectual classes of that country, the recovery by Afghanistan of the management of her foreign affairs, the wresting by Arabia of its independence from Turkey and the establishment of Egypt as an independent Sultanate are some results of the growth of Asiatic nationalism.

European Problems.—Europe is a mass of racial problems. The surge from the East which brought the Magyars into the heart of Europe, the pressure of the Turk, the thrust of the Alpine race to the plains and peninsulas, the clash of Slav and Tartar and Mongol in Russia, have played, and still play, a decisive part in shaping the political conditions of Europe. Differences of culture, religion, language and institutions go with differences of race, and, in southeastern Europe, the tangled mountains enhance the separatist tendencies of the folk that dwell there.

Contact with Northern Africa and the Mediterranean littoral is of great antiquity. The population of Portugal has a strong African element. The Moorish occupation of Spain has left its mark on the characteristics, physical and political, of the Spanish people. The population of southern Italy and Sicily contains elements of African origin. The population of the south of France is very mixed. The extension of the French and Italian colonial empires to Africa has enlarged the area of contact, and with it, the range of problems. The Mediterranean peoples historically display a comparative readiness to absorb coloured groups, while the Nordic stock holds aloof from such intermarriages.

Asia is firmly held by the Mongolians and dark Caucasians. Africa is the home of the negro and of a negro-dark Caucasian intermixture in the north, and taking the continent as a whole, the pure whites are in a small minority. Native influence tends to increase. The three other continents are the possible heritage of the European, though North America may have to absorb a considerable proportion of negro, and Australia will have to accept inevitable delays in the cultivation of its tropical lands by white labour. From tropical and sub-tropical countries come the raw materials which Europe needs for her factories. These areas are valuable markets for European products. The problems vary with the historical circumstances in which European control was established in each area, and with the local political and economic conditions.

II. THE BRITISH COMMONWEALTH

Thus race problems in the British Commonwealth are of extreme complexity, for its autonomous dominions, with their different circumstances and traditions, necessarily adopt different labour and immigration policies. This differentiation is possible so long as each dominion shows reasonable consideration for the responsibilities of the Empire as a whole, and is prepared to tolerate the limitations involved in partnership.

Canada.—The racial problems in Canada are comparatively simple, in spite of the complications due to the French-speaking population, which is increasing in numbers and spreading westward both in Quebec and Ontario. The Indians of Canada are few and of no political importance. The colour line is an issue only in British Columbia, where there has been a considerable immigration from India, China and Japan in the past, though it is now insignificant. The main racial problem in Canada concerns the mixture of the present population, which is derived from north-western Europe, with immigrants from eastern and southern Europe. A vast immigration of Italians and Slavs has been flowing into the United States; and Canada, like that country, may restrict her Slav and Italian immigrants.

South Africa.—In South Africa the position of "the poor white" forms a serious problem. South Africa has an extremely mixed population, for both the white and coloured sections are composite. The white settlers include Dutch, British and some French Huguenots. The coloured population consists of negroes from many different South African tribes, the descendants of West African negroes introduced in the 18th century, and Asiatics. The West African negroes and Asiatics have given rise to the class known as the Cape Boy.

The European position in South Africa has been weakened by the feud between British and Boer due to difference of ideas on native policy. It early led to the quarrel over the abolition of slavery, and is still shown by Cape Colony having granted the negro the franchise, which is refused him in the other South African states. The racial problem in South Africa illustrates the difficulty of maintaining a fair standard of life for the less efficient members of a dominant minority.

In the effort to save the position of the white artisan the South African Govt. proposes the policy of segregation. No white man can settle in some parts of South Africa without the sanction of the Governor-General; and it is proposed that in some areas certain occupations should be reserved to the white artisan. The principle of segregation was adopted by the Natives' Land Act of 1913, and its extension was proposed in measures under consideration in 1925. It is opposed by many capitalists on the ground that it will raise the cost of labour; but the elections in South Africa in 1924 show that a large section of the white population regards some plan of segregation as indispensable for the maintenance of the European position.

Tropical Africa.—In Tropical Africa the race policies are based upon two different principles. In West Africa the Govt. acts as the trustee of the native, and protects him against the sale of his ground or produce on unfavourable terms. The native is encouraged to become a small holder and cultivate his own land. The resultant increase in numbers and wealth of the population has given the Europeans probably greater prosperity as merchants than they would have achieved as planters using native labour. In Kenya (East Africa) European settlers were invited to develop the fertile lands beside the railway, large land grants were given and the natives were expected to enter the service of the Europeans. The Indians, including many who had been employed in the construction of the railway, spread through the country and were especially useful in retail trade with the negroes. The extension of European plantations has now created a greater demand for labour than the population can supply. More labour is required to reap a harvest than to sow the crop. Hence efforts have been made to discourage the natives from working in their reserves and to force them by taxation and other means into the European service. The problem in Kenya Colony is how to work both the native reserves and the European estates without forced labour, which has been rejected by the responsible leaders of each of the three British political parties as approximating to slavery. The opposition of Europeans in Kenya to the further immigration of Asiatics has been strongly criticised by Indian public opinion.

Australia.—Australia is the one continent which is blest with the absence of any inter-racial problem. When European colonisation began it was inhabited only by a few nomads. After the Federation of Australia in 1901, the White Australia Policy was adopted, and the coolies who had been imported to work the sugar plantations were sent back, excepting those who had made homes

in the country. The Queensland sugar industry was thus left dependent on white labour. Despite emphatic predictions to the contrary it has continued to develop. Its success, the health of the people of tropical Queensland and the general trend of medical opinion (see, for example, Gregory, *Menace of Colour*, chapters 8 and 9) show that tropical Australia can be developed by white labour provided the standard of life be maintained by the absence of coloured labour.

India.—India presents inter-racial problems of peculiar difficulty due to the great diversity of race, language and religion. The population is mainly dark Caucasian, with some Mongolian elements and in the south possibly a negro strain. Racial differences are vital in India. Much evidence has been collected by Indian scholars in support of the view that the caste system is in origin a colour reaction of a dominant light-skinned group which, by its superiority, imposed hegemony and its institutions upon the indigenous, darker-skinned stocks. Caste is *varna* and *varna* is colour. In the south where the dark-skinned proto-Indics (*see* RACES OF MANKIND) are most numerous, the segregation of the lower groups is still a feature of the social polity. The languages are a Babel, and the two chief creeds, Hinduism and Islam, represent the very antithesis of religious thought. The problem for the Govt. of India is how a small oligarchy can harmonise the conflicting interests of 320 millions of such diverse people. The growth of Indian Nationalism has led to an extensive measure of self-government, which has so far proved only a partial success. The establishment of elective councils is a mark of the faith of the British Govt. in the depth of British influence in India. The spread of western education has rendered many Indians capable of taking a responsible part in the administration of the country.

III. THE UNITED STATES

In the United States, after the Civil War of 1861–5, the negro was given his freedom and endowed with full political rights. Then followed a period after 1867, which was known as the "Reconstruction," when the Southern states suffered from deplorably incompetent and corrupt government. In 1876 the Northern states, distressed by the failure of the system which they had forced upon the South, withdrew support from the "carpetbaggers" and allowed the whites in the Southern states to resume control.

By trickery, fraud and legislative measures, some of which, such as some clauses in the Oklahoma constitution, in recent years have been declared unconstitutional by the Supreme Court, the negro was practically disfranchised. Negroes were excluded from many universities, schools and theatres used by the whites, especially in the South; they were debarred even from the churches and from such organisations as the Young Men's Christian Association, unless they founded separate centres of their own. They complain and, according to many independent investigators, with justice, of unfair treatment in the law courts, which is not surprising as the judges and officials are appointed by public election in which the negro has no vote. Moreover, in 29 of the states intermarriage between whites and negroes is illegal, and according to the Virginia "Act to Preserve Racial Integrity" of 1924, no marriage in that state is legal between a white person and any person who has a trace of non-Caucasian blood other than one-sixteenth or less of American Indian.

The policy of racial repression seems now impracticable. It has led to increasing bitterness which has been remarked by many observers during the past 20 years. It is held responsible for the fierce race riots in 1919 at Houston, Texas, at Washington, D.C., Chicago, Elaine (Ark.), East St. Louis, Knoxville (Tenn.), Omaha (Neb.) and Bogalusa, Louisiana. The traditional Southern policy toward the negro may become impossible owing to his migration to the Northern states. There the negro has long enjoyed, theoretically, all the rights of a full citizen. In the words of Lincoln he is "in his right to eat the bread he earns equal to any other man"; but the Northern system prevented him from earning his bread except in small numbers in menial employments. The conditions are now changing in consequence of the Immigration Restriction Act of 1917 and the still more rigorous act of 1924. Labour scarcity compels the Northern manufacturers to turn to the South for negro labour. Southern agriculture, and especially the cotton crop, is dependent on the negro. Yet the movement of negroes to the Northern towns, if continued, may embarass the Southern states industrially.

The U.S. Dept. of Labor (Bulletin 1924, p. 35) enumerated as the causes of the migration "poor wages, poor housing, abuses due to the overseer system of farming, inadequate educational facilities, the 'Jim Crow' law, inequality in law enforcement, the Labor Contract Law which renders possible the peonage system, mob violence and disfranchisement." The negroes themselves at a representative conference in Atlanta, Ga., declared that the migration was due to their complete loss of faith in the willingness of the white people ever to treat the coloured people justly. This migration actually brings Southern colour problems to Northern thresholds.

IV. THE POLICIES CONTRASTED

As the permanent subjection of one race by another appears under modern conditions impracticable, as well as unjust and undesirable in the interests of both peoples, the available policies are reduced to assimilation or independent evolution. The policy of assimilation means that the race question might solve itself by the fusion of the races by intermarriage, since the absorption or extinction of the weaker race appears to be the inevitable result of co-residence.

Fusion.—According to some authorities race prejudice is so mischievous that the world would be much happier if the races were completely fused. Many observers in the United States consider that racial feeling there is becoming less acute, and that the repression is being reduced as numerous half-castes form a complete transition between white and negro. The policy of fusion is supported on the ground that intermarriage produces superior offspring. The success of some European nations has been attributed to the varied qualities which they have inherited from their mixed ancestry.

The crossbreeding of races which are nearly akin is often beneficial. "Heterosis," or hybrid vigour, has been proved experimentally by the crossbreeding of plants and domestic animals. The evidence is weighty, however, that the intermarriage of races that are very different produces offspring inferior to either parent. Herbert Spencer recommended Japan to avoid the intermarriage of Japanese and Europeans. National character is a hereditary complex, which has been developed by generations of natural selection. The interbreeding of two stocks of which the hereditary complex is slightly different may be expected to lead to improvement, but if they are very dissimilar the progeny will probably be inferior. Herbert Spencer's view has been reaffirmed by many modern eugenists as the result of careful investigation of such cases as the intermarriage of the Scandinavians, who are Teutonic, with Lapps, who are Mongolians.

Segregation.—The third policy is the independent evolution of the different races when geographically separated in mass, under conditions which allow of such individual intercourse through missionaries, teachers, men of commerce, scientific experts, administrators, etc., as will enable the races best to co-operate in the development of the world. The conditions in most of South and Central America illustrate the results of racial fusion. Independent evolution is possible in the other continents.

CONCLUSION

Inter-racial hatred is one of the serious menaces to human progress. Men of different races engaged in a joint enterprise often work together harmoniously and with true affection; but race hatred easily develops where men of different civilisations compete side by side for the necessaries of existence. The repulse of the negro capacity for affection is the bitterest element in his lot, as expressed by the negro poet, Paul Lawrence Dunbar:—

> Because I had loved so deeply,
> Because I had loved so long,
> God in his great compassion,
> Gave me the gift of song.

Because I had loved so vainly,
And sung with such faltering breath,
The Master in infinite mercy,
Offers the boon of death.

To avoid such poignant disagreement the most hopeful policy available seems to be segregation in mass, combined with such individual intercourse as will enable the different races to help each other, without arousing the violent repulsion generated when people of dissimilar cultures and colours meet with grating friction in competition for their daily bread.

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COLOUR PHOTOGRAPHY: *see* PHOTOGRAPHY.

COLOURS OF ANIMALS (*see* 6.731).—Since 1910 important advances have been made in the study of mimicry and in our knowledge of adaptive colour changes in fishes, but consideration may first be given to the work of Thayer on concealing coloration and to Mottram's researches on the general principles underlying the colour patterns of animals.

Concealing and Revealing Coloration.—Thayer established that what he terms obliterative countershading is of very general occurrence, *i.e.*, that in most animals the colour grades from dark on the back to pale below, tending to counteract the effect of light falling from above and so to conceal the solidity of the animal when seen against a background of the same tint. He also proved that many patterns that appear very conspicuous when an animal is seen out of its natural habitat may help to conceal it in its usual surroundings. Markings tend, by their separate and conflicting patterns, to obliterate the visibility of the details of boundary and form, and when an animal is covered by sharply contrasted bold patterns of pale and dark the contour will be broken up against either a pale or a dark background; such patterns, cutting up the aspect of the animal, Thayer terms seccant. The white rump marks of the prong-buck would be seen against the sky by a crouching carnivore and at night would merge into this background, rendering the animal almost invisible.

Although Thayer's researches are valuable, he goes too far in claiming that all patterns are for concealment, and some of the pictures which he gives with specially painted backgrounds are not very convincing. Mottram has shown that a pattern of dark and pale squares, spots or stripes blends to a uniform colour at a distance which is dependent on the size of these areas. In many mammals the effect of obliterative countershading is produced by many or large dark spots, or broad dark stripes on the back, gradually changing to few or small spots or narrow stripes, below. The zebra has stripes of this type, and Mottram considers that at the blending distance this pattern has the advantage over obliterative countershading, as it produces a blurred outline. With the cheetah the spots are closer together on the back. Within the blending distance such patterns may imitate the surroundings, but Mottram thinks this is unusual, and contrasts the striping of the tiger, effective for concealment among reeds, with that of the zebra, which would in his opinion be ineffective in such an environment. Mottram finds that most concealing patterns break out along the animal's margin and tend to obscure its characteristic shape, whereas revealing patterns often follow the margin and tend to accentuate the animal's shape and to isolate it from its surroundings. A pattern of this kind, commonly seen in butterflies, is a broad black band following the outer margins of both wings and often enclosing a brilliant yellow or blue central area. Experimental evidence and the study of the habits do not bear out the view of Thayer and his school that all coloration is for concealment.

Without observation of an animal in its natural surroundings it may be difficult to comprehend the meaning of its coloration. A number of unrelated species of sea-perches of the large genus *Epinephelus* are covered with more or less hexagonal reddish spots separated by a pale network. The reason for this was made clear by Alcock. He was in a boat with an Indian fisherman who tried to spear a large fish of this type; the wounded fish at once made for an adjacent clump of corals, where it lay concealed, the red spots exactly resembling the coral polyps; although it could easily have escaped, the fish would not leave its shelter and was eventually captured.

Mimicry.—Poulton, who has made special study of mimicry in butterflies, has recently given an account of the most interesting and elaborate example known. An African swallowtail butterfly, *Papilio dardanus*, is represented in Madagascar and Abyssinia by closely allied forms, in which both sexes are alike and non-mimetic. Elsewhere in Africa the male is of the same type, but the females have lost the tails to the hind wings and differ from the males also in coloration, mimicking butterflies of a very different group, the Danainae. Three forms of female of *P. dardanus* mimic three very distinct Danaine patterns; two of these patterns are modified in passing from one area to another, and in the same regions the mimetic females are correspondingly altered. In Uganda and West Africa a fourth form of female occurs, mimicking two species of Acraeinae. Experimental breeding has shown that the different female mimetic forms may occur in the same brood.

The work of Gahan on mimicry in the Coleoptera is an important contribution to our knowledge of this fascinating subject. In this group mimicry is not so restricted as in butterflies; beetles may mimic ants or wasps, and may be mimicked by flies or moths. Gahan points out that there are some who believe that mimicry is wholly the result of chance. Nature, they say, who is engaged in turning out thousands upon thousands of different patterns, is bound sometimes to repeat herself.

Although this may possibly be the true explanation of a few such resemblances, Gahan rejects it for the great majority. Pascoe had pointed out a close similarity in appearance between two unrelated species of beetle from widely separated parts of the world, but Gahan remarks that this is not due to chance, but to the fact that both species are mimics of ants. The beetles of the family Lycidae are conspicuously coloured, fly slowly and secrete distasteful liquids. They show little diversity in form, and, in the same region, but little in colour, most of the Asiatic species being red and the South American black and yellow. Thus they are easily recognised, and it is established by observation and experiment that they are singularly free from the attacks of insectivorous birds and mammals. Wherever the Lycidae occur, they form mimetic associations and are mimicked by day-flying beetles of other families, and sometimes also by day-flying moths and other insects. Some critics have suggested that mimetic resemblances are due to the direct action of the environment, or to similarity in habits and mode of life, or even to relationship, the species concerned being supposed to have retained their ancestral coloration, while they have diverged in structural characters.

To this Gahan replies that the Lycidae and their Longicorn mimics belong to widely separated groups; they differ from one another as larvae as much as they resemble one another when they reach the perfect state, and they lead a different kind of life. Gahan contrasts with the uniformity of the Lycidae the diversity of the Cerambycidae, which are not protected by a distasteful secretion. Many of these look quite unlike their nearest allies, but show a close resemblance in form, size and colouration to unrelated insects, either noxious beetles of other families or stinging

insects such as wasps. In the coloured plate[1] (see note below) are shown a number of Cerambycidae and the insects that they resemble, the mimics (Cerambycidae) being placed on the left (figs. 1 to 7), their models, wasps (figs. 1*a* to 4*a*, 7*a*) and noxious beetles (figs. 5*a*, 6*a*) on the right. Attention may particularly be directed to the fact that the beetles have one pair of wing-covers, or elytra, and one pair of wings, whereas the wasps have two pairs of wings, and that the one pair of wings of the mimics generally resemble the two pairs of their wasp models in form, size and colour. As a rule the elytra are small and inconspicuous in the mimicking beetles, but there are some exceptions: for example, in *Acyphoderes odyneroides* (fig. 7) the wing-cases have a glistening appearance, imitating transparent wings. In an Australian species, *Tragocerus formosus* (fig. 4), the elytra are quite long and are coloured with bands of black and red to look like the banded abdomen of the wasp; moreover, the elytra are strongly emarginate on the outer edges near the base, giving free play to the wings when the elytra are kept close together. The same wasp serves as a model for another beetle (*Esthesis ferrugineus*) belonging to quite a different group from *Tragocerus*, and in this the resemblance is brought about in another way, the elytra being short and the abdomen banded.

Gahan points out that mimicry is unknown in beetles that fly by night, which as a rule have a colouration that harmonises with the object on which they rest during the day. He concludes that one of the chief operating causes in bringing about mimicry must be some agency that is at work only in the hours of daylight, and he thinks that the facts of mimicry strongly support the theory of natural selection, which is the only one that offers an adequate explanation of them.

Critics of the natural selection theory have naturally turned their attention to mimicry, especially in relation to butterflies, the main group that has been studied in this connection. Some critics have asserted that butterflies are not attacked by birds, the enemies believed to be responsible for the deceptive resemblance of mimics to models. Attention having been thus directed to the subject many naturalists have made a special study of it, and have proved this assertion to be unfounded.

Under the heading of mimicry may also be considered the work of Stuart Baker (1923) and Jourdain (1925) on the eggs of cuckoos. These birds form a large family with a nearly cosmopolitan distribution; most of them have the habit of laying their eggs in the nests of other birds, which hatch and rear the young cuckoos. The eggs of those species of cuckoo which make their own nests and rear their own young are white or pale blue in colour, but the eggs of the so-called parasitic cuckoos exhibit a great diversity, generally resembling those of the birds in whose nests they are laid. Some cuckoos—for example our British species—are polymorphic as regards the colour of the eggs; individuals of such forms not infrequently lay in nests of birds whose eggs they do not match; some of these birds appear to take no notice, whereas others may eject the egg or desert the nest.

Baker gives some interesting examples of dimorphism, *e.g.*, *Cuculus pliocephalus*, which in Japan lays chocolate eggs only, in the Himalayas white ones, but in Assam both kinds, generally in appropriate nests; and *Hierococcyx sparveroides*, which lays pale blue eggs in the nests of laughing-thrushes and olive brown ones in those of the giant spider-hunter. Baker, who has formed and studied a collection of over 2,500 eggs of cuckoos from Europe, Asia and Australia, says that several species lay only one type of egg, and these always choose the same foster-parents. Thus the two commonest Indian species, *Clamator jacobinus* and *Hierococcyx varius*, lay their deep blue eggs in nests of birds of the common Indian genera *Argyra* and *Turdioides*, the eggs of which are extremely similar; and a large Indian cuckoo, *Eudynamis scolopaceus*, has its eggs pale blue, blotched with red, coloured like those of the Corvidae which it uses to rear its young.

Colour Changes in Fishes.—A great advance has been made in our knowledge of colour changes in fishes, especially through the experiments of Mast (1916). The tropical sea-perches from Bermuda in the New York Aquarium are a source of constant interest to visitors on account of their changes of colour and markings, one species suddenly changing from crimson to dull green, another from yellow to red or dark brown, whilst a third may turn on or off cross-bars, spots or other markings. These changes appear to have little meaning under such conditions, although Townsend has noted that alarm generally produces a pale colouration and excitement and intensification of pattern; but under natural conditions the different colour-phases may harmonise with different environments. The flat-fishes have long been known to simulate closely the ground on which they lie. Sumner, experimenting with a Mediterranean flat-fish (*Platophrys podas*), obtained some remarkable results by placing them on patterns such as black and white squares, to which they were not accustomed in nature; on such backgrounds the fish responded more slowly than when placed on sand, gravel or mud, but with practice acquired the power of changing more rapidly than at first. The capacity of this species to adapt itself is limited to the black, brown, grey and white of its customary habitat; also it has definite spots and markings, which vary in their relative intensity and may disappear, but when present always have the same form or position. Thus pale and dark areas are reproduced by areas of about the same size, but not of the same form; squares and circles produce the same effect.

Mast has carried the matter much further; for he has found that flat-fishes of the genus *Paralichthys* on white, grey, black, brown, blue, green, yellow, orange or pink assume a colour very near that of the background, but that reds are less accurately simulated. Yellows and browns take much less time to copy than reds, greens or blues; for the latter some days may elapse before the full effect is produced. These effects are produced by the concentration or distribution of granules of pigment in the pigment-cells of the skin, under the control of stimuli received through the eyes. The flat-fish has to see the ground before it can resemble it, but there is no visual comparison of skin with ground.

One important result of Mast's experiments is that he concludes that in respect to motion and colour the vision of these fishes is much the same as human vision, although it is less acute in distinguishing differences of size and form. It is a fair assumption that, if the colour vision of these fishes is like our own, this is true of vertebrates in general; thus an argument that has sometimes been urged in relation to the adaptive coloration of insects, that we have no evidence that the exact resemblance to the surroundings or to other insects is necessary to deceive birds, loses much of its validity.

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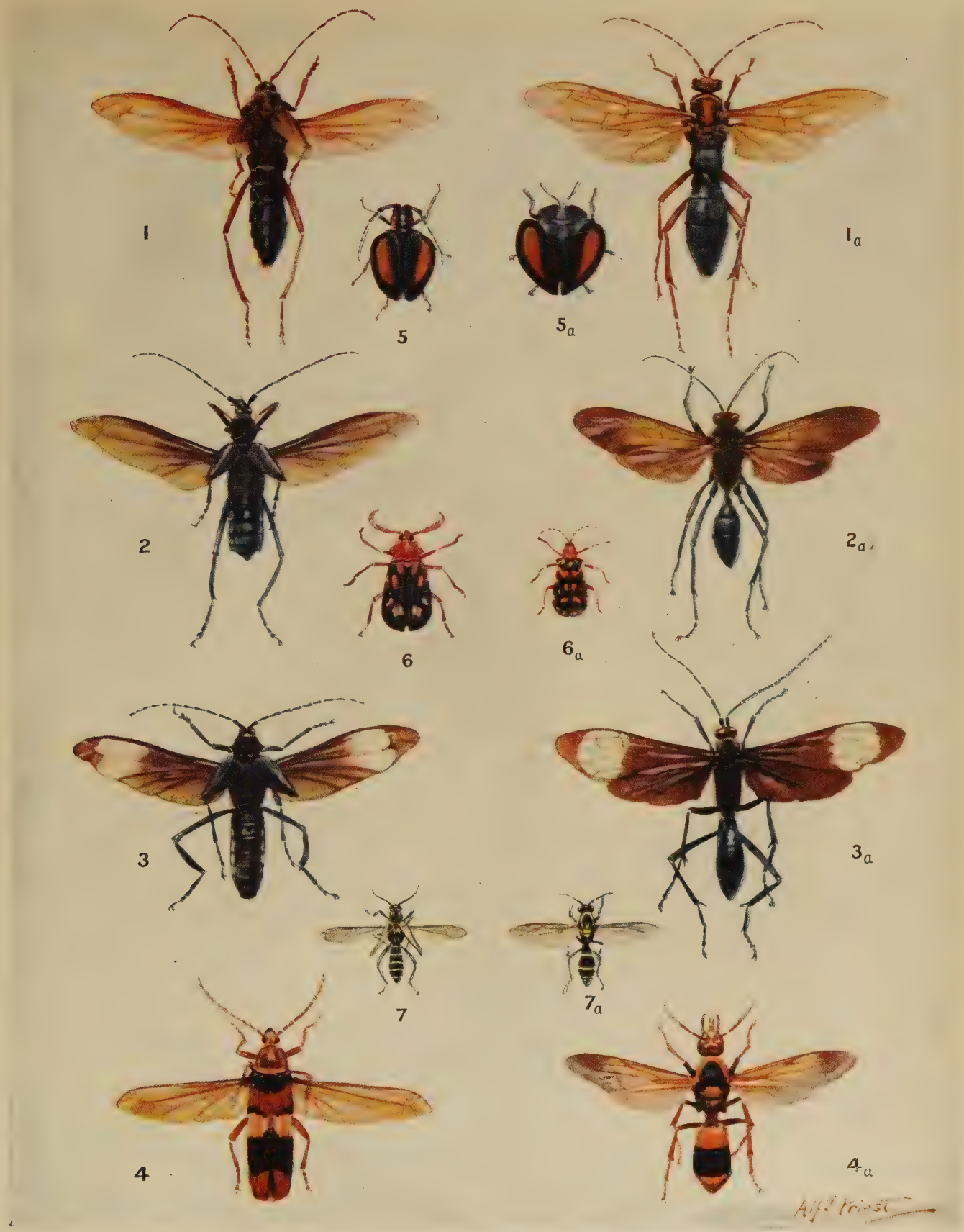
(C. T. R.)

COLOUR VISION AND COLOUR BLINDNESS.—The images of external objects are formed upon the outer layer of the retina, the layer furthest away from the front of the eye, so that the light has to pass through all the other layers before it reaches the sensitive portion. This sensitive layer consists of two elements, which are called respectively, on account of their shape, the rods and the cones. A slight depression in the centre of the retina, the fovea, is the region of most distinct vision. In the fovea, only cones are present.

In the region external to the fovea each cone is surrounded by a group of rods, and the number of rods to cones increases as portions of the retina further from the fovea are taken, except at

[1] Explanation of Plate.—Mimetic Beetles and their Models.

Mimics (Cerambycidae)	*Models*	*Habitat*
Fig. 1. Nothopeus auricomus.	1*a*. Salius ceylonicus (Wasp)	Ceylon
Fig. 2. Nothopeus hemipterus	2*a*. Macromerus splendida (Wasp)	Burma
Fig. 3. Nothopeus fasciatipennis	3*a*. Mygnimia princeps (Wasp)	Borneo
Fig. 4. Tragocerus formosus	4*a*. Abispa ephippium (Wasp)	Queensland
Fig. 5. Ites plagiatus	5*a*. Mesomphalia Latevittata (Beetle, Fam. Cassididae)	Ecuador
Fig. 6. Ctenodes decemmaculata	6*a*. Cephalodonta spinipes (Beetle, Fam. Hispidae)	Brazil
Fig. 7. Acyphoderes odyneroides	7*a*. Polybia liliacea (Wasp)	Brazil



MIMETIC BEETLES COMPARED WITH THEIR MODELS

Palatable Beetles of the family Cerambycidae (1-7), compared with wasps (1^a-4^a and 7^a), and unpalatable Beetles (5^a and 6^a), showing the striking similarity in appearance.

the extreme periphery, where, again, only cones are found. In the outer segment of each rod there is a rose-coloured substance, the visual purple, which is photo-chemically sensitive to light. This visual purple is not found in the cones, but only in the rods. For this reason it was not considered to be essential to vision, because it was absent from the cones, and only cones are to be found in the fovea, the region of most distinct vision. Though visual purple is not present in the cones of the fovea, it is found between them, four special canals aiding the flow from the periphery to the centre of the fovea. When there is no visual purple in the fovea it is blind, as shown by the varying sensitiveness of the fovea, and the disappearance of objects in the central area of vision when there is no stimulation of the periphery. The rods and cones project into a thin layer of fluid, which is kept in its place by a membrane.

The visual purple is diffused into this liquid and on being decomposed by light stimulates the cones, thereby setting up a nerve impulse, which causes the sensation of vision. The movement of after-images shows that the stimulus in vision is fluid and situated outside the cones. The rods are not percipient elements but regulate the formation and distribution of the visual purple.

The decomposition of the visual purple by light stimulates the ends of the cones, and a visual impulse is set up which is conveyed through the optic nerve fibres to the brain. The character of the impulse differs according to the wave-length of the light causing it. Therefore, in the impulse itself we have the physiological basis of the sensation of light, and in the quality of the impulse the physiological basis of the sensation of colour. The impulse, being conveyed along the optic nerve to the brain, stimulates the visual centre causing a sensation of light, and then, passing on to the colour-perceiving centre, causes a sensation of colour. But though impulses vary in character according to the wave-length of the light causing them, the colour-perceiving centre is not able to discriminate between adjacent impulses, the nerve cells not being sufficiently developed for the purpose.

Even with the normal-sighted, there is room for much further development in the discrimination of colour, but when the development is not up to the normal standard, or there is a defect in any portion of the apparatus diminishing the power of discrimination, colour blindness is the result.

On numerous points in the above theory there is no evidence. We do not know whether one nerve cell is able to appreciate all colours according to its stimulation by impulses of varying character, or whether distinct nerve cells are required for different colours. We do not know whether nerve impulses differ in character, but we do know that light and colour perception are quite distinct and, therefore, we require a different set of nerve cells for the perception of light and colour. The colour-perceiving cells may be only indirectly connected in the visual path.

Though the position of the visual centre in the brain has been accurately determined, the position of the colour vision centre is still unknown. It may, indeed, be in some portion of the visual tract between the eye and the visual centre. For instance, one portion of the end of the cone when stimulated may possess fibrils which are either connected with, or pass through, a portion of brain giving rise to the sensation of red, whilst stimulation of the other end of the cone stimulates fibrils which, with their neural connections, give rise to the sensation of violet. The intermediate portions give rise to the sensations of green, yellow and blue. There is a considerable range both at the red and the violet ends of the spectrum which does not vary in hue, but only in luminosity, and it is therefore extremely probable that rays from these regions affect only one portion of the cone respectively, but in different degrees.

Colour Blindness.—Now, whether the colour vision centre be above, or below the visual centre, the results will be the same. The nerve fibrils from one end of the cone may be connected with one side of the colour vision centre so that stimulation of one side of the centre causes the sensation of red and the other side the sensation of violet, and stimulation of the intervening portions the sensations of yellow, green and blue. It should be noted, however, that this does not support the trichromatic theory, because there is the strongest evidence showing that colour sensation can be abolished without interfering with light sensation and that the colour perceiving centre—whether it be above or below the visual centre—is more easily affected than the latter. A man may entirely lose his sensation of colour without interference with his perception of light and form, as in a case of a signalman on the railway who became totally colour blind after tetanus.

Again, the continued use of the eyes for colours of high luminosity may cause colour blindness. After an illness a person may become temporarily colour blind. A man, after an attack of influenza, was so colour blind as to designate the whole of the green region of the spectrum as white. Tested with the lantern he called green, white and red; red, white; and white, red. A few months afterwards his colour sense was quite normal. There is much less likelihood of an accident occurring through acquired colour-blindness than congenital, because in acquired colour-blindness the man knows that his colour vision has altered.

Cases of colour blindness may be divided into three classes, which are quite separate and distinct from each other though one or more may be present in the same person. In the first class there is light as well as colour loss. In the second class the perception of light is the same as in the normal-sighted, but there is a defect in the perception of colour. In the first class certain rays are either not perceived at all, or very imperfectly. Both these classes are represented by analogous conditions in the perception of sounds. The first class of the colour blind is represented by those who are unable to hear very high or very low notes. The second class is represented by those who possess what is commonly called a defective musical ear. Colour blind individuals belonging to this class can be arranged in a series. At one end of this series are the supernormal-sighted and at the other end the totally colour blind. In the third class of the colour blind there is defective perception of colour through the fovea or central region of the retina not being normal.

Tests.—The test which should be used for the marine and railway services is a lantern in which the requisite conditions are represented. A lantern of this kind is used in Great Britain by the Admiralty and the Board of Trade. A man who cannot distinguish the red, green and white lights in these lanterns will not be able to do so in actual practice, and this fact is easily proved by testing with signal lights.

The wool test is a failure. It is now obsolete, as it allows over 50% of dangerously colour blind persons to pass, and it will be noticed in certain reports that of those who were rejected by the wool test and who appealed, over 50% were found to be normal-sighted and had been wrongly rejected. See F. W. Edridge-Green, *The Physiology of Vision* (1920). (F. W. E.-G.)

COLUMBIA UNIVERSITY (*see* 6.739).—The work of Columbia University during the period 1910–25 was greatly extended. A school of journalism was founded in 1912, a school of business in 1915, a school of dentistry in 1917 and a school of library service in 1926. The degrees of doctor juris (J.D.) and bachelor of science in engineering were established in 1923. By agreement with the Presbyterian Hospital the university will rebuild the school of medicine on property adjoining the new hospital buildings as the nucleus of a great medical centre. In co-operation with the Ministry of Education in Porto Rico the university in 1924 assumed responsibility for educational and scientific work of the school of tropical medicine on the island of Porto Rico. Three research institutes have been organised—the Institute of Educational Research, the Institute of Cancer Research and the Institute of Public Health. In order to render the largest possible service to the community, courses in university extension were organised for men and women who could give only a portion of their time to study, but who desired to pursue subjects included in a liberal education. These courses, as such, do not lead to degrees, but may be offered as credit toward a degree under one of the faculties. Under university extension there was organised also an Institute of Arts and Sciences which conducted a series of lectures

and recitals of a popular nature, as well as a system of courses for home study for persons unable to attend classes in the university. These courses also do not lead to academic credit or degrees. Women are admitted by all faculties of the university with the exception of those of law and applied science. During the period 1910–26 the physical equipment of the university was greatly increased by the addition of Kent Hall, Philosophy Hall, the President's House, Avery Hall, School of Journalism, Furnald Hall, Crocker Research Laboratory, School of Business, Russell Hall, Barnard Hall, Faculty House, Physics Research Laboratories, an additional wing to Havemeyer Hall and four faculty residential halls and John Jay Hall. The university has acquired by gift of Geo. F. Baker 28 ac. of land at the upper end of Manhattan I. for use as an athletic field. In 1924 there were in Columbia University in all departments 2,000 instructors and administrative officers, and in the twelve months ending June 30 1925 were enrolled 34,845 students. Of these, roughly one-third were registered in the 1924 summer session; one-third in the degree-granting schools and faculties during the academic year 1924-5; and one-third in university extension during the academic year 1924-5.

The productive endowment of the university, including the endowments of Teachers College, Barnard College and the College of Pharmacy, amounted in 1924 to $57,456,803, which, added to the property occupied for educational purposes, made a total capital investment of $93,162,938. To meet the increased costs of education, the fees in the several schools were raised so that they ranged in 1925 from $300 to $500. The alumni of the university were given a definite part in the government of the institution by an agreement under which 6 of the 24 trustees were elected on alumni nomination. In 1912 the corporate title of the university was changed from the " Trustees of Columbia College in the City of New York " to the " Trustees of Columbia University in the City of New York."

The university took an active part in the World War. Immediately upon the severance of diplomatic relations with Germany in Feb. 1917, it placed its resources, both physical and intellectual, at the service of the Government. There were established at the university, schools for training men for both the army and the navy, including work in radio, photography, quartermaster's routine, explosives, gas-engines, submarine detection and the Students Army Training Corps, which prepared men for the various officers' training camps of both armed services. Students, faculty and alumni to the number of 4,125 were enlisted in the army and navy, and 2,175 left their previous occupations and assisted the Govt. in some one of the civilian branches. Two hundred Columbia men died in the War. (N. M. B.)

COLUMBUS, O., U.S. (*see* 6.746), increased in population 30·6% in the decade after 1910, reaching 237,031 in 1920, of whom 22,181 were negroes (an increase of 74·1% due to migration from the south) and 16,187 foreign-born (a slight decrease). In 1925 the census bureau estimate was 279,836. The area was 13,018 ac. in 1910, 14,427 in 1920, 22,705 in 1925. The factories within the city limits had an output valued at $49,032,000 in 1909, $184,022,000 in 1919, $186,842,798 in 1923; and an average force of 16,428 employees in 1909, 26,751 in 1919, 27,618 in 1923.

In the floods of 1913 about 100 lives were lost, three bridges were destroyed, over 4,000 dwellings were flooded and some 20,000 persons were temporarily homeless. Flood-protection works undertaken to prevent a recurrence of such losses involved a widening of the channel of the Scioto, building revetments and reconstructing three bridges in addition to replacing the three that were destroyed. Columbus took advantage of the home rule amendment (1912) to the state constitution, adopting a new charter which, taking effect on Jan. 1 1916, provided for a mayor as executive, a legislative council of seven elected at large, a non-partisan ballot, preferential voting, the recall of elected officials and the referendum. A city planning commission was created in 1920; a zoning ordinance was adopted in 1923.

Ambitious plans were made for a civic centre on the Scioto river, embracing two of the new concrete bridges, the central high school on the west side of the river, completed in 1925, a new city hall to replace the one destroyed by fire in 1921, a Masonic temple (site acquired), an Oddfellows' temple and the proposed building of the City Federation of Women's Clubs. The city's water supply was greatly increased by the construction of the O'Shaughnessy dam (1922–4) to impound 5,000,000,000 gal. in a reservoir covering 800 acres. One of the three general reserve depôts of the U.S. Army is located in east Columbus on a government reservation of 281 acres. The warehouses, built in 1918, have a floor area of 2,406,334 sq. ft., and the supplies stored in them (1924) represented a value of $150,000,000. Norton Aviation Field was established near by in 1923. In 1922 Columbus Barracks was chosen as headquarters of the V. Corps area of the army, and later was renamed Fort Hayes. Ohio State University had a registration of 9,002 students in the autumn of 1925. Its magnificent horseshoe stadium, which covers 10 ac. and has permanent seats for 62,110, was opened in 1922.

COLYN, HENDRICK (1869–), Dutch politician, was born June 22 1869 at Haarlemmer Meer, Holland. After serving as a government official in the Dutch East Indies, he returned to Holland in 1909 and became a member of the Second Chamber. From 1911 to 1913 he was Minister for War. In 1914 he left politics and became manager of the Batavian Oil Co., a position which he held until 1919. From 1919 until 1922 he was managing director of the Asiatic Petroleum Co. and director of the Royal Dutch Shell and Anglo-Saxon Companies. In 1922, after the death of Abraham Kuyper, Colyn returned to political life as leader of the anti-revolutionary party. He became Minister of Finance in 1923, and retained this portfolio in the new Cabinet formed by him in 1925 and which resigned after a few months. Colyn, who is a sound business man, contributed much toward the balancing of the Netherlands Budget after the World War.

COMBES, ÉMILE (1835–1921), French statesman (*see* 6.751), was one of the five Elder Statesmen in the Briand Ministry of 1915–6, but without portfolio. He died May 25 1921.

COMBINE: *see* TRUSTS.

COMBING: *see* TEXTILE MACHINERY.

COMMERCE, DEPARTMENT OF, one of the executive departments of the U.S. Government. It succeeded the earlier Dept. of Commerce and Labour by an Act of Congress, approved March 4 1913, which also created a separate and independent Dept. of Labour (*see* LABOUR, DEPARTMENT OF). The Secretary of Commerce is a member of the President's Cabinet but is not in line of succession to the Presidency. It is his duty to promote the commerce, domestic and foreign, of the United States. There is also an assistant secretary and a solicitor, the latter acting as legal adviser to the secretary and to the heads of the various bureaux of the department.

As originally organised there were nine bureaux, as follows: (1) The bureau of the census, charged with the collection of data concerning population, agriculture, manufacture, mining etc.; (2) the bureau of foreign and domestic commerce, for the collection and diffusion of information of use to the manufacturer and exporter; (3) the coast and geodetic survey, for charting coast waters and surveying rivers to the head of tidewater or ship navigation and for making deep-sea soundings, magnetic observations, etc.; (4) the bureau of fisheries, for regulating and conserving fisheries; (5) the lighthouse service, in charge of the aids to navigation on all U.S. territory, except Panama and the Philippines; (6) the bureau of navigation, having general superintendence of the commercial marine and merchant seamen, and the enforcement of navigation laws; (7) the steamship inspection service, which inspects steam vessels for the purpose of ensuring safety at sea, and issues licences to masters, mates, pilots and engineers of the merchant marine; (8) the bureau of standards, for determining all American measurements; and (9) the bureau of corporations. The last-mentioned bureau, on March 16 1915, was transferred to, and merged with, the Federal Trade Commission (*see* FEDERAL TRADE COMMISSION). In 1925 two bureaux were added, being transferred from the Dept. of the Interior by order of the President: the Bureau of Mines, which investigates scientific and economic problems in the mining, metallurgical and quarrying industries; and the Patent Office, which issues letters patent, including designs, and registers trade-marks and commercial prints and labels under the copyright law.

Because of the importance to manufacturers, there had long been agitation among various commercial organisations of the United States for the creation of a governmental department for promoting commercial interests; but it was not until 1903 that a bill establishing

the Dept. of Commerce and Labour was passed by Congress; it was approved by President Roosevelt, Feb. 14. For the next 10 years the joint interests of labour and capital were entrusted to this department. The arrangement proved unsatisfactory because of the frequent conflict of these interests, and, in 1913, an independent Dept. of Labour was created, the name of the Dept. of Commerce and Labour being changed to Dept. of Commerce.

COMMERCIAL EDUCATION.—The history of commercial education is rather a chequered one. On the whole, much has been done, but done piecemeal, and no adequate general plan has been made to grapple with the problem, because the state has been slow to concern itself with it, as with elementary, secondary and even technical education. Commercial education, when recognised at all, has frequently been looked on as a sort of poor relation of the latter.

I. IN GREAT BRITAIN

The Institute.—The beginnings of public commercial education in England may be largely ascribed to the activities of the Mechanics' Institutes in the early and middle periods of the 19th century, in which evening classes in both bookkeeping and languages gradually grew up. These were succeeded by Technical Institutes, such as the Birmingham and Midland Institute and the Manchester high school of commerce. In fact, up to 1890, and even later, the north of England and the Midlands were, as regards commercial education, in advance of London and the rest of the country. In 1890 the School Board gained the right to undertake evening work. This ultimately led to the country being covered with a network of evening schools. The work at first was of a rather elementary nature, consisting of bookkeeping, shorthand, typewriting, English and often French. The Technical Education Act likewise gave a considerable impetus to the spread of commercial education in Polytechnics and similar institutions.

Still the movement had to face a good deal of opposition, or at least inertia, mainly from the widespread belief, which has not yet entirely disappeared and which is based on a half-truth, that commerce is best learned in the shop and the counting-house. Again, there was a good deal of muddle-headed thinking on the subject. Mr. Sidney Webb, who was one of the first to clarify public opinion on the subject, pointed out in a London conference held at the Society of Arts in 1897 that the term commerce covered a multitude of things—a vast number of distinct callings, from accountancy and banking to typewriting. It therefore involved an education of very varying degree, from elementary to university.

Universities.—Mr. Sidney Webb was largely responsible for the creation in 1895 of the London School of Economics and Political Science as an institute for higher commercial work. Beginning largely as a college for evening work, it subsequently developed a flourishing day side, and became a school of London University. Further developments in the course of higher education were the creation of faculties of commerce in the University of Birmingham (1900) and the re-constituted University of Manchester (1904), while London in 1917 established a bachelorship and mastership of commerce. A commercial degree can also be obtained at Newcastle (University of Durham) and at Liverpool a B.A. is awarded for proficiency in certain commercial subjects.

Economics figure as a prominent subject in the syllabus of other universities, but are taught mainly on theoretical lines, and no degree in commerce is obtainable. Probably the most complete choice of subjects for commercial study is offered by the London School of Economics and Political Science, amounting to nearly 270 courses given by some 80 lecturers and assistants. More than half of its departments are concerned wholly or partially with commerce. The school prepares for the bachelor of commerce and master of commerce, and provides for research work

Schools of Commerce.—Below the universities come the various day schools of commerce, often forming a section or department of a technical institute. The age of entry is generally 16, and some prepare for the bachelorship of commerce. Such are, for instance, the City of London College, the Regent Street Polytechnic Higher School of Commerce, the West Ham Technical Institute, with its course in commerce (three years), the Manchester municipal high school of commerce. There are also junior commercial schools, where the age of entry is usually 13 and the course is two years (occasionally three). Such schools (generally forming part of a technical institute) are to be found at Chatham, Blackburn, Southport, Wigan and other places.

Secondary Schools.—Certain secondary schools, like Hackney Downs and Holloway (London), prepare their students for degrees in commerce, while at least one of the public schools (Bradfield) has a definite commercial section. A large number of girls' secondary schools also do commercial work, which in many cases is confined to pupils who have passed the first school examination. In others it is begun by pupils of 15 who desire to specialise in commerce. Typewriting, shorthand and bookkeeping, with commercial French, history and geography, are the staple subjects.

Higher Elementary Schools.—Up to 1908 the curricula of the higher elementary schools were based on lines giving a general education. In that year, the London schools of this type were reorganised with a dual bias, commercial and technical, and renamed Central—a school might have one or both sections. The London Central School largely became the model for other central schools for the rest of the country. In the voluntary day continuation school, the teaching, which at the outset was general, became, in London at least, largely commercial.

Evening Work.—Some evening work in the London School of Economics and elsewhere is of university standard. Below this ranks the work of the evening schools, many of which, especially in the country, are situated in technical institutes, notable examples being the Manchester and Birmingham Municipal Schools of Commerce, the Hull Central School of Commerce, the Bradford Commercial College, the City of London College and the 24 London Evening Institutes.

The range of work is considerable, and, apart from typewriting, shorthand and bookkeeping, includes preparation for examinations in accountancy of all kinds, banking, insurance (life, fire, marine), railway administration, civil service (post-office, inland revenue, customs and excise), courses for solicitors' or stockbrokers' clerks, for secretaries or grocers' assistants. This involves classes in economics, including economic history and geography, and the economics of shipping, railways, etc.; the theory and practice of commerce, banking, currency, foreign exchanges, statistics, the machinery of business secretarial practice, knowledge of commodities, law of all kinds—general, conveyancing, banking, company, commercial, mercantile, marine, joint stock, income tax, etc.

The teaching in languages comprises French, German, Spanish, Italian, Esperanto and other less known languages. Again, by the course system, all students under 18 who have not had a good secondary or central school education are obliged to take a course in which a language often forms a part. Students enter the institutes at sixteen. Below these are the junior institutes, usually entered at 14, where all the pupils are obliged to take a course. In some of these, French is taught. They are generally affiliated to senior institutes.

Private Initiative.—There also exist a number of schools attached to big business houses, as well as many private institutions, which prepare mainly for the lower and intermediate walks of commerce and the Civil Service, such, for instance, as Pitman's and Clark's colleges. Two hundred thousand young people had successfully passed through the latter up to 1926, while Pitman's trains over 10,000 students a year.

Examinations.—In addition to the examinations mentioned above, and some higher commercial certificates, a large number of students in the evening institutes and elsewhere take the examination of the Society of Arts, the Chamber of Commerce and other societies. The Society of Arts held its first practical examination in 1856, and among the subjects were French and bookkeeping. The candidates, mainly drawn from mechanics' institutes, numbered 56. In 1925, the number of papers worked was over 70,000. The London Chamber of Commerce, which began in 1890 with 65 candidates and 17 passes (all junior), had, in 1925, 22,114 candidates, with 12,159 passes. Since its inception, 246,346 candidates have entered for its examinations, and 129,333 have passed. (C. BRE.)

II. IN THE UNITED STATES

The agencies which provide for the training of those who enter upon commercial vocations are public secondary schools, private business colleges, correspondence schools, corporation schools and colleges of commerce.

Private Institutions.—The oldest of these institutions is the private business college. In 1910 the number of persons registered in such institutions was 134,778; in 1915 this number had increased to 183,286; and, in 1920, the number was estimated to be somewhat more than 300,000. The private business school flourishes because it usually gives shorter courses than the public high school, and because it makes provision for individual students by allowing each one to progress as rapidly as he can, and by assuming more responsibility for securing positions for graduates at the end of the course.

Public High Schools.—The number of commercial courses given in public high schools has increased rapidly in recent years. In 1922 there were 191,901 pupils in public high schools taking shorthand and 281,524 taking typewriting. In addition there were pupils taking courses in commercial arithmetic, commercial law, commercial geography and other commercial subjects. There are no reliable statistics earlier than 1922 to show the rate of increase in these subjects, but two indications are to be found in the following facts: In 1915 there were 39,816 pupils registered in book-keeping; this was 3·42% of the total number of pupils registered in these schools. In 1922 the registrations in book-keeping were 270,517, or 12·55%, of the total high-school population.

In 1911 a survey made by the City Club of Chicago showed that as much money was being paid to private business colleges in that city, in the form of student tuitions, as the city was paying for the maintenance of all its public high schools. These findings led to the rapid development of high-school courses in commercial subjects. What happened in Chicago is paralleled in all parts of the country. The competition of the private institutions has led the public high school not only to introduce commercial courses, but also to attempt to give the training necessary for entrance on practical positions in as short a period and as early in life as possible. The result is that there are in many high schools two-years' commercial courses. In some cases the experiment has been tried of offering commercial courses to pupils in their seventh and eighth school years. The experiment has, however, in general proved unsuccessful, because pupils at this stage are not sufficiently trained in fundamentals to make them mature enough for practical positions.

There are two methods of providing commercial courses in public high schools. In some cities separate schools called commercial high schools are organised; in others commercial courses are conducted as electives in a general high school. The quality of the students who take commercial courses has improved in recent years. In earlier years only students incompetent in other lines were usually to be found in these courses. The quality of the teaching staff is often inferior. Until very recently there have been no higher institutions which give advanced courses, and teachers were recruited from private business colleges or selected from among the secretaries who wished to withdraw from business.

Universities and Colleges.—A number of universities and colleges have set up business divisions. The first institution of this type in the United States was the Wharton School of Finance and Economy of the University of Pennsylvania, founded in 1881. There were 22 such schools in 1921, a number of them giving graduate courses. The student registration in these schools is estimated at 20,000.

Corporation Schools.—The corporation commercial schools are of various types according to the needs of the concerns which organise them. In retail stores there are schools for the training of salesmen and saleswomen; in insurance companies there are schools for salesmen and managers; in banks and houses with large accounting departments there are schools for office employees; and so on. The range of subjects covered in these corporation schools and the time given to instruction have steadily increased in recent years under the stimulation of business competition.

Courses similar to those given in the institutions described in foregoing paragraphs are made available to a great many persons through correspondence courses and night sessions of high schools. By these means persons who are regularly employed may take courses during unoccupied hours. It is estimated that 38,495 persons were pursuing correspondence courses in 1922, and 842,863 were registered in city evening schools. (C. H. J.)

COMMERCIAL TREATIES.—Down to the outbreak of the World War of 1914, almost all states in the world were linked together by a close network of commercial treaties, by means of which the need of each country for customs revenue and for protection of its products could be reconciled with the ever-increasing need for expansion of foreign markets resulting from the growth of industrialisation.

The War made a serious breach in this development. It is true it did not alter the basic principles of the policy of concluding commercial treaties, but it brought financial and protectionist interests so strongly into the foreground that the interest in international trade was extraordinarily restricted and is only now beginning to receive greater recognition. Two forms are characteristic for all modern commercial treaties: tariff rates and the most-favoured-nation clause. By tariff rates are meant the concessions in the rates of the customs tariffs on both sides. Treaties which embrace both forms are called tariff-treaties and are preferred by states which carry on a very active commerce with one another. By far the greatest number of all commercial treaties are restricted to the most-favoured-nation (M.F.N.) clause; they are called most-favoured-nation treaties, for, although the first type also include M.F.N. treatment, this is subordinated to the tariff rates which constitute their chief feature. Treaties of a different type, merely comprising tariff rates without M.F.N. treatment, were of rare occurrence and were mostly a survival of an earlier period.

Most-Favoured-Nation Clause.—M.F.N. treatment secures to the treaty state equality of position with those foreign countries which receive most favourable treatment. In the form in which it has developed since the year 1860, it secures for this state not merely all the privileges which any other state has received in the past and still enjoys, but also those which it will receive in future, and moreover immediately and without additional compensation. There is, it is true, a still more favourable treatment than the foreign parity given by the M.F.N. clause, namely inland parity or national treatment, which places the persons and goods of the country concerned on an equality, not with those of other foreign countries, but with those of the nationals of the country itself; but its sphere of application is a different and at the same time a more limited one.

By its nature it only applies to such economic measures as are not confined to foreign goods and persons, such as import duties, admission of consuls, etc., but may affect both domestic and foreign goods and persons, so that discrimination in their treatment would constitute a new and arbitrary protection for the home country, *e.g.*, taxes on consumption, admission to trade and settlement, conditions for the use of railways and roads, etc. In oriental countries in which foreigners received special privileges, it sometimes occurred that the foreign parity was more favourable than the inland parity. Reciprocity, by virtue of which a favour is only accorded to the treaty state in return for an equivalent compensation, is less favourable than M.F.N. treatment or foreign parity. This principle was to be found in many commercial treaties down to the middle of the 19th century and still exists in later commercial treaties, in cases where it is a matter not merely of a passive permission, but of an active intervention on the part of the state, *e.g.*, the admission of joint-stock companies, privileges for commercial travellers, the granting of benefits of workers' insurance, etc.

There are several varieties of M.F.N. treatment. The unconditional is to-day the most common, but the conditional is also to be found, by virtue of which the treaty state has a right to a privilege granted to another country if it was given without compensation,

but can only secure it for an equivalent compensation if this privilege has been acquired by the other country as a result of a concession on its part. This latter form is distinguished from reciprocity by the fact that it contains an obligation to grant equality of position when the necessary condition is fulfilled, which is not the case with reciprocity. Unconditional M.F.N. treatment has, it is true, the disadvantages (1) that it diminishes the value of every concession, because the area to which this applies is extended, (2) that it hinders a concession to one treaty state because this would subsequently benefit automatically a stronger competitor, (3) that by adapting the concession to the special conditions of the treaty state, its extension to the other most favoured countries can in practice be excluded. It has, however, the great merit that it guarantees to the treaty state equal competitive conditions in the territory of the other for the whole period of the treaty and greatly facilitates the conclusion of commercial treaties.

Conditional M.F.N. treatment involves fresh negotiations with the other states on the conclusion of each tariff treaty, and may give rise to technical and political difficulties which may endanger the whole treaty structure. The post-War period has brought about an interesting and characteristic change; while the United States in contrast to the European countries maintained before the War conditional M.F.N. treatment which, by its nature, is relatively unfavourable to the treaty method, they have gone over in the latest commercial treaties, *e.g.*, the treaty with Germany of Dec. 8 1923, to unconditional M.F.N. treatment. This change is attributable to an alteration in their commercial interests. Formerly they supplied mainly raw materials (cotton, copper, etc.), which the European states needed urgently for industries, while they constituted an important market for European manufactures and therefore were in a strong position when treaties were negotiated.

Now, however, the export interests of their industries have come into greater prominence and demand a modification of their foreign commercial relations. On the other hand, France, which before the War had not favoured the treaty method, is now contemplating, in accordance with the law of July 20 1919, the conclusion of commercial treaties in which reciprocal tariff concessions are granted, and has thus in theory returned to the principle of reciprocity. This policy has, it is true, been substantially modified in practice, for she has not merely allowed the former M.F.N. treaties to continue in force, but has also adopted M.F.N. treatment in newly concluded commercial treaties, though subject to considerable restrictions.

M.F.N. treatment as a rule binds both contracting parties to reciprocal treatment, but this is not a necessary condition, for in the treaties with countries in the East it only applies unilaterally in favour of the European states. The victorious states also chose the unilateral form for the Peace Treaties of 1919, but only for a period of five years; the Council of the League of Nations has made no use of the power granted to it to extend the application of this clause. In many commercial treaties of the former enemy states, the limitation was already set aside at an earlier date.

M.F.N. treatment can, however, be restricted not only in its form, but also in its contents. In its widest scope it covers all matters of trade and shipping, but in all cases it applies to the customs tariff and customs procedure. In the post-War period some states have restricted it to certain customs items or parts of the customs tariff. On the other hand, the commercial treaty between England and Germany concluded on Dec. 2 1924 contains reciprocal, unconditional, unlimited M.F.N. treatment.

Tariff Systems.—Tariff treaties depend largely on the tariff system which is at the basis of the tariffs of the treaty states. We can distinguish the single-line tariff, which has only one tax for each article for all countries, from the double tariff which consists of two columns of tariff rates of which the one with the lower rates is applicable to the most favoured countries, and the other with the higher rates to remaining countries. Depending on the origin of the lower column, the double tariff can be a general-conventional tariff in which only the higher general tariff is fixed by an autonomous law of the country concerned, while the conventional tariff is composed of the concessions or binding rates granted to other countries by commercial treaties.

By a binding rate is meant the transfer of a tariff rate from the general tariff to the conventional tariff at the same figure, in order to secure its application for the whole period of the treaty, since an autonomous tariff can at any time be modified by the country concerned, by a new law. The double tariff can, however, also be a maximum-minimum tariff, in which the column with the lower rate is also fixed by autonomous legislation and therefore provides the limit to which tariff concessions can be granted to foreign countries.

The single-line tariff which Great Britain and some countries of northern Europe have applied, necessarily involves M.F.N. treatment because it leaves no room for tariff concessions, but there is the possibility, of which Belgium has taken advantage, of granting tariff concessions by commercial treaties which are then taken over into the single-line tariff and thereby extended to all countries, whether or no they have granted M.F.N. treatment by treaty. In the general-conventional tariff which is predominant in Germany and other Central European states, the chief emphasis lies in tariff treaties with M.F.N. treatment. The maximum-minimum tariff is less favourable to the treaty method. This, although of Spanish origin, can to-day be described as the French tariff system, because the unilateral and therefore relatively high minimum rates offer small inducement to the conclusion of commercial treaties, and their autonomous regulation affords no security against subsequent increases. In its most extreme form it might result in the same article being subject to divergent tariff rates according to the country of origin, which would naturally exclude any M.F.N. treatment. Even if France herself has never gone so far as this yet, her commercial treaties in the post-War period exhibit great specialisation. In the treaty with Czechoslovakia of Aug. 17 1923 she grants some tax rates of the minimum tariff (list B), then some rebates from the tariff rates of the maximum tariff (list C) and applies elsewhere the maximum tariff. In the case of preference granted by France to Austria and Hungary, she extends unconditional M.F.N. treatment, but for the tariff rates of lists B and C only conditional M.F.N. treatment.

Post-War Changes.—The pre-War commercial treaties corresponded to the normal market conditions in which production outran demand, so that it was the concern of the seller to find a market for his goods and not of the purchaser to obtain the goods he required. The state only sought to facilitate the path of trade in foreign countries; whether and how far advantage was taken of this was the concern of the merchant. The scarcity of goods brought about by the War, however, upset the normal market conditions; instead of the purchaser the seller had the stronger position, and it was not the man who wanted the goods who dictated conditions, but the man who controlled their supply. Commercial treaties of the old type were temporarily pushed into the background by two new types; the compensation treaties and the treaties based on quotas, which are distinguished from the ordinary forms by the fact that the contracting states pledge themselves, not merely to permit movement of private trade, but to a definite undertaking. In the compensation treaties the state declares that it will supply specified quantities of certain goods, in return for which it receives others of which it is urgently in need. Here the obligation to deliver is in the foreground, since it is mainly a matter of essential goods, such as wheat, coal, etc.

Occasionally, as for example in the case of France in relation to Switzerland, there was also an obligation to accept delivery, when the other party was at pains to secure at least part of a market for its high-grade luxury products (embroideries) which it had lost as a result of the War. A condition of these treaties was the suppression of private trade and the setting up of state *Centrales* for the most important goods, because the state administration can only deliver goods which are under its own control. The treaties with quotas which arose later are distinguished from the above by the fact that the treaty states do not pledge themselves to the delivery of goods against goods, but merely agree to the issue of export licences for specified quotas of goods, for which it was also necessary that an import licence should be granted by the receiving state, but whose actual delivery, where the goods were not still subject to state control, remained in the hands of private trade. Such treaties were often not published at all but only communicated to the government departments and the undertakings concerned.

After the War, normal market conditions gradually returned, though less owing to a rise in production than to a general fall in purchasing power. The consequence of this equalisation of supply and demand on a lower level was that the struggle for foreign markets gave place to a struggle for the retention of the home market. Protection came so strongly to the fore that even England had to sacrifice part of its traditional free-trade policy. The Protectionist tendency was appreciably strengthened by the currency depreciation in many countries, which results in an export bounty for the products

of the country concerned. The countries with high exchanges protect themselves against such exchange dumping by raising their import duties or by special additional duties (*e.g.*, Spain, Czechoslovakia). The countries with weak exchanges in turn are forced to prohibit imports of luxury goods, and to hinder payments to foreign countries by controlling exchange transactions, in order to prepare for stabilisation by improving the balance of payment. Hence it resulted that the protectionist system was even accentuated by a system of prohibitions such as people had believed to have finally disappeared with mercantilist ideas by the middle of the 19th century.

It is true that gradually the need for normal commercial treaties with M.F.N. treatment and tariff rates has been receiving greater recognition, but the after-effects of the conditions of political and commercial war have by no means vanished. The commercial treaties concluded before the War were determined by the belligerent Powers contrary to former custom, when their operation used merely to be suspended for the period of the War. Negotiations entered into since then have been confronted with such great conflicts of interest and uncertainty of conditions that often agreements could only be made for a year, terminable at three months' notice, whilst formerly they used to hold good for 10 years and more. M.F.N. treatment amongst the European states has often been only conditionally granted, and restricted to certain categories of goods. Further, events in Russia have caused a severe dislocation of the old-established trade relations, for she demanded the recognition of her state monopoly of the export trade and of the abnormal political institutions of the Soviet régime.

On the other hand, owing to the economic crisis and the political unrest of Europe, endeavours have been made to join certain states into a customs union by abolishing the customs duties between them. Thus abortive proposals were made that Austria, whose continued existence appeared hopeless, should be united to Germany or should join with other neighbouring states into a Danubian Federation. Schemes for economic union have also been discussed in the Balkans and between the Baltic states. But such preferential relations arouse political objections, because the union of economic interests may also bring about political ties, and are also impeded by the fact that the states receiving M.F.N. treatment are not willing to be excluded from the advantages of preferential relations. Up to now these ideas have nowhere been realised. (*See* also TREATIES.)

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COMMUNISM (*see* 6.791) is a special movement within Socialism (*q.v.*) with the same ultimate goal, namely the abolition of social stratification by the destruction of private ownership of the means of production.[1] By this means it is hoped to liberate the oppressed and to emancipate the proletariat. Communism is peculiar, in that, basing itself on the utterances of Marx and Engels, it holds that this end is *only* attainable by means of a revolution. Revolution is not rejected by Socialism as a last resort for overcoming historical and social obstacles; but communism regards revolution as *necessary* and a period of the dictatorship of the proletariat based on open terror as the only means of creating the socialist economic and social system.

Modern Developments.—Communism has undergone very far-reaching changes since the World War, not so much in theory as owing to its international expansion. Russia, by coming under the rule of a communist party, has become the parade ground of communist practice. Communism, in its Russian form, has some remarkable features which originally did not belong to it. Russian communism forsakes the path of Marxian Socialism when it regards the social revolution as possible in every capitalist country of Europe without regard to the stage of its economic development. This clearly springs from its thesis of a world revolution which can break out anywhere, and which must then spread from the country of origin over the whole world.

[1] The communism discussed in this article has nothing in common with that "ideal" communism often aimed at in the past by religious or utopian "communities." Modern communism is built up on the basis of the *Communist Manifesto* issued in 1848.

Modern communism, especially Russian communism, based as it is on the "Communist Manifesto" issued by Marx and Engels in 1848, emphasises the initial necessity of civil war. It regards the Paris Commune not as a purely political movement but as an economic revolution for the emancipation of the proletariat which was stamped out with bloodshed. Similarly, the 1905 revolution in Russia is treated as a prelude to communism. Communism in its Russian form is closely allied to syndicalism but not to anarchism, as is often falsely maintained. Syndicalism is the revolt of the rank and file of the workers against the democratic State, against capitalism, but also against trade union bureaucracy. It is born of impatience of the compromises brought by daily life. It is the transplanting of the *élan vital* into the social conflict. Just as syndicalism places action above everything, and moreover direct action—not only strikes but also sabotage—just as it seeks to conquer the capitalist structure even at the cost of the temporary destruction of productive forces, so also in the case of Russian communism (Bolshevism) force is the necessary road to success and the militant period constitutes a necessary training of the proletariat for the control of society.

On the other hand, communism differs from syndicalism in that the latter glorifies the "militant minority" and believes that a determined minority is necessarily superior both in wisdom and power to the loosely associated majority, whereas communism considers that the acquiescence, at least, of the majority must be obtained by propaganda. Furthermore, syndicalism is in revolt against all forms of centralised control, above all, of economic processes. If the proletariat is to achieve its aim it must as a class elect its own representatives. Just as in the French commune the sections, *i.e.*, the individual city quarters, elected their representatives directly, so also Russian communism has created a similar direct representation of the proletariat in the workers and peasants' councils. But the proletariat itself, according to Communist ideas, does not form a political body suitable for democratic organisation. For, according to Communist theories, the proletariat at the beginning of the revolution is no homogeneous mass but contains within itself the various stages of historical development. Only the most enlightened workmen employed in the technically most advanced branches of industry are capable of grasping the situation. The great mass of the workmen employed in medium and small workshops, or in handicraft, the exploited, degenerate masses of the home workers are not in a position to recognise their interests and their "social status" in the moment when revolution breaks out.

For the domination of the bourgeoisie and of capital is not only an economic and (in the first stages of the industrial system) a physical dictatorship. The bourgeoisie, according to Communist theory, rules over the proletariat, not only by virtue of unemployment and through the police; its rule is at the same time a spiritual one, in that the whole ideas and ambitions of the workman are perverted by the interests of the bourgeoisie. A proletarian revolution, therefore, based on democratic franchise, even if confined to the workmen, would have little chance of success, and the proletariat must, therefore, trust to its advance guard, the Communist party, which includes only a small fraction of the workmen, and must not include more in the interest of its fighting strength. For all these reasons the Soviet system, which originally (1905) had been based on democratic ideas, was soon transformed; voting was made public, in order to ensure the election of communists. The Communist party, furthermore, drew up the lists of candidates in such a way that candidates other than Communists could not be elected in the electoral assemblies. The system of indirect election to the higher Soviets serves the same purpose. The working proletariat alone is entitled to vote for these bodies; the other social classes, in so far as they exist at all, are deprived of any political rights as "exploiters."

According to Russian communist theory the working classes as such are quite capable of seizing the power of the State, but not of maintaining it with success. For this purpose they require

a Committee which acts for them: the Communist party. This party must therefore exercise the dictatorship during the period of civil war, and hence it is necessary that only members of the Communist party, or those in sympathy with it, should be elected to the councils. The period of dictatorship is regarded as a transitional stage, in which a freely democratic expression of will would lead to the victory of the counter-revolution, in view of the greater mobility and the economic strength of the former ruling classes. It is only when the socialist society has been achieved that a free expression of will and the representation of the whole people is again possible. Communists do not reject the current conceptions of democracy because they believe in the superiority of the few, but because they believe that the phrases of democracy bear no relation to present realities. True democracy is held to be unrealisable in capitalist society because of the fundamental helplessness of the propertyless man; parliamentary forms only serve to veil the reality of the " bourgeois dictatorship " by an appearance of popular consent which is rendered unreal by the capitalist control of the social structure.

The Theory of the Dictatorship.—The Russian practice of communism, especially the Dictatorship of the Proletariat and its maintenance by the Terror, has its theoretical basis in the "true Marxian doctrine of the State," as this was developed by Marx and Engels. According to this, the State is not the reality of the ethical idea, nor the realisation of a universally valid system of law, nor a power standing above society, but the State is an organ of class rule, an organisation of the exploiting class in power at any time for the maintenance of its external conditions of production, and especially for the suppression of the exploited class. It is finally a " special force of repression " even in the case of the democratic State. Hence it can never represent the whole society, except where this consists of one class—the proletariat. For whereas all previous class struggles have resulted simply in the rule of a new minority, the victory of the proletariat carries with it the emancipation of the whole of humanity, because there is no remaining class below them to be freed. The struggle of the working class is thus the struggle of the humanity of the future.

When the State seizes the means of production in the name of Society (and that is the Social Revolution), then, and not till then, does it represent the whole Society. Then government over persons is replaced by the administration of things and the control over productive processes. The State is not " abolished;" it dies out. " The machine of the State is put into the museum of antiquities, alongside of the spinning wheel and the bronze axe " (Engels). For in proportion as the proletarian State carries out its task of suppressing class distinctions, it destroys its own class basis, and the State as a special organ of class power and repression gives way to the machinery of a homogeneous communist society. It is only in this subsequent phase of communism that freedom becomes realisable.

This end cannot be attained immediately by the conquest of the State power. If the proletariat overthrows the bourgeois government and takes over the army and the administration, socialism and the classless society are not yet achieved. On the contrary, the workers must then, by means of the dictatorship of the proletariat, take and maintain possession of the State as the " special force of repression " for keeping under the bourgeoisie. This is, briefly, the theory.

Practical Modifications.—Since communism to-day is no longer a mere theoretical political system, but has become a political power, it is going through different phases. Faced with reality, principles melt like snow in the sun. Further, there are the rapidly changing conditions which may necessitate quick changes in tactics or even the temporary sacrifice of principles. As the Soviet State has developed in Russia, many concessions have had to be made to economic necessities. The early militant phase of War Communism gave place to the new economic policy and to a far-reaching recognition of private trade and in particular of the right of the peasant to the free disposal of his products, subject to certain fixed taxation. This in turn has been modified in certain respects, but Russian Communism is still essentially in a transitional condition, and it may be argued that it has very little right to the name of Communism at all. Communist thought in other countries has been relatively little affected by the changes in Russian practice, and is still very greatly influenced by the theoretical writings of Lenin and the policies advocated by the Third International (*see* RUSSIA: THIRD INTERNATIONAL). Just as the political development of the 19th century was profoundly modified by the French Revolution, so economic life during the present century will continue to feel the repercussion of the ideas of the Russian Revolution, even were a new Napoleon to arise and to restore the former capitalist system in Russia.

The strength of the Communist movement outside Russia varies greatly in different countries, being greatest wherever economic distress is most acutely felt. The continuance of the intensive propaganda of the Third International, despite very prejudicial effects on the political relations between the Soviet State and other Governments, is mainly attributable to the sense of insecurity of the Russian Communists, and to their belief that the Russian experiment depends for its lasting success upon the accomplishment of the world revolution. (*See* also THIRD INTERNATIONAL.)

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COMMUNIST INTERNATIONAL: *see* THIRD (COMMUNIST) INTERNATIONAL.

COMPANIES AND CORPORATIONS (*see* 6.795).—This article deals first with the position of certain classes of trading companies in Great Britain, and afterwards with companies, or corporations, as they are called, in the United States and France.

I. GREAT BRITAIN

As regards Great Britain, the term " company " is used with special reference to two types of company—(1) registered companies, *i.e.*, companies which are registered under the Companies Acts, 1908 to 1917, and (2) statutory companies, *i.e.*, companies incorporated under special Acts to carry on works of public utility. This classification follows that previously adopted with the modification that the prefix public is used no longer to denote companies in class 2, but those companies in class 1 which are not private. As in the previous article attention is concentrated on companies " limited by shares " as distinct from " unlimited companies " and " companies limited by guarantee," types which still remain comparatively unimportant.

REGISTERED COMPANIES

The progress of British joint stock enterprise during the period 1910 to 1925 illustrates Lord Bowen's observation that " very often the course of business in the city walks in front of the law merchant," for the uses to which the commercial world has put the Companies Acts have undergone extensions more striking and important than any of the legal changes introduced.

Legal Changes.—The statutory changes, comprised in three Acts which supplement the Companies (Consolidation) Act, 1908, may be summarised as follows:—

1. By the Companies Act, 1913, safeguards were provided to prevent private companies from continuing to enjoy the privileges and exemptions accorded them under the Companies (Consolidation) Act, 1913, when any of the conditions mentioned in that Act

(Section 129) and embodied in the companies' Articles are no longer fulfilled.

2. By the Companies (Foreign Interests) Act, 1917, Companies which by their articles restrict the amount of capital which may be held by aliens were prohibited either from eliminating such restrictions or entering into voluntary liquidation without the consent of the Board of Trade.

3. By the Companies (Particulars as to Directors) Act, 1917, the provisions of the "Registration of Business Names Act, 1916" were applied to companies and the disclosure of certain particulars respecting directors was made obligatory.

Although something on the lines of the Registration of Business Names Act had been contemplated before the War, it is plain that both the Acts of 1917 were directed to minimise the danger of the control of British-registered companies by enemy or ex-enemy aliens. In a case which came before the House of Lords in 1916 (Daimler Co. Ltd. *v.* Continental Tyre Co. Ltd. (1916) 2 A.C.) Lord Parker, referring to the history of joint stock enterprise used these words:—

> English legislation and decisions have developed mainly since this country was last engaged in a great European war and have taken little if any account of warlike conditions. The ideal of joint stock enterprise that, with limited liability the more unlimited trading the better, is an ideal of profound peace.

In the case in question the main point at issue was whether a company, registered in England (and therefore British) but in fact controlled by Germans, had or had not certain legal rights as a British subject (*e.g.*, in the matter of recovering a debt). By a majority the House of Lords decided that it had not—thus abandoning the doctrine which it had formerly established (in the case of Saloman *v.* Saloman and Co. Ltd. (1897) A.C. 22), that a company once incorporated "must be treated like any other independent person with its rights and liabilities appropriate to itself."

The Wrenbury Report.—Early in 1918 a committee under the chairmanship of Lord Wrenbury was set up by the Board of Trade to inquire what amendments were expedient in the Companies Acts "particularly having regard to the circumstances arising out of the War and of the developments likely to arise on its conclusion." The committee reported (Cd. 9138) in favour of amendments (*a*) to ensure the disclosure of alien nationality by shareholders, and (*b*) to ensure that, in the case of companies engaged in shipping or in "key" industries, "not more than 20% of the power of control should be in alien hands." Neither of these recommendations has found a place in the statute book.

Growth of Joint Stock Enterprise Since 1910.—Apart from a heavy additional burden of taxation taking the form of higher stamp duties and (from 1921–5) of a special tax on profits (the Corporation Tax) the restrictions imposed upon joint stock enterprise as a result of the War proved to be of a temporary nature. On the other hand War and post-War conditions were favourable to joint stock activity in many directions.

According to the Board of Trade Annual Reports on Companies the number on the register in 1910 was 51,787, having a paid-up capital of £2,178,619,734; by the end of 1924 it was 90,918 for England and Scotland with a paid-up capital nearly twice as large (£4,355,869,530). The increase was not continuous. During the war years 1915 to 1918 the net addition was only 866 companies with a paid-up capital of £194,048,192, but the two years 1919 and 1920 more than made up for the falling off by adding 12,689 companies and a paid-up capital of £1,293,537,410. During the next four years, in spite of a setback in 1921, the rate of increase both in numbers and capital was comparable to the rate of increase in the four years 1910 to 1914.

Relatively to that of public companies, the increase in private companies has been remarkable. In 1910 the proportion of private to public companies was stated (*see* 6.800) to be one-third. In 1918 the Wrenbury Committee found that out of 66,000 on the register no less than 50,000 were private. In 1924 the proportion was 89% (81,809 out of a total of 90,018). This rapid increase is reflected in the Board of Trade returns regarding the capitalisation of English companies. Between 1911 and 1917 companies with a nominal capital of less than £5,000 comprised over 50% of the total in each year. During the boom years that followed the proportion declined to 31·5%, but in 1921 companies with less than £5,000 were once more in the majority, the numbers reaching over 62% of the total in 1924. When it is realised that there were registered in 1919 95 companies and in 1920 121 companies (compared with 27 in 1913 and 14 in 1924) with a nominal capital of £750,000 and over, the increase during 1919 and 1920 in the proportion of companies with a quite small capital will be understood. After allowance has been made for the possibility that an increase in the stamp duty (from 5s.% to £1% of the nominal capital in 1920) may have been a contributory factor in favour of low capitalisation, it seems reasonable to infer that, since 1910, small private businesses and firms have, to an increasing extent, found it advantageous to adopt the company form of organisation.

The full significance of the above figures will be missed unless some attempt be made to answer the following questions: (1) Into what parts of the industrial field have joint stock companies spread most during recent years? (2) To what extent have the shares in public companies been bought by small investors? (3) What have been the main effects on the joint stock system of the economic disturbances arising out of the War?

Spread of Joint Stock Organisation.—General statistics showing the extent to which the corporate form of trading has permeated business undertakings in the United Kingdom are unfortunately not available (*cf.* United States statistics referred to below under corporations in the United States). There can, however, be little doubt that in those branches of production and distribution where the growth of large-scale organisation has been most rapid, companies—especially of the "holding" type—have become common. The British United Dairies Ltd. is a good example. Registered in 1915 with a capital of £1,000,000 this company (with a capital now four times as large) was, according to the "Linlithgow Report" of 1924, in control of "by far the greater part of the London wholesale milk trade" and—through its 16 subsidiaries—one-third of the London retail trade as well.

In regard to other commodities the advent of the multiple shop has brought many departments of retail trading under corporate ownership, such as groceries, household stores, drugs, etc. In a memorandum submitted to the Greene Committee (*see* below) the Manchester Chamber of Commerce stated (*Minutes of Evidence*—26th day, *Appendix KK*) that, among undertakings covering 85% of Lancashire spinning and weaving mills, companies now comprised 96% of those engaged in spinning, 75% of those engaged in weaving, and 89% of those which combined spinning and weaving. As in weaving, so also among merchant exporters there was stated to be a growing tendency for private concerns to take advantage of the private company form.

The Small Investor.—In his last work, *Money, Credit and Commerce*, Prof. Alfred Marshall, commenting on the fact that "many railways and other undertakings are owned in great part by multitudes of small capitalists," said: "The main effect of this development is to strengthen the position of the middle classes relatively to the working classes on the one hand and to the wealthy classes on the other." While there is no reason to doubt that small investors have been increasing in number relatively to large, reliable statistics to show this tendency are lacking—at any rate for the United Kingdom. Between smallholdings in land and those in shares there is no analogy: and the fact that the average size of the shareholdings in 19 representative companies was in 1925 no more than £267 (*vide* an analysis made by the Liverpool and District Economic League) may perhaps only indicate that large investors now-a-days prefer to distribute their capital in small parcels over a wide field.

Economic Effects of the War.—With the prolongation of the War the number of trades drawn into the orbit of war-time demand tended steadily to increase until nearly the whole range of private enterprise was occupied in catering for a market the absorbent qualities of which seemed to be unlimited. At the same time restrictions were imposed by the Government on the flotation of new share issues. The result was that successful

companies were compelled largely to provide for their capital requirements out of profits. In particular open reserves, represented by investments in stock-exchange securities, increased rapidly. An analysis by *The Economist* of some 1,000 companies showed that between 1914 and 1917 the average percentage of profits placed to reserve increased from 26·3 in 1914 to 37 in 1917, while in some industries such as iron and steel and oil the percentage rose to over 60.

The termination of the War found the financial position of most public companies still further strengthened. To open reserves were now added secret reserves, automatically created by the enhanced and increasing value of their physical assets. According to a decision of Lord Justice Fletcher Moulton in 1911 (Spanish Prospecting Co., Ltd., 1 Ch. 92) such reserves might be treated as profit and paid out as dividend. In general, however, companies adopted the practice of distributing their surplus profits (including these increases in the valuation of their assets) in the form of bonus shares. And in fact, in 1920 alone bonus shares to the nominal value of £65,249,398 were distributed on a paid-up capital of £97,957,114 by 235 public companies. Wealthy shareholders in particular benefited by this practice, since it was decided by the House of Lords (The Commissioner of Inland Revenue *v.* Blott, 1911) that such property in the hands of shareholders is not liable for super-tax.

Bonus share distributions in 1919 and 1920 account only in part for the enormous increases in issued share capital that occurred in those years. A period of rapidly rising prices had always been favourable to the merger of companies and the buying up of the smaller by the larger concerns. And so it proved then. Since, however, the payments involved in these transactions had to be made (whether in cash or shares) in accordance with the high prices which business assets then commanded, the nominal value of the shares issued to cover these payments was necessarily large.

At the end of 1920 prices began to fall and a prolonged trade depression set in. Industrial companies generally, and especially those created or reconstructed during the boom period, were now faced with the position that their liabilities (*equitable*, not legal liabilities, of course) in respect of paid-up share capital were in excess of the true value of the assets, tangible and intangible, set against them. This excess was the measure of the amount of "water" in their share capital. Watered capital meant that the weaker companies were unable to earn dividends even on preference shares, while the heavy fall in the market price of their shares made it difficult for most companies to raise working capital except by borrowing. According to the Monthly Review of the Midland Bank (for March 1926) the ratio of loan capital to share capital raised by companies rose from 9·6% of the annual total in 1919 to 46·8% in 1921 and 49·5% in 1922. The remedies were no doubt obvious. The remedy for over-valuation of assets was a drastic writing down of share values. The remedy for falling markets was a reduction in working costs. But neither was easy to apply. The first meant the expense and inconvenience of an application to the Court for leave to reduce capital. The second meant a reduction of wages on the ground that shareholders were entitled to expect at least some return on their investment. This argument, however, carried little weight with trade unions, able to point out that perhaps 50% of the share capital was water. To the knowledge of this fact and the publicity given to it has been attributed the collapse at the end of 1923 of the opposition of the shipping companies to a wage demand from the organised dock labourers.

At the end of 1922 only a small part of the water had been squeezed out by capital reductions. The burden of this legacy from the sanguine days of rising prices, coupled with the fact that the unsheltered industries still showed no genuine signs of recovery, makes all the more remarkable the recuperative power shown by companies in general from 1923 to 1925. According to *The Economist*, if 100 be taken to represent the general level of profits realised in 1920, then the profits in 1921 were 79·9, in 1922 56·7, in 1923 74, in 1924 78·9, and in 1925 85·8. The same upward tendency from 1922 to 1925 is indicated by the rise in the average rate of return paid on ordinary shares from 8·4% in 1922 to 10·3% in 1925, as well as by a decrease in the ratio of loan capital to total capital (raised by companies annually) from 49·5% in 1922 to 34·2% in 1925.

Companies as Investors.—For this unexampled power of recovery some explanation is required. The secret lies, it is believed, in the strides which the financial integration of companies (through investment by companies in other companies' shares) has taken in recent years. For companies as for private investors the field of profitable and safe investment has widened considerably since 1910, not merely because the market in securities is larger but because the lesson has been learnt that debentures and other gilt-edged securities offer no better prospect of a safe return than a varied assortment of holdings in which ordinary shares as well as government bonds have a place.

Investment by companies has developed three distinct forms: (*a*) The investment by companies in general of their reserved profits; (*b*) the investment by companies (the so-called investment banks or trusts) whose sole or main object is investment; (*c*) the investment by holding companies in the shares of subsidiaries.

With regard to (*a*), attention has been drawn to the extent to which industrial companies during the depression have found their trade losses counterbalanced by profits in the shape of income from investments. The reserve fund has become an instrument for making past profits earn future profits. Speaking of Insurance Companies' profits in 1925 *The Economist* noted that "in these days the profit from interest is most substantial, a good deal larger than it was before the war." This statement is fully borne out by an analysis of the income of 21 insurance companies in 1924, showing that the return from investments amounted to 46·5%, net trading profits to 53·5% of a total income of over £12,000,000.

With regard to (*b*), the growing importance of the rôle played by the investment company in the modern joint stock system has been often emphasised. The primary function of this type of company is to act as an expert investment agency which brings the private and especially the small investor into touch with joint stock enterprise in all parts of the world. Sir George Paish has estimated that in 1913 British foreign investments had reached a total of £3,800,000,000 of which £750,000,000 were in the United States of America. The main vehicle of this huge capital export has been the investment company. To its pre-War activity must be attributed in large measure the services which "dollar securities" rendered to the British Govt. during the War.

The Holding Company.—With regard to (*c*), one must note that in this case investment is a mere device for securing an amalgamation or consolidation of interests between separate undertakings. The typical holding company is a public company which derives its profit, if any, from having a controlling interest in a number of subsidiary private companies, carrying on allied trades or different branches of the same industry. One of the great advantages of this arrangement (from the point of view of the directors of the parent company) is that the combine can conduct its affairs in complete secrecy. The private companies do not (as the law does not compel them to) publish balance sheets; the balance sheet of the holding company merely shows the income which it has derived (in the course of a year) from its investments in subsidiaries. Thus nothing is revealed as to the amount of profit (or loss) made by any of the subsidiaries. The convenience of this was well described by Mr. D'Arcy Cooper, Chairman of Lever Bros., Ltd. (a large, if not the largest holding Company with some 200 subsidiaries) when he said in evidence before the Greene Committee (Minutes of Evidence, 3751):—

> If you are asked to publish details of these private companies the result will be that you will get tremendous competition in regard to the particular articles on which you are making good profits.

It is clear that the holding company is a product of the modern trust movement in industry and trade (*see* TRUSTS); it may in fact be described as the principal vehicle in which the British trust movement travels.

Company Law Reform Proposals.—It was not to be expected that the popularity of private companies and the advent (through inter-investment) of co-operation or combination among companies would not bring in their train a good deal of dissatisfaction with the existing state of the law in regard to companies. Early in 1925 a departmental committee under the chairmanship of Mr. W. Greene, K.C., was appointed by the Board of Trade "to consider and report what amendments are desirable in the Companies Acts 1908–1917." Some of the proposals made before the Committee favoured a greater degree of freedom in the conduct of companies' affairs than is at present possible under the Acts, and others a tightening-up of the law so as to diminish the opportunities for deceit or fraud in the promotion and direction of companies. In the first category are to be placed such proposals as the following: the right to issue shares at a discount (*e.g.*, one pound shares fully paid at a discount of ten shillings); the right to issue shares of no par value (*i.e.*, new shares to be sold for what they will fetch in the market at the time of issue); the right to issue redeemable shares or stock (*see* below under statutory companies); greater latitude in regard to "objects." In the second category are to be reckoned proposals: to abolish or restrict the power of companies to give a floating charge on their present and future assets; to compel private companies to file balance sheets; to increase the responsibility of directors (the vexed question of directors' liability was brought to the fore in connection with the notorious "Bevan case" in 1922); to give reality to the "minimum subscription" clause (*see* 6.798); to compel issuing houses when offering new shares of a company to the investing public to give the same full and complete information as the law would require the company to give if it were offering these shares to the public direct.

The Greene Committee in its *Report* (1926, Cmd. 2657) favoured a proposal made by the Federation of British Industries to allow companies to issue redeemable preference shares, though they were not in favour of allowing a redemption out of profits to have the effect of a reduction of capital without the consent of the court. With regard to the issue of shares at a discount and the issue of shares of no par value, the committee were in favour of conceding, under restrictions, the former privilege, but not the latter.

On the whole, apart from these innovations, the tenor of the report is conservative and cautious. The private company's privilege of financial secrecy is not assailed; the commercial convenience of the holding company type of organisation is accepted without criticism; complaints of the prejudice created by the floating-charge type of debenture have failed to move the committee in favour of any drastic change. On the other hand, the committee's proposals in regard to the marketing of the shares of public companies, both new and old, are designed to ensure full disclosure (or the means of obtaining full disclosure) of a company's prior history and prospects (sections 38–41 and 92–93). The shareholder is to be further protected by disallowing the insertion in Articles of clauses enabling either directors or auditors to contract out of the general law for negligence or breach of duty (sections 46, 47 and 73), and by prohibiting the directors of public companies from proceeding to allotment unless and until a certain minimum amount of capital (set forth in the prospectus as necessary for certain specified purposes) has been raised.

The firm hold which the company has taken on the business world, has given rise in recent years to a good deal of critical speculation. Dr. Rathenau in Germany and Prof. T. N. Carver in America, have seen in the modern company a departure from the naked individualism of the 19th century and a promise—a kind of instalment in advance—of socialisation. Others, such as Lord Haldane and Lord Milner, have taken a more sober view of its social value. Criticism has concentrated mainly on the position of shareholders vis-à-vis their companies. The shareholder has been compared (by Veblen) to an "Old Man of the Sea" who sits tight, secure in the knowledge that through his shares he retains (for an unlimited period) along with his co-shareholders a right to or equitable lien over the whole of the future net profits earned by his companies.

Statutory Companies

By far the most important event in connection with the incorporation of companies by special Act has been the Railways Act of 1921 (*see* Great Britain: Communications). In 1920 the Public Utility Companies (Capital Issues) Act was passed which authorised the Board of Trade to consent to the variation of the provisions regulating the raising of capital by gas, water, water power, electricity and tramway undertakings. Such companies were to be allowed (inter alia) to issue stock at a discount and to issue redeemable preference stock in lieu either of ordinary stock already authorised or of irredeemable preference stock. The Act was to expire (but so as not to affect the validity of anything done in pursuance of it) on May 20 1925. The second provision was clearly intended to enable public utility companies to effect a conversion of preference stock on favourable terms when money rates were lower by redeeming or retiring preference stock entitled to a high rate of return at the time of issue. It thus belongs (together with those older expedients,—the auction clause and the sliding scale of prices and dividend) to a type of provision which the legislature has seen fit to introduce into the constitution of particular companies in order to ensure, for the benefit of consumers, that the companies in question shall not pay an excessive price for their capital.

II. THE UNITED STATES AND FRANCE

An important legal change that affects the legal powers of corporations has been the permission given to issue stock of no par value. The first legislation authorising this change was adopted by New York State in 1912. Subsequent alterations have made it possible for any New York corporation (other than a financial one) to issue no par stock of any class, save that in the case of public service corporations the permission of the appropriate Commission must be sought. Since 1912 34 States had (up to May 1924) passed legislation either on the model of the New York law or of that of the State of Delaware. Unlike New York Delaware goes so far as to permit a corporation to be formed without any stated capital whatever.

The policy behind the Act of 1912 has been described as recognising

> "That shares in a corporation represent only aliquot interests in its capital whatever that may be and that their nominal or par value is no indication of the actual capital of the corporation." (V. Morawetz.)

The supporters of no par value stock claim that (1) it compels investors before applying for stock to rely upon the real value of a Corporation's assets instead of on an illusory nominal value attributed to the stock; (2) it prevents Corporations from issuing stock at a discount (when the market price of the same class of stock is below par) and so "watering" the capital. On the other hand the practice has excited unfavourable criticism in some quarters. Thus the eminent American jurist, Mr. W. W. Cook, has pronounced against it in the following terms:—

> These no par value statutes are destroying the respectability of the corporate form of organisation. The abolition of real capital stock and the freedom as to dividends on no par value stock render it the ready instrument of concealment and fraud.—(*Principles of Corporation Law*, 1925).

It seems probable that whether wise or the reverse, the introduction of no par value stock has been brought about by the issue of shares or stock at a discount,—a practice which, though hitherto denied to British registered companies, has been allowed to American corporations.

Valuable comparative statistics illustrating the steady growth of joint stock enterprise in the United States were furnished by the Census Department after the last Census. The returns showed that in 1909 25·9% of total establishments were owned by corporations, 21·7% by partnerships (including co-operative undertakings) and 52·4% by individuals; in 1919 the percentages were 31·55, 20·85 and 47·6 respectively. In 1909 of the total value of American products, corporations contributed 79%, partnerships, etc., 11·1% and individuals 9·9%; in 1919 the percent-

ages were 87·7, 6·6 and 5·7 respectively. In 1909 of all wage earners in the U.S.A. corporations employed 75·6%, partnerships, etc., 12·2 and individuals 12·2; in 1919 the percentages were 86·6, 6·6 and 6·8 respectively.

As regards the distribution of corporate ownership Mr. H. T. Warshaw in an article under that title (*Quarterly Journal of Economics* for Nov. 1924) has conjectured that while the total capital stock of all corporations had risen from 64 billion dollars in 1910 to nearly 71½ billion dollars in 1923, the number of stockholders had increased from about 7,400,000 in 1910 to about 14,400,000 in 1923. This calculation was based partly on (*a*) an analysis of income tax returns between 1916 and 1922, partly on (*b*) figures showing the growth in the number of separate stockholdings relatively to the growth in the capital stock of all corporations. The first analysis showed that in 1916 large payers of income tax (on incomes of over $20,000) received 79·3% of all the dividends paid which figured in the returns, but in 1921 only 46·8%, while the share taken by incomes of $1,000 to $5,000 rose from 9·5% in 1917 to 22·7% in 1921. The second analysis showed that the average size of stockholding had declined from $8,630 in 1910 to $4,970 in 1923. Although, as already noted above, the second analysis does not by itself afford conclusive evidence of a more widespread distribution of capital, the first analysis, confirmed as it is by evidence from other quarters, certainly suggests that the working class in America is becoming more and more also an investing class.

That the War has been largely responsible for this change in distribution is the conclusion arrived at by the National Bureau of Economic Research which reported that "the net effect of our participation in the War was to diminish somewhat (at least temporarily) the inequality in the distribution of American incomes. The top 5% took a share declining from 33% in 1913–6 to 25% in 1918–9."

France.—A recent important innovation in French company law has been made by the Act of March 7 1925 which has enabled "sociétés à responsibilité limiteé" to be established. This "private company law" contrasts with the British Act of 1907 in imposing conditions of a restrictive kind. Thus under the French Act:—(*a*) shares must be fully paid before the company can be incorporated; (*b*) if there are more than 20 members a supervision committee of three members must be set up which is held liable for the non-fulfilment of duties to the company and to third parties, and (*c*) $\frac{1}{20}$ at least of the yearly profits must be put to reserve until the reserve so created is equal to at least $\frac{1}{10}$ of the company's capital.

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COMPAYRE, JULES GABRIEL (1843–1913), French educationalist (*see* 6.809), died March 23 1913.

CONDOURIOTES, PAUL (1855–), Greek admiral and statesman, was born April 14 (new style) 1855 in the island of Hydra. He adopted a naval career and served in the Greco-Turkish War of 1897. He commanded the fleet in the Balkan War of 1912–3, and twice defeated the Turkish Navy in the Dardanelles. In the Zaïmes and Skouloudes Cabinets of 1915 he was Minister of Marine, but followed M. Veniselos to Salonika in 1916 and formed with him and Gen. Danglès the Provisional Govt., opposed to that of King Constantine. After the King's first deposition in 1917, he again became Minister of Marine in the third Veniselos Cabinet, resigning in 1919, when Parliament bestowed on him the title of "admiral" for life. In 1920, on the death of King Alexander he was for a short time regent. Soon after the defeat of M. Veniselos he resigned and went abroad, but returned, and on Dec. 20 1923, the day after George II. left Greece, was again appointed regent. On March 25 1924 the National Assembly, after deposing the dynasty, confirmed his mandate until after the plebiscite of April 13, and his title was then changed to that of president of the republic.

CONDUCTION, ELECTRIC (*see* 6.855).—The principal advances since 1910 have resulted from attaining unprecedentedly low temperatures, high pressures and large single crystals.

I. CONDUCTION IN SOLIDS

Supraconductivity.—Five metals are known to experience sudden well-nigh total disappearance of resistance at characteristic temperatures T_0 superior to the lowest (1·5° K) yet attained; viz., indium ($T_0 = 3{\cdot}41°$ K), tin (3·78°), mercury (4·19°), thallium (2·3°), lead (7·2°); also a tin amalgam (4·29°). In the supraconductive state existing below T_0 the resistivity is less, probably much less, than 10^{-9} as great as at 273° K. Currents in supraconductive lead rings started by a transient E.M.F. (caused by annulling a magnetic flux originally linked through the rings) were observed to remain constant to within $\frac{1}{20000}$ part of an hour (this being deduced from constancy of their electrodynamic interaction). Magnetic field pervading the conductor displaces T_0 downward, tension (on tin) shifts it upward. Hall-effect vanishes with resistance, but thermal conductivity, elasticity, specific heat and (for lead) crystal lattice change little.

Effects of Pressure, Tension, Melting.—Resistance decreases steadily with increasing pressure over the range 0–12000 kg/cm² for 38 out of 44 metals (including a few metalloids) tested; increases steadily for 5 (Li, Ca, Sr, Sb, Bi) and passes through a minimum for one (Cs). The largest alterations from the values at zero pressure are 97% increase (P), 72% increase (K), 82% decrease (Sr); most changes are much smaller. Tension usually increases resistance (to current-flow along the direction of stress), but there are at least three exceptions, two of which (Bi, Sr) are likewise exceptions to the usual rule for sign of the pressure-effect, while one (Ni) is not. At melting the conductivity always changes in the same sense as the density. Ohm's law ceases to be valid when the current-density in gold or silver surpasses 10^6 amp./cm².

Single crystals (except cubic ones) show dependence of resistance upon orientation of current-flow; the characteristic values of resistance are that for currents along the axis of 3-, 4- or 6-fold symmetry, and that for currents in the basal plane. Often, but not always, currents flowing perpendicularly to the planes of easiest cleavage or slip encounter the greatest resistance. The variation of resistance with direction may be in a proportion as great as 9:4. The pressure-coefficient of resistance varies relatively more than the resistance itself, and an instance is known (Sb under certain conditions) in which increase of pressure increases the resistance to currents in some directions and decreases it for those in others. Cubic crystals are isotropic in conducting electricity; their conductivity is stated for very pure Cu to exceed that of a polycrystalline mass, while for very pure W there is reported to be no difference.

There is no adequate theory of metallic conduction; the data acquired since 1910 merely augment the evidence that the so-called "classical" theory (of free electrons moving like atoms of a gas in thermal equilibrium in the interspaces between the metal atoms) is untenable. The rule that conductivity increases with pressure shows that if an analogous theory should be devised the electrons must be supposed to move within the atoms instead of the interspaces; but the exceptions to this and other rules show that no simple theory can suffice universally. Supraconductivity shows that the straight, free paths postulated in the classical theory cannot exist, for they would be 1,000 times as long as the longest straight line that can be drawn in a coiled supraconductive wire. As there is no supraconductivity for heat, thermal and electrical conduction cannot be as intimately linked as was formerly believed.

Photoconductivity.—The extra current-flow occurring when certain non-metallic solids are illuminated while exposed to electric field appears to be unusually simple in certain cases of single homogeneous crystals of substances which are good insulators in the dark and have high refractive indices (diamond, ZnS, HgS). If the light-intensity and the field are kept below certain limits, the primary effect of the light apparently consists in loosening electrons initially fixed in the lattice, one electron per absorbed quantum. These electrons flow towards the anode, leaving the interior of the crystal positively charged; a compensating process (apparently a creeping of electrons inward from the cathode side) eventually sets in, or may be hastened by infra-red light. Similar effects occur in crystals of NaCl in which free sodium has been isolated by X-ray irradiation, and in phosphorescent solids, the excitation of phosphorescence evidently beginning with such detachment of electrons.

For the conduction of electricity through gases, the reader should consult the Article by Sir J. J. Thomson on GASES, ELECTRICAL PROPERTIES OF. (K. K. D.)

II. CONDUCTION IN LIQUIDS

The experiments of Faraday, Kohlrausch and Hittorf demonstrated that the conductivity imparted to a badly conducting liquid such as water by the addition of a salt was due to the movement of the charged ions of the salt under the influence of the applied electromotive force. According to the older views a salt such as sodium chloride on solution in water underwent partial ionisation which would be expressed in the form of the equation

$$NaCl \rightleftarrows Na + Cl'$$

The fact that solutions of salt in different media exhibited different conductivities brought into prominence the effect of the solvent which might be interpreted as affecting the equilibrium of the ions and molecules—

$$NaCl + H_2O \rightleftarrows Na(H_2O)_y + Cl'(H_2O)_z$$

The conducting particles are accordingly not simple ions but ions with a solvate atmosphere around them. From an analysis of the heats of ionisation and solution of salts in water Born has compiled the following table for heats of hydration of individual gas ions.

Ion	Heat evolution in Calories per gr. ion	Ion	Heat evolution in Calories per gr. ion
H.	262,000	Cs.	74,000
Li.	110,000	Cl′	77,000
Na	103,000	Br′	68,000
K.	82,000	I′	57,000

The thermal effects are large, indicating a marked affinity of ions for water. Since the conductivity of a solution is dependent on both the mobility and number of such solvated ions, many investigations have been made to determine these values for solutions of different concentrations. The direct determination of ionic velocities under the influence of definite potential gradients or ionic mobilities has been made by Lodge, Whetham and Steele, and values have been calculated from transport ratios by Kohlrausch and Hittorf; that for the hydrogen ion in water is ·003139 cm. per sec. under a potential gradient of one volt per cm. at 18° Centigrade. The evaluation of the number of such ions in a solution presents greater difficulties. If it be assumed that the ionic mobilities are independent of the concentration of the ions, then the molecular conductivity should be a true measure of the number of free ions in a solution of definite concentration. Experimental determinations indicate that the number of free ions computed from conductivity data is always less than the total salt present, a fact in accordance with our preconceived opinions in respect to a mass law equilibrium between hydrated salt and ions.

If one gram molecule of a binary salt be dissolved in V litres of water and a fraction α be imagined as dissociated into ions, we obtain for the conditions of equilibrium between hydrated salt and ions $K=\frac{\alpha^2}{(1-\alpha)V}$ where K is the equilibrium constant, independent of the actual concentrations employed. Further, the fraction of free ions which alone contributes to the conductivity can be determined from a comparison of the conductivities at various dilutions. At two dilutions we obtain the expression $\frac{\lambda_1}{\lambda_2}=\frac{\alpha_1}{\alpha_2}$ where λ_1, λ_2 are the conductivities and α_1, α_2 the respective ionic concentrations, each divided by the concentrations at which the determinations are made.

This method of determining the number of ions in a solution yields a satisfactory constant for the mass equilibrium expression noted above in the case of weak electrolytes. In the following table are given the experimental data of Kendall for the case of acetic acid dissolved in water.

V	λ	$\alpha\times100$	$\frac{\alpha^2}{(1-\alpha)V}=10^6K$
13·57	6·086	1·570	18·45
54·28	12·090	3·118	18·49
217·10	23·810	6·141	18·51
434·20	33·220	8·568	18·49
868·40	46·130	11·900	18·50
1,737·00	63·600	16·410	18·54
3,474·00	86·710	32·360	18·55
6,948·00	116·800	30·130	18·70
∞	387·700	..	..

The accuracy of this dilution law has been confirmed for many hundreds of weak acids, bases and salts. For strong electrolytes on the other hand, that is, for electrolytes in which the conductivity data would lead us to suppose that practically all the hydrated salt was present in the solution in the form of the solvated ions—the values of K determined in this way are by no means constant, as is in evidence from the data of Kohlrausch and Maltby for aqueous potassium chloride at 18° Centigrade.

V	λ	$\alpha\times100$	$\frac{\alpha^2}{(1-\alpha)V}=10^3K$
1	98·27	75·65	2,350·0
2	102·41	78·83	1,434·0
5	107·96	83·10	815·4
10	112·03	86·24	540·5
20	115·75	89·10	364·2
50	119·96	92·34	222·1
100	122·43	94·24	154·2
1,000	127·34	98·02	48·5
10,000	129·07	99·36	15·4

It is claimed, however, that even strong electrolytes appear to obey the mass law at sufficiently great dilutions; the disturbing factor thus appears to be the concentration of free ions in the solution. If this view be admitted it immediately raises the question whether the premises on which these calculations of the ionic concentrations are made may be considered as correct. It was assumed firstly that the mobility of the solvated ion was always constant irrespective of the concentration; and secondly that all free ions of the same species possessed identical mobilities in solution. By the method of ionic migration developed by Hittorf, it is possible to examine the ratio of the mobilities of the cation and anion $\frac{u}{v}$. If the mobilities of each ion remain constant over a range of dilution, or if their mobilities change equally with the variation in concentration, this ratio will remain unchanged. It is found that the relative mobilities of ions do in fact change with the concentration, as is indicated by the following data for the transport number NK of the silver ion in silver nitrate solution and the mobilities of the sodium and chlorine ions in sodium chloride at 18° Centigrade.

$AgNO_3$		NaCl		
V	NK	Molarity	uNa 10^6cm/sec	vCl′ 10^6cm/sec
0·42	0·532	0	450	690
1·00	0·500	0·0001	448	681
2·00	0·483	0·0010	440	670
4·00	0·473	0·0100	415	644
40·00	0·475	0·1000	360	592
..	..	1·0000	278	487
..	..	5·0000	153	285

This change in relative ionic mobilities with the concentration is indicative of marked changes in the ionic mobility of each ion. Again, it is clear from a consideration of the mode of passage of an ion through a solution containing other ions that the "mobility" is

no more than the average rate of progress in a linear direction by an ion which is being continuously deflected from its path by repulsion or attraction by neighbouring ions. These considerations have led to two diverse methods of attempting to explain the alteration in conductance with dilution of solutions of strong electrolytes. Nernst and Jahn assume that the law of mass action is fundamentally correct, but that the active masses or effective concentrations of the molecules and ions present are affected by two factors, the degree of hydration and the electrostriction exerted by the dissociated molecules. Others, especially Bjerrum, Milner, Debye and Hückel, reject the concept of a mass law equilibrium between molecules, in which a kation and anion are held close together possessing no power of relative movement, and ions which are all equally free in the sense that they can move independently of one another, *i.e.*, that all ions of one species possess identical mobilities. They assume that the interionic electrical attraction obeys the usual inverse square of the distance law, and that the mobility of any one particular ion will thus naturally depend upon the total concentration of ions present and their distances from the ion under consideration. A sharp distinction between the terms "bound into molecules" and "freely movable as ions" is therefore lost.

We have noted that the heats of hydration of the ions are relatively great, and the view that each ion is hydrated, is supported by the parallelism which is found to hold between the temperature coefficients of conductance and viscosity. Attempts have been made in various ways to determine the number of molecules of water bound by each ion. These methods include determination of the transport ratios of the ions in the presence of a non-electrolyte; from these values relative ionic hydrations may be evaluated.

The development of these ideas, especially by Debye and Hückel, has shown that the observed alteration in the conductivity of a salt such as potassium chloride with increasing concentration, can be calculated with reasonable accuracy over a relatively wide range of dilute solutions, but for strong solutions the agreement between theoretical and experimental values is by no means good. It appears probable that a second factor in addition to the interionic attraction or electrostriction, viz., the hydration of the ions and its variation, has to be considered.

Varying results are obtained with minor modifications of method; thus we find values of ionic hydration ratios of $a' : k$ varying from 2·8 : 1 to 7·5 : 1. A second method involves the determination of some property which is taken as proportional to the "free" water in a solution. These include solubility determinations both of solids, liquids and of gases in salt solutions and the effect of neutral salts on catalytic activity. Von Hevesy assumes that gaseous ions on solution in water will acquire a constant potential of 70 millivolts. Since the potential of an ion is expressed by the relationship $V=\frac{\epsilon}{Kr}$ monovalent ions will acquire a radius on immersion in water of dielectric constant 81 a value of $2{\cdot}8\times10^{-8}$ centimetres. Thus small ions will acquire a large water envelope; very large ions, on the other hand, may possibly coalesce together to form an ionic micelle. This view may be criticised in that the small hydrogen ion with a large water envelope moves with great velocity, and the potential of 70 millivolts assumed to be acquired by the ion is a value obtained by considering the rates of electric endosmose and cataphoresis in colloid particles. It has been shown, however, that the mobility of colloid particles is not affected so much by their charge, but rather by the magnitude of the electrokinetic potential, which represents but a fraction of the total potential difference between the two phases and is in no way related to it. Since water molecules are essentially small dipoles, orientation around a charged ion is to be anticipated, and since the molecule of water is somewhat elongated the effect of orientation in close packing (as opposed to the more open packing obtaining in ice) will be to effect a decrease in volume. In aqueous solutions the contraction amounts to 10–12 cc. per equivalent of univalent electrolyte ionised.

Conductance in Non-Aqueous Solutions

Fused metallic alloys are good conductors. Whilst in solid metals the conduction of current takes place by the movement of electrons in a space lattice through the space lattice of the metal, this method of conduction does not appear to be the only method for fused metals, especially for liquid mercury amalgams. In sodium amalgams Lewis noted the transport of alkali metal from cathode to anode. In fused salts of the heteropolar type the conductivity is high and Faraday's laws are obeyed. In these cases the undissociated solvent such as water is absent, and calculations on the degree of dissociation as determined from conductivity data must be misleading, the alteration in conductivity being attributable to alteration in electrostriction and the formation of complex ions.

Increasing attention has been paid to the determination of the conductivity of salts dissolved in non-aqueous media. The close parallelism between the magnitude of the conductivities of a salt solution in various solvents and the dielectric constant of the medium was noted by Sir J. J. Thomson and Nernst. Walden has suggested that the relationship between the apparent dissociation as measured by conductivity methods and the dielectric constant may be expressed in the form $R=(1-\alpha)K\sqrt[3]{V}$ where R is a universal constant and K the dielectric capacity of the medium. This apparent alteration in the degree of dissociation may, however, be ascribed to the alteration in the electrostriction, for the force between two charged ions varies inversely as the dielectric capacity of the medium. Walden's rule, however, cannot be considered as anything more than a qualitative expression indicating a close relationship between K and α. Part of the discrepancies between the experimental data of Walden and others with the simple theoretical expression may be ascribed to lack of precise information on the values for the dielectric constant. Not only does the dielectric constant of a medium change with the frequency of the field which is employed to measure this property, but it is also affected by application of strong fields. Again, evidence is accumulating that the dielectric constant for material in thin films is different from that in bulk; thus water K = 81 at 18°C. appears to possess a value of K = ca 6 in very thin films. In solutions of electrolytes it is clear that all these factors have to be taken into consideration. It is thus not surprising that the mass law expression which is found to hold for weak electrolytes in aqueous solutions but not for strong electrolytes likewise fails for electrolytes in non-aqueous solvents, as can be exemplified by the following data of Cohen for solutions of potassium acetate in alcohol.

V	λ	K
11·4	8·28	·242
113·0	17·18	·055
1,120·0	27·00	·014
3,520·0	29·20	·006

In dilute solutions where ionic migration can proceed without serious disturbance due to the effect of electrostriction the mobilities of the ions in various solvents will be determined to a great extent by the characteristics of the medium. Thus we find that the ratios of the limiting conductivities of many salts in water and ethyl alcohol are identical with the ratios of the diffusion coefficients, as is noticed in the following data—

Salt	KI	CH_3COOK	LiCl
$\frac{\lambda H_2O}{\lambda C_2H_5OH}$	0·37	0·33	0·33
$\frac{DH_2O}{DC_2H_5OH}$	0·33	0·32	0·33

The conductivity of a weak electrolyte may in fact be greater in a medium of low dielectric constant than in a solvent of greater ionising powers owing to the increase in ionic mobility. If the mobility were governed entirely by the mechanical resistance suffered by a solvated ion moving through a homogeneous fluid of uniform viscosity, it might be anticipated that Stokes' law would be applicable from which ionic radii might be calculated. The investigations of Cunningham and Millikan, however, have indicated that Stokes' law breaks down for small particles. In spite of this failure a general relationship of the type

$$\lambda \propto \frac{1}{\eta}$$

where λ is the conductivity at great dilution and η the viscosity of the medium is found to obtain. In the following table are given a few of Walden's data for potassium iodide dissolved in various solvents at 25° Centigrade.

Solvent	η	λ	$\eta\lambda$
Water	0·00891	151·30	1·350
Glycol	0·16800	8·00	1·320
Glycerine	6·33000	0·35	2·220
Formamide	0·03230	26·30	0·849
Formic acid	0·01620	65·00	1·050
Hydrazine	0·00914	118·00	1·100
Ethylene cyanide	0·02490	35·50	0·800

Two interesting examples of conductance in non-aqueous solvents may be mentioned. Fused lithium hydride is found to be an electrolytic conductor in that the products of decomposition appear at the electrodes. It is found that the alkali metal appears at the cathode, the hydrogen at the anode; we must consequently assume that dissociation is effected to yield a hydrogen anion:—

$$Li\,H \rightleftarrows Li^+ + H'$$

Again, the solutions of the alkali metals and alkaline earth metals in liquid ammonia were found by Kraus to yield good conducting blue coloured liquids. According to this investigator, two definite stages in dissociation can be determined; firstly, the dissociation of the small quantity of sodamide present in a sodium solution, viz.,

$$Na\,NH_2 \rightleftarrows Na^+ + NH'_2$$

and secondly, the dissociation of the metallic sodium to yield a sodium ion and an electron.

$$NaxNH_3 \rightleftarrows Na'yNH_3 + ezNH_3$$

The ionic mobility of the amminated electron is 19·890, or some seven times greater than that of the sodium ion in the same solution.

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CONDUIT: *see* AQUEDUCTS.

CONFUCIANISM (*see* 6.907).—Confucianism is a general term embracing the teachings of the Chinese classics upon cosmology, the social order, government, morals and religion. While Confucius has been associated with the system, he is not the founder of it, but is the transmitter of the teachings of antiquity and the editor of some of the classics. Mencius (372–289 B.C.) interpreted the work of Confucius. Confucianism was formulated in the Han dynasty (206 B.C.–221 A.D.). Beginning with the first century of our era the system came into contact with Buddhism and underwent certain changes which were interpreted by Chu Hsi (1130–1200) and by Wang Yang Ming (1472–1528). Though the government of the Manchu dynasty (1644–1912) made Chu Hsi's commentaries the standard, the scholars attempted to restore the primitive teaching of Confucius and the ancients. In this they were hindered by the impact of the West upon Chinese culture.

Cosmology.—In cosmology Confucianism starts out with the Tao, the world ground, an impersonal cosmic energy and principle which produced the *yin* and the *yang*, the negative and the positive principles. These by their interaction produced Heaven and Earth and all beings. The social order evolved from the universal order or the Tao. The models of government, social life and morals existed in the universal order as ideas or images. These were transmitted as symbols to the saints and the sages and interpreted and adapted by them to the needs of the people.

Government.—The government was modelled upon that of the patriarchal family, the country being regarded as a large family. The emperor was considered as appointed by Heaven to be the father and the mother of the people and ruled as a benevolent patriarch. The conception of the state as an abstract entity was never developed. The emperor was assisted by the officials recruited from the people on the basis of a civil examination in the classics. They were arranged in ranks, each possessing certain rights and duties and were bound together and to the emperor by a rigid ceremonial. The emperor and officials united all the functions of government, being the priests, executives, the law-makers and the judges. The government was one of men rather than of laws.

Moral System.—The moral system started with the axiom that all men were by nature good, formulated by Mencius. A corollary to this was the dogma that goodness is developed by the study of the classics. Society was divided into five relations: ruler—subject, father—son, husband—wife, older brother—younger brother, friend—friend. The fundamental theory underlying these relations was that of reciprocity expressed by the words "What you do not wish done to yourself do not do to the other man."

The virtues were finally grouped under five: love, the root of all the others, corresponding to our word humanity in its old meaning; justice, which assigns to each one his place and his duties and rights in that status; reverence, through which the rights are acknowledged and the duties performed; wisdom, which discriminates between good and evil; sincerity, which imparts reality to all. The outstanding virtue was filial piety, which also includes loyalty and is the outgrowth of reverence.

As Religion.—Confucianism as religion was a mixture of nature worship and ancestor worship. There were three classes of sacrifices under the last dynasty; the great sacrifices, namely, Heaven, Earth, the imperial ancestors and the gods of the grain and the ground; the middle sacrifices, the sun, moon, certain cultural heroes including Confucius and nature gods; the general sacrifices, performed entirely by the officials, including cultural heroes, nature gods and departmental deities. To the people were left their ancestors and gods approved by the state. The emperor as the high priest of the nation worshipped Heaven at the winter solstice and Earth at the summer solstice. The purpose of the worship was the conservation and the perpetuation of this system.

In China the establishment of the republic in 1912 brought with it far-reaching changes. The relation between Heaven and the emperor upon which the government was based was abandoned and the new idea that the people are the real rulers of China is being inculcated. Confucianism ceased to be a state system, though certain practices have survived. It has become a church and is slowly trying to collect and organise its heritage. The new cult is being organised about Confucius. Religious toleration, however, is granted by the constitution and Confucianism after over 2,000 years as the dominant state system is taking its place as one of the cults of China.

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CONGO FREE STATE: *see* BELGIAN CONGO.

CONGREGATIONALISM.—The outstanding features in the development of Congregationalism during the first quarter of the 20th century have been an intensifying of the denominational consciousness and a strengthening of the tendency towards Connectionalism.

I. IN THE BRITISH DOMINIONS

England and Wales.—On its practical side this forward movement took the form of collecting £500,000 in order to establish the various organisations of Congregationalism on a sounder financial basis, and to supply more adequate retiring pensions for aged ministers. The latter object was the main element in the scheme, proving conclusively that the Congregational Union is now more prepared than it was to recognise some corporate responsibility for its ministers. This point was further emphasised by certain new and more stringent regulations for the admission and recognition of ministers. The normal entry to the ministry is through a recognised college. Failing this, exceptional cases may be provided for by a three years' probation and periodic examinations under the supervision of a county union. Nothing here interferes with the autonomy of the individual church. Churches are still at liberty to call whom they will to minister to them. But recognition by the union and a share in the union grants and superannuation funds is only available for those who submit to the conditions which the union imposes. The churches generally have accepted these conditions which safeguard their interests as well as those of the ministers and establish the status of the ministry on a much more satisfactory footing.

Organisation.—In 1919 the country was divided into nine administrative areas called provinces and a moderator appointed over each area to act as adviser and "Father in God" to the churches within it. The tentative scheme then adopted was after a few years' trial amended in 1924. It was provided that the provinces should be formed by the grouping of county unions, and that a moderator, who might be either a minister or a layman, should be appointed for each such group. The duties of the moderators were defined in the following terms:—

The general duties of the moderators shall be:
(*a*) To stimulate and encourage the work of the denomination within their own provinces, and to act as the friends and counsellors of ministers and churches.
(*b*) To act as advisers with regard to all financial assistance from denominational funds.
(*c*) To assist churches and ministers in all matters connected with ministerial settlements and removals by personal action and by constant and regular conference with one another. This is not to be understood as excluding other means of effecting changes of pastorates, but it is desirable that the moderators should be kept informed of any introductions effected so as to avoid overlapping.

N.B. Whereas it may be considered fitting that the moderator attend the ordination, induction or recognition services in his province, his presence shall not be deemed essential, nor shall he preside *ex officio*, but only when invited to do so.

It was further provided that moderators shall act in concert with the county union executives and with special provincial committees elected *ad hoc*. Moderators are to be appointed for periods of five years, and the following rules were laid down for their election:—

The appointment of moderators shall rest with the Assembly of the Congregational Union of England and Wales, acting for the purposes of nomination through a joint committee consisting of (*a*) Representatives of the province, not exceeding 14 in number, appointed by the provincial committee, each county union having at least one representative and (*b*) Representatives of the Congregational Union of England and Wales, not exceeding 9 in number, to be appointed annually by the council, on the nomination of the general purposes committee.

Before being submitted to the assembly of the Congregational Union of England and Wales the nomination made by the joint committee with regard to a particular province shall be confirmed by a joint meeting of the assemblies or by a joint meeting of the executives of the county unions concerned (as may be determined by the provincial committee), or where so desired by the provincial committee acting in their name. The general purposes committee shall have the general administration of the scheme and shall report annually to the council.

It is perhaps too soon as yet to form any definite estimate of the result of these constitutional changes, but the fear that these would interfere unduly with the autonomy of the churches has not yet been realised. The system of moderators seems to be making for efficiency and closer co-operation.

Statistics.—So far as numbers are concerned the Congregational churches have no great increase to report. There is a decline in the number of Sunday-school scholars, and a distinct shortage of candidates for the ministry, while new chapels are not being built in sufficient numbers to meet the normal increase in population. At the same time there is a more hopeful spirit abroad. The Forward Movement has entered on a new phase. On the material and mechanical side it has been thoroughly successful. What is needed now is that this should be followed by a revival of faith, hope and self-sacrifice. Conscious of this the churches are everywhere girding themselves for a new missionary campaign both at home and abroad. There has been a marked increase in denominational loyalty, and the churches are conscious of their unity and corporate responsibility as they have never been before. The two new publications, *The Congregational Quarterly* and *The Congregational Church Monthly*, reached a paying circulation in a very short time and have contributed very materially to the maintenance and strengthening of the new denominational spirit. As to Congregationalism overseas, numerically little or no progress has been made. The churches in some cases have a struggle to hold their own. Movement is rather in the direction of consolidation than of expansion. This has made for an increased efficiency and for a strengthening of the denominational consciousness.

Canada.—In Canada the Congregational churches, with a few negligible exceptions, are now merged along with the Methodists and Presbyterians in the United Church of Canada. This reunion is the culmination of negotiations and discussions which have been going on for some years. Congregationalists have taken a leading part in the reunion movement. They have shown themselves willing to accept a central organisation and a closely-knit church fellowship, while safeguarding spiritual liberties. In the doctrinal basis of the United Church they helped to secure that the declaration of faith accepted by the partners to the union should be purely declaratory and should not be made "an imposition upon any." To them the union will bring a great accession of strength in social, evangelistic and educational work. Though their identity will be sunk in the United Church the Congregational churches of Canada will continue to give their distinctive contribution to the religious life of the Dominion all the more effectively through the union. Their college at Montreal, affiliated with others in the theological faculty of McGill University, is doing fine work in training men for the very varied types of ministry which the country requires.

Australia.—Congregationalism in Australia has not kept pace with the growth of population. In spite of its freedom and adaptability it has made less progress than the more closely organised churches. It maintained too long an individualist type of independency and rather lived on the reputation of certain large and prosperous churches led by men of outstanding ability. But the general level of the ministry is higher than it ever was, and with three colleges in Sydney, Adelaide and Victoria it should not be difficult to maintain it. The Congregational Unions foster a sense of corporate responsibility among all the churches. The down-town and country churches now feel themselves part of a living organism and they and their stronger brethren stand or fall together. The establishment of provident, sustentation and building funds has done much to increase the denominational consciousness and makes for efficiency and home missionary enterprise. The failure of the recent negotiations for reunion among the Australian churches may prove a blessing in disguise. It is said that Congregationalism now breathes more freely and is preparing to give itself more heartily to its distinctive witness. The difficulties are very great in a country where practical materialism and religious conservatism seem to go hand in hand. But these very difficulties constitute a challenge and an opportunity, and there are many indications that the Congregational churches are alive to the need and are preparing themselves to meet it.

South Africa.—The Congregational problem in South Africa is much complicated by the existence of native and coloured churches. These greatly outnumber the white churches, and since the withdrawal of control by the London Missionary Society, have tended to interpret their independency very literally. But guidance and fostering are supplied partly by the white churches, which have to find men for administrative posts and most of the money, and partly by the Colonial Missionary Society. The Congregational Union of South Africa now comprises all the churches under a central organisation and is creating a new sense of corporate fellowship and responsibility. It is tackling the educational problem among the natives, training teachers and preachers and initiating social work.

Other Unions.—In the smaller Congregational Unions of Nova Scotia, British Guiana, New Zealand, Jamaica, Tasmania and Newfoundland, the new spirit of fellowship, co-operation and denominational responsibility is making itself felt to the great advantage of the Churches themselves and to the increase of their capacity for aggressive work. They represent a new and very effective type of federated independency. (W. B. Se.)

II. IN THE UNITED STATES

The years since 1910 have been one of the most formative and significant periods in the history of the Congregational churches in the United States. In point of institutional development the following table shows what has taken place:

	1924	1910
Churches	5,680	6,033
Members	878,995	735,563
Benevolence	$ 3,112,520	$1,269,409
Home Expenses	19,507,607	8,965,894

The decrease in the number of churches from 1910, the year of maximum since 1620, is due to the closing of a large number of small congregations, often by federation or union. The increase in membership and benevolent gifts is noteworthy.

Administration.—The ideals of Congregational church government are the independence of the local congregation and the fellowship of the independent churches for mutual counsel and for the prosecution of those enterprises which no single church alone could compass. Harmonious balance between these two principles involves and assures the symmetry and success of the whole plan. The years 1910–26 have witnessed a striking development of the fellowship of the churches. This appears in the growth of the influence of the state conferences and the

larger function of the state superintendent, not merely because of counsel and financial support given to the small or missionary-aided congregations, but also through increasing co-operation in the affairs of the larger and self-supporting churches. In effecting pastoral relations, organising and carrying out their own community programmes and in all matters of policy, the churches have come to look for guidance to the superintendent and also, through him, to the board of directors, of the state conference. This service is rendered without assuming any rights of judicature, and it issues in a gratifying increase of practical efficiency.

National Organisation.—The development of the national organisation of the Congregational churches has kept pace with that of the state units. The effort to perfect closer organisation, cut down overhead cost, and increase the community service of the churches has been strongly influenced by similar movements in the economic world. After a period of careful study by a commission chosen for its representative character, the first step in advance was taken at Kansas City in 1913. The National Council was given larger functions in the work of the church, still safe-guarding the autonomy of the individual congregation. A general secretary was chosen to represent the churches of the nation in their relations with smaller Congregational groups, other denominations and in international relationships. The various societies through which the churches had carried on their missionary work were more closely integrated with the National Council. Again, after intensive study by a commission, new plans were adopted by the National Council in 1925, by which the work of the denomination is divided into two groups, home and foreign, and the administrative costs are further simplified.

Doctrinal Position.—The Congregational churches always have laid more emphasis upon their covenant with God and with one another, entered into in order to constitute church membership, than upon formal creeds. All Congregational creeds have been looked upon as platforms for action and testimonies as to faith generally accepted rather than as dogmatic statements and tests. No single statement can be indicated as the authoritative creed of all the Congregational churches, since each congregation adopts its own creed and there is wide variety. During a period of intense doctrinal debate, which has proved divisive in other bodies of American Protestantism, the Congregational churches have not been seriously disturbed. All shades of opinion are represented among the clergy and laity: their deepest unity seems to be in their worship and their programmes of service. They occupy in general a liberal evangelical position. Interdenominational movements towards comity and unity have been shared largely by the Congregational churches and their missionary programme has been sustained with growing power and enthusiasm. (O. D.)

CONJURING (*see* 6.943).—Advancement in conjuring is mainly to be measured in the improved manner of achieving the limited number of effects possible to the art. These are, chiefly, apparent creation; destruction and restoration; disappearance (" evanishment "); surprising transformations; substitutions; transportation (" apporting ") and similar acts seemingly done in defiance of natural laws.

The decapitation act (involving the apparent severance of the left arm, left leg or head of a man), introduced by Dr. Lynn in 1874 under the title of " Palingenesia," was revived, and a variation presented in the form of " sawing a woman in half." The effects depend on optical illusions and mechanical principles cleverly utilised. Among acts done in apparent defiance of the law of gravitation is that known as " Asrah," which involves the disappearance of a floating form and its reappearance.

Houdini's Performances.—The most radical development in conjuring in the present century is the series of sensational escapes which have been devised or developed by Houdini. His success depends partly on his great physical strength and the fact that he is slightly bow-legged. In an outdoor exhibition he allowed himself to be suspended, head down, some 75 ft. above the ground, in which position he freed himself from a straight jacket previously fastened upon him. The release is accomplished by first gaining slack of about two inches at the shoulder. Another remarkable act is that from the so-called " Chinese water torture cell. " The " cell " is a metal-lined mahogany tank having a front of plate glass. This tank is filled with water, into which Houdini is lowered head first, his feet being fastened in stocks, that is, a mahogany cover in two sections, brass-bound. When he is submerged, the cover is padlocked on the tank, which is enclosed in a curtained cabinet. By his unaided effort he effects an escape within the space of two minutes.

In his " overboard act " he is shackled with irons and placed in a box, which is locked, roped and weighted. The box is then submerged from a boat, to which he returns after freeing himself under water. The " milk-can escape " involves the use of a trick can. The top is locked to an outer section, which envelops the inner can containing the liquid. A simple lifting movement puts the operator safe from harm and makes escape easy. Other sensational effects produced include the " evanishment " of an elephant from a cabinet situated in the centre of a fully-lighted stage and the so-called " Hindu needle trick," in which upwards of 100 needles and several yards of thread are apparently swallowed, and afterwards withdrawn from the mouth with the needles threaded at intervals.

Mind Reading.—Logically classifiable under conjuring are those effects produced through natural means by many so-called spirit mediums and mind readers. The mortality of the World War quickened interest in psychic phenomena and thereby opened a frequently lucrative field for clever charlatans. A noted performer claimed a vision able to penetrate metal, reading the time through a closed watch case and deciphering messages placed in a closed metal box. It was subsequently shown that his power depended on normal vision, view of the objects being obtained by such adroit handling of the object that he was able to obtain a glimpse of the contents. A medium, " Eva " of Paris, attracted much attention by her ability, in suitable surroundings, to emit and reabsorb " ectoplasm," the movement of which, on investigation, was shown to be obstructed when a veil was placed over her mouth.

Another notable instance was that of " Margery " (Mrs. Crandon of Boston), whose acts of levitation, bell ringing and other phenomena, ostensibly through a spirit, " Walter," were investigated in 1924 by a committee on which were psychologists from Harvard and other universities and shown to be reproducible by natural means. Among other effects commonly produced by mediums are slate writing, spirit photography and the revelation of information of which the medium is presumably unaware. The devices for securing these effects by natural means are very numerous, many of them requiring great adroitness of mind as well as much mechanical ingenuity.

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CONNAUGHT, ARTHUR WILLIAM PATRICK ALBERT, DUKE OF (1850–), the third son of Queen Victoria (*see* 6.950), went, in 1910, to South Africa to open the Union Parliament on behalf of King George V. He was appointed in 1911 to succeed Earl Grey as Governor General of Canada, retiring from this office in 1916. In Dec. 1920 he went to India as the representative of King George in order to inaugurate the provincial legislative councils of Madras, Bengal and Bombay. It was agreed, on his return to England, that valuable help had been given by his speeches to the work of self-government in India under the new régime.

The Duchess of Connaught died in London March 14 1917. The Duke's only son, Prince Arthur of Connaught (b. 1883), married, in 1913, Princess Alexandra, Duchess of Fife, daughter of the Princess Royal, who had succeeded in 1912 to her father's dukedom by special remainder. Prince Arthur was, in 1920, appointed Governor General of the Union of South Africa. The Duke of Connaught's elder daughter, Margaret (1882), was married in 1905 to the Crown Prince of Sweden, and died at Stockholm May 1 1920. The younger daughter, Patricia

(b. 1886), married, in 1919, the Hon. Alexander Robert Maule Ramsay, third son of the 13th Earl of Dalhousie. Princess Patricia of Connaught resigned her royal title on her marriage, and elected to be known as Lady Patricia Ramsay.

CONNECTICUT (*see* 6.951).—A state of the United States of America. In 1920 the population was 1,380,631 as compared with 1,114,756 in 1910, an increase for the decade of 23·9%. The total land area of the state is 5,004 square miles.

Political History.—In 1911–2, the 34th and 35th and in 1915–6 the 36th amendments to the Connecticut constitution were adopted. The first stated the conditions under which the lieut.-governor was to take the place of the governor; the second provided that the General Assembly should adjourn not later than the first Wednesday after the first Monday in June; and the third allowed the passage by the General Assembly of a law to cover the payment of mileage to the legislators. In 1914 a workmen's compensation law, which applied to all work-places in which five or more persons were employed, was passed.

In 1925 a commission vested with power to end the pollution of streams, whether the nuisance be committed by firms, corporations or municipalities, was established. In the same year a new medical practice Act provided for more strict supervision, and a commissioner of agriculture was substituted for the older Board of Agriculture in order to make state assistance in the development of agriculture more effective. During the years 1920–5 a marked development took place in the amount and the conduct of the public welfare work of the state.

Connecticut failed to ratify both the 18th (Prohibition) and the 19th (Woman Suffrage) amendments to the Federal Constitution, and in 1925 refused by a large majority to ratify the proposed child-labour amendment. The governors of Connecticut from 1909 to the beginning of 1925 were Frank B. Weeks (1909–11); Simon E. Baldwin (1911–5); Marcus H. Holcomb (1915–21); Everett J. Lake (1921–5). On Aug. 16 1924 Anson T. McCook was appointed Treasurer to fill the unexpired term of S. Harold Gilpatrick; he reorganised and improved the methods of handling and safeguarding the State's money and securities. On Jan. 7 1925 Hiram Bingham was inaugurated as governor. He resigned the following day, having been chosen a senator of the United States in a special election to fill the unexpired term of Frank J. Brandegee, and the lieutenant-governor, John H. Trumbull succeeded to the office of governor.

Education.—Beginning on July 15 1909 the organisation of public education was changed from the district type to that of town management. In 1921 there were less than 10 townships that had not availed themselves of the law by which all the schools are under the direction of the town school committee. Appropriations for the support of the schools are made at a town meeting. Compulsion was made more rigid by the enactment providing that after Sept. 1 1911 no employment certificate should be accepted by any employer except such as were issued by the State Board of Education. On July 1 1917 a law provided that all new public school teachers must pay 5% of their salary into a pension fund. The outstanding educational development of the five years ending 1925 was the improvement in the professional preparation of teachers. In 1911 the Connecticut Woman's College was opened at New London, and in 1925 a woman's college, Albertus Magnus (Roman Catholic), was opened at New Haven. In 1925 Trinity College established an extension department.

Agriculture.—In 1920 32·2% of the population was classed as rural, though the actual farming population was somewhat smaller. In 1920 the farms of the State numbered 22,655, a loss of 4,160 since 1910. The average value of land per ac. in 1920 was $53.28 as compared with $33.03 in 1910. Tobacco is the most important agricultural product; the crop increased from 28,110,453 lb. valued at $4,415,948 in 1910, to 42,193,196 lb. valued at $15,189,551 in 1919. In the season of 1922 the Connecticut Valley Tobacco Association, a pool with a Connecticut membership of 2,400 growers farming 90% of the acreage of outdoor tobacco in the State, was formed for the collective marketing of the crop. The association sorts, packs, sweats and sells the leaf. Dairying is practised on more than four-fifths of the farms of the State. The quality of the milk is being steadily improved through a system of inspection put into effect by the Milk Regulation Board and administered by the Dairy and Food Commission. The number of milch cows fluctuates around 120,000. The production of milk increased from 45,749,849 gal. in 1909 to 49,458,287 gal. in 1919. In the same period the output of butter fell from 3,498,551 lb. to 1,926,127 lb.; cheese output rose from 79,156 lb. to 90,500 pounds. The poultry industry increased very rapidly owing to the favourable climate and the large market close at hand. For the same reasons market gardening increased, the gardeners being organised into one State and 16 local organisations. The estimated values of five leading crops of 1924 were: tobacco, $12,223,312; hay, $10,400,000; potatoes, $3,425,000; apples, $2,363,000; and corn for silage, $2,310,000. These figures indicate a very considerable decline from those of 1923.

Manufacturing Industry.—The World War brought a great volume of orders to Connecticut factories and caused large numbers of plants to change the character of their product. In May 1918 80% of Connecticut manufacturing was directly or indirectly engaged in producing munitions, rifles, machine guns, clothing and other articles used by the military forces, and there were five plants where ships and power boats were constructed. Wages were high during this period. In the years of rapid expansion there were a great many strikes, and labour organisations increased in membership. During the two years following the Armistice the factories began the process of readjustment to peace-time conditions, which was completed by the depression of 1920–1. The leading branches of manufacturing industry and the values of the products of each in 1921 were:—

Brass, bronze, copper and allied products	$65,795,194
Cotton goods	62,987,202
Silk goods, including products of throwsters	50,838,974
Hardware	50,277,218
Foundry and machine shop products	46,144,807
Electrical machinery apparatus and supplies	33,839,350
Woollen goods	20,504,074

In 1922 the situation steadily improved; unemployment declined, and in Dec. 1922 the Department of Labour reported an actual shortage of labour in the State. The growth of industry after 1922 was indicated by the fact that in 1923 and 1924 the cost of new factory construction and additions was $16,807,775. The years 1923–4 were remarkably free from strikes and lockouts.

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(R. H. G.)

CONRAD, JOSEPH (1857–1924), English novelist (*see* 6.968), was born on Dec. 6 1857 in the Ukraine, of a Polish family of the name of Korzeniowski; his father, a man of letters, became involved in the Polish insurrection of 1863 and was banished to Vologda, whence he returned to Cracow before his death. In Cracow, the son, Joseph, passed his boyhood. He learned to speak and write French with fluency as a boy; his first acquaintance with English literature was made through Polish translations of Shakespeare and Dickens; later on, the novels of Marryat and Fennimore Cooper—particularly Cooper's *The Pilot* (1888)—inspired him with romantic ideas of the seaman's life.

At the age of 19 he found his way to Marseilles, and for two years served in French ships in the Mediterranean and on the South American coast. With hardly a word of English speech at his command, he came to Lowestoft in 1878, qualified as able seaman on coasting vessel, and in Aug. 1880 sailed as third mate to Sydney on the Clyde-built, Clyde-owned sailing ship "Loch Etive," commanded by a famous clipper captain, William Stuart of Peterhead, of whom, later, in *The Mirror of the Sea* (1906) Conrad said "To this day I preserve his memory, for indeed it was he, in a sense, who completed my training." Four years later he was a master in the British Merchant Service, and for

years his calling sent him to many parts of the world and through a constant succession of adventures, all contributory to the cosmopolitan spirit and the range of incident in his subsequent stories.

A Sequence of Novels.—During a period of ill-health (the result of Congo fever whose *sequelae* were to give pain to his later years and shorten his life), he started his first novel, *Almayer's Folly*, the writing of which engaged him, with frequent and protracted intermissions, from 1889 till 1894. Into its composition went many personal experiences of his own as first officer of a ship in which he had sailed between Singapore, Borneo, Celebes and Sumatra. When published in 1895 it was recognised, by acutely discerning readers, as a portent of something new in English fiction, the product of a rare temperament and of unusual experiences, expressed in a fastidious choice of phrase, in a studied cadence whenever that would carry an emotional effect, or best suggest half-lyrical moods evoked by natural scenes or moments of human crisis. His style in general had dignity, clarity and idiomatic vigour, with an elusive quality of charm which few readers probably suspected might be due to the writer being a foreigner, with at least three languages at his command wherefrom to choose and adapt the colours and harmonies of his verbal palette.

This first novel was enough to establish a small though devoted band of permanent Conradians, but neither it, nor its immediate successors—*An Outcast of the Islands* (1896), *The Nigger of the Narcissus* (1897), *Lord Jim* (1900), *Youth* (1902) and *Typhoon* (1903), found any large body of the reading public to share the enthusiasm of the critics till many years after. Of *The Nigger of the Narcissus*, Conrad, in the year before he died, declared it was "the story by which as a creative artist I stand or fall; at any rate, no one else could have written it." It and *Youth* and *Typhoon* brought out hitherto unexploited aspects of life at sea with amazing effect, and gave ocean storms and the trials and endurance of the mariner an epic grandeur. The scene of *The Outcast of the Islands* and of *Lord Jim* was laid on the same coasts as *Almayer's Folly*.

Soon after his emergence as a writer, he gave up the sea, and went to live in Kent. But the public apathy regarding his work, and the stress of pecuniary cares paralysed his pen for a while; ever a slow writer, he began to find a whole day at the desk produced no more than a few sentences, and thoroughly disheartened, decided to go to sea again. Fortunately for himself and English letters, his efforts to get a command on a Clyde ship, four years after giving up the sea, failed. A modest Civil List pension was secured for him, and relinquished as soon as the sales of his books made his circumstances easier. Still in the prime of life, he wrought industriously and could yet call up reserves of zest, passion, poetic and romantic mood to vivify the recollections of his earlier strange experiences. In the following 25 years he produced a score of volumes of fiction; complete novels for the most part, others, collections of his short stories; as well as several volumes of his own reminiscent experiences.

Conrad's "first period" is generally classified as ending with *Nostromo* (1904), a tale of an imaginary state in South America, with its atmosphere created from an old book of South American travels. *The Mirror of the Sea* which followed, a blend of reminiscence, fable and reflection, may be looked upon as commentatory on a chapter closed.

The Second Period.—It was, in many respects, a new Conrad who produced in 1907 *The Secret Agent*, a fantastic tale of the anarchist and criminal underworld, which 15 years later, he dramatised. *Chance* (1919), *Within the Tides* (1915)—a series of short tales—was followed by *Victory* (1915) (with the old Celebes and Java background), *The Arrow of Gold* (1919), *The Rescue* (1920) and *The Rover* (1923). For many of Conrad's earliest admirers those novels, though delightful, missed something of his first creative ecstasy, but by them he secured a great vogue for all his works in Britain and America, and on his death he was recognised and honoured on both sides of the Atlantic as a classic novelist.

The Rover—an historical tale with its scene laid in the peninsula between Toulon and Hyères—was, in a sense, the residual product of a much greater Mediterranean story he had been brooding on since 1907, dealing with French intrigue at Napoleon's Elba period. This latter work, begun only June 1920, was but half or two-thirds done when he died, and was published in its fragmentary state in 1925, with the title of *Suspense*.

An Estimate.—Conrad, as has been said, brought to his first essays in English writing at least tri-lingual knowledge, and although he never contemplated writing in the language, found in the best French writers effects of balance, light and shade, a delight in words for their own sake, as well as more subtle psychological results arising from the indulgence of personal mood even at the cost of action, held momentarily in suspense. This French influence was rarely absent from his work, and wonderfully enriched it.

He came to the study and practice of English in his maturity, with an instinctive sense of verbal beauty, a respect for good technique, a cultivated mind and high ideals as an artist. In all his books is manifest a scrupulous avoidance of *cliché* either of thought or phrase, and a philosophy that forbade surrender to romantic sentimentalism on the one hand or "realistic" squalor on the other. It was his conviction that only through an unremitting care for the shape and ring of sentences, an approach could be made to plasticity, to colour, and the light of magic suggestiveness could be brought to play for an evanescent instant over the commonplace surface of words worn thin by ages of careless usage. "The sincere endeavour to accomplish that creative task, to go as far on the road as his strength will carry him, to be undeterred by falterings, weariness or reproach, was" he said, "the only justification of the worker in prose."

There was no deliberate ethical purpose in his books. "I suspect" he said, "that the aim of creation cannot be ethical at all. I would fondly believe that its object is purely spectacular—a spectacle for awe, love, adoration or hate, if you like, but in this view—never for despair. These visions, delicious or poignant, are a moral end in themselves." For the most renowned Russian novelists he had neither respect nor admiration, which perhaps is not to be wondered at in a Pole. Though he disliked the appellation of "romantic novelist" and preferred to be known as a "creative artist," he greatly vindicated romance in a period of "realistic" reaction. He died at Bishopbourne, near Canterbury, on Aug. 3 1924. A volume, *Last Essays*, was published in 1926. (N. Mu.)

See Ford Madox Ford, *Joseph Conrad* (1924); A. Symons, *Notes on Joseph Conrad: With some unpublished letters* (1926).

CONRAD VON HÖTZENDORF, FRANZ (1852–1925), Austro-Hungarian soldier, was born in Vienna Nov. 11 1852. Conrad was the leading military figure of the old Dual Monarchy, and also one of its most influential politicians. In 1899, as a brigadier in Trieste, his observations on Italian Irrdentist propaganda inspired him with a lasting mistrust of the third member of the Triple Alliance. Here he made the acquaintance of the heir to the throne, the Archduke Francis Ferdinand, whose ideas coincided with his own in many respects. Francis Ferdinand's influence elevated Conrad to the post of chief of staff in 1906. His predecessor, General Beck, had held this post for some 20 years, in the course of which Beck, who shared the Emperor Francis Joseph's optimism, had allowed the army to lag far behind modern progress, in technical matters, and had paid little attention to the nationalist problems which complicated the home and foreign politics of the Monarchy.

Conrad at once began to reorganise the army, especially the artillery. His activities earned him the hatred not only of the German Liberals but also of the Slavs and the Magyars, all of whom, if for different reasons, were opposed to an aggressive army policy. His most serious conflict, however, came with the Emperor himself and the minister of foreign affairs, Count Aehrenthal. Conrad was convinced that the Monarchy could not avoid a conflict with Serbia; and further that Italy must be considered not as an ally but an enemy. He believed the only salvation to be in aggressive "preventive" measures. Both before

and after the annexation of Bosnia and Hercegovina he urged that the only solution of the Southern Slav question would be the "preventive" annexation of Serbia. When Italy became engaged in war with Turkey in 1911, he again advocated a "preventive" war against the Monarchy's ally. This last suggestion led to such a conflict of views with Aehrenthal, who believed that peace could be maintained, that Conrad was forced to resign. He was reappointed, however, a few months later, when events in the Balkans again grew critical. Conrad did not overestimate the strength of his army, and, therefore, when war broke out and the attitude of Italy and Rumania grew critical, he urged—vainly—that these former Allies be appeased by territorial concessions. Meanwhile he conducted the operations of the Austro-Hungarian troops in Galicia with skill and boldness, and later, when they entered the World War, also saved his country from much devastation by his bold strategy. When, however, the young Emperor Charles himself took over the command of his army in place of the previous nominal commander, the Archduke Frederick, he took offence at Conrad's assured manner and dismissed him from his post. From March 1917 on Conrad commanded an army group on Austria's Italian Front. No further successes crowned his efforts, and finally the troops under his command disintegrated with the collapse of the Monarchy.

Conrad's political views aroused much controversy. From his own point of view—the maintenance at all costs of the dynastic power of the Habsburgs—they were undoubtedly correct; he took too little account however of the stronger but more remote influence of world politics. As a strategist he was bold and skilful but unlucky. As a personality he was simple and deeply respected; his chief failing was his often faulty judgment of human character. After the downfall of the Monarchy Conrad withdrew entirely into private life and occupied himself with the preparation of his monumental memoirs *Aus Meiner Dienstzeit*, of which five volumes had appeared in 1925. He died at Mergentheim Aug. 26 1925. (C. A. M.)

CONRADY, AUGUST (1864–), Austrian orientalist, was born at Wiesbaden April 28 1864. In 1897 he was appointed a professor at the university of Leipzig, where he eventually became director of the school of oriental studies. He achieved great distinction as an authority on Chinese languages and literature and on Indo-Chinese philology of which he originated the study. Among his works are *Eine indochinesische Kausativ-Denominativbildung* (1896); the section on "China" in J. von Pflugk-Harttung's *History of the World* (1910); *Die Chinesischen Handschriftenfunde Sven Hedins in Lou-Ian* (1920).

CONSERVATIVE PARTY (*see* 6.976).—The Conservative, or as it was temporarily named the Unionist, party had not, by 1911, fully recovered from the débâcle of 1906. For 10 years prior to 1906 the Conservatives, in close alliance with the Liberal Unionists, had been continuously in power. Twice Gladstone had attempted to carry a Home Rule bill for Ireland; twice it had been resisted by the Conservatives and Liberal Unionists in Parliament, and twice (1886 and 1895) the conservative attitude had been emphatically endorsed by the electorate.

In 1903, however, Joseph Chamberlain raised a new issue by promulgating his policy of Tariff Reform. Tariff Reform split the Unionist party as Home Rule, 20 years before, had split the Liberal party, and at the General Election of 1906 the Unionists suffered a crushing reverse, and the Liberals came into power, fettered only by the still co-ordinate authority of the House of Lords. Unsparingly did the Lords work their will on radical measures from 1906–10. Consequently the King's speech of 1910 foreshadowed proposals "to secure the undivided authority of the House of Commons in finance and its predominance in legislation"; and in April the Parliament bill was introduced.

This did much to reunite the Unionist party, which, ever since 1903, had been hopelessly divided on the fiscal and perhaps on other issues. To the Parliament bill, however, the Unionists were stoutly and unanimously opposed, but their leaders took part in the conference at which all parties were represented that followed the accession of George V. After this broke down the struggle was renewed. The Unionists fought it strenuously, though vainly in the Commons, but in the Lords the Tory peers were divided: the "hedgers" led by Lord Lansdowne favoured an acceptance of the inevitable, the "ditchers" with Lord Halsbury at their head preferred the bolder but more perilous policy of compelling Mr. Asquith to carry out his threat and ask the King to create 500 new peers. The former prevailed and on Aug. 10 the Lords accepted the Parliament bill.

In the following November the Conservative party was compelled, by the resignation of Mr. Balfour, to elect a new leader. Its internal condition had not for months, indeed for years, past been satisfactory. Mr. Balfour, in a laudable attempt to prevent an open schism between free traders and protectionists, had given the impression of vacillation. He now insisted that he had no longer the vigour to conduct a ministry; that grave questions which might involve another early dissolution were impending, and that he could best serve the interests of the party by handing over the leadership to a younger man. The industrialists and protectionists urged the claims of Mr. Austen Chamberlain; the old Tories, the Churchmen, and the country folk preferred Mr. Walter Long. Ultimately both stood aside in order to secure unanimity, and the choice of the party fell on Mr. Bonar Law.

Leadership of Bonar Law.—The choice proved a happy one, though the new leader's powers were displayed to much greater advantage in the House of Commons than on the platform. His presence was undistinguished and his voice thin, but by his simplicity and modesty, no less than by his considerable intellectual gifts, he established a strong hold over those with whom he came into contact. His leadership continued until his resignation of the Premiership, after only a few months' tenure, in 1923.

To resume the sequence of events. After the passage of the Parliament Act in April 1912, Mr. Asquith introduced a Home Rule bill. The Conservatives fought it in the House of Commons, but the third reading was carried by 367 to 257. The Lords, however, rejected it by 326 to 69. It met a similar fate in 1913 and 1914, but the Parliament Act had deprived the Lords of the power to prevent it from becoming law.

Meanwhile, however, Ulster was preparing to resist forcible disjunction from the United Kingdom, and behind Ulster stood the bulk of the Unionist party. At the eleventh hour (July 1914) the Buckingham Palace conference of eight leaders attempted a settlement, though in vain. But by that time the issues of European peace and war were hanging in the balance. Party controversies were instantly put aside, and on Aug. 2 1914 Lord Lansdowne and Mr. Bonar Law addressed to Mr. Asquith an historic letter promising, in the event of war, the whole-hearted support of the Conservative party to the Government.

The War Period.—That promise was fulfilled in the letter and the spirit and the whole of the party organisation was diverted to national service. In May 1915 Mr. Bonar Law and other Conservative leaders joined forces with the Liberals and Labour men in an administration, formed to conduct the War to a successful issue. But the issue was not yet; victory tarried; public dissatisfaction grew, and in Dec. 1916 a political crisis supervened. Mr. Asquith announced (Dec. 3) the reconstruction of the Govt., but ultimately preferred resignation. Mr. Bonar Law was invited to form a Government but declined, and chose instead to serve as Chancellor of the Exchequer and Leader of the House of Commons under Mr. Lloyd George as Premier. A real coalition of the three parties ensued, and was maintained until the conclusion of the Armistice (Nov. 11 1918).

Post-War Changes.—The long Parliament was at last dissolved (Nov. 1918) and Mr. Lloyd George and Mr. Bonar Law jointly appealed, as leaders of the Coalition, to the new and vast electorate created by the Reform Act of 1918. The country gave them an overwhelming majority and, as spokesmen for the nation, they attended the Peace Conference at Paris. After the conclusion of peace the cohesion between the two wings of the Coalition manifestly weakened. A considerable section of the Conservative party became increasingly restless under Mr. Lloyd George's leadership, and after the concession of Dominion Home Rule to Southern Ireland (1921), the "die-hards," as they were termed, decided that when the inevitable appeal to the

country came, they would make it as Conservatives, *sans phrase* and under their own leaders. In the early part of 1922 the uneasiness of the Conservative wing of the Coalition was heightened by rumours that the Prime Minister intended to anticipate, and if possible avert, schism by a premature appeal to the country.

Matters reached a crisis on Oct. 19, when a meeting of Conservative M.P.'s was held at the Carlton Club, London, under the presidency of Mr. Chamberlain, the leader of the party in the House of Commons. Mr. Chamberlain definitely refused to break from Mr. Lloyd George and was supported by Lord Balfour, and the majority of his colleagues in the Cabinet. The meeting, however, decided by 187 to 87 votes, "that the Conservative party while willing to co-operate with the Liberals, should fight the election as an independent party, with its own leader and with its own programme."

To this result two speeches largely contributed. One was a singularly direct, manly and courageous speech by Mr. Stanley Baldwin; the other was a firm declaration by Mr. Bonar Law, who had been reluctantly persuaded to emerge from retirement and head the revolt against the Coalition. But it was a soldiers' battle; the victory was that of the rank and file who for the last two years had been increasingly suspicious of Mr. Lloyd George's policy.

The die was now cast. The Coalition was smashed; Mr. Austen Chamberlain and the bulk of his Cabinet colleagues went into the wilderness; Mr. Lloyd George resigned, and Mr. Bonar Law became Prime Minister and the head of a purely Conservative Ministry, the first since 1905. The electorate showed its confidence in the new administration by returning (Nov. 1922) 344 Conservatives as against 53 Asquithian Liberals and 61 National (or Lloyd George) Liberals, and 142 Labour-Socialist members. The Parliament elected in Nov. 1922, on the cry of rest and recuperation, was short-lived. Mr. Bonar Law was compelled by illness to resign in May 1923. Who was to succeed him? Length and distinction of service, great experience, superb intellectual endowments—all pointed to Lord Curzon of Kedleston. The King, however, decided that a peer premier was, under the circumstances, impracticable, and his choice fell on Mr. Stanley Baldwin.

The new Govt. did not last long. Mr. Baldwin, convinced that only Protection could provide a positive cure for unemployment, asked the country (Nov. 1923) to endorse that conviction. At the ensuing general election the country declined. The Conservatives, who at the dissolution numbered 344, returned only 258 strong. The Liberals, impelled towards unity by the threat of Protection, numbered 159, and the Labour-Socialists 191. The two latter parties combined to turn out Mr. Baldwin's Government; the Labour party took office on Liberal sufferance, but in the early autumn became involved in irretrievable difficulties and appealed to the country. The country showed even less liking for Socialism than for Protection, and Mr. Baldwin achieved a victory almost national in dimensions. The new Parliament contained nearly 420 Conservatives and 151 Labour men, while the Liberal parties were in the aggregate reduced to 40. Mr. Baldwin, rightly interpreting the verdict of the country as a call to the union of all Constitutionalists, included in his new Ministry not only those Unionists who, like Mr. Austen Chamberlain and Lord Birkenhead, had gone into temporary exile with Mr. Lloyd George, but Mr. Winston Churchill, who took office as Chancellor of the Exchequer. Thus the Conservative party has regained the position which under Lord Salisbury and Mr. Balfour it had for 20 years (1885–1905) enjoyed. (*See* English History.) (J. A. R. M.)

CONSTANS, JEAN ANTOINE ERNEST (1833–1913), French statesman (*see* 6.986), resigned from the embassy at Constantinople in May 1909 and died April 7 1913.

CONSTANTINE, King of the Hellenes (1868–1923), eldest son of George I. (*see* 11.746) and of the Grand Duchess Olga Constantinovna of Russia, was born Aug. 2 1868 and succeeded to the throne March 18 1913, on the assassination of his father. Having received an early private education in Athens, on reaching the age of 18 the prince was sent to Germany, where he attended the university of Leipzig, served in the Guards and studied at the Prussian Staff College. It was then that the future King met the Princess Sophia Dorothea of Hohenzollern, daughter of the Emperor Frederick, whom he married in 1889. This union was popular in Greece because of the superstition that when a Constantine and a Sophia were upon the throne the Empire of Byzantium would be restored, and, coupled with the fact that he was appointed a field marshal in the Prussian Army in 1913, it played a prominent rôle in shaping the King's attitude during the World War.

On returning to Greece, the Crown Prince was given various military appointments; in 1897 he took over the command of the army in Thessaly, and he was held largely responsible for the disastrous campaign of that year. In 1909 the Diadoch Constantine and his brothers were once more made scapegoats by the Military League and they were compelled to resign their commissions. Subsequently, on the initiative of Veniselos, the royal princes were recalled from their practical exile. Thenceforward, acting in co-operation with the French military mission, Constantine, now Inspector-General of the Army, devoted himself to reforms which were markedly apparent during the Balkan wars, and the successes that were then gained completely re-established his prestige.

In spite of the victories of the Balkan campaigns, various factors influenced the King's policy in the World War; the future of Greece depended largely upon the rôle of Turkey, and the people, who are not hard fighters by nature, always had leanings towards neutrality. The Sovereign was immensely popular; he admired Germany, and believed in her efficiency, and he was anxious to stand well with his brother-in-law. Beyond the fact that on Aug. 7 1914 Constantine expressed his personal sympathy for the German Emperor and advocated a neutrality which would be useful to him, nothing of marked importance, however, happened until early in 1915. But after the entry of Turkey, and in connection with the Allied attack upon the Dardanelles, the King, probably influenced by his military advisers, vetoed Veniselos' proposal to co-operate with the Western Powers in exchange for their promises of concessions in Asia Minor. Veniselos resigned (March 1915), but at the subsequent election in June he obtained a large parliamentary majority.

By this time, however, the King was ill, the operations at the Dardanelles were not going well, and the negotiations with Bulgaria having been mishandled by the Allies were reaching a critical stage. When Veniselos was recalled in Aug., therefore, the King had secured increased support for his policy of neutrality, Bulgaria had ordered a general mobilisation in Sept. and Veniselos was in favour of a loyal interpretation of the Greco-Serbian frontier agreement made prior to the Treaty of Bucharest in 1913; but when he announced in the Chamber that if Greek support for Serbia brought Hellenic troops into contact with the German Army they would act in accordance with their honour, the King demanded his immediate resignation upon the plea that in questions of foreign policy he alone was responsible. Subsequently Serbia was left to her fate and a fresh dissolution of the Chamber was ordered. At the elections held in Dec. the Royalists secured a large majority, principally because the Veniselists abstained from voting, and from then until the departure of the King, in June 1917, the Government was in the hands of various Royalist politicians, who favoured neutrality.

For some months the struggle between the King and Veniselos continued, but from Oct. 1915 the rupture was complete and thenceforward his Majesty was more occupied by his relations with the Allies than by the internal crisis. There are those who contend that Constantine had always been determined to support Germany to the utmost of his power, and there are others who suggest that he favoured neutrality as being in the interests of Greece. However this may be, the King pursued a policy detrimental to the Allies, and this policy gradually became more and more marked.

The closing months of 1915 and the earlier part of 1916 passed without any overt signs of hostility, but in May of the latter year Fort Rupel, which commanded the Struma Pass into eastern Macedonia, was surrendered to the Bulgarians and the

Allies demanded the complete demobilisation of the Hellenic Army, which menaced them in Macedonia. Five months later (Oct.) the Greek fleet (except three vessels) was taken over by the Allies, and in Nov., the demobilisation having proceeded slowly, a further demand was made for the cession of war material. This request was not complied with, and, although it would appear that the King had given personal assurances to the French admiral, an Allied landing at the Piraeus was opposed and the naval contingents, disembarked there on Dec. 1, had to be withdrawn after material losses. A month later a further blockade was declared and the removal of the whole Greek army to the Peloponnesus was insisted on. This was agreed to and a formal apology was made for the events of Dec. 1, but it soon became obvious that the Allies could not continue to accept a régime dangerous to their whole position at Salonika.

The final stage in this part of King Constantine's history occurred when the transference of the army had proceeded unsatisfactorily, when the downfall of the Tsar (March 1917) had taken place, and when the question of the distribution of the Thessalian harvest to the whole of Greece and not merely to the Royalist section of the community had become a matter of urgency. In June, M. Jonnart, acting as the High Commissioner of the protecting Powers, arrived at Athens, where, backed up by strong forces, he demanded better guarantees for the safety of the Allied army in Macedonia, the more true working of the constitution and the departure of the King. Constantine, accompanied by the Queen and the Crown Prince, sailed from Greece on June 12, leaving his son Alexander upon the throne; but, whilst it was generally claimed that he had abdicated, the proclamation then issued by the King clearly left open the way for him and for his supporters to contend, as they subsequently contended, that he had no intention of finally renouncing his rights to the throne. Constantine spent the following three years of his life in Switzerland, where the climate seems to have improved his health. At the end of this period, too, arrangements were made for the marriages of the Diadoch to Princess Elizabeth of Rumania and of Princess Helen of Greece to Prince Carol, then Crown Prince of Rumania.

As a result of the election of Nov. and of the subsequent plebiscite, Constantine returned to Athens at the end of Dec. 1920. This event met with almost general approval, but the King was once more placed in a nearly intolerable situation. Never recognised by Great Britain and France, he was compelled either to pursue the Asiatic policy of his predecessors—and this without the international support which they might have continued to enjoy—or to make himself unpopular by sacrificing gains promised to Greece under the already signed Treaty of Sèvres. Rightly or wrongly, he adopted the former alternative; he declared himself in favour of a continuation of the Turkish campaign and he failed to condemn, if he never encouraged, the Greek objections to the several offers of mediation made by the Western Powers.

The King, accompanied by various members of the royal family, went in person to Asia Minor, where he was present at the time of the temporary successes of Aug. and Sept. 1921. But the difficulties of the campaign were too great, the Hellenic army was not sufficiently strong to secure a decision and the whole international and local situations were modified by the Franco-Turkish agreement signed in October. Thus, when the Royalists had placed the Hellenic cause in the hands of the Great Powers and when the King had been back upon the throne for almost exactly 12 months, the close of the year 1921 found the military and diplomatic positions at a serious discount.

The opening months of 1922 were occupied with developments bound up with the Paris conference held in March and it is difficult to define whether or not Constantine was personally responsible for the delays and complications which hastened on the ultimate disaster of September. The Greeks nominally accepted the proposed evacuation of Asia Minor, but this was not carried out. In July, the Hellenic Govt. proclaimed its freedom of action and announced a plan for the occupation of Constantinople and the Greek High Commissioner declared that Ionia would be autonomous.

These events, coupled with a speech made by the British Premier on Aug. 4, so infuriated the Turks that, three weeks later, they initiated the attack which resulted in the recapture of Smyrna and in the driving of the Greeks out of Asia Minor. By the last week in Sept. an insurrection had broken out in the army, and, at the demand of a revolutionary committee headed by Col. Gonatas, the King abdicated in favour of his son George. On Sept. 30 Constantine left Athens for Palermo, where he died on Jan. 11 1923 from haemorrhage of the brain. The revolutionary government having refused to allow his remains to be brought to Athens, they were transferred to Naples, where an impressive funeral service was held in the Greek church.

Thus ended the life of a man whose greatest misfortune was a series of events over which he had but little control and whose want of success constituted his worst sin.

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(H. C. Wo.)

CONSTANTINE VI. (1861–), Patriarch of the Greek Orthodox Church, was born in 1861 at Bighi near Mudaniya on the Asiatic coast of the Sea of Marmora, his family name being Araboghlou. After studying at the theological college of Halki, he was in 1896 appointed Bishop of Kirk-Kilisse (Saranda Ekklesiai) in Thrace. In 1899 he was nominated Metropolitan of Trebizond, being subsequently transferred first to the see of Cyzicus, and then, in 1924, to that of Derkos, with residence at Therapia. After the death of Gregory VII., he was, on Dec. 17 1924, elected Œcumenical Patriarch. But his Patriarchate was brief. On Jan. 30 1925 he was expelled from Constantinople by the Turks, on the ground that, not having been registered as residing at Constantinople, he did not come under the category of *établis* or those persons exempted from the exchange of populations by the Treaty of Lausanne. His expulsion at first caused great indignation at Athens, and he was honourably received at Salonika, where he took up his residence; but a compromise was eventually made, by which in May he was induced to resign, and he retired to Khalkis. Another Patriarch, who took the name of Basileios, was elected in his stead.

CONSTANTINOPLE (*see* 7.3), a city and vilayet of Turkey (Turkish, ISTAMBUL). The city, formerly the capital of the Turkish Empire, includes the old city of Stambul, the Europeanised quarters of Pera and Galata on the opposite side of the Golden Horn, suburbs on the Golden Horn and the Bosporus; and on the Asiatic side, Scutari, suburban towns on the Marmara and the Princes Islands. Estimated population 881,000 (1925).

Constantinople passed through several periods of political and economic disaster, relieved only by very brief periods of normal life and prosperity, during the years 1900 to 1925. Four wars following each other in quick succession caused at times a complete cessation of trade, the influx of hordes of refugees, demoralisation in the organisation and regulation of civic life, loss of population and an acute impoverishment of all classes. Within this period also Constantinople lost, in theory as well as in fact, the position held well-nigh uninterruptedly for 16 centuries—that of the headship of a great empire.

War Periods.—During the Balkan wars (1912–3) the city narrowly escaped capture by the Bulgarians; the refugees who poured in from Thrace taxed the resources of the city to the utmost, and the loss of European provinces unfavorably affected its trade position. During the World War the city was in a state of complete blockade by sea, subjected to numerous air attacks, and during the last months before the Armistice, almost denuded of food, fuel and other necessities of life. The outstanding features of the period of the occupation by Great Britain, France and Italy (Nov. 13 1918–Oct. 2 1923) were: a short period in 1919–20 of intense commercial activity and relative prosperity, brought to an abrupt end in 1921 by the combined effects of the War in Anatolia and the worldwide trade depression; the outbreak in 1919 of the nationalist movement and the Greek war; the invasion of the city in 1919 and 1920 by some 100,000 destitute

refugees, the bulk of whom were Turks (30,000) and Russians (65,000); the arrival in the city at intervals, mostly in 1922 and 1923, of over 200,000 Greek deportees from Anatolia, most of whom were speedily moved on to Greece; the seizure of the machinery of government by the nationalists after the Mudaniya armistice in Oct. 1922; the flight of the deposed Sultan, Mehmed VI., on Nov. 17 1922; and the formal evacuation of the city by the Allies on Oct. 2 1923.

Transfer of the Capital.—The vital factor in the fortunes of the city was its relation to the nationalist movement. When in March 1920, the British attempted to suppress the activities of those supporters of the nationalist movement who were still in the city, many were exiled to Malta, and thousands of sympathisers left for Anatolia to assist in the task of liberation. These circumstances brought about a certain moral isolation of Constantinople from the rest of Turkey, and induced a sentiment of hostility towards the city on the part of the nationalists, who considered the political leaders who remained and co-operated with the Allies as traitors to their cause and the city as the centre and symbol of the old order. The determination on the part of the Anatolian leaders that Constantinople should no longer exact that tragic tribute of lives and treasure which had repeatedly exhausted their country in the past had no doubt much to do with the decision taken after the evacuation to maintain the seat of national administration at Angora. The subordination of Constantinople to Angora and Anatolia was definite and complete when, on March 3 1924, the Caliph, Abdul Mejid, was expelled and the city thus deprived of even the shadow of its former sovereignty.

The effects of the transfer of the capital are seen in the departure of a part of the large official class and the extreme poverty of the remainder; in the absence of the picturesque and imposing ceremonies of the days of imperial grandeur; and in the down-at-heel condition of the palaces of princes and pashas, many of which have been converted into tobacco factories. Resentment of the ascendancy of Anatolia made the city the centre of the short-lived political opposition on the part of the adherents of the old party of union and progress and of fierce press attacks against the government. With the passage of time the population became more or less resigned to the new situation, and came to understand that the national leaders are not obstinately antagonistic to the city, but desire its economic wellbeing in the interests of the country at large.

Modernised Constantinople.—The modernisation of the city made remarkable strides in spite of the adverse conditions. In 1912 electric lighting and in 1913 and 1914 the first electric tramways and telephones were introduced. During the war period the municipal organisation and services seriously deteriorated. With the restoration of complete Turkish control, and particularly under the energetic administration of the prefect, Dr. Emin Bey, a decided change for the better took place. A genuinely effective fire-fighting organisation was created for the first time in the history of the city, periodically devastated throughout its long history by terrible fires; the condition of the streets, which during the occupation were morally and materially in a deplorably unclean state, was improved; 25 km. of new roads were constructed and 250 km. of old roads repaired; the water supply was augmented; the construction of a thoroughly modern sewage system was begun in Stambul; a new slaughter house, an ice factory and refrigerating plant, six dispensaries and a hospital were built and placed under municipal management. During 1925 the city budget was increased from £T4,000,000 to £T6,500,000. Two of the former imperial palaces, Yildiz and Cheragan, were leased to an Italian *entrepreneur* for conversion into casinos, and it was hoped that their operation would be a source of revenue to the city.

The city remains the educational and cultural centre of the nation. The National University was installed in the commodious buildings of the old War Office. The two normal schools, one for men and one for women, continue to function. Since 1923, 40 new secondary and primary schools have been established, making a total in 1926 of 562 schools with 81,865 students. The foreign schools which existed before 1914 are allowed to continue their work, but no new ones may be opened.

The most striking social changes relate to the status of women. The veil was almost completely discarded during the World War, and in 1925 the European hat began to supplant the traditional "charshaf." Men and women mingle freely in the streets and at public gatherings, and the compartments reserved for women in public conveyances have been done away with. The university has opened all its departments to women. The complete suppression in 1925 of the fez and the adoption of European headgear for men removed one more picturesque and distinctive feature of the life of the city.

With the abrogation of the capitulations in 1923 the situation of the foreign elements radically changed in that they lost all their old rights of extra-territoriality. The results of this subjection to the Turkish administration of justice and *régime* of taxation have not been as calamitous as was predicted by most foreigners. Although some regulations are arbitrary and vexatious, life and property are secure.

Population.—No accurate statistics of the city's population up to 1926 could be obtained. The first scientific census was to be undertaken in 1927. It is estimated that the population fell in 1923 and 1924 to 700,000 as a result of war mortality and the departure of Greeks and Armenians. No reliable estimates of the Christian exodus are available, except in the case of the 70,000 Greeks who came to the city after 1918 and who were included in the scope of the agreement for the exchange of populations. It is presumed that altogether some 100,000 Greeks and 60,000 Armenians have left. In 1925 the population increased by about 100,000, owing to the transfer of large numbers of Turks from Greece. Although substantial Greek, Armenian and Jewish communities still remain (Greek—175,000; Armenian—60,000 to 70,000; Jewish—50,000 to 60,000) the population is much more nearly homogeneous and preponderantly Turkish than ever before in the history of the city.

Trade.—The trade position was seriously undermined by the succession of political cataclysms. During the World War foreign trade was almost completely extinguished, but in 1919 and 1920 the city performed for a brief period a rôle in keeping with its natural situation—that of a port of transit for commodities shipped to Russia, Rumania and other parts of the Black Sea littoral. A sudden cessation of buying and an acute fall in prices occurred in 1921, and for three years the city was in the throes of an economic depression so severe that many predicted it would never recover. But very definite improvement was evident in 1924 and in the first months of 1925, and still more substantial progress was made in the latter half of that year.

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(H. Sc.)

CONSTANTSA (*see* 7.11), the chief port of Rumania, is in the Dobruja and had in 1914 a population of 27,662, an estimate in 1924 being 65,000. Building has been carried on fairly extensively since 1910, but even in 1925 the public services were poor much of the town was in darkness at night in 1924, owing to shortage of electric current, and the water supply from the Danube was irregular. The industries are few and small, though a glass factory was started in 1924; the communications are poor; and the facilities for loading and unloading in the port inadequate, though the main quay, destroyed during the World War, was rebuilt. In 1925 the port provided 28 berths for general cargo and 6 for petroleum ships, with 37 oil reservoirs, connected by pipe-line with the Wallachian oil fields. The actual tonnage was rather more in 1925 than in 1913, but the number of ships entering has decreased since the War. Much damage was done to Constantsa before its evacuation by the Rumanians in face of the Austro-German advance, and the pipe-lines were destroyed.

CONSUMPTION: *see* TUBERCULOSIS.

CONTINUATION SCHOOLS (*see* 26.489).—Early in the 19th century, it came to be recognised in Great Britain that the existing elementary schools could no longer satisfy the national educational needs, which had increased considerably through the immense social and economic changes brought about by the Industrial Revolution: accordingly, attempts were made to supplement their work by that of night schools for persons fully occupied during the daytime. Under the influence of such men as Dr. Birkbeck and Lord Brougham, Mechanics' Institutes were founded with the object of giving the new race of factory workers instruction in the scientific principles in workshop practice.

Early History.—These institutes at first attracted large numbers of artisans, but their popularity amongst working men

quickly declined; one of the most important reasons for this was that the elementary education of the workman was in general not sufficient to enable him to profit by the instruction provided in science and mathematics. Other organisations, including "night schools" taught by elementary teachers came into existence and were carried on for many years without any public assistance. In 1851, however, the Government decided to make additional grants to elementary day schools which held continuation classes and the number of these increased steadily until 1870, when they had more than 80,000 students. Elementary education became compulsory after 1876 and the attendance at night schools declined for a time; the attendance increased, however, after the removal by the evening school code of 1893 of the previous age limit of 21, and of the requirement that all scholars should be instructed in elementary subjects.

The Act of 1902.—Side by side with these night schools, there were in existence from 1856 state-aided classes in science and art. There was, however, no definite connection between the two: the "night schools" were carried on by the managers of elementary schools and aided by the Education Dept.: the science and art schools were conducted by voluntary committees and aided by the Science and Art Department. After the fusion of the Education Dept. and the Science and Art Dept. into a single Board of Education, steps were taken in 1901 to secure some connection between the two groups of schools. When the Education Act of 1902 placed the responsibility for both elementary schools and schools for "further education" on the county and county borough authorities the continuation schools began to be organised in a definite relation to the technical schools, as the science and art schools had come to be called.

The technical school and the continuation schools in a single area are now commonly directed as an organised system by the principal of the technical school; and, even where this is not the case, the continuation schools exist partly, though not solely, for the preparation of children who have left the elementary school at 14 for entrance at 16 to the more specialised instruction of the technical school. The course of instruction usually requires attendance at school for three evenings a week from Sept. until Easter. For boys who are in industrial occupations, instruction is usually given in mathematics, technical drawing, science and English, since every boy to be engaged in a skilled occupation should be familiar with workshop calculation and workshop drawing, have some understanding of natural phenomena and be able to express himself readily and accurately either orally or in writing. For those in commercial occupations, the instruction includes English and arithmetic, together with subjects of a more vocational character. For those not needing vocational instruction, general and domestic courses are provided.

Statistics.—During the year 1922–3—the latest period for which statistics are available—there were 118,974 boys and girls between 12 and 15 years of age attending evening schools; during that year the number of children of the same age-range who left elementary schools on or after becoming exempt from school attendance was 491,592.

Act of 1918.—The Education Act of 1918 laid upon local authorities for higher education the duty of establishing and maintaining day continuation schools in which suitable courses of study, instruction and physical training extending over 320 hours a year were to be provided for all persons between 14 and 18 not attending other schools: attendance at these schools was to be compulsory and free. During a period of seven years from the "appointed day" for each authority attendance was, however, to be compulsory only on children from 14 to 16 and for a period of 280 hours a year.

A number of authorities, including the London County Council decided to exercise their powers at once and proceeded to establish day continuation schools: accordingly in 1921–2 there were in the country 122 of these schools with 95,530 pupils. During the next year all the authorities except Warwickshire (Rugby) discontinued, for financial reasons, their compulsory schools, and replaced them, in some cases, by schools at which attendance is voluntary: the number of day continuation schools during 1922–3 had diminished to 82, with 23,317 pupils. Usually, the curriculum has no decided vocational bias, but resembles very closely that of the evening continuation school, even when, as sometimes happens, the pupils are nearly all engaged in the same industry or are employed by a single firm (*see* EDUCATION). (A. AB.)

IN THE UNITED STATES

In the United States continuation (or compulsory part-time) schools are now (1926) found in more than half the states, the age of required attendance reaching 17 or 18 in several states, as New York, California, and Wisconsin. Generally, however, four to six hours of daytime attendance per week is required for all employed young persons between 14 and 16 years of age.

The first state to establish compulsory continuation schools was Wisconsin (1909). Before 1915 Massachusetts and New York had enacted legislation permitting any community to require such attendance. All other state legislation has been enacted since 1915, and very generally its application is now state-wide, leaving no option to local areas.

American interest in continuation schools derives from several sources. As far back as the middle of the 19th century the decay of apprenticeship as a means of superior technical training led to the foundation of "Mechanics' Institutes" in many cities. These inspired the extensive establishment of public evening classes, especially in industrial centres. But evening classes, valuable as they might be for young adults, seemed poorly adapted and inhumane for juvenile workers.

Investigations made in Massachusetts (1905), New York (1919), and elsewhere very generally indicated: (*a*) excessive withdrawal from schools of poorly equipped juvenile workers between 14 and 16 years of age; (*b*) unsuitability of evening classes for their needs, and (*c*) possibilities of either full-time or part-time training, for industrial pursuits or for still much needed general education of part-time day attendants. The successful examples of Bavaria, Saxony, Baden and Scotland in providing such schools were carefully studied. The passage of the (English) Education Act of 1918 served as an additional stimulus.

Continuation schools are now generally administered by city and town school authorities, but with exceptional state and some Federal supervision because of the fact that relatively large proportions of their support derive, not from local funds, but from state and (under the Smith-Hughes Act) Federal sources. A few cities (notably Boston, Milwaukee, New York and Newark) have established central schools exclusively for continuation-school pupils. In some cases classes are maintained in commercial or industrial establishments employing large numbers of workers within the required attendance age.

The difficulty of providing competent teachers for continuation schools has heretofore prevented the public from having anything like a full realisation of their possible benefits. Classes or groups formed in continuation schools are necessarily more heterogeneous than are classes in ordinary public schools. Each teacher must meet from 150 to 300 pupils per week, with a consequent dispersion of personal contact and impairment of understanding. Theoretically, at any rate, the subjects taught should be very differently organised from subjects of similar names in ordinary public schools.

The problems of appropriate curricula have been found still more complicated. Doubtless many of the earlier supporters of compulsory part-time schools believed that these schools would solve problems of vocational training. In practice they have done so only in a limited number of instances. On the other hand, at best these schools have been found very efficacious in making more real and significant such kinds of general education as pupils had already had, and also in keeping them in touch with school procedures in such ways that many have returned to full-time schools.

Authorities still differ considerably as to the actual educational functions that should be made the primary objectives of these schools. One group favours a considerable range of studies, even though profound learning is not practicable within the

limits of the time available. Another group favours much concentration on the part of individual pupils according to bent, outside employment, possibilities ahead and the like. In the meantime, minority groups of dissatisfied employers or parents in certain states have made many attempts to repeal the legislation establishing continuation schools. In practically no instance have these attempts succeeded. It is therefore reasonable to assume that continuation school education has finally been adopted as an integral and important part of the American public-school system. (D. Sn.)

CONTRACEPTION: *see* BIRTH CONTROL.

CONTROL, INTER-ALLIED.—The national controls of shipping and commodities, especially foodstuffs, which gradually developed in each combatant country throughout the World War were, during its last years, linked together in a comprehensive international system. This international control was a counterpart of the unity of military command which was achieved at about the same period, and it was among the decisive factors in the issue of the struggle. It was different, not only in its enormous range and extent, but in the principles of its organisation from anything previously known in administration. And it has had a profound effect on the developments of the methods and machinery by which post-War world problems are now handled. For these reasons it deserves more attention from the student of political and economic science than it has yet received.

A full account would need to describe not only the purely international system but the national organisations in all the countries concerned on which it was based, and through which its decisions were translated into action. The present brief account will describe the international machinery, and it will give a short account of the national controls in Great Britain, without which the international system is scarcely intelligible.

It will deal only with the arrangements designed to secure the supplies of the Allies, and not with those designed to intercept the supplies of their enemies (*see* BLOCKADE). No consideration is needed of the system in Germany or the countries allied with her, for her unchallenged predominance in her own system made any real international organisation unnecessary; nor of the controls in neutral countries which were separate and independent.

Controls before the War.—Before the War most of the organised and continuous international activities of the world were on a voluntary basis. When we turn from the sphere of voluntary to that of official action we find that international organisation was of the most modest and limited character. There were a few institutions devoted to scientific research and not involving executive action, like the Institute of Agriculture at Rome, and some others with power of action, but of a very definitely restricted or intermittent character, like the Danube Commission or the Postal Union. But the official organisation of the world was essentially national. Except for such secondary and strictly limited tasks as those just mentioned, there was no permanent machinery of international administration or even consultation. Where agreement between countries was needed negotiations were conducted through the Foreign Offices and their embassies. Conferences were arranged from time to time, but these were improvised for special tasks, leaving no nucleus of permanent machinery when these tasks were finished. It is necessary to bear clearly in mind this almost exclusively national character of the official organisation of the pre-War world, if we are to understand the significance of the fundamentally different Allied system during the War and the development of international machinery which succeeded it.

At the same time such bodies as the Danube Commission were, within their restricted limits, independent and autonomous authorities. Once they had been established by agreement between the governments concerned they were independent of those governments and of their administrations for the conduct of their current work. They possessed sufficient delegated authority to act without reference back to the governments by which they were originally constituted. This was only possible because of the narrow range of their task and the fact that its execution did not seriously affect national policies.

The War organisation was in the nature of the case fundamentally different from this. The essence of its work was to guide and direct the vital supplies system of the Allies, which was a basic factor in the national policy of each country. No international authority could, under these conditions, have been entrusted with delegated powers independent of, and overriding, the national governments. The principle of the new system therefore was to link together the national systems. Every international control was based on national control. It would indeed be more correct to say that the national controls were incorporated into an international system than that a new system was created. It is for this reason that we must begin by understanding the national controls, particularly in Great Britain, which was the main centre of the Allied supply organisation.

I. THE BRITISH SYSTEM

We are all familiar with the ordinary economic system by which supply and demand were adjusted before the War and which afterwards was being painfully and with modifications re-established. Its essential characteristic, so familiar and yet so wonderful, is that it works itself. The equation is balanced without any human brain understanding it or needing to understand it. Over the whole range of human activities and human need, production is adjusted to consumption by a process which is automatic, elastic and responsive. If the public demands more of any article than the market can at that moment supply, prices rise. Those least willing or least able to pay the higher prices abandon or defer their purchases. A little later the higher profits encourage greater production. Neither consumer nor producer need calculate by how much consumption need be reduced or production increased. Each finds his sufficient guide in the changing price level. The adjustment is thus effected by a mechanism which registers and expresses the desires of myriads of consumers, not by the individual decisions of a few who judge between these desires and direct accordingly.

But for the conditions of War needs and shortage this system, independent of deliberate direction and control, proved blind and wasteful. It produced too little, it produced the wrong things, and it distributed them to the wrong people. It produced too little. It had, it is true, the spur of individual enterprise and individual profit. But the exact adjustment to the individual taste of the consumer effected by the ordinary economic process involves the allocation of an enormous proportion of work to what may, in the widest sense, be called distribution as distinct from production. Marketing is as important, and as expensive, as making. In war, however, the state can make its own demands in mass. It can order direct, and without middlemen. And the commodities which the individual consumers need, and all that in a national crisis they should have, are the necessities of life for which the demand exceeds the supply. For these conditions, the economic system, surveyed from the central point of view of the country's necessities, was seen to be swarming with middlemen who had suddenly become superfluous. Under these special conditions of mass orders by the Govt., and a pressure of demand from the civilian population, which transformed the problem of marketing into one of rationing, the economies of central control proved enormous.

Similarly the ordinary economic system, by the new standards of the country's necessities, produced the wrong things and distributed them to the wrong people. Its criterion was not essential need, but effective economic demand. Under conditions of national shortage this criterion is no longer a tolerable one. With production reduced by recruiting, the manufacture of luxuries will compete with supplies to the front. With only bread enough for bare physical needs it will cause alternate surfeit and starvation.

Under the special conditions of the War the normal mechanism of the adjustment of supply to demand thus proved inadequate. It failed to respond to the imperative need for intensive production, for selection between the essential and the superfluous, for a tolerably fair distribution. Within a year the delicate machine was smashed. In its place the constructive brain had to build

rapidly something to replace it; to survey needs and resources as a whole; to measure the relative importance of food beyond a certain amount, and of munitions beyond a certain amount, when more or both were wanted but, through shortage of production, of transport or finance, more could not be supplied. So, one by one, the necessities of life were brought under control, their purchase centralised, their transport allotted, their prices fixed, their consumption rationed.

And, for the central problem of this huge task, there was no expert knowledge to draw upon. No one before had had to weigh the competing claims of munitions, of raw materials and of food; to decide up to what point each should be met at the expense of the others; and in accordance with his judgment to determine. For this new task the skill had to be developed, the experience acquired, the organisation improvised.

The new system was not introduced full-fledged on any recognition of such general principles as have just been indicated. On the contrary it was applied piecemeal, gradually and often with obvious reluctance, to one commodity after another under the compelling force of a breakdown of the peace system. Usually, though the order varied from commodity to commodity, the first motive was to save the Treasury the expense of inflated competitive prices for war materials, then to mitigate the public indignation at similar prices for their own purchases, and lastly the need of distributing equitably what had become a bare sufficiency of the necessities of life.

Sugar.—The first commodity to require action was sugar. Over three-quarters of British supplies in 1913 were drawn from Germany and Austria-Hungary. War therefore threatened immediate shortage. The Govt. acted promptly, and within the first three weeks of the War had made large purchases and appointed the Royal Commission on Sugar Supplies. The loss from Austria and Hungary was made good from the West Indies, Cuba and Java. The Commission arranged distribution throughout the trade, allotting amounts and fixing prices. At first it was found sufficient merely to instruct the retailer to sell at a certain price under penalty of the stoppage of supplies. But later the distributing trade became in effect the agents of the Govt. selling on public account at a fixed rate of profit. And ultimately the Ministry of Food rationed the individual consumer.

Wheat and Flour.—For a time wheat was bought, and bread made, under the normal system. The problem was less urgent and more intricate than that of sugar. For wheat was partly produced at home, and the balance was drawn, not from enemy countries, but from Dominions or neutrals whose supplies were still available up to the limits of finance and sea transport. Supply through private enterprise continued, and on the whole successfully, though at rising prices, until 1916. In that year difficulties of supply and of transport compelled the Royal Commission on Wheat Supplies to undertake the complete control of purchase and importation on the same principles as the Sugar Commission. In the following year control was extended from the comparatively simple task of purchase to the infinitely more intricate task of distribution; and it included not only sugar and wheat, but all the prime articles of food, other cereals as well as wheat, fresh as well as frozen meat, oils and fats and the scores of subsidiary foodstuffs.

In the same year most of the external arrangements were also put upon an official basis. The Australian and Indian governments already sold as governments, making their own internal arrangements with the individual producers. But hitherto the sellers in America had been the private trade. In June 1917, however, a Canadian Food Controller was appointed and in Aug. the American Food Controller obtained power to fix prices. Henceforth wheat was bought from Canada and the States, from Australia and India alike on the basis of bulk agreements between governments. The Argentine was the only producing country of the first importance still outside the system of official control.

Munitions Supply.—The same process of increasing control, each new step forced partly by the inadequacy or expensiveness of the private system and partly by the consequences of partial measures already taken, is to be seen in the sphere of munitions supply, which quickly absorbed practically all the metal imports and engineering resources of the country. When war was declared a few guns and rifles were being made at Woolwich and Enfield, a few explosives at the Royal Powder Factory. But even the small Expeditionary Force was largely dependent on private manufacture, and neither public nor private factories could cope with more than the smallest fraction of the new requirements. Gradually the Ministry of Munitions, created in June 1915, brought under its authority the manufacture of munitions throughout the country, developing new resources, building its own factories and controlling in every detail the manufacture in private establishments. For the latter purpose an intricate system of "costing" (afterwards a main feature of the food control) was devised, *i.e.*, a system of ascertaining the exact cost of each operation under different conditions of manufacture. The price of the finished article was then limited to this cost plus an addition giving a sufficient margin of variable profit to encourage rapidity of output.

The way in which the Govt. was forced on from step to step is well illustrated by the Ministry's experience with steel. Action was first forced by the necessity of limiting prices. The War Office was buying for Woolwich, Enfield and the army repair shops, private firms were buying for public and private work. The state was thus directly or indirectly bidding against itself through hundreds of different agents. The Ministry began by fixing a maximum price for shell steel. The immediate consequence was that "commercial steel" fetched prices more attractive to manufacturers and shell steel suffered. Prices had therefore to be fixed for all classes of steel alike. It then became necessary to arrange the distribution of the steel available among all the many departments and factories who needed it, whether for military or civilian work, because, once prices had been fixed, the automatic regulator of the price level was gone, and nothing but deliberate allotment could decide who was to get the steel available. Thus the Ministry was forced to a general survey of all resources, both foreign and internal, and of all needs, both public and private. With an infinite variety of method the Ministry extended its grasp over all the raw materials required for munitions, over the metals, both ferrous and non-ferrous and over the chemicals required for explosives: iron, ores, copper, zinc and spelter, lead, tin, platinum, aluminium, oils, nitrates, coal-tar, etc. By the end of 1917 the national system was practically complete for both metals and food, and the two great Ministries ultimately brought under their direct authority 70% of the national imports. (*See* MUNITIONS OF WAR.)

War Office Control of Raw Materials.—Many of the remaining raw materials were being simultaneously dealt with by the War Office. Wool, flax, jutes, hides and leather were required for uniforms, for tents, for sandbags, for saddles and boots. If these raw materials had been left under competitive conditions, no firm contract could have been made with the manufacturer of the finished article, for he could not estimate within wide limits one of the main factors in his costs. The War Office, therefore, purchased the raw materials in bulk. This, however, necessitated monopoly of purchase; otherwise private competition, under the conditions of shortage, would again have driven prices to fantastic heights. But, monopoly once obtained, the responsibility was thrown direct upon the Govt. to decide what quantities should be allotted for civilian consumption and under what conditions. The easiest method would, of course, have been simply to sell to the trade and let the trade deal with the different manufacturers. But, since the supplies available were far short of the full civilian demand, this would have meant exorbitant profits for the trade and intolerably high prices for civilian clothing and boots, etc. The War Office, therefore, supervised in detail the supplies of the whole country. They fixed the prices at which the manufacturer obtained his raw material and sold to the retailer, and at which the retailer sold to the public.

Board of Trade Control of Other Commodities.—Meantime, more slowly, less completely and by more commercial methods, the Board of Trade brought under its authority the remaining imports: timber (through a timber controller), tobacco, cotton (through a committee formed by the trade at Liverpool), paper and pulp (under a paper controller).

Ultimately over 90% of the imports of the country were handled by the Govt. or by committees acting for them, and through them the uses to which they were devoted were directed in the public interest. The system, with an enormous variety of method and expedient, was uniform in its main principles and, before the War ended, astonishingly complete and effective. The home Govt. bought in bulk from foreign countries, often from their governments or at prices fixed by them, and requisitioned at fixed prices the home supplies. With the raw materials thus in their hands they directed the uses to which they should be put, the distribution and the price of the finished article. The great bulk of the producing and distributing trades of the country, while working under their normal processes and methods of internal organisation, had become agents of the Govt., selling on public account on the basis of commission.

So much for the British control of commodities. With varying methods and varying efficacy national control was similarly established in Allied countries. These separate national controls were, as we shall see, the essential foundation of the joint Allied control which developed from them.

Merchant Shipping.—But, if we are to understand the process of this development, we must first consider one more control, which the submarine made the centre of the whole system, the control of merchant shipping.

A few statistics will show in a moment why shipping became the centre of the international supply organisation, and why London was its inevitable headquarters. Before the War the communications of the world were maintained by some 8,000 ocean-going ships. Of these over one-third were destroyed by

the submarine. New building could make little compensation for these losses till 1918, when the immense increase in American building, combined with the successful protection afforded by the convoy system, began to redress the balance. And while the supply of shipping was thus reduced, the need of transport, for troops, for munitions, for the raw materials of the armies' supplies, was immensely increased. The result was that the total supplies of Great Britain and her Allies depended upon how much they could transport, and the character of these supplies on the way in which the available ships were allocated. And of the 8,000 ships the British Empire owned over 4,000, France, Italy, Belgium and Portugal owning barely 1,000 between them.

At the outbreak of War the Govt. at once requisitioned, at fixed prices, the ships it needed for its own direct requirements: liners for the transport of troops and colliers for the conveyance of coal to the fleet. Outside such requirements, however, the market was for the time left free. The way in which those entrusted with this power of requisition were gradually forced to extend their control over all shipping, and through it over all supplies, first national and then Allied, the expedients by which, with legitimate reluctance, they attempted to escape or postpone this immense responsibility, and the mechanism of control which was at last developed, form one of the most interesting tales in economic history. It can be only briefly summarised here.

The withdrawal of requisitioned tonnage for the transport of troops and army and navy supplies caused an immediate shortage and drove up freights. The higher freights drove up all prices; and comparative luxuries began to outbid necessities. Attempts were made for the first two years or so to meet this difficulty without controlling all ships and supplies, by a system of prohibiting or limiting certain classes of less necessary imports. This system, however, failed as the submarine became more successful; for the extent to which whole categories of imports can be classed as unnecessary is very limited. Moreover, as one commodity after another was controlled by the Govt., it was natural that transport should be arranged in requisitioned tonnage. With every such new extension the area of competitive chartering became reduced; and within the area of requisitioned transport the regulator of freight rates had necessarily disappeared. When sugar and cereals and munitions were all government commodities, when all were carried in requisitioned ships, and when there were not enough ships to go round, the Govt. alone could decide how much tonnage should go to each. And if the Govt. as a whole did not decide, the responsibility necessarily fell on those entrusted with the allocation of the ships, a responsibility for which they felt unfitted, which they were reluctant to assume, but which they could not escape.

The years 1915 and 1916 saw a series of expedients designed to mitigate or share this responsibility. A Ship Licensing Committee, a counterpart to the Prohibition of Imports Committee, restrained some ships from obviously unnecessary work. This was useful so far as it went, but it was not far. The shortage remained. When the shortage bore hardly on wheat imports, ships were directed into the wheat trade. The wheat trade was thus helped, but other essential trades only suffered the more. Finally in 1916 a Shipping Control Committee was formed, with Lord Curzon as chairman, to ease the burden on the shipping department. They attempted to increase enormously the list of prohibited imports. But their programme was too summary, too much based on purely shipping considerations and too little on a detailed examination of all the uses for which the imports they proposed to prohibit were needed, for which neither they nor anyone at that time possessed the necessary knowledge. They felt unable to undertake the detailed survey of all requirements without which allocation of shipping was a mere groping in the dark. And this expedient, too, failed with its predecessors.

Shipping Control the Pivot of Other Controls.—Meantime the extending control of commodities by a few great government departments was preparing the way for the real solution. In all the big supply departments, as we have seen, specialised experts were incorporated in the official machine. Day by day they were testing the requirements of each industry by the criterion, not of market prices (which control abolished) but of intrinsic importance in the general scheme of national policy. All under the daily pressure of insufficient finance, or of available resources, or of transport, were becoming more expert in distinguishing the essential from the merely useful. And the whole system was becoming centralised. The separate controls were soon nearly all grouped under four central authorities: the War Office, the Ministry of Munitions, the Ministry of Food and the Board of Trade. The Ministry of Shipping, therefore, no longer had to deal with innumerable demands from hundreds of private industries, nor even directly with a score of government controls, but only with a few great Ministries, which presented comprehensive programmes covering between them almost the whole range of imported supplies. A new committee, the Tonnage Priority Committee (Feb. 1917), presided over by Sir L. C. Money, the Under-Secretary in the Ministry of Shipping, included the executive officials from each of these great departments and advised the Ministry in the allocation of ships.

The Milner Committee.—The problem of organisation as a national one was now near its solution. It needed one further development. After the intensive submarine campaign of 1917, the allocation of tonnage became the crucial factor in the policies of the great supply departments, particularly those of Munitions and Food. The decisions involved in modifying programmes of supply exceeded the authority of the officials of whom the Tonnage Priority Committee was mainly composed. By the end of the year, therefore, a standing Cabinet Committee was formed under the presidency of Lord Milner, on which both the great supply departments and the Ministry of Shipping were alike represented by their ministers, attended by their chief officials. At this committee the competing claims for tonnage were fought out and in main principle decided. There was at last a mechanism, a central committee of supreme authority, and behind it centralised and co-ordinated commodity controls, by which the nation's requirements as a whole were surveyed, adjusted and directed. The problem of national organisation was solved; and with it was secured the foundation of the wider international organisation which was to follow.

II. THE INTERNATIONAL SYSTEM

For, from the beginning, the real problem was international as well as national. And the need for common action developed as the stress increased. France and Italy were buying supplies in the same neutral markets, and they needed transport from the same interchangeable pool of tonnage under British and Allied control. We must now follow the steps by which the international machinery necessitated by these conditions was built up.

Shipping was the centre of the final organisation, because in the end shipping was the "bottle-neck" of the whole supply system. But it had little to do with the early first efforts at Allied co-operation, because in the early part of the War the Allies wanted many things which Great Britain could best supply —guns, shells, uniforms, equipment of every kind, more than they needed ships. Above all they needed money, for money could buy all these things and, in 1914, most easily of all the use of ships to carry them.

Allied Purchases in London.—The first trouble to deal with was that the arrival of hundreds of Allied agents in England placing orders with private manufacturers in competition both with each other and our own War Office meant confusion and waste of every kind. To prevent this a body known as the Commission Internationale de Ravitaillement (C.I.R.) was established in London in 1914. It included representatives of the Allied purchasing departments and distributed their demands among British manufacturers with due consideration of similar British orders. It served a useful purpose in restraining prices, and to some extent in pooling knowledge and experience. It was, however, an essentially British organisation to help Allied purchasers. It was formed to co-ordinate purchases in Great Britain. It was under British direction, and obtained its effectiveness from the fact that the purchases were made with British credits. At the

same time it was already a notable step in Allied co-operation. In ordinary times if the French Ministry of Commerce needs to arrange something with the British Board of Trade, *e.g.*, about shipping, it transmits its request through the British embassy in Paris, or the French embassy in London, to the British Foreign Office, who in turn send it on to the Board of Trade. The reply comes by the same channel, so that the communication between two specialised departments passes four times through the hands and pens of non-specialists—or to be more exact of those who are specialised not in shipping but in the foreign relations of the two countries. The principle of the system, and a natural one for ordinary times, was that if British and French departments needed to discuss shipping the primary fact was, not that shipping was the subject, but that it was France and Great Britain who were discussing. It was often a convenience to set off, say, a shipping concession on the one hand against a concession of quite another kind, perhaps political. This could only be done by those dealing with the general foreign policy of their countries.

But in War this procedure was obviously unsuitable. The intricacy of detailed administrative arrangements required direct contact between specialised ministers and officials of the different countries and the common interests of Allies clearly outweighed their divergences. We shall see, as we follow the development, how these two dominant facts gradually compelled the creation of quite a different system, of which it was a principle that a French official wanting British ships was primarily a person wanting ships from someone who could supply them, and not primarily a Frenchman negotiating with an Englishman. The common interest made it unreasonable to make arrangements about food or munitions or ships mere items in general policy between Great Britain, France and Italy, and their technical and complex character made it impracticable. The differences of interest remained, but they were fought out each in their own sphere between the appropriate specialists.

The C.I.R., although still on a national basis, already began the inevitable development towards this end. At first the British representative in the C.I.R. would collect Allied demands, centralise them and then himself deal with the British officials in the supply departments. Then he would bring the Allied supply specialist with him. Then he ceased to come himself. "Direct contact," the principle of the final system, was established in individual cases. It still needed to be developed and organised into a system.

Shipping assistance from Great Britain to the Allies was in 1915 and 1916 rather improvised than organised. Great Britain managed her own shipping programme. If appealed to for help she did her best to deal with the case on its merits. It was a haphazard method of emergency assistance not unjustified in the earlier part of the War, when shipping was among the least of the Allied problems. But as the pressure increased, more regular methods became necessary under much the same compelling forces as we have seen operating in the establishment of national controls. The Allies were for example all chartering neutral ships. At first they competed against each other. An Inter-Allied Chartering Executive, formed to prevent competition, was successful in preventing the Allies from rushing up the rates against themselves and each other, but it did not touch the question of how they should be allotted and employed.

The British Shipping Control Committee, formed Jan. 1916, tried to establish principles to guide the allocation of British ships to the Allies. It failed for the same reasons which made it unsuccessful in dealing with the internal British problem. It knew too little about British needs and less about those of the Allies. A year later (Jan. 1917) an advance was made by the creation of an Inter-Allied Shipping Committee, which included representatives of Great Britain, France and Italy, and attempted to survey the shipping needs of the three countries. This experiment again failed, partly because it was still not fully recognised that, in allocating shipping in time of serious shortage, knowledge of shipping is the least of the difficulties.

The important thing, infinitely more intricate, is a knowledge of the supplies which require transport and the uses for which these supplies are needed; and at this date the national work in organising supplies in the different countries was insufficiently developed to enable a central committee to make an adequate survey. But the committee was also constituted on a wrong principle. It included neither ministers with power to bind their governments, nor the officials responsible for the daily work of arranging ships. An effective system required both. Though nominally "Inter-Allied" it was essentially a committee of Allied representatives negotiating for the grant of British ships, not a body bearing a common responsibility for a task examined as a whole. Like most of the earlier experiments it had some limited and temporary utility, but was chiefly useful in suggesting by its own failure the principles on which a true Allied organisation must be built. Meantime the path of real progress was being suggested more positively by some international developments in the system of controlling not ships but commodities.

Inter-Allied Allocation of Supplies.—The British Royal Commission on Wheat Supplies, established as we have seen in 1916, found itself at once faced with all the evils of competitive purchase in the same markets by France and Italy. A most effective Allied Committee, the "Wheat Executive," was therefore formed to arrange for the wheat supplies of all three countries and their allocation by agreement. The benefits of co-operation were at once apparent. Combined purchase restrained the rise in prices, and there were other and greater advantages. The cereal specialists of the different countries settled among themselves the proportion of the total supplies each country should have. Henceforth those dealing with shipping could deal with cereal demands in the mass. They had no longer to weigh France's claim against Italy's, but only the competing claim of cereals as a whole against munitions, other food, etc.

The next development to follow on the same lines was the creation of a body (ultimately developing into the Allied Munitions Council) to survey Allied munitions requirements as a whole. This body not only dealt with the question of purchase and claims for transport of all the raw materials required for the manufacture of munitions, but with the allocation of manufacturing facilities and the finished product.

Allied Purchases in the United States.—With the entry of America into the War in 1917 a new authority was created which, but for the continuing destruction by the submarine, might have occupied the central position in the international control system, the "Inter-Ally Council on War Purchase and Finance." This was a council formed to co-ordinate the demands of European Allies for American credit. So far as America wished to restrict credit to less than the full amounts asked for, this involved an examination of the rival claims for the different supplies. Had therefore finance been the limiting factor, as on the whole it was until America's entry, this body must have dominated the whole supply arrangements. Apart from what their own resources could produce, the Allies would have had just such supplies as they could persuade America to give them credits for. But in fact, with America's entry, finance ceased to be a fundamental factor in the Allied position. For the new alliance as a whole was almost self-sufficient, and finance in such conditions is a matter of national legislation and inter-allied arrangement. Within a country, or within an alliance of which every member is determined upon victory, finance can be created in a moment by a vote of Congress or Parliament.

Ships, however, cannot be so hastily improvised. Shipping was already desperately short and the immediate effect of America's entry was rather to increase than to relieve it. Till the end of the War the total number of American ships in War service was indeed less than the number required to carry American troops and supplies. Under these conditions it was only for the most vital supplies that transport could be found, and for such supplies it was certain that American credits would not be refused. The real struggle was therefore to squeeze supply demands within the limits of available shipping, not within those of available finance. This meant that the shipping organisation was the centre of the system. The Inter-Ally Council on War

Purchase and Finance, though in principle of co-ordinate authority, in fact accepted the results of the decisions fought out on shipping.

We now come to the final impulse, deriving from the shipping scarcity and directed by the shipping authorities, which linked all the highly developed national controls and the more partial Allied organs into one comprehensive international system

Transport Crisis of 1917.—By the autumn of 1917 the pressure on shipping was greater than it had ever been; 17,000,000 tons dead-weight of the world's shipping had been lost, and less than half had been replaced. More shipping had been lost in the first 10 months of this year than in the previous 30 months of the War. American building had not yet seriously begun. The prospect of her vital contribution to the armed forces meant further demands on transport. And, apart from this, the demands were constantly increasing. All the distant expeditions, except to the Dardanelles, were fully maintained, and both troops and supplies were being sent to Salonica, Mesopotamia, Palestine and East Africa. Drafts were still required from Canada, South Africa, Australia and New Zealand. The scale of the War in France grew constantly, and the development in the character of warfare involved a larger expenditure of munitions. The navies were at their maximum strength. And serious food troubles throughout the winter and spring were anticipated in Great Britain, France and Italy alike.

The strain on the shipping authorities, while there was still no comprehensive Inter-Allied organisation fitted to determine priority between the different supplies, was in these conditions an intolerable one. At any moment the allocation of a batch of ships to food might mean a shortage of vital munitions, an allocation to munitions might entail starvation.

But by this time, as we have seen, the national organisation in the several countries, which was the indispensable condition of the Inter-Allied system, was at its full development, and in wheat and munitions partial international arrangements were already working. In Great Britain the Ministry of Shipping had full and effective control over every voyage and every cargo, and the whole system supply was centralised under the Milner Committee. A Standing Committee under M. Clémentel, Minister of Commerce, played a similar rôle in France. Italy's problem resolved itself practically into coal and cereals, and she had both of these as well as her shipping under complete control. Except, however, for consultation between munitions experts and the more fully developed Allied action of the Wheat Executive, these national supply systems were working with little knowledge of each other's needs. As regards most commodities there was still no means of judging fairly whether the standards of sacrifice and restriction were approximately equal or not.

The Allied Maritime Transport Council.—Those who realised the desperate position of shipping were convinced that it was now essential to develop and complete the system by extending Allied Committees like the Wheat Executive over the whole range of supplies, and linking them up by dependence for their transport upon a supreme Allied Shipping Council. On their proposal the necessary decisions were taken at the important Allied Conference which met in Paris in Nov. and Dec. 1917; and the Allied Maritime Transport Council, consisting of two ministers of the three principal European Allies and two delegates, was constituted and furnished with an executive organisation.

What was the nature of this new council and of the Allied Supply organisation which now developed rapidly round it? It is essential to realise that it was not a supreme authority acting with a delegated power enabling it to override the governments which created it. No body of men could have been entrusted with such power, and those who at this time proposed either the appointment of a council with supreme executive power or a single economic dictator, were misled by the military analogy or ignorant of the realities of the supply situation. A single decision of such an authority, a reduction in sugar or in wheat imports for example, would penetrate in its effects every civilian household in the countries concerned. No Cabinet could abdicate responsibility for such decisions and for their effects. The Paris Conference rightly therefore rejected the proposal of an "International Board with complete executive power over a common pool of tonnage." "It would," they explained, "be difficult for any country, and particularly for America or Great Britain, to delegate absolute power to dispose of its tonnage

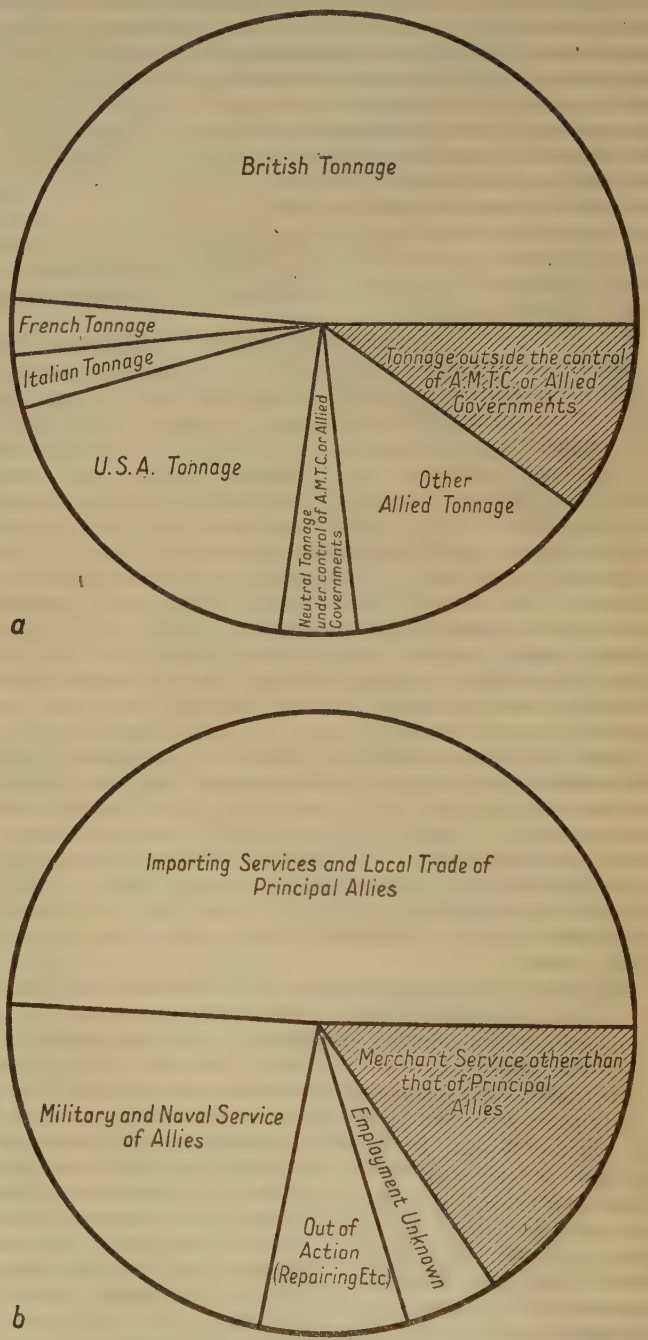
British Tonnage
French Tonnage
Italian Tonnage
Tonnage outside the control of A.M.T.C. or Allied Governments
U.S.A. Tonnage
Other Allied Tonnage
Neutral Tonnage under control of A.M.T.C. or Allied Governments
a
Importing Services and Local Trade of Principal Allies
Merchant Service other than that of Principal Allies
Military and Naval Service of Allies
Employment Unknown
Out of Action (Repairing Etc)
b

FIG. 1.—*a.* Extent of Allied Shipping Control, at the Armistice. *b.* Employment of World Tonnage, at the Armistice. (N.B. Tonnage covered by these diagrams consists of sea-going vessels of 500 G.T. and over.)

(which is the basis of all its civilian and military requirements) to a representative on an International Board on which he might be outvoted. Under such conditions executive authority, even if conceded in principle, would certainly have broken down in practice."

Its Constitution.—On the other hand, if the Allied Maritime Transport Council was not in principle executive, it was in practice much more than advisory. If the first was impracticable, the second would have been useless. How could the need for urgent and desperate decisions be met by a body which, when

it had itself decided, could only make recommendations to four governments and wait for their assent?

The solution of this dilemma, and it is the fundamental principle of the whole of the new Allied system, was found in appointing as members of the council the ministers who in their own countries had the right to decide, and in forming the executive organisation of the officials who in their own countries actually directed, or could effectively influence, the execution. This principle practically destroyed the distinction between the executive and the advisory. In principle the council was advisory. But, if the British Shipping Controller agreed as a member of it to a decision involving orders to British shipping, he gave effect to it as a minister in his own department. So, too, if the French Minister of Commerce agreed as a member to a decision involving a change in French supplies.

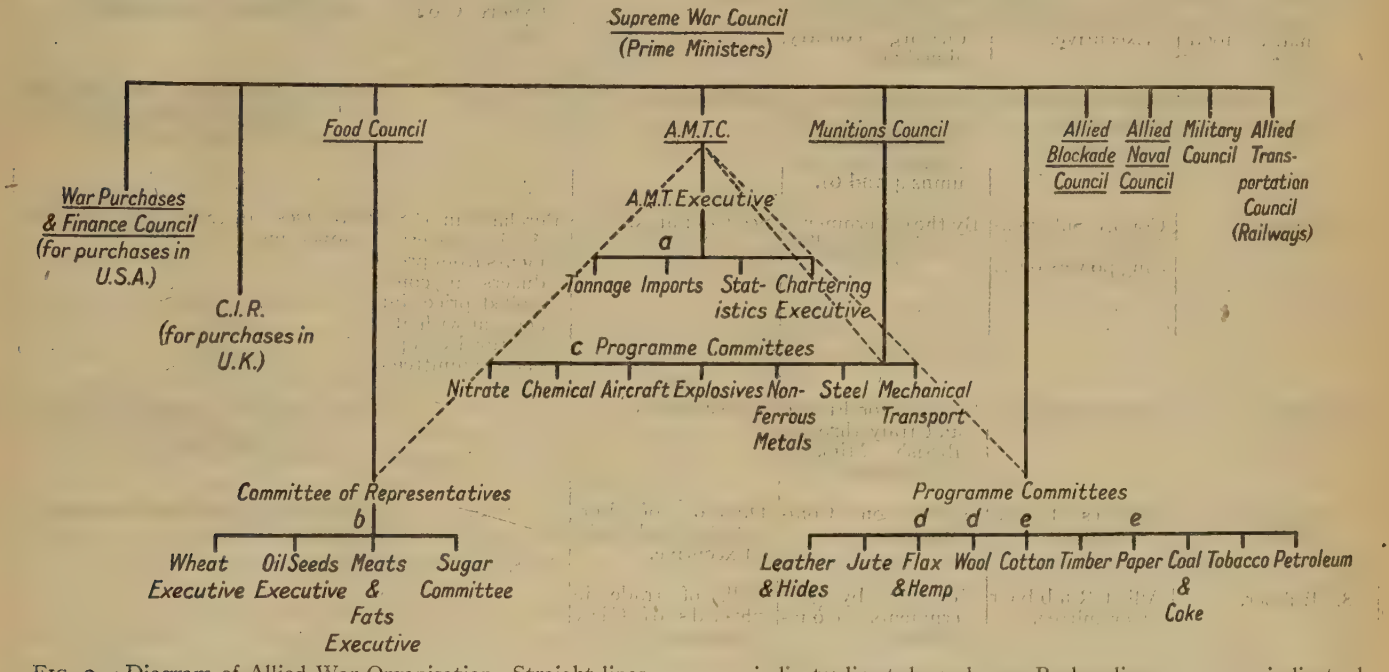

FIG. 2.—Diagram of Allied War Organisation. Straight lines ——— indicate direct dependence. Broken lines - - - - - - indicate dependence for sea transport. Councils underlined were composed of Ministers. Executives and Committees not underlined were composed of officials. The Ministers were usually those responsible for the Departments entrusted with the relevant national control, *e.g.*, the British Member of the Munitions Council was the Minister of Munitions. The officials were also usually officers of these Departments, *e.g.*, the British members of the "*a*" Committees were officers of the Ministry of Shipping; of "*b*" Committees, of the Ministry of Food; of "*c*" Committees, of the Ministry of Munitions; of "*d*" Committees, of the War Office, and of "*e*" Committees, of the Board of Trade.

Had this principle been confined to the ministerial councils it would have represented some advance, but a quite insufficient one. Departmental conferences of ministers had often taken place before. To develop these into councils with a regular constitution and periodical meetings would have been useful, but not decisive. Ministers meet for a day or two and return. On matters of such intricate and detailed daily administration as are involved by arranging supplies in war, no such occasional meetings can resolve the difficulties of diverging national interest. If ministerial decisions, often conveyed in ambiguous or over-simplified formulae dictated by the necessity of hurried agreement, are referred to different national administrations to execute, the old difficulties will recur in detail. The novelty of the new system consisted in the extension of this new principle, so far as was materially possible, to a series of committees of officials covering the whole range of shipping and supplies and responsible to the A.M.T.C. and two similarly formed Munitions and Food Councils.

Immediately under the A.M.T.C. was the first of these bodies, the Allied Maritime Transport Executive, of which, on the principle described above, the British member, who was the chairman, was the Director of Ship Requisitioning in the Ministry of Shipping, the French member the influential *chef du cabinet* of the French Minister of Commerce, the Italian an official of great influence in the Italian Supply departments, while the American was one of the American members of the council. The headquarters were in London, and the staff was grouped in four national divisions under the direction respectively of the four members of the executive. The council itself met only three times before the end of the War. But the executive met frequently, and in the long intervals between the council meetings was the instrument through which Allied co-ordination in the direction of shipping was secured.

In close association with this shipping authority, the supply authorities were linked together in "programme committees" created on a similar principle on the model of the Wheat Executive, and the more important of these were grouped under two great ministerial councils, the Munitions and Food Councils, formed on the same principle as the A.M.T.C.

Ultimately the whole range of imported commodities was covered by the following committees:—

Under the (Allied) Food Council:
1. Cereals (the wheat executive).
2. Oils and Seeds.
3. Sugar.
4. Meats and Fats.

Under the (Allied) Munitions Council:
5. Nitrates.
6. Aircraft.
7. Chemicals.
8. Explosives.
9. Non-Ferrous Metals.
10. Mechanical Transport.
11. Steel.

And (without being grouped under a similar ministerial council):
12. Wool.
13. Cotton.
14. Flax, Hemp and Jute.
15. Hides and Leather.
16. Tobacco.
17. Paper and Pulp.
18. Timber.
19. Petroleum.
20. Coal and Coke.

It had been intended to group these last nine committees under a Raw Materials Council, but this council had not been formed when the Armistice brought the development to a end. The organisation may be shown in diagrammatic form (see fig. 2).

These committees secured combined Allied plans on all questions within their respective spheres on which combined action was necessary. Their character, authority and the range of their duties varied greatly from article to article. The most important had duties independent of arranging agreed demands

TABLE SHOWING THE ORGANISATION OF INTER-ALLIED CONTROLS

1. Commodity	2. Inter-Allied Body	3. Method of Purchase	4. Purchasing Body or Bodies	5. Represented in United States by	6. Represented in certain other countries as follows:
1. Wheat.	Wheat Executive.	Single buyer.	Royal Commission on Wheat Supplies (British).	Wheat Export Company of America.	Canada: Wheat exporters. India: Controlled firms. Argentine: Controlled firms. Brazil: Controlled firms. Russia: French Commission.
2. Sugar.	Inter-Allied Sugar Programme Committee.	Single buyer in London and from International Sugar Committee in U.S.A.	Royal Commission on Sugar Supplies (British).	Representatives of Royal Commission on the International Sugar Committee.	In addition to purchases made as in column 3, the produce of some small British colonies was secured through the British Colonial Office.
3. Meats and fats, covering many foodstuffs.	Inter-Allied Meats and Fats Executive.	Purchasing Organisation in each procuring country aimed at.	Various.	Allied Provisions Export Committee.	British Colonies and also Argentine by the British Government.
4. Oil and Oil-seeds.	Oil and Oil-seeds Executive.	Purchasing through A.P.E.C. or the governments concerned (see columns 4 and 6).	The Executive.	A.P.E.C.	British and French Colonies by the respective governments. Brazil by agents of Wheat Commission.
5. Copper.	Copper Sub-committee, allocating powers only.	By the governments requiring supplies.	See Column 3.	Purchase in U.S.A. by governments from producers at controlled price, in account with allocation by Copper Committee.	Purchases in Spain by British Government.
6. Tin.	Tin Executive.	Supplies for France and Italy through British Ministry of Munitions.	Tin Executive.	..	The Executive generally represented in the producing countries by controlled firms.
7. Nitrate of Soda.	Nitrates Executives.	Agents on Commission.	Director of Purchases under the Executive.	..	Special agreement with the Government of Chile.
8. Rubber.	Allied Rubber Committee.	Generally by governments concerned.	Bulk of trade in hands of City merchants.	..	..
9. Wool, hair and products of wool and hair.	Wool Programme Committee (Advisory).	Australian and N.Z. clip bought by British Government, otherwise trade channels.	..	..	France partially controlled prices and quantities through Inter-departmental Wool Committee.
10. Cotton.	Cotton Programme Committee.	Usual trade channels except for Egyptian crop.	..	..	Egyptian crop bought by British and Egyptian governments.
11. Jute, hemp and flax:— (*a*) Jute.	Jute, Hemp and Flax Programme Committee.	Purchase by British Government from leading jute firms.	..	..	..
(*b*) Hemp.	Jute, Hemp and Flax Programme Committee.	British Government purchase for European Allies.	..	..	Controlled firms in Manila.
(*c*) Flax	Jute, Hemp and Flax Programme Committee.	Local Allied representatives at Archangel.	..	..	Informal Inter-Allied buying arrangements at Archangel.
12. Hides and Leather.	Hides and Leather Programme Committee (an Executive under consideration.)	British Government purchase in India through Buying Committee of British firms in Calcutta.	Great Britain and United States control the market (chiefly India and Argentina).	..	..
13. Timber.	Timber Programme Committee and Commission Internationale d'Achats de Bois.	Purchase centralised in Italy, France, Gt. Britain, C.I.A.B. control purchasing policy.	C.I.A.B.	Purchase in United States through War Missions.	..

TABLE SHOWING THE ORGANISATION OF INTER-ALLIED CONTROL—Continued

1. Commodity	2. Inter-Allied Body	3. Method of Purchase	4. Purchasing Body or Bodies	5. Represented in United States by	6. Represented in certain other countries as follows:
14. Coal.	Coal Programme Committee.	British Govt. controls the mines and works them through existing channels on basis of profits over period of pre-War years.		..	France.—Office National des Charbons, buying in United Kingdom through existing channels on a fixed basis. Italy.—All purchases made on Italian Government account.
15. Paper.	Paper and Paper-making Materials Programme Committee.	Central purchase of woodpulp in each country.	Centralized purchase through British Controller for European Allies suggested.	..	Italy.—Italian Paper Commission. France.—Office National de la Presse.
16. Petroleum.	Inter-Allied Petroleum Conference (Advisory).	By central purchase in United States of America at fixed price. Usual trade channels in other countries, subject to allocation by Conference.	..	United States Fuel Administration.	..
17. Tobacco.	Tobacco and Matches Programme Committee.	No purchasing arrangements between the Allies, price control being purely national through medium of the state monopolies in France and Italy, and the Tobacco and Matches Control Board in Great Britain.			..

for shipping. The Wheat Executive, for example, as we have seen, arranged common purchase in foreign markets, as well as distribution. The Munitions Committees discussed allocation of manufacturing facilities and of the finished munitions. For such duties they acted under the authority of their respective councils (Munitions or Food) or, in their absence, with the consent of the different governments obtained through the national members of the committees. It was only so far as their programmes needed shipping that they needed the approval of the A.M.T.C. But as the allocation of shipping was the crucial factor in all the main supply arrangements, the A.M.T.C. and its executive acquired the dominant position.

Working of the Machine.—As an example of the working of this system let us look at the duties of the most important of the Supply Committees, the Wheat Executive, say in the spring of 1918. The committee is working within a general programme agreed for the cereal year 1917–8. It has arranged through common agents for the provision of supplies in the United States of America, Canada, the Argentine and elsewhere. In contact with the shipping authorities, shipping has been sent to the loading ports. The ships are provisionally allotted for discharge in Great Britain, France and Italy; but the stocks, port facilities, etc., in each of these countries are watched daily, and the ships directed where desirable by orders sent to the ports of loading or even on arrival on the eastern side of the Atlantic.

Meantime, the Wheat Executive is negotiating with the Transport Executive as to the new programme for 1917–8. The latter, conscious of the competing claims for munitions, etc., is urging reduction. The Wheat Executive makes efforts at reduction and tries to distribute this reduction among the three countries. The margin of difference between the two executives is diminished, but not removed. An attempt is made by negotiations with the other food committees, and under the general authority of the Food Council, to balance the respective claims of cereals and other food stuffs. The final food programme put forward by the Food Council is still in excess of what is likely to be obtained, but the difference is reduced to manageable dimensions. And the final issue is presented to the A.M.T.C. when it is practically simplified to a decision between the competing claims of Allied food as a whole and Allied munitions.

The concluding stages of this process are best illustrated by the decisions taken at the A.M.T.C. meeting in Sept. 1918. The council, at that meeting, reviewed the whole of the prospective shipping position for 1918–9. They had before them estimates carrying the authority of the shipping experts of all the countries concerned to the effect that, after allowing for ships allotted to military expeditions and the fleets, the total imports could not exceed

72,500,000 tons { for coal / raw materials / food / munitions } for Great Britain / France / Italy.

They decided, on the advice of the Transport Executive, that 25,200,000 tons must be allowed for coal, and 7,500,000 tons for raw materials, leaving 39,800,000 tons for food and munitions; against demands of 49,000,000 (27 for food and 22 for munitions). Finally, after difficult negotiations, they allowed 20,000,000 for food and 17,800,000 for munitions. The conclusion of the Armistice a few weeks later robbed these decisions of the practical importance they would otherwise have possessed. But they illustrate the way in which the whole Allied system was, by the end of the War, linked together and dominated by the supreme shipping authority.

It must be borne in mind that the new Allied mechanism was developing in authority and efficacy throughout 1918 until the Armistice. The centre of gravity shifted slowly from the national to the international administration. At the point of executive action the machine was always the national one, though more and more this action was determined by the comprehensive surveys and recommendations of the international bodies. But the new system was still not fully and equally working when it was brought to an end by the Armistice. It was tested and working fully for food and beginning to work for munitions; but was still in its preparatory stages for miscellaneous raw materials for civilian use.

Imperfect as it was, however, and having to build up its elaborate organisation and carry on its work simultaneously, its achievements were very striking. Though the shipping available for European supplies was some 2,000,000 tons less, the import services of France and Italy were, in 1918, for the first time put on a substantially satisfactory and substantially equal basis. Food stocks were raised to a much safer level. The Belgian relief requirements, previously in a desperate condition, were adequately met and the American trooping needs substantially assisted. These results were obtained partly through shipping economies effected by the pooling of tonnage and partly by supply economies effected by the common examination of needs and resources by the Programme Committees.

Essential Characteristics.—Before we follow the subsequent

history of the system, let us consider again its essential characteristics. The fundamental principle is the *direct* contact of specialised ministers and officials of different countries effected through a regular organisation whose members are grouped according to their special experience and authority and not according to nationality.

We have seen how three great Ministerial Councils were formed on this principle; and how twenty Allied Programme Committees formed on the same principle covered the whole range of imported supplies. The members of these bodies were essentially national ministers or officials uniting for international work. The agreement they arrived at in Allied discussion was thus carried into practice in their own departments. Thus the new Allied principle did not override or replace the national organisations—it penetrated them. It linked them together. In fact the instrument of Allied action consisted of the national administrations themselves thus linked together and in union acting for a common end. The new mechanism was essentially a " coupling " between them.

Thus was co-operation between the Allies at last shifted from a diplomatic to an administrative basis. We have followed the steps by which the pre-War system of negotiations through Foreign Offices and embassies was gradually transformed. More and more frequently, and then as members of regular councils, department ministers dealt direct with each other and not through their respective Foreign Offices, and departmental officials met first for special transactions and then, as the need compelled, in more regular and constant contact to make shipping and wheat arrangements. Then, as the stress increased, the final stage was reached; the supply departments of the different countries were themselves linked together from within by programme committees composed of their own officials.

The national administrations now touched each other, not at one point (the Foreign Offices), but at scores (the officials engaged in the different controls) and the contact was no longer occasional but continuous. Any divergence of national interest was settled within its own sphere, and independently of differences elsewhere. Agreement once reached within each specialist committee, the further issue was not between nation and nation but between supply and supply. The Allied munitions demands were pressed as a whole with the support of the representatives of all countries against the claims of Allied food demands supported by all theirs.

These principles, of direct contact between specialists, and of forming an instrument of international action by linking together national departments through committees of their officials, are the necessary basis of all international administration that touches vital interests. A specific piece of limited technical work may be entrusted to a Danube Commission or a Postal Union acting with permanently delegated powers. But where the work seriously affects national interests the necessary authority will rarely be given, or if given will be withdrawn, as in practice it was from the Reparation Commission. The international administration which has vital work to do will supplement its own permanent organisation by specialised committees composed of those who represent not only the special knowledge required, but the special interests, both public and private, affected.

The Transition to Peace.—But before we follow these later developments, we must glance at the immediate history of the War system we have described in the interval between War and the re-establishment of normal peace conditions. It was the view of those who had built up this system that it should, with the necessary modifications, be continued for the scarcely less urgent tasks of the Armistice period.

The British Govt. pointed out immediately after the Armistice that Allied discussion was still essential as to the assistance required for the reconstruction of devastated territories, as to food supplies, and in general as to the acquisition and distribution of commodities of which there was a shortage. They proposed the transformation of the Transport Council into a General Economic Council, controlling, with some changes, the same subordinate organisation.

The American Govt., however, took the view that the termination of the War should at once be marked by the disbandment of specifically War organisations, and that appropriate new machinery should be created if required. This, under the diminished impulse to co-operation that attended the cessation of hostilities, proved to be a long and difficult matter. After months of discussion a new Council, " The Allied Supreme Council of Supply and Relief," was formed in Jan. 1919. Too restricted in its functions, and without the assistance of a personnel accustomed to work together, it proved entirely ineffective. It was replaced by the Supreme Economic Council which in personnel, in functions and in the principles of its organisation was almost exactly the same as the " General Economic Council " proposed two days after the Armistice.

This council, and an Allied system of committees responsible to it, though handicapped by the loss of three vital months, made rapid progress in the Armistice tasks of removing the blockade, bringing the German ships into use, re-allotting ships for the repatriation of troops and prisoners, for the import of raw materials required for reconstruction, arranging relief to the starving countries of Europe, and re-establishing railway transport and communications. The Supreme Economic Council, under the chairmanship of Lord Robert Cecil, remained in existence for some years. But its main work was finished, and the greater part of the connected Allied organisation disbanded before June 1919, when the Treaty with Germany was signed.

The League of Nations.—The experience gained in the war system, however, proved of great value in the construction of the great and permanent organ of international action which was then brought into being under the Covenant of the League of Nations. The task of the League was indeed very different in character from that which the Allied Councils and Committees had to carry through in the War. There was no longer the need of urgent executive action, no longer the same subordination of national interests in the face of a common enemy. Its organs of supreme authority, the Assembly and the Council, were composed of members representing their respective governments on all questions dealt with. There was no series of co-ordinate Ministerial Councils divided by function. But the system built up was in fact very different from the pre-War national one, in which every case was worked up from the beginning by purely national specialists till fully formed and opposing national policies confronted each other in international negotiations. For under the Assembly and Council an intricate, varied and elastic system of technical and specialist committees and commissions has been built up on the same essential principles which we have seen in the War system.

Before a question is settled by the Council (consisting of 10 national representatives) it will have been worked at by a permanent technical body, for finance, economics, transit, mandates, opium, etc., or a specially appointed commission. The members of such a committee regard themselves primarily as specialists in their particular subject-matter. At the same time, as they are in fact of differing nationality and know the tendencies of opinion and interest in their different countries, they afford just the kind of bridge between opposing views which we have seen were provided by the Programme Committees. It was perhaps useful that all three of the European members of the Transport Executive joined the Secretariat of the League and had a part in building up the new machinery. But essentially that machinery was constructed as it was because it is among the fundamental principles of the League itself, first that the common interests of nations are no less important than their differences, but secondly, that these common differences must be resolved by agreement and not by the overriding decision of a superior authority.

With some difference of emphasis these were the principles which determined the Allied system; with some difference of application the international system follows the same principles. With this system the real instrument of the League's action is not merely its permanent staff but the national organisations, public and private, which are linked together through its specialist committees and commissions. Its real executive is located not

in one city but in sections, in all the main capitals of the world. Its central staff is the "coupling" which unites this intricate mechanism and enables it to achieve an international task. Geneva is not a centre of controlling power but an instrument to co-ordinate activity which is world-wide in its influence and means of action. It is an instrument, not for governing the world, but for assisting the world to govern itself in agreement and in co-operation. It permeates and transforms the policy of the world as the Allied organisation permeated and transformed, without an overriding authority, the policy of the Allies. (*See* also INDUSTRY, WAR CONTROL OF; RAW MATERIALS.)

BIBLIOGRAPHY.—Most of the documents concerned with the Inter-Allied control of shipping and commodities were secret, and remained unpublished. A selection of the more important papers are printed in J. A. Salter, *Allied Shipping Control* (Oxford, 1921), in the British series "Economic and Social History of the World War" (Carnegie Endowment for International Peace). This book covers control of commodities as well as shipping, and the national and international system. The full bibliography is very voluminous. The following English books may perhaps be specially mentioned as giving a good picture of the general principles and actual working of the Control system. J. L. Garvin, *Economic Foundations of Peace* (1919); Sir L. Chiozza Money, *Triumph of Nationalisation* (1920), written from the point of view indicated in title but includes much first-hand information not otherwise available; H. D. Henderson, *The Cotton Control Board* (Oxford, 1922); E. M. H. Lloyd, *Experiments in State Control at the War Office and Ministry of Food* (Oxford, 1924); F. H. Coller, *State Trading Adventure* (1925).

(A. SR.)

CONVERTER: *see* DYNAMO.

CONVOY (*see* 7.67).—The problem of mercantile convoy, the protection of groups of trading ships by naval escort, was fundamentally different in the World War from what it had been in the days of sailing ships. Merchant vessels in the 18th century made very few round voyages in the year, often only one. The length of each passage was uncertain, depending on wind and weather conditions and the delays caused by assembly, awaiting escort and sailing in groups, were comparatively unimportant. The owners of fast sailing vessels might lose the profits to be gained by forestalling the market, but the nation suffered little. Hence trade could be carried on in time of war by a comparatively few convoys of great size. A homeward bound West Indian convoy might comprise 100 or 150 vessels; there are records of Baltic convoys during the Napoleonic wars of over 500 sail.

Since those days, the greater frequency and certainty of voyages under steam had permitted the growth of massed industrial populations, depending for their very life, not merely on an immense volume of imported foodstuffs and raw materials, but on its arrival in a steady, continuous stream of cargoes. Throughout the World War the stocks of food, of munitions materials, and of materials for civil industries were small in comparison with annual requirements, and had to be continually renewed. The holding back of supplies for a few months, or even for a few weeks, might entail irremediable disaster. Thus, if trade were to be run in convoy at all, it must be in numerous small convoys run to a regular schedule, not in a few large convoys at irregular intervals. The contrast may be illustrated by the fact that, during the first two years of the War of the Austrian Succession, 35 outward and 45 homeward convoys sufficed for the requirements of the ocean trades; in the summer of 1918, 40 outward and 42 homeward convoys were run in the ocean trades alone every 32 days.

In these circumstances convoy called for a greater allocation of force and a far more elaborate organisation than in the past. At the best, too, it entailed very serious delays to the faster ships, owing to the wide discrepancies in speed between steamers even of similar type. Neither to the commercial nor to the naval mind was convoy a matter lightly to be taken in hand.

Early Part of the War.—During the first two and a half years of war, the use of convoy was restricted to the protection of troop movements. As the submarine campaign increased in intensity, escort was frequently given, within the danger zone, to tankers and vessels with important government cargoes; but the introduction of organised mercantile convoy was delayed until 1917. So long as the attack on commerce was carried on by surface warships, the total effect, despite the notoriety attained by the "Emden" and other raiders, was comparatively trifling, and even the submarine campaign, in its earlier stages, produced an astonishingly small effect on the flow of commerce. Towards the end of 1916, however, the losses of neutral as well as of British and Allied shipping, became very serious, and the outbreak of unrestricted submarine warfare in Feb. 1917 compelled a reconsideration of the whole problem of trade protection.

At this time the general run of opinion at the British Admiralty was strongly against convoy. It was condemned both as impracticable and undesirable; impracticable because there were not enough cruisers, destroyers and patrol craft to provide escorts for the trade, and because accurate station keeping would be impossible in a group of steamers of varied type and speed; undesirable because of the delays involved, and because any protection derived from escort would be outweighed by the disadvantage of offering a large target to torpedo attack.

Organised Convoys Begin.—The delays caused by the holding up of shipping and by deviation to avoid danger areas were now, in fact, so serious as to discount one of the chief objections to convoy, and the losses suffered during the first three months of unrestricted warfare (*see* SUBMARINE CAMPAIGNS) were so heavy as to threaten disastrous results to the supply system of the Allies. For the three months Feb.-April they amounted to over 1,200,000 tons of British and 800,000 tons of Allied and neutral shipping. The existing methods of protection were clearly inadequate, and the advocates of convoy became insistent. In Feb. 1917 the French coal trade was organised in a system of controlled sailings which rapidly developed into regular convoys, and in April a Scandinavian convoy was introduced to protect the helpless, unarmed neutrals trading on Allied account in the North Sea. Meanwhile, the application of convoy to the ocean trades was being persistently urged both within and without the anti-submarine division of the Admiralty. A special committee was appointed at the Admiralty during May to draw up a detailed scheme of convoys for the ocean trades, and during the same month two experimental convoys were sailed from Gibraltar and Hampton Roads respectively.

Both these experimental convoys arrived without loss, and the experience gained went far to dispose of the bogey of station-keeping. Meanwhile, investigation had shown that the difficulty of providing escort had been magnified by an exaggeration of the number of voyages to be protected, and the arrival of United States destroyers at Queenstown increased the available force. Regular convoys from Hampton Roads were started in June; from Sydney (Cape Breton), New York and Gibraltar in July; in Aug. the system was extended to the South Atlantic trades and the outward traffic.

The system adopted for homeward convoys was for a group of steamers, collected at a port of assembly, to be escorted by a cruiser or armed merchant cruiser, giving protection against surface raiders, to a rendezvous outside the submarine danger zone, where the convoy was met and brought in by a destroyer escort. Outward convoys, collected at assembly ports on the west and south coasts of England, were taken through the danger zone by a destroyer escort, to a point of dispersal outside the ordinary limits of submarine activity, whence the ships made their way individually to their ports of destination. In order to economise the forces used as destroyer escorts, which included destroyers, sloops and in some instances P-boats and trawlers, the escort, which had taken an outward convoy clear of the danger zone, was required to steam from the point of dispersal to the rendezvous with a homeward convoy, which it then brought in. The whole system thus depended on an exact synchronisation of the outward and homeward programmes, which threw an immense strain on the Convoy Section at the Admiralty, and on the commanders, officers and crews of the escorts themselves.

Work of the Convoys.—At the height of the system two homeward convoys sailed every 16 days from Halifax; two from Sydney, Cape Breton; four from New York; two from Hampton Roads; four from Gibraltar; one from Port Said for the

" through " Mediterranean traffic, with destroyer escort throughout the voyage; two from Dakar; two from Sierra Leone; and two from Rio de Janeiro, combining with the Dakar convoys at sea. During each similar period two outward convoys sailed from Lamlash; seven from Liverpool, including one " through " convoy to Port Said; four each from Devonport and Milford; two from Falmouth and one from Southend. In the French coal trade there were daily sailings on four different crossings; the Scandinavian convoy, in its final form, sailed from Methil to Bergen and *vice versa* at five-day intervals; a small convoy ran about every six days to Dutch ports; and there were local convoys on the east coast of Great Britain and in the Mediterranean.

All these convoys, which included Allied and neutral ships bound for British or northern French ports, were organised by the British Admiralty, and the bulk of the escorts were provided by the British Navy, although valuable assistance was given by United States cruisers and destroyers in the Atlantic and by Japanese destroyers in the Mediterranean. The French Navy also assisted in the ocean escort of a special convoy started during 1918 for American storeships to ports in the Bay of Biscay.

The transport of United States troops to Europe was carried out in part by special troop convoys, organised and escorted by the United States Navy; but in the spring of 1918, when the great German offensive made it necessary to speed up reinforcements, a large amount of British tonnage was allocated to the service, and special fast troop and cargo convoys were inaugurated from New York to Liverpool and from Halifax to Liverpool and London. Thanks mainly to these convoys, well over 1,100,000 United States troops were carried in British ships, with a total loss, from war and marine perils, of 637.

Success of the System.—From the first the convoys proved a triumphant success, and conclusively refuted the arguments against the system. The grouping of the ships diminished the number of targets offered to the attack, and since the convoys themselves followed carefully chosen and carefully varied routes, and could be deflected, by wireless, from areas of known submarine activity, they proved as valuable in their power of evading attack, as in the actual protection provided by the escort. When located by a submarine, they proved far less vulnerable than the opponents of the system had supposed. The threat of instant retaliation by the escort, and the menace presented to a submarine by a group of ships manoeuvring in concert on a broad front, hampered the movements of the assailant and even when the attack was successful, there was no such wholesale havoc as had been feared.

In the North Sea there were two serious disasters, both due to attacks by surface vessels; but in the ocean trades, even when a successful attack was made on a comparatively large convoy, it was rarely that the submarine claimed more than one, or at the most two victims. The total percentage of loss was as follows:—

Ships escorted safely in ocean convoy	16,539	99·08%
Torpedoed in convoy	102	0·61%
Lost by marine peril	16	0·09%
Lost after parting company, etc.	36	0·22%
Total sailings	16,693	100·00%

In the short sea convoys, Scandinavian, Dutch, British east coast, French coal trade and Mediterranean local—there were over 80,000 sailings, with a loss of less than .5%.

At the outset the advantages of convoy, more particularly in the North Atlantic, were partly neutralised by the additional delays due to steaming to the port of assembly, awaiting the sailing date and adjusting speed to that of the slowest ship in the group. These delays, however, were greatly reduced, during 1918, by a more careful grouping of the ships, and by co-operation between the Admiralty, the Ministry of Shipping and the shipowners themselves. Convoy Committees of shipowners at Liverpool, New York and London did yeoman service in the adjustment of sailings to the escort programmes, and the fast troop convoys, in particular, ran with almost the regularity of a railway time-table. In station keeping and manoeuvring also there was improvement and in the later convoys there were few stragglers.

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COOK, SIR EDWARD TYAS (1857–1919), British journalist, was born at Brighton May 12 1857 and educated at Winchester and New College, Oxford. Having settled in London, he was for a time associated with the university extension movement, afterwards becoming a contributor to *The Pall Mall Gazette*, then under the editorship of John Morley. He was later assistant editor, and editor 1890–2, resigning when the paper changed its politics. In 1893 he became first editor of the new Liberal journal, *The Westminster Gazette*. He resigned in 1896 and became editor of *The Daily News*, holding this position until 1901, when his refusal to denounce the South African War led to his resignation. From 1901 to 1912 he was a leader writer on *The Daily Chronicle*. During the World War, conjointly with Sir Frank Swettenham, he directed the official Press Bureau. The work by which he will be chiefly remembered is, however, his monumental edition of Ruskin—a tribute difficult to parallel in modern literature. He was knighted in 1912 and died at South Stoke, Goring, Berkshire, Oct. 1 1919.

Among Cook's publications are *Studies in Ruskin* (1890); *Rights and Wrongs of the Transvaal War* (1901); *The Life of John Ruskin* (1911); *Life of Florence Nightingale* (1913); *Delane of " The Times "* (1915); *Literary Recreations* (1918); and *More Literary Recreations* (1919). He also edited the works of Ruskin (1903–7).

COOK, SIR JOSEPH (1860–), Australian politician, was born at Silverdale, Staffs., and at the age of nine started life in a coal-mine. In 1885 he went to Australia and, six years later, entered the New South Wales Legislature, holding office as Postmaster-General 1894–8 and Minister of Mines and Agriculture 1898–9. He was elected to the Commonwealth Parliament for Parramatta as a free trader in 1901 and became Minister for Defence under Mr. Deakin 1909–10. In 1913, after the defeat of the Labour party, he became Premier and retained office until just after the outbreak of the World War in Aug. 1914, when, his party having lost the general election, he resigned. He did not take office again until 1917, when he was Minister for the Navy in Mr. Hughes' second Ministry. In 1921 he became high commissioner in London. In 1922 he was senior Australian delegate to the third Assembly of the League of Nations and Australian delegate to the International Conference at Genoa.

COOKING APPARATUS: *see* HOUSEHOLD APPLIANCES.

COOLIDGE, CALVIN (1872–), 30th President of the United States, was born at Plymouth, Vt., July 4 1872, the son of John C. Coolidge and Victoria J. Moor. He was descended from a long line of typical New England farmers and storekeepers, living in Puritan simplicity and taking a characteristic interest in local civic affairs. His father, like others in the ancestral line, was selectman and moderator of the town meeting; he held the office of town constable for many years, and became a member of each House of the state Legislature.

It is possible that much of the younger Coolidge's flair for practical politics was developed at an early age as he listened to the conversation that passed in his father's country store, where the Yankee democracy settled political issues over the nail and cracker barrels. His early education was characteristic of the region; he was first sent to the rural schoolhouse, later to Black River Academy and to St. Johnsbury Academy, where he was prepared for Amherst College, which he entered in 1891. There he displayed the qualities which were to distinguish his later career, a dislike of ostentation, a capacity for hard work and clear thought, an ability to express his ideas in phrases that were frequently humorous and invariably terse. Such qualities did not make him a leader in his class (1895), either as scholar, social light or athlete; they did capture the admiration of a small group of the stronger men, and finally led to his election as " Grove Orator " at commencement. His interest in history led him to prepare an essay on " Principles fought for in the War of the American Revolution," which was awarded the prize by the

Sons of the Revolution in a national competition of college students.

As Lawyer and Legislator.—Upon graduation, Coolidge studied law with a Northampton firm, Hammond and Field, and two years later, in 1897, began its practice. The members of the firm were interested in local politics, and he himself soon found opportunity to follow his natural inclination. He was elected a councilman of Northampton in 1899, city solicitor in 1900, and was appointed clerk of the courts, a county office, in 1904. He was a member of the Republican city committee. In 1907 and 1908 he served as a member of the general court of Massachusetts, the legislative body of the state, winning the reputation of a hard-working committeeman; he returned to Northampton to become mayor for two terms in 1910 and 1911. At the close of his second term he secured the Republican nomination for state Senator, which in his district was tantamount to election. From that time his political career in the state progressed by regular steps. In 1914 and 1915 he was chosen president of the Senate; he was elected Lieutenant-Governor of Massachusetts for three terms, 1916, 1917, 1918, and Governor of Massachusetts for two terms, 1919 and 1920. In each case of re-election he was returned to office by an increased majority.

His success was not achieved by conventional electoral methods, for he avoided ostentatious advertising and was regarded personally as a poor "mixer," shy, taciturn and apparently cold. Coolidge himself expressed in a characteristic phrase his conviction that electoral success ought to depend upon the candidate's devotion to official duty. "Let men in public office," he said, "substitute the light that comes from the midnight oil for the limelight." And again, "We need more of the office desk and less of the show window in politics." He translated his epigram into action, and the success he achieved as mayor of Northampton and as Governor of Massachusetts, in securing both economy and efficiency, explains much of his consequent recognition at the polls. At all times he displayed a political shrewdness which saved him from mistakes, and a dry common-sense, skilfully expressed in trenchant phrases that caught the imagination of his auditors.

Governor of Massachusetts.—Coolidge, as Governor of Massachusetts, proved himself an expert administrator; he was the first governor of the state to submit an executive budget for legislation and he pushed through various laws providing for the reduction in the number of administrative agencies in the state. But it is likely that his name would not have become nationally prominent if it had not been for his handling of the strike of the Boston policemen. The Boston charter provided that the police department should be under the direction of a commissioner appointed by the governor (in this case the commissioner had been chosen by Coolidge's predecessor); the mayor of Boston, however, may in certain contingencies take control of the police, and in "case of tumult, riot or mob," may call out such part of the state guard as is within the city of Boston; if the situation passes beyond his control he may call upon the governor to mobilise the remaining state militia.

The Boston Police.—During the first week of Sept. 1919, the Boston police threatened to go on strike because of the refusal of the commissioner to permit affiliation with the American Federation of Labor; the commissioner was steadily supported in his position by Gov. Coolidge. On the afternoon of Sept. 9, about three-fourths of the policemen left their posts; disorder in the streets commenced during the night, which became riotous the following morning. The mayor, who had been previously informed by the commissioner that he did not need the state guard, on the morning of Sept. 10 called out the state guard in Boston and requested the governor to send at least three regiments of infantry. Coolidge immediately issued the order. It is possible that, thus reinforced and with the aid of young college graduates, the local authorities might have handled the situation successfully. In view, however, of a threatened general strike calculated to disorganise transportation and business activities, as well as the danger of continued rioting, Coolidge called out the entire state guard, and on Sept. 11 took charge of the police department. The strike was broken and order restored. Coolidge steadfastly supported the commissioner in his refusal to reinstate the striking policemen, and in a public reply to an appeal of Samuel Gompers clarified the issues involved: "The right of the police of Boston to affiliate has always been questioned, never granted, is now prohibited. . . . There is no right to strike against the public safety by anybody, anywhere, at any time." Warned that labour would prevent his election to any office in the future, he replied, "It does not matter."

As Vice-President.—The action and words of Coolidge in this crisis were eminently characteristic. He took no step until it seemed necessary, but then he took it decisively. The effect upon the popular mind was impressive. In the election of Nov. 1919, standing for re-election as governor, he received a majority of 125,000. His name was at once included in the list of possible presidential nominees for the following year. Already mentioned in 1916 by a few supporters, he might have received the nomination in 1920 if he had been given the solid backing of politicians from his own state. But at the National Republican Convention, where the senatorial group in control did not approve him, the Massachusetts delegation was divided and he did not have the support of the senior senator, Henry Cabot Lodge. He failed thus to profit by the deadlock, which was finally broken in favour of Warren G. Harding. But when it came to a call for vice-presidential nominees, a wave of enthusiasm for Coolidge caught the convention which, with 674½ votes, nominated him on the first ballot. He was elected Vice-President of the United States in the following Nov., receiving with Senator Harding 404 electoral votes.

As Vice-President, Coolidge was the first who attended meetings of the Cabinet, but he made no attempt to enlarge the functions of his office. He attended faithfully to the routine duties that went with the presidency of the Senate, consistently supported the policies of the Harding administration, and did nothing to bring himself before the public eye. Early in the morning of Aug. 3 1923, in his father's house at Plymouth, Vt., he learned of the death of President Harding. The oath of office was administered by his father, a justice of the peace, and he immediately left for Washington.

Becomes President.—Characteristically, President Coolidge's first interest was to assure the efficiency of the public administration, his second not to weaken his future position by any false step. Following four months' silence, his first presidential message, in Dec. 1923, commanded universal attention. It was brief and categorical. In it he made plain his opinion on the major problems before the country. He approved the maintenance of the tariff without frequent revision, a reduction of taxes; he disproved the soldiers' bonus as well as any complicated scheme of government relief for the farmers. As regards foreign policy, he advocated co-operation without entanglement, opposing entrance into the League of Nations, but approving adherence to the World Court. The message was courageous in its lack of equivocation and attractive in its emphasis upon economic common-sense.

With its delivery Coolidge caught the admiration and confidence of the ordinary citizen of the United States as a whole, as he had previously in Massachusetts. None the less, he faced a difficult situation in Washington. The Republican party in Congress was broken into blocs, disinclined to accept his leadership, torn by factional struggles to secure advantage in the coming National Convention. Congress sustained the veto of Coolidge of the Postal Salaries bill by only one vote, and passed the Bonus bill over his veto. In the spring the disclosures of the Teapot Dome leases threatened to involve his Cabinet and discredit the Republican party. The President met the demands for wholesale purification of the Administration with discretion and restraint; he immediately appointed special counsel to prosecute an investigation, but refused to satisfy popular clamour by hasty dismissal of accused officials: "I do not propose to sacrifice any innocent man for my own welfare, nor do I propose to maintain in office any unfit man for my own welfare." Opinion finally accepted the President's judgment as decisive. At the

Republican Convention, largely because of popular feeling in his favour, his control was unthreatened and he was nominated with ease; the vote of the convention was in many cases an unwilling tribute by the party leaders to the overwhelming power of public opinion "back home."

Coolidge did not take an active part in the campaign, remaining for the most part in Washington and dealing with current problems of administration. In the few speeches which he made he reiterated the basic principles which he had already stated: economy in public affairs, efficiency of public service, abstention from the League of Nations, adherence to the World Court. He made slight effort to answer the bitter criticism passed on the Republican party for the scandals and its reactionary attitude, by the Democratic and Third party nominees; he relied upon the increasing prosperity of the country under his administration and the widespread feeling that he embodied a shrewd common-sense in which the nation might trust. He was vindicated by the result of the election, which gave him 382 electoral votes against 136 for Davis and 13 for La Follette. The popular vote was 15,700,000 for Coolidge, 8,400,000 for Davis, 4,800,000 for La Follette.

On March 4 1925 Coolidge was inaugurated President by virtue of election. His position in the country and the party was strong. He still met difficulties with the old Congress, for the insurgent Senators combined with the Democrats to refuse confirmation of his nominee for attorney-general. But the back of the insurgent-radical movement seemed broken, and his control of the new Congress was solidified. He made plain in his presidential messages of Dec. 1924 and Dec. 1925, that he did not plan to use his increased political strength for far-reaching legislative reform. But he insisted, with success, upon his plans for tax reduction and administrative economy. As regards foreign policy, he pushed irresistibly the demand for adherence to the World Court. By his willingness to co-operate in a disarmament conference to be held under the auspices of the League of Nations, he displayed a sincere desire to assist in solving the problem of the world peace despite the prejudices of the irreconcilables. Under his direction an arrangement of the foreign debt question was reached with Belgium and Italy, although negotiations with France broke down temporarily.

After two years as President, Coolidge appeared as a skilled administrator, shrewd in his judgments, an idealist, but, like his Puritan forefathers, eminently practical, determined to make sure of his footing before taking any step in advance.

On Oct. 4 1905 he married Grace Anna Goodhue, of Burlington, Vermont. Two sons, John and Calvin, were born on Sept. 7 1906 and April 13 1908, respectively. The younger died on July 7 1924, as a result of blood poisoning. (C. SEY.)

CO-OPERATION (*see* 7.82).—In the urban areas of industrial countries it is chiefly the middle and wage-earning classes which are interested in the co-operative movement. The needs which it attempts to fill by its programme of self-help and mutual aid are growing ever more numerous; nevertheless, three great forms of activity may be distinguished; consumers' co-operation, producers' co-operation and credit co-operation. In practice, it often happens that the same institution assumes more than one or even all of these functions; but this division is a convenient one.

I. DISTRIBUTION AND THE CONSUMERS' SOCIETIES[1]

The consumers' co-operative societies showed the most rapid growth in the urban co-operative movement between 1911–25. Even the insufficient statistics available show the important place taken by consumers' societies in the economic life of certain countries. The membership rose in Germany from 1,600,000 in 1911 to about 4,000,000 in 1924; in Finland from 87,000 in 1910 to 371,000 in 1924; in France from 856,842 in 1911 to 2,329,869 in 1922; in Great Britain from 2,640,429 in 1911 to 4,702,868 in 1924; in Sweden from 85,359 in 1911 to 289,704 in 1923. In Switzerland, 9% of the inhabitants, and in Finland 10%, belong to consumers' societies. As the members of these societies are generally heads of families, it is probable that in Finland and Switzerland, for example, one-third of the population make part of their purchases from the co-operative societies.

In the new European countries, especially in Poland, in Czechoslovakia and in the Baltic States, where the movement is strongest in rural districts, as it is in Denmark, there are numerous and prosperous consumers' societies which have done much to create and strengthen the economic and social structure of the country. According to Charles Gide (*Les Sociétés Co-opératives de Consommation*, 1924), there were in more than 50 countries over 50,000 consumers' societies with a total membership exceeding 35,000,000. The business done is proportionately large. In France in 1922 it amounted in value to 223,000,293 frs.; and in Great Britain in 1924, to £175,077,825. In Germany, these societies suffered during the period of inflation, but since the currency was stabilised in 1923 their development has been renewed, and their total turnover exceeded 600,000,000 marks in 1924. Similarly, the co-operative wholesale societies (C.W.S.) have become considerable enterprises. The total turnover of the C.W.S. of Hamburg increased from 109,605,470 gold marks in 1911 to 168,466,278 gold marks in 1924; while in Great Britain the total business done by the English and Scottish Wholesale Societies amounted in 1924 to £90,200,258. In 1911 it was £35,744,069.

The growing importance of the consumers' societies on the national markets and the important part which certain co-operative wholesale societies play on the international market, have produced a certain reaction in the national legislative and political activity of certain countries. The consumers' societies were long permitted to develop unnoticed by the Press, while political parties and public authorities remained indifferent or were even hostile. Socialists of all countries, under the influence of Karl Marx, remained hostile to co-operation. But in the late summer of 1910, a decisive change took place, when the International Co-operative Alliance (I.C.A.) at Hamburg and the Socialist International at Copenhagen held their Congresses simultaneously, and the Hamburg assembly received a resolution from Copenhagen recognising the autonomy of the co-operative movement but affirming its value as a factor of social transformation. During and immediately after the World War public authorities became similarly converted. In almost all the belligerent and in many of the neutral countries the Governments, confronted with the complicated task of rationing their populations, turned to the existing machinery of distribution of the non-profit making type of the consumers' societies, and asked them either to distribute provisions directly purchased by the State or to oppose the rise in prices.

In Russia, the Soviet Government tried to go further still. At first it hoped to absorb the consumers' co-operative movement, and to make it the single channel of distribution within the Communist State, to which the entire population, grouped in every town and village in consumers' communes, must adhere. When the new economic policy was adopted in the spring of 1921, compulsory membership was dropped, and the co-operatives recovered their autonomy. Nevertheless the State entrusted them to a very large extent with the organisation of internal trade, especially among the agricultural population, both to sell the products of state industry and to supply the towns with agricultural products.

[1] By the side of the consumers' co-operative movement there should be mentioned the movement which compels small retail traders to associate to organise their common stock on a co-operative basis. In Germany these co-operatives have existed since 1879 and are already old and numerous. Yet they only acquired a certain importance in 1907, when they united in the federation of German co-operative societies of small merchants (Edeka). In 1923 this federation had a purchasing centre, a banking centre, a publishing centre, etc., and included 541 of the most important of the existing 1,421 societies. In the other countries of Central Europe, especially Austria, Switzerland and Czechoslovakia, and also more recently (1919) in France, similar groups have been constituted. So in the struggle for existence the small private concern, which is so profoundly individualistic, has had to borrow the principles of mutual aid or the methods of technical concentration from the co-operatives, the wholesale traders, and the great enterprises with numerous branches.

As a result of war services the co-operative movement was called to take an official part in public life. In Germany, and also in Czechoslovakia, according to a bill under consideration in 1926, chambers of consumers were created side by side with chambers of commerce and chambers of industry; while in Austria organised consumers are represented in the special committees constituted to examine economic questions in workmen's and employees' chambers. In the German Federal Economic Council the consumers' societies are represented, and the draft constitutions of similar proposed bodies in other countries contain provision for similar representation. The co-operatives are everywhere recognised as qualified to represent the consuming public.

Movement Towards Federation.—In the heart of the co-operative movement, which has acquired a fresh power and authority, two great tendencies are apparent: (*a*) the grouping of societies in powerful federations; and (*b*) the fusion of new or economically weak societies with each other or with stronger societies. Progress towards federalisation was made not only in countries where the consumers' movement is relatively young—as in Finland, where non-federated societies practically do not exist, or in Sweden, where the federated societies represented 70% of the total consumers' societies in 1910, 89·6% in 1923—but is also taking place in older and more highly developed movements, as in Switzerland, where the number of non-federated societies is extremely small, or in Great Britain, where the percentage of societies affiliated to the Co-operative Union was 83·2 in 1913 and nearly 90 in 1924. Non-federated consumers' societies are nearly always small.

In Great Britain the consumers' societies adhering to the Co-operative Union totalled 93·65% of the total membership in 1913 and more than 98% in 1924. In 1910 the Swedish Co-operative Union embraced a total of 67,928 members out of 85,358 consumers' co-operatives, or 79·6% of the total; in 1923 the federated societies included 257,163 members out of a total of 289,274 or 92·2%, and were responsible for 98·6% of the total turnover of all the societies. The concentration which has been effected in Poland is particularly remarkable in view of the long dismemberment of the nation and the scattered nature of the movement due to historical and political reasons. The rapid development in organisation astonished the most experienced co-operatives in other countries, and in 1925 existing unions of long standing were federated in a big union. In Czechoslovakia the Czech and German Unions began to consider the creation of organisations which should promote national unity.

The tendency to fusion has been even more important. It was particularly strong in Austria, in Czechoslovakia, and in Germany, where the number of societies only increased by 43 units from 1911–24, while the total membership of the societies increased by 2,400,000. In France, the regional societies formed since 1913 and known under the name of Co-opératives de Développement ou de Fusion, only numbered 46 on Jan. 1 1925; yet they maintained 2,600 shops and had 565,000 members. Their turnover in 1924 rose to about a quarter of the turnover realised by all the consumers' societies in France. In Great Britain the membership of consumers' societies increased by 2,000,000 between 1911–24, while the number of societies diminished by 89 during the same period. In Sweden, the average number of members per society has more than doubled for the same reasons and during the same period. This partly explains the size of the consumers' societies in great industrial centres, some of them having more than 100,000 members; Woolwich had 109,535 members in 1924; London had 117,266 members at the same date; Hamburg 150,000; Berlin and district 160,000; Vienna 167,000.

The Economic Unit.—The appearance of the large society has raised the problem of what is the best economic unit. The large undertaking, whether co-operative or not, clearly possesses certain advantages lacking to the small; better conditions of purchase, better financial resources, better possibility of utilising modern mechanical appliances, etc. But these advantages do not always increase on parallel lines with the increase in the dimension of the enterprise. There comes a point when the return ceases to increase proportionately with the increase of general expenses. There is a danger that the cumbersome and expensive administrative apparatus will bring the disadvantages of bureaucracy. Extension of area, in particular, does not necessarily result in greater efficiency because of the increase of transport costs entailed by stocking widely dispersed centres of distribution.

Moreover, the very large enterprise is rarely conducive to the best co-operative education; the social bond is loosened, contact between members and administration becomes less close, and the members cease to take a direct active share in the conduct, responsibility and control of the business. Thus an essential distinction between the co-operative society and the limited company vanishes. As the consumers' societies have grown, the functions of the general meeting have become more and more difficult or illusory. Members no longer know one another. They cannot appreciate the activity exercised by their society in all its details and in its entirety; they can no longer vote with full knowledge and with the sense of personal responsibility. Co-operative democracy tends to become formal, and the enterprise is no longer directed by the members as a whole, but by a small group of them. A very large membership sometimes even makes general meetings impossible for material reasons; and it has been necessary to consider replacing general meetings by meetings of delegates. This process, with certain modifications of detail, has been made legal in Germany (amendment of July 1 1922 to the law of 1899), in Poland (law of Oct. 20 1920) and in Switzerland (proposed revision of the Code des Obligations). In France, sections constituted by arrondissement or by commune within the Co-opératives de Développement ou de Fusion appoint delegates to the general assembly.

The virtues of the small society are beginning to be recognised; it is admitted that as forcing houses for the development of the co-operative spirit in the new generation they are justified if they receive the economic support of larger societies and are organically bound to a federation. A type is required which shall combine the economic advantages of the larger society, with the democratic control and the educative value of the small society. No formula has been reached. In some cases the large regional societies are being transformed into federations with the duty of controlling and performing common services for the small societies, which recover their autonomy and with it their social life. Sometimes the large regional societies are maintained, and autonomous centres of activity are formed within them in the shape of town or district shops, groups constituted for savings, social work, etc. Everywhere centres of education and propaganda are being organised for the women members to secure their effective collaboration.

Extension of the Movement.—The growth of the consumers' movement has had other aspects. It has considerably enlarged its bases of recruitment. Through the regional societies it has spread rapidly among the rural populations. In Finland, in 1922, 49·4% of the membership of the co-operative movement consisted of independent farmers or small holders or agricultural labourers. In Germany, the number of farmers and agricultural labourers grouped in the central union of German consumers co-operative societies has increased from 40,760, or 3·95% of the total, in 1911, to 226,003, or 6·51% of the total, in 1924. Similarly in Sweden, the number of farmers and agricultural labourers in consumers' co-operative societies increased fivefold between 1910–22 from 11,438, or 17·6% of the total, to 56,387, or 22·3% of the total. In the towns, while still catering especially for wage-earners, the consumers' movement, especially since the War, has attracted the middle classes. In 1922 this class represented 14·6% of the members in Finland; in Germany they had increased from 11·66% in 1910 to 20·3% in 1924 and in Sweden from 8·7% in 1910 to 18·8% in 1922.

Finally, the consumers' movement has penetrated the poorest sections of the urban proletariat. For this reason, and because of the conditions under which wages are paid, the societies are increasingly concerned with the problems of giving credit to their members. Ever since its inception the movement has been pledged for its own sake to insist on cash payments, since the giving of credit increases overhead charges and endangers the

security of the enterprise. This is also in the interests of the member, who finds cash payment a guarantee of liberty and dignity as well as a stimulant to thrift. But in certain difficult situations or for certain purchases a working population undeniably needs credit and the total sum of its indebtedness of members at the end of the financial year rose in 1924, to £2,800,110. In fact, of 1,314 shops in Great Britain more than 1,100 give credit. In Finland, only 15% of the societies sell for cash; in the Scandinavian countries the extension of credit has given the directors of the movement some anxiety. In Norway the percentage of credit transactions grew continuously from 1916 onwards, passing from 1·7% at that date to 4·5% in 1924. In that country the rise of the exchange and the fear of an economic crisis and a period of unemployment, which seemed imminent, added to the disquietude and the question was brought up at the congress of 1925.

The Labour Question.—With the vast growth of the movement the societies have had to face the labour problem. In small societies the work of directors, managers, etc. was at first performed gratuitously by members in turn or as elected. As the societies grew and their responsibilities increased they had to seek professional skill and paid labour. In certain countries the consumers' societies and their federations have even become important employers. In 1924, the societies affiliated to the German Central Union employed 42,350 persons in their distributive and productive undertakings. At the same date the consumers' movement in Great Britain employed 207,211 persons with a wage bill of £25,596,987. Thus the problem of relations with the personnel employed and with the trade unions arose. Though the societies have tried to establish model conditions of work, and though they have to meet the competition of private enterprise, they have often led the way in improving hours of work, wages, insurance, holidays, collective agreements, etc. Thus, they have been able to establish with the trade unions relations which, if they have not always everywhere been so intimate as the two parties might desire, nevertheless show great mutual confidence. In Great Britain, France, Switzerland, Belgium, Czechoslovakia and elsewhere, committees have been established on which the representatives of the central trade unions and co-operative organisations sit in order to determine wages and conditions of labour, and to act in case of disputes as organs of conciliation and arbitration. It is generally understood that strikes, particularly those covering an entire trade, will not affect the co-operative societies; while the latter pledge themselves to apply trade union conditions of labour and wages.

In the main centres of distribution an effort has been made in some countries to place their managers in psychological and social conditions similar to those of the small retailer. Fixed salaries have been replaced or supplemented by a system of premiums for economies in working, commission on sales, etc. In Germany the employees have often pronounced in favour of fixed salaries, but in an increasing number of societies a variable fraction of the salary bears a relation to the sales effected. Similarly, in Austria, where the consumers' societies are most deeply impregnated with Labour and Socialist influences, the directors of the movement favour a basis of remuneration proportional at least in part to the commercial results. In France, the regional societies have entrusted the branch management to managers paid on a commission basis.

As their strength developed, the societies have tried to satisfy the greatest possible number of their members' needs. Starting with the provision of groceries and bread, they have in some cases gone on to found restaurants and cafés, shops for the sale of dairy products, drapery, clothing, shoes, hardware, household goods, fuel, furniture, etc. Many societies have even attempted to attract members by procuring them houses, either building themselves or assisting special building societies.

Relations Between Wholesale and Retail Societies.—The central organisations seek to extend their supply services to their affiliated societies. In return they expect the affiliated societies to reserve for them the highest possible proportion of their custom—not always with success, for reasons many of which are perfectly legitimate. In Germany the retail societies bought only 23·2% of their goods from the wholesale, and 23·8% in 1924. The proportion is more satisfactory in Sweden, having risen from 21·6% in 1913 to 32·5% in 1923; in Switzerland from 28·2% in 1910 to 49·9% in 1924; it is naturally most satisfactory in Great Britain (47·9% in 1911 and 51·77% in 1924). These figures show a relative increase of purchases made by the societies from the wholesale societies, corresponding roughly both to the progress effected by the wholesale societies themselves and to the steadily increasing loyalty of local and regional societies. Nevertheless some societies show regrettable neglect of their wholesale societies.

Productive Enterprises.—At an early stage the consumers' co-operative societies attempted to produce, either in their own establishments or through their central organisations, the greatest possible number of articles and goods which they required, with the object of eliminating the commercial as well as the industrial profit.

Progress in the quantity, variety and value of the products manufactured was considerable from 1910 onwards. The English C.W.S. has the greatest variety of productive enterprises, from the manufacture of flour, biscuits, chocolates, soap, cycles, motors and sewing machines to the ownership of tea plantations. It more than doubled its production between 1911–24, the value rising from £12,471, 414 to £29,938,339. In Germany the production of the industrial enterprises of the Hamburg C.W.S. increased in value from 2,935,581 marks in 1910 to 26,298,325 marks in 1924. The value of the production of the French C.W.S., which was insignificant in 1911, was 23,700,000 fr. in 1924. The Swedish Union had no productive enterprise before 1921, but in 1923 produced goods to the value of 10,900,000 kroner. Its congress in 1922 voted the raising by subscription of a special fund of 3,000,000 kr. for production. This subscription was closed in 1924 after producing 3,500,000 kr. and in 1926 the Swedish consumers' movement had two of the largest flour mills in Sweden.

The development attained by certain productive enterprises raises a grave problem. Impelled by the necessity of cheap production, the co-operatives desire to extend their market and thus tend to introduce the risks and profits of capitalist methods. On this question divergent reports were presented to the international co-operative congress at Ghent in 1924 by Sir Thomas Allen and Max Mendel, and raised very animated discussions in the German co-operative Press and at the congress of the German Central Union at Stettin in 1925.

Moreover, it sometimes happens that the producing services are completely detached from the purely commercial services and are carried on by specialised, distinct and autonomous societies, of which their customers, the local or regional societies, become members if they wish. This specialisation of functions is well illustrated in the co-operative enterprises of the Swiss Union of Consumers Societies for special purposes: two flour-mills, a furniture factory, a creamery, a society for market gardening and a shoe factory. In Germany, a clothing society was formed in 1922 by the Hamburg C.W.S in conjunction with the State of Saxony. In France, at the Bordeaux Congress in 1923, a proposal was considered for the constitution of national societies for special purposes for each of the industrial undertakings carried on by the C.W.S. A society distinct from the French C.W.S. was constituted by the most important societies of northern and eastern France to exploit a salt mine.

In the course of the movement, which is leading them from distribution to production and even to the exploitation of raw materials, the consumers' societies, especially the central organisations, have undertaken direct agricultural production with the help of hired labour. Experiments in this direction have been made chiefly in Great Britain and on a smaller scale in Switzerland, but have not given very satisfactory results. Since the Nottingham congress in 1924 and still more since the Southport congress in 1925, the British consumers' movement appears to be taking a quite different direction. In Switzerland, the agricultural estates, exploited by the consumers' societies, are conducted merely with the idea of providing first-hand information on the cost of agricultural products.

II. RELATIONS BETWEEN CONSUMERS AND AGRICULTURAL CO-OPERATIVE SOCIETIES

By direct touch with agricultural co-operative societies, the consumers' societies seek to ensure the supply of farm products to their members. These relations, desirable and fruitful, as they are, pre-suppose a sincere and tenacious desire for rapprochement and adequate development on both sides, and they present certain technical difficulties. The acute disagreement between the rural and urban population in Europe caused by the War conditions has diminished. One proof of this is the spirit in which agrarian problems have been worked out after the War by the Socialists and Communist parties. The co-operative movement itself has been actively associated in securing an understanding. In those agricultural countries where both the consumers and the agricultural co-operatives are well organised, the union between them has long since been effected. In Ireland, the Baltic States, the Balkan States, Russia, Siberia, India, many states of North America, Palestine, etc., it often happens that the same societies fulfil the functions both of distribution and of agricultural supply and marketing. In other countries all kinds of societies belong to the same federations, and have formed committees to ensure understanding and common action among the specialised federations. In the overseas British Dominions a permanent and close rapprochement has even been brought about in political action (*see* CO-OPERATION, AGRICULTURAL).

Economic relations have been established in two directions: (1) the farmers buy from the consumers' societies not only foodstuffs, but also fertilisers, seed, agricultural implements, etc.; (2) the consumers' societies buy the farmers' products. Both kinds of transaction can be arranged either through the central organisations of the two movements or by the rural branches of societies of urban origin. Exchanges of this kind have been made with varying methods and success, in Germany, Denmark, France, Great Britain, Norway, Switzerland, Czechoslovakia, the United States, etc.

These exchanges may be occasional or part of an organised system. Perhaps the most ingenious form of organisation is that of the mixed society, in which the agricultural and the consumers' societies contribute equally the capital of the common enterprise and have equal representation in all meetings, committees, etc. Similarly, the profits of the enterprise are equally shared; each group then distributes its share among its members proportionately either to deliveries or purchases respectively.

In addition to local or national relations, exchanges have been made between agricultural societies in one country and consumers' societies in another. The outstanding example of these international organisations gives an apt illustration of the mixed society. This is the New Zealand Produce Association, Ltd., set up by the English C.W.S. and the New Zealand Producers' and Marketing Association. This association, which began operations in April 1921, sells New Zealand butter, cheese and other agricultural products in Great Britain. During the six months ending June 1924, the purchases made by the English C.W.S. from the New Zealand Produce Association amounted to £223,170. Another example, but a less purely co-operative and less elaborate one, is furnished by the Russo-British Grain Export Co., Ltd., founded in 1923 for the purpose of exporting Russian wheat to Great Britain and other countries of Western Europe, among whose members are the C.W.S. and Centrosoyus.[1]

Although a practical formula is still to be found, there is a real desire for rapprochement between the different forms of urban and rural co-operation, as witnessed by the following resolution adopted at the Ghent congress in 1924:—

> It is desirable that direct and organic relations be established between the consumers' co-operatives and the agricultural co-operatives in order to unite in local and national organisations the consumer-producers of the towns and the country and, in the international field, the industrial and agricultural countries, on the basis of mutual respect of their conditions of labour and life.

The same desire inspired the International Institute of Agriculture and the International Labour organisation. They undertook a joint enquiry on the relations between agricultural marketing societies and consumers' societies.

[1] The Central Organisation of the Russian Co-operatives.

III. THE PROBLEM OF PRODUCTION

In the towns, co-operative production has four aspects: artisan societies, workers' productive societies, industrial undertakings belonging to consumers' societies and labour contracting societies.

Artisan Co-operative Societies.—Co-operative artisan societies are as numerous and as various in form as peasant societies. They include not merely organisations for the common utilisation of apparatus for certain operations, but also credit societies, societies for the purchase of raw materials and tools and marketing associations. They are distinguished from workmen's productive societies in that they do not organise work in common. The development of these artisan societies has greatly helped the single-handed worker and the *petit patron* to hold his own against large-scale industry.

The classical country of artisan societies is Germany, where they play an important part in the urban co-operative organisation which developed in the latter half of the 19th century. Inspired originally by Schulze-Delitzsch, the movement in 1920 included 1,373 societies with 134,489 members. Belgium, at the beginning of 1923, had 217 societies for the common purchase of raw material, machines, tools or the sale of products manufactured by their members. In Czechoslovakia these societies on Jan. 1 1924 numbered 944. In France, artisan co-operation dates from the passing of the law of Dec. 27 1923 (credits to co-operative societies and artisan co-operative unions).

There are also intermediary forms between the artisan societies, properly so-called and the productive societies, which are not always distinguished in statistical returns from Hungary, Italy, Yugoslavia, India, Japan and other countries. In Austria, where the development of labour societies has been greatly encouraged by the State, there were on Jan. 1 1923 858 societies of small industry and commerce; in Poland statistics show 357 societies on Jan. 1 1923 for supplying their members with industrial raw material; and in Russia, where small and home industry (Kustar) represents, according to some calculations, about one-third of the entire industrial production, there were on Jan. 1 1923 18,050 artisan societies in very diversified trades.

Productive Societies.—Productive co-operation has developed most characteristically in France; in Italy it has taken a slightly different form, and in Great Britain it is far less advanced. In France there were 498 productive societies in 1911, and 531 on Jan. 1 1923, though the business done has slightly decreased in real value. In Great Britain the number of productive societies increased from 91 with 22,919 members in 1911, to 98 with 27,767 members in 1924. Though the movement is not stagnant, a close examination shows that productive societies have a short life. The numerous dissolutions indicate the difficulties encountered; while the persistence with which new societies are formed indicates the strong desire of the workmen to escape from the status of the wage-earner. Productive societies show an increasing tendency to enter into relations with the public services and with the consumers' societies to find a market for their products. They sometimes even allow themselves to be absorbed by the central consumers' organisations. Success often leads the co-operatives into grave dangers, and those which succeed are liable to abandon co-operative principles. They make it difficult for new members to join by raising the cost of the shares, and evolve towards a capitalist system. Many of them employ a high proportion of paid assistants.

In France and Great Britain about 40% of the persons employed in productive societies receive wages. The productive societies are seeking a formula to secure the liberation of their members and also ensure their economic success and safeguard their social value.

Productive Undertakings Controlled by Consumers' Organisations.—Many people, perhaps most of the leaders of the movement, believe that production undertaken by the consumers' societies and by their federations is a true form of industrial

democracy. The work of the employees acquires the character of a public service, from which capitalist profit is eliminated, or more exactly, the surplus realised is placed at the service, not of a few privileged persons, but of the co-operative community. Nevertheless, discontent and even strikes have broken out among the personnel employed. The truth is that in the workmen's revolt against the wages system there is a profound desire that the workman shall achieve his emancipation in the actual course of his work. Starting from these considerations, the international co-operative congress of 1924 discussed and adopted a resolution drawing the attention of the consumers' societies to the part which labour associations can play in the organisation of industrial labour.

Co-operative Labour Associations.—The co-operative labour associations, which often take permanent form as societies, are groups voluntarily constituted in which the members work under the direction of delegates whom they have chosen and can depose. The collective remuneration of the work of the group is shared on principles worked out by the members themselves. This differs from other methods of collective remuneration, where the employer himself engages the gangs, or the foremen of the gangs, or where he intervenes in the division of the collective salary. The labour associations provide a method of industrial organisation by the workers, since the members hire out their labour collectively and themselves exercise personally and through their delegates the functions of control and of the distribution of tasks. On the other hand, the labour associations differ from the productive societies in that they do not have to raise and manage capital; that they do not assume administrative and commercial organisation, and neither purchase raw material nor sell the finished products.

Labour associations and productive societies have developed in several countries, particularly in connection with agricultural labour and public works; also among transport workers, porters, etc. In Italy, the State has entrusted important public works—of drainage, hydraulics, building, railway construction—to societies known by the name of Co-operative da Produzione e di Lavoro. In New Zealand the labour associations operate chiefly in the mining industry and in railway construction. In Russia, labour associations are known as labour artels. They exist under various names in Germany, Australia, France, Hungary and Lithuania. Labour associations act chiefly in little-skilled or unskilled branches of labour and in small scale enterprises. Nevertheless, in certain countries in certain branches of highly skilled labour, they have begun to enter into larger enterprises. This is the case in France in the printing industry, for instance; in New Zealand in the mining industry, etc. In France, these societies are known by the name of *commandite d'atelier*. The labour association, by substituting a contractual relation for that of a subordinate, constitutes a form of workmen's participation in management. In this way co-operation contributes to the perfecting of the organisation of labour.

IV. SAVINGS AND CREDIT

Credit in consumers' co-operation is concerned with the credit requirements of small independent enterprises, of common enterprises of consumers' societies and of individual households. Urban credit societies of the Schulze-Delitzsch type supply the credit needed by small merchants, industrial workers and artisans. Credit societies have recently been formed in France under the name of *banques populaires;* in 1924 they numbered 325, and their total balance-sheet amounted to 24,400,000,000 francs. The law of May 19 1917, in defining their legal status, insisted that the annual profit after the provision of reserves, must be divided among the depositors, not in proportion to the interest which they had received, but in proportion to business transacted.

The consumers' societies have not been able to reach their present development with their own capital alone. They soon began to ask their members for capital, either in the form of long-term loans or of deposits. In collecting the people's savings and utilising them, under the control and to the profit of the savers, in economic enterprises and social work initiated by themselves, they were educating their members and encouraging thrift. This explains the creation of savings and banking departments within the great federations of consumers' societies. The increase and development of these organisations was one of the salient features of the urban credit movement between 1911–25.

Relation to Wholesale Societies.—The banking departments and institutions of the consumers' movement have almost always developed out of the accountancy branches of the wholesale societies. In some cases, in the Hamburg C.W.S. and the English C.W.S., these are more or less independent departments, which yet remain integral parts of the wholesale society. Sometimes, as in France and Czechoslovakia, the banking department is completely separate from the wholesale society, and an autonomous co-operative bank has been established; sometimes, as in Austria or Denmark, the savings of the people are collected by collaboration between consumers' societies and trade unions. In other cases, as in Sweden, the trade unions abstain from forming a special workmen's bank and simply recommend their members to support the deposit and savings departments organised by the consumers' movement. In Germany, on the contrary, the trade unions have created the workmen's, employees' and civil servants' bank side by side with the banking department of the C.W.S. In Russia, the autonomous co-operative bank (Vsekobank), which was first instituted by the consumers' movement, has become the common bank for the whole of the Russian movement. The labour banks of the United States are more or less connected with the local co-operative movement and are partly co-operative in principle.

In Great Britain, the banking department of the C.W.S. received deposits in 1924 amounting to £552,837,668. From its beginning it has inspired the greatest confidence in the trade unions. Of the 18,732 current accounts, individual and collective, 8,766 have been opened by the trade unions. In France, the banking service of the Paris C.W.S. was transferred in 1922 into a bank which is known under the name of the Banque des Coopératives de France; in 1924 its deposits amounted to 106,000,000 francs. In Sweden, the savings department, founded in 1908 by the co-operative union, included at the end of 1922 355 savings banks with deposits amounting to 16,297,000 kroner. On June 6 1925 there were 31 labour banks in the U.S.A. with total deposits of $85,608,633.

Building Societies.—Co-operative building societies (which must be distinguished from building guilds) are purely credit institutions. The building societies aim at facilitating the acquisition of houses and in purely credit institutions. The original capital, supplemented by loans contracted by the society, is furnished by the members, each of whom is called upon to subscribe shares or to make deposits proportionate to the cost of the house. He receives interest and pays off the total price of the house in instalments spread over 10 to 15 years. Housing societies aim at building houses to be sold or let to their members. In housing societies each member can take up as many shares as he likes. The capital is made up of sums raised on mortgage, by issuing bonds and by the deposits of members. The supplementary payments made by members take the form of rent. In Great Britain there were 12,055 building societies in 1921; in 1922, 232 tenant societies, with 2,795 members and a turnover of £8,000,000. In Germany the number of housing societies rose from 1,056 in 1910 to 3,792 in 1924. In 1910 there were in the United States 5,869 building and loan associations with a total membership of 2,169,893 and total assets of $931,867,175. In 1924 the number of associations had increased to 11,844 with a total membership of 8,554,352 and total assets of $4,765,937,197.

Consumers' societies or their management often share in the foundation and management of building societies. They also seek to organise the savings of their members for other emergencies. Besides co-operative insurance funds, there are institutions like the provident funds of certain German consumers' societies. These funds, to which a part of members' dividends are added, enable members to accumulate reserves for critical periods—unemployment, strikes, illness, etc.

Credit Unions and Labour Banks.—The credit unions developed since 1910 in the United States certainly have the advantage of a purer and more elaborate formula. While the savings and credits institutions of the consumers' societies unite in the same organism, two functions distinct by their nature, the credit unions, which specialise in a most definite function, are better adapted to more numerous and various needs of credit. They are most highly developed in great cities like Boston and New York, where they render to workers' households services comparable to those which the Schulze-Delitzsch organisations render to the small independent workmen or the Raiffeisen banks to the rural population. In the credit unions members' responsibility is limited to the amount of the shares subscribed, and they do not usually grant loans for trade purposes; otherwise in their aims and methods they closely resemble Raiffeisen banks. Their members are usually recruited from a small and homogeneous group of persons, who either live near each other or work in the same establishment. The unions are thus perfectly adapted

to collecting small savings. Like the Raiffeisen organisations, they can make small loans without other guarantee than that of the member. In principle, they give loans exclusively for productive ends, but they have had to admit a wide meaning for the word "productive." Thus they grant loans for current needs, but only if such expenditure improves the condition of the borrower. The credit unions are formed by share subscription. The denomination of these shares is generally low, five or 10 dollars. Each member has to subscribe for one or more shares; he can also make deposits. Credit unions have now (1926) developed in 24 States. In Massachusetts, where they started, there were 90 in 1924 with 34,469 members and total resources of $6,297,000.

The credit unions have carried on a successful war against money-lenders. An inquiry instituted in Boston in 1915 showed that every week 100 workmen spent half a day's work in payment to money-lenders, and that most of the loans were made at an interest of 180% per annum. Since the development of the credit unions, which charge 8% on loans, half the money-lenders in Massachusetts have disappeared, and the other half have lost half of their business.

These institutions have aroused interest in other countries, especially in Austria, France and Sweden. These credit unions, being autonomous, mitigate the hardship resulting from the strict application by the consumers' societies of the principle of cash sales. The insistence by the consumers' societies on cash may be prudent finance, but tends to diminish their turnover; if this insistence teaches members not lightly to run into debt, it does not meet legitimate emergencies or save them from recourse to money-lenders. The credit unions therefore render an essential service.

V. THE INTERNATIONAL CO-OPERATIVE ALLIANCE

The International Co-operative Alliance (I.C.A.) was suggested in 1886 at the British congress at Plymouth by the French co-operator, Boyve, and definitely constituted in 1895. Originally it included eminent persons interested in co-operation and its principles, not necessarily representing societies. But gradually, thanks to the activities of its first president, Henry W. Wolff, who employed in its service his personal influence and his extensive knowledge of all forms of co-operation, the Alliance rallied round it the co-operative organisations themselves. At the ninth international congress, held in Glasgow in 1919, its statutes were modified to give it the constitution of a union of national federations. Most of the affiliated organisations are federations of consumers' societies. But other forms of co-operation, notably productive societies, and the societies serving the multiple activities of the rural and agricultural populations, are also represented in the Alliance.

In Europe the I.C.A. includes almost all the federations of consumers' societies, the wholesale societies; federations of productive societies of France, Great Britain and Italy; the federations of agricultural societies of France, Hungary, Italy and Rumania; federations of societies (either specialised, or with multiple functions) of Denmark, Esthonia, Finland, Ireland, Italy, Latvia, Lithuania, Yugoslavia, Russia, the Ukraine and Georgia. The federations of consumers' societies of Canada, United States and Argentina have joined the Alliance, as have the federation of the Bombay societies, and the federation of the Japanese unions. The relations which have been established between the English C.W.S. and the overseas agricultural societies permit the hope of closer bonds in the near future and even of eventual formal union between the Alliance and the mainly agricultural movements of South Africa, Australia and New Zealand. Taking into account only the federations, actually affiliated to the I.C.A., where the number of societies and members is known to us, the following figures give a low estimate: 70 federations of 32 countries, with about 75,000 societies, and a total of more than 40,000,000 members. In the words of its statutes:—

> The Alliance is not concerned either with politics or religion; it considers co-operation as a natural ground on which persons of the most various opinions and different beliefs can act in common.

Its political and religious neutrality on which the unity of the co-operative movement rests, does not exclude affirmation of the moral and economic ideal which is common to all co-operators. This is why the Alliance has introduced in the first article of its statutes a definition of the end towards which it leads the co-operators of the whole world:—

> The International Co-operative Alliance, continuing the work of the pioneers of Rochdale, pursues quite independently and by its own means the substitution for the present competitive régime of private enterprise, the co-operative régime organised in the interests of the community as a whole and based on mutual assistance and self-help.

The international co-operative congresses constitute the highest authority of the Alliance. Eleven congresses have met: London, 1895; Paris, 1896; Delft, 1897; Paris, 1900; Manchester, 1902; Budapest, 1904; Cremona, 1907; Hamburg, 1910; Glasgow, 1913; Basle, 1921; and Ghent, 1924. In the intervals between its congresses the Alliance is administered by a general secretary, Mr. Henry J. May, and an executive committee, whose president is G. J. D. C. Goedhart; (vice-presidents, A. Whitehead and E. Poisson) and eight other members; and a committee composed of representatives of all the national organisations which are members. The development of the activities of the Alliance has therefore necessitated the institution of specialised auxiliary committees.

The international committee of the co-operative wholesale societies, constituted in 1919 and transformed in 1924 into a society under the name of the International Co-operative Wholesale Society, collects information concerning the commercial relations between the co-operative centres of the different countries and studies the possibilities of supply as a whole. The value of purchases made abroad by 13 of the wholesale co-operative societies rose in 1923 to £29,053,068. The purchases of the British wholesale societies were £25,127,472; of the merchandise bought abroad by 13 wholesale houses together 3% was manufactured articles and cloth, and 2% coal, wood and mineral products; the other 95% represented provisions.

Seven articles by themselves form 70% of the total value of the imports of wholesale co-operative societies:—

Butter	£5,214,259	Tea	£3,499,932
Wheat	5,018,001	Sugar	1,573,548
Lard and Bacon	4,682,046	Coffee	659,837
		Rice	364,703

Europe furnishes 37% of the total of £29,053,068; America 28%; Asia 17%; Australia 53%; Africa 3%. The International Co-operative Banking Committee, constituted in 1922, has already collected important documents on the development of co-operative banking, and is in touch with 27 central organisations of 16 countries. Its immediate task is to facilitate the establishment of co-operative banking relations between country and country, such as the regulation of commercial operations with or without opening credits, the transference through co-operative channels of the savings of members, etc. The development of these relations will prepare the way for the establishment of an international banking centre. The International Co-operative Women's Guild (est. 1921) unites the national women's guilds. The first women's guilds were established in Scotland and Ireland and guilds were later formed in Austria, Belgium, Holland, Switzerland, France, the United States, Canada, etc., in order to educate women to take a more active part in the co-operative movement. The countries actually affiliated to the I.C.W.G. are: Austria, Belgium, Holland, England, Ireland, France, Norway, Scotland, Sweden, Switzerland and the United States.

Finally, the Alliance has taken under its patronage the committee constituted on the initiative of the Belgian Prévoyance Sociale to study the co-operative and workmen's insurance societies. The I.C.A. issued in 1906 a very complete bibliography of all works which had appeared up to that date on co-operation in any country, and in 1910 and 1913 it has published monthly an *International Co-operative Bulletin* in English, French and German, giving authoritative articles on co-operative questions and on the activity of the co-operative movement. Since 1907 it has issued a *Yearbook of International Co-operation.*

Of all the social movements, perhaps the international co-operative movement has recovered its unity most rapidly since the War. Strictly speaking, its unity was never formally broken, and as early as 1920 the International Co-operative Alliance again took up direct relations between the co-operators who had been separated by hostilities. It was also able to surmount the difficulties resulting from events in Russia. But experience has

shown the importance of a practical activity applied to specifically co-operative tasks. It is by directing all its efforts to co-operative education and the practical tasks of organisation that the Alliance will be able to maintain its influence and bring all the countries of the world within its scope.

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CO-OPERATION, AGRICULTURAL (*see* 7.87).—The development of agricultural co-operation has taken widely different courses in various countries according to their specific needs. The main difference to be observed is between countries which are primarily producers of agricultural commodities for export, and those which produce mainly for home consumption. In the former, the co-operative movement has chiefly concentrated upon the organisation of marketing; in the latter—apart from the development of rural credit and insurance—mainly upon the purchase of farm requisites, or the formation of co-operative dairy, bacon, or other producing societies. Although this broad distinction holds good, it is nevertheless true that practically all types of co-operation are to be found to a greater or lesser extent in the principal agricultural countries.

CO-OPERATION IN EUROPE

In western Europe, where the majority of countries are importers of food or are approximately self-supporting, the growth of co-operation has been mainly in the direction of developing rural credit societies (*see* AGRICULTURE: ECONOMICS) or of societies for the purchase of agricultural requisites, though often combining these functions with that of the sale of produce. But even here, Denmark, conducting a considerable export trade, has developed its marketing organisations on co-operative lines in addition to its highly organised system of supply societies; indeed it has been the model upon which many of the marketing organisations in the newer countries have been based.

Leadership in agricultural co-operation belongs to Germany and Denmark. Of the 38,000 agricultural co-operative societies in Germany in 1924, there were 19,000 rural banks, 4,700 purchase and sale societies, 3,500 dairies and 10,000 societies for other purposes, together with 98 " central " societies. In 1920, Denmark possessed more than 5,000 co-operative associations, including over 1,600 consumers' societies, 1,100 creameries, 40 bacon factories, besides a number of central associations, export associations and co-operative bodies for various minor purposes.

A general characteristic of the European co-operative movement is that both in its origin and subsequent development there has been a certain idealism which has given it a special vitality. Thus, in Denmark, the movement was associated with a moral educational revival accompanied with the development of the people's high schools; in Belgium the co-operative organisation had a basis of religious and social culture; in Germany the birth of the co-operative credit movement was largely a question of the social regeneration of the rural population. In most of these cases it started with the clubbing together of a small number of villagers to carry out a common object, whether it was the purchase or sale of produce, or the provision of credit. But, although built up upon this small foundation, the movement has gradually assumed a different character through the consolidation of the small units into large federated organisations, the gradual centralisation of control, and the development of many of the features of big-scale enterprises. Indeed, federation describes in a word the modern development of the co-operative movement in most agricultural countries.

The newer countries, taking advantage of the early experience of Europe, have extended co-operative organisations on a very large scale in connection with the special problems of marketing and export. It is shown particularly in the large co-operative marketing enterprises in the United States of America and in the development of wheat " pools " and other similar organisations in Canada and Australasia.

The main divisions of the co-operative movement in Europe are: supply, production, marketing, credit and insurance. Other minor, but important branches, are the co-operative use of farm machinery, cattle breeding, the supply of electric light and power, the manufacture of potato meal and potato alcohol, forestry and fishing. Supply and production are dealt with here; the other matters are discussed under AGRICULTURE; MARKETING.

Supply Societies.—These have aimed at purchasing agricultural requisites in bulk at wholesale prices and delivering them to members at cost. They have been widely developed upon " Rochdale " principles, the goods being delivered to members at certain fixed prices and the profits of the societies being distributed amongst its members as a " dividend " in proportion to the gross amount of their purchases. This principle applies in many European countries, though an exception is to be found in France, where the profits of the " syndicats " go to the formation of a reserve fund which belongs to the members equally, irrespective of the amount of their purchases. The recent tendency in the development of these societies is to federate the local distributive societies to central wholesale societies on the general plan of the British distributive movement. In the countries where agricultural co-operation was adopted comparatively early, such as Germany, Denmark and Switzerland, great progress has been made in this direction, resulting in a very large amount of farm requisites—and often household requisites in addition—being supplied through co-operative channels. Certain countries have adopted the principle under which members bind themselves by contract to purchase the whole of their requirements through their society.

In Germany, the pioneer society in the movement towards wholesale federation was the Haas Society at Insterburg, founded in 1871. This example was subsequently followed by the rest of Germany, membership of the provincial wholesales being usually confined to the local distributive societies. The first permanent successful federation amongst consumers' stores in Denmark started in 1884 with the formation of the Co-operative Wholesale Society of Denmark amongst the societies on the Island of Zealand, for the supply of farm requisites as well as ordinary household requisites. Four years later a similar wholesale society was started in the Jutland Peninsula, and in 1896 these two were amalgamated into one organisation—the Co-operative Wholesale Society of Denmark. Since then it has made remarkable growth, the number of consumers' societies which were members of the wholesale having risen from 310 in 1896 to 1,250 in 1910 and to 1,805 in 1922. The Co-operative Wholesale Society is a member of the Scandinavian Co-operative Wholesale Society, which is a joint buying organisation for the wholesale societies of Denmark, Norway and Sweden. Although the Co-operative Wholesale Society of Denmark initiated the first efforts towards the co-operative buying of farm supplies, subsequent developments in Danish co-operation have led to specialisation, resulting in the formation of independent pur-

chasing associations, each to buy and distribute one particular kind of farm supply.

In Switzerland, very similar progress has been made. The Verband-Ost-Schweizerischer-landwirtschaftlicher-Genossenschaften was formed as a central society. The business was divided into two departments—the agricultural, dealing with seeds, manures, cattle food, etc., and the store department dealing with household requisites. The organisation has also undertaken the sale of members' produce, though its supply side remains its more important function.

In France, the local, and more particularly the communal, " syndicats agricoles " have united in departmental unions, and these unions have formed the starting point of larger organisations—the *unions régionales*. The growth of the movement in France may be judged from the fact that the number of syndicats rose from 39 in 1885 to 4,948 in 1910, and to 6,667 in 1914. In the latter year the total membership exceeded 1,000,000 persons.

In Great Britain, agriculturists have taken little part in the British consumers' co-operative movement except in so far as they may have been co-operators for the purchase of ordinary household requirements. Attempts to develop supply societies independently have been carried on particularly by the Agricultural Organisation Society (founded in 1901; came to an end in 1924), but in spite of some progress in this direction in 1923 the total number of farmers' supply societies was only 347, with a total membership of approximately 73,000. A central wholesale society known as the Agricultural Wholesale Society was founded in 1918, but failed in 1924 and went into liquidation. The important movement in Ireland is separately dealt with (*see* IRELAND).

Production Societies.—Probably the most successful branch of productive co-operation is to be found in the dairy societies existing in large numbers in all countries in which agricultural co-operation is firmly established. Leadership again belongs to Germany and Denmark, the former having as many as 3,491 co-operative dairies in 1924, while the latter had some 1,118 at the outbreak of the World War. Switzerland, France, Holland, Belgium and some of the countries of south-eastern Europe have also made considerable progress in recent years. Ireland, one of the most successful countries in developing co-operative creameries, had, in 1921, 336 of these societies. In Great Britain, the number of dairies in 1923 was 94, with a membership of approximately 13,000.

Mention should also be made of the bacon factories and egg and poultry societies, the former of which have been brought to a high degree of efficiency in Denmark. In 1922 there were 40 bacon factories, dealing with 2,215,000 pigs per annum. These are factories requiring a considerable amount of capital and provided with subsidiary plants for the disposal of by-products. They are usually financed by loans jointly and severally guaranteed by the members, and receive the pigs from members under contracts binding them to supply their whole output for a period of years. The individual bacon factories are federated in the National Federation of Danish Co-operative Bacon Factories, with head offices in Copenhagen. One of the most remarkable achievements of this co-operative organisation is the improvement of breed which it has enabled producers to bring about. A close study of the requirements of the British market (the principal export market) combined with scientific pig breeding under the supervision of the Govt. and the National Federation of Co-operative Bacon Factories, has led during the last 30 years to an improvement in quality, without parallel in other countries.

To Denmark also belongs the credit of laying the foundations of co-operative marketing which has lately been developed on an enormous scale in the newer countries. The tendency is to establish strong central selling or export agencies of which local productive societies are members. The need for co-operation amongst the local co-operative societies gave the impulse towards the centralisation of marketing, and the formation of provincial and ultimately national associations, but many difficulties were experienced before the structural development of the marketing organisations was complete. The turning point was reached when the principle of binding contracts for the supply of produce was adopted. Under this system the members of a local co-operative marketing association undertook to supply the whole of their produce to their society for a term of years. The term ranges from one to as many as 20 years. On this firm foundation it has been found possible to build up the modern organisation which markets the greater part of Danish agricultural produce. The local units, having a democratic membership control, are usually federated to the central society on " commodity " lines, that is to say, the federation of local societies is usually concerned with one agricultural commodity or commodities of closely allied character. Members are paid for produce by an advance at the time of delivery followed by a distribution of the profits at certain intervals. The produce thus delivered is classified and graded at the headquarters of the association, and the initial payment is made on the basis of this classification. For the purpose of marketing, the produce is " pooled." These principles—contracts, commodity organisation and pooling—form the basis upon which a great part of Danish co-operative marketing is conducted, and have been widely copied in America, Canada, Australia and elsewhere.

The benefits which agriculture has derived from the European co-operative system—apart from social amelioration which in many cases was the original aim—are many. By the centralisation of purchase and of sale, considerable economies have been effected not merely in consequence of the elimination of the middleman, and of bulk handling of the produce, but by the removal of the powers of exploitation which buyers and sellers of agricultural commodities not infrequently exercised over unorganised farmers. In organised marketing, large scale handling has enabled scientific grading and standardisation to be carried out, which in turn has led to the production of standard grades of produce and standard breeds of live stock on the farms. This again, as in the case of bacon, has led to a general improvement in the quality of farm produce, and has greatly added to the competitive strength of the central export associations in foreign markets. Their products have earned a reputation for uniformity and high quality against which unorganised farmers have found it increasingly difficult to compete.

AGRICULTURAL CO-OPERATION OUTSIDE EUROPE

The most rapid advance in co-operation of recent years, particularly since the World War, has been made in connection with marketing in the newer countries of the world—the United States, Canada, Australia, New Zealand and others. It forms by far the most remarkable development of co-operative enterprise of the present century; indeed, there is little similarity between the small village co-operative societies in Europe of the 'eighties and 'nineties, and the vast organisations that have sprung up on the continent of North America for handling some of the primary farm crops.

United States.—In its recent developments co-operation in the United States has been associated with the achievement of certain economic purposes which never entered into the schemes of the earlier pioneers of co-operative marketing. One is known as the " orderly marketing " of agricultural produce, another is the realisation of a high degree of monopolistic control by the central marketing association over the movement to market the crop or crops with which it is concerned. In some cases, not only in America but elsewhere, monopoly appears also to have been sought with the direct object of raising prices, but owing to the impossibility of limiting production this has usually ended in failure. Profiting by the previous experience of Denmark, the United States have developed and extended the Danish practice, with the result that certain working principles, applicable to some types of co-operative marketing organisation, may be said to have been established which may be summarised as follows:

(1) The organisation must be on a " commodity basis," that is to say, a single co-operative organisation must deal with only one commodity or with commodities closely allied to each other.

(2) The local co-operative associations must be federated to a central association in order to concentrate in a central authority the control of a sufficiently large volume of produce.

(3) Members must bind themselves under contract to supply the whole, or a definite proportion, of their produce prepared for market to the society of which they are members.

American co-operative marketing has not always been developed upon this pattern, but generally speaking it is the case that the aim has been to centralise in the hands of single authorities the control of the marketing of a large volume of produce in order that it may be able to exert an effective influence upon the amount of produce delivered to the markets. A full account of the various American co-operative marketing organisations is given under FARMERS' ORGANISATIONS.

How far the co-operative organisation will go towards solving the problem of " orderly marketing " it is still too early to say. Some critics are sceptical, and many of the newer organisations are still of an experimental character.

Canadian Wheat Pools.—Canada affords some remarkable examples of the development of large scale co-operative marketing enterprise, of which the wheat organisation is the most significant. The Saskatchewan Co-operative Elevator Co. (which handled in 1922–3 about one-fifth of the grain produced in the province, amounting to over 40,000,000 bu.) originated in the widespread discontent which was felt by farmers at the growing powers of the elevator companies. With financial assistance from the Govt. it acquired a number of elevators of its own situated at suitable centres for the collection of members' grain. In 1924, it owned 425 country elevators, and as development took place it was found necessary for the institution to own terminal elevators and " hospital " elevators for treating damaged grain, and they have at the present time over 6,500,000 bu. of capacity in terminal and hospital storage.

Alberta followed the lead of Saskatchewan by setting up the Alberta Farmers' Co-operative Elevator Co. in 1913, and four years later this company was taken over by the United Grain Growers, Limited. In the last year or two the movement towards centralised marketing has undergone further important developments. For the purpose of selling, an organisation known as the Saskatchewan Co-operative Wheat Producers, Limited, was formed, with headquarters at Regina. Members of the company, who already form a substantial proportion of the wheat growers in the province, enter into a five years' contract to sell the wheat through the company. Very similar arrangements have been made in Manitoba and Alberta, the respective organisations being the Manitoba Co-operative Wheat Producers, Ltd., with headquarters at Winnipeg, and the Alberta Co-operative Wheat Producers, Ltd., with headquarters at Calgary. To complete the system of centralisation only one step remained, namely, to unite the three provincial pools into one organisation. This step has now been taken. The Canadian Co-operative Wheat Producers, Ltd., with headquarters at Winnipeg, has been formed as the central selling agency for the above three producers' pools, and operated for the first time in respect of the 1924–5 crop. The handling of milk, butter and cheese; the marketing of wool, live stock, poultry and eggs, fruit and other produce by co-operative enterprise has also made considerable advance in Canada since the World War.

Australian Wheat Pools.—The co-operative wheat pools of Australia are an example of a somewhat different character, since they came into being as the result of direct state action in order to meet the abnormal conditions during the War. They have brought about a fundamental change in the system of marketing wheat in that country. The original scheme was compulsory. It was entered into by the governments of the Commonwealth, the states of New South Wales, Victoria, South Australia and Western Australia for the purpose of realising to the best advantage the wheat harvests of the respective states, and for making advances to farmers pending the realisation. The scheme was first applied to the 1915–6 crop, and it was subsequently decided to deal with the succeeding crops on the same principle. This actually took place in respect of each crop up to that of 1920–1. The duty of realising the crop was placed in the hands of the Australian Wheat Board, consisting of ministerial representatives of the governments of the Commonwealth and the respective states, and one representative of the growers from each state.

The board was assisted by an Advisory Board, consisting of well-known wheat shippers, and the distribution of freights amongst the respective states was undertaken by the Wheat Board. As the United Kingdom was the chief export market for Australian wheat, and London the chief port, a London Wheat Committee, consisting of the High Commissioner, and the Agents General of the states concerned, acting with the advice of the London representatives of the wheat shippers, arranged the overseas sale.

In each state a local board or commission controlled the operations of the scheme within its area, and the local board effected all local sales, including sales to millers. Under arrangements with the Australian banks made by the Commonwealth and state governments, advances were made to farmers upon delivery of their wheat at railway stations to the appointed representatives. The proceeds of the wheat sales were applied, as realised, in reduction of the bank overdrafts which had been used for the payment of advances and expenses. In 1922 the compulsory pooling of wheat was abandoned, but the principle of pooling the exportable surplus was continued on a voluntary basis under the respective state governments. Under this scheme, as in the case of the compulsory scheme, each state ultimately receives, in respect of the grain actually shipped, the average net profit from the overseas realisations, which, after paying expenses, is distributed *pro rata* amongst the growers. This system of pooling remains in operation (though some doubt has been expressed as to its future), and the grain exported to the United Kingdom is distributed in the United Kingdom, through the " Australian Wheat Pools Agency," consisting of two firms, which receive and market the whole of the wheat exported by the respective wheat pools (with the exception of Victoria, which sells independently) operating upon the British corn exchanges, mostly in London.

Other British Dominions.—In most provinces of Canada and in the states of Australia and New Zealand and South Africa (and the U. S. A.) special legislation has been enacted to enable co-operative associations to function on the general lines which have been indicated above. The case of Queensland provides what is perhaps the most remarkable example of the degree to which legislative support of co-operative marketing has been carried. Queensland not only permits, but in certain circumstances compels, producers to market through a co-operative association. Under the Primary Products Pools Act, 1922, provision is made for the constitution of a compulsory pool for any agricultural commodity at the request of a specified number of growers of such commodity, with provision also for a pool to be taken on the question if such is demanded. Under this act, pools have been constituted for the marketing of eggs, cheese, maize and pigs.

Mention must also be made of the rapid growth of agricultural co-operation in India, which has mainly taken place during the present century. Indian co-operation bears a much closer resemblance to European than to the American or Australian systems. As in Germany, it has been developed largely to provide credit (and insurance) facilities and to a limited extent for the purchase of requisites, and the sale of produce. Its remarkable growth may be judged from the figures. The total number of co-operative societies in 1907 was 149; in 1914 it was 15,673; at the end of the War 26,465; and in 1922 it had reached 52,000. Of this total, 46,700 are agricultural societies; 3,600 are non-agricultural; 1,200 are supervising and guaranteeing unions; and 480 are central societies, including provincial and central banks, and banking unions. Of the agricultural societies all except 1,165 are credit societies. Production is represented by 302 societies, the remainder being organised for purchase and sale.

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(R. E.)

CO-PARTNERSHIP.—By co-partnership, or labour co-partnership, is now generally understood a definite arrangement whereby capital and labour may co-operate in the same business undertaking on terms which give labour not merely a share in the net profits, but also a share in the control of, and responsibility for, the undertaking. Thus it is now more usual to associate co-partnership with profit-sharing than with producers' co-operation (*see* CO-OPERATION, 7.85). But while co-partnership necessarily implies profit-sharing, the latter does not necessarily imply the former.

The Labour Co-partnership Association (the chief propagandist body in the United Kingdom) only recognises a scheme as a co-partnership (a) where the workers receive a share in the final profits additional to their trade union or standard wage, (b) where in virtue of their position as working shareholders the workers have a share in the management, and (c) where the arrangement is a matter of fixed rules. In 1919 the labour co-partnership association further defined these conditions by adopting the principle that:

> The worker should acquire some share of the control of the business in the two following ways: (*a*) by acquiring share capital and thus gaining the ordinary rights and responsibilities of a shareholder. (*b*) by the formation of a Co-partnership Committee of workers having a voice in the internal management.

This principle has been applied in the well-known scheme of the South Metropolitan Gas Company which in 1889 adopted the plan of paying a bonus on wages varying in inverse ratio with the price charged for gas and set up a standing co-partnership committee, representing in equal numbers the officials and employees of the company. Since 1898 the employees have acquired the further right of representation on the board of directors.

With the publication of the first report of the Whitley Committee (*see* INDUSTRIAL RELATIONS) in 1917 the idea of co-partnership received an emphatic, if somewhat vague, blessing:

> We are convinced, moreover, that permanent improvement in the relations between employers and employed must be founded upon something other than a cash basis. What is wanted is that the work-people should have a greater opportunity of participating in the discussion about and adjustment of those parts of industry by which they are most affected.

In the report of the conference of operatives and manufacturers in the pottery industry the claim of the operatives to be regarded not as "hands" but as "partners in an important social task" was set forth. How far the Whitley scheme in its application to some 70 industries has succeeded in implementing this aspiration is a matter of opinion.

In a report on profit-sharing and labour co-partnership issued by the Committee on Industry and Trade in its *Survey of Industrial Relations* (1926) the Ministry of Labour had to record that by the end of 1924 some 230 firms exclusive of co-operative societies had in operation 242 profit-sharing schemes in which some 172,000 employees participated. These schemes were the survivals of 493 known to have been started, and only a proportion of them embraced an element of co-partnership as well as of profit-sharing. On the whole this report, like the more detailed report issued in 1920 (Cmd. 544), does not encourage optimism in regard to the practical success of co-partnership up to the present. There has been a marked falling off since 1921 in the number of new profit-sharing schemes started, and the average duration of the schemes abandoned during the past 50 years is stated to be not more than 8½ years. This comparative failure is largely attributable to the attitude of organised labour, which is described as "either unfavourable or, at best, indifferent." The following resolution agreed to at the Trades Union Congress of 1923 is significant:—

> That this Congress, believing that capitalist attempts to introduce forms of Co-partnership are designed to mislead the workers and to prevent Trade Union solidarity, instructs the General Council to explore all working of the various labour co-partnership and profit-sharing concerns in the kingdom with a view to reporting upon their advantages or disadvantages to the next Trades Union Congress.

No report however appears yet to have been issued. Mr. G. R. Stirling (*2 Jour. Soc. Comp. Leg.* 3rd Series, 1920) after a careful survey concludes that "there seem to be no important industrial businesses in this country where the workers have any control which is effective against the general body of shareholders." As far as company law is concerned there is indeed nothing to prevent a company from adopting in its Articles a scheme for ensuring a full measure of co-operation by employee shareholders. And in legislating for private companies Parliament has given at least negative encouragement to co-partnership by suspending any limitation to the number of shareholders in the case of employee or ex-employee shareholders.

The Movement Outside the United Kingdom.—In the United States, in spite of the fact that several large corporations have encouraged stock holding by their employees, it appears that the success of definite co-partnership arrangements has been no greater than in the United Kingdom. And this comparative failure contrasts with the rapid extension of the Producers' Co-operative movement among farmers. (See *Ministry of Agriculture and Fisheries, Economic Series*, No. 4, 1925.)

One of the most interesting and successful attempts to effect a gradual transfer of control over a business from the outside shareholders to those actively engaged in it, has been that made by the Dennison Manufacturing Company in Massachusetts. In 1911 after a long period of successful trading it was decided (a) to limit to ordinary interest rates the return of those connected with the business solely as investors; (b) to put back into the business all profits beyond this return and to issue against them partnership stock to the managerial employees; and (c) to transfer to the partnership stock as soon as it reached the sum of $1,000,000 all voting power in the company.

In 1921 the further step was taken of issuing partnership stock also to the non-managerial employees, but this stock was to be non-voting. The effect of these arrangements has been (a) that the original shareholders have received in place of their stock taken at the current market valuation 8% 1st cumulative preference stock; (b) that the managerial employees (numbering about 370) have now the legal control of the company subject to the right of the first preference stock-holders to recover their control if their dividends are in arrears for more than a certain length of time; (c) that the non-managerial employees have through their works committee a limited participation in the management and through their stock a share in the profits equal pro rata to that taken by the managerial employees; and (d) that all partnership stock is non-assignable, and the holders must, on leaving the company's employ exchange their stock for 7% 2nd cumulative preference stock (*see* Calvert Magruder "Labour Co-partnership in Industry," *Harvard Law Review*, vol. 35, pp. 910–25).

In France a noticeable attempt in 1917 to make labour co-partnership compulsory on joint stock companies (sociétés anonymes) resulted in the passing of a permissive Act (sur les sociétés anonymes à participation ouvrière). If a company decides to adopt the form "à participation ouvrière" it must divide its shares into (*a*) capital shares and (*b*) labour shares (actions de travail), which latter then become the collective property of the employees over 21 who have served the company for at least one year. These employees are incorporated in a société commerciale co-operative de main-d'œuvre, which is represented at the general meetings of the company and on its managing committee in proportion to the ratio borne by capital shares to labour shares.

(A. L. D.)

COPENHAGEN, Denmark (*see* 7.96), had a population in 1921 of 561,344, or, with suburbs, of 700,610. The city has expanded greatly since 1910 and numerous new quarters have appeared. North and east Voldgade have been levelled and laid out as a boulevard. Many of the wooden houses erected during the World War to meet the housing shortage were still in use in 1925.

New public buildings include the Technological Institute on a large site in the Aborrepark, the Andelsbank (1920), the Students' Union building and that of the Danish People's Insurance Company. The Christianborg, on the site of the old castle, has been occupied since 1918 by Parliament, the Supreme Court and the Foreign Office. During building operations fresh ruins of the old castle were found. The Hirschsprung Museum, with works by Danish artists, was opened in 1911; and since 1924 the Danish Museum of Applied Art has been housed in the old Frederiks Hospital. A large state hospital has been built in Faelled Park; in front of it is a monument to Finsen. The Finsen Institute has been state controlled since 1916. In 1919–20 the Arsenal was repaired and restored. The land and artillery defences, prepared during the War, were abolished in 1920. The Royal Porcelain Factory, which employs about 1,000 hands, was enlarged in 1920, and a contract for an electric power plant placed by the municipality in 1924. Between 1915 and 1919 the free port was enlarged from an area of 59·3 ac., with 4,116 yd. of wharfage, to 81·5 ac. with 5,217 yd. of wharfage. The equipment has been much increased, and the construction of a basin at the north end of the harbour was begun in 1920. A promenade, ending in a pier with a lighthouse and restaurant, has been laid out on the east mole.

COPPER (*see* 7.102).—A very large part of the world's supply of copper from 1910 onwards came from deposits so low in grade that they could not be worked under the conditions of 1905. The major developments were the enlargement of the scale of operations; reductions in the cost of mining by the introduction of the caving system and steam shovelling; reduction in the cost of milling and increase in the extraction of mineral by the introduction of the flotation process; reduction in the cost of smelting by the application of coal-dust firing to reverberatory furnaces and the successful operation of basic-lined converters; and the development of processes for the hydrometallurgical treatment of certain ores and the direct production of refined electrolytic copper.

These developments facilitated the exploitation of the "porphyry" deposits, which may be described as fine disseminations of copper minerals through large masses of igneous rock. These deposits are large, and occur at or near the surface in substantially horizontal positions. Fine disseminations of copper had been exploited for many years in the Lake Superior region, but there the copper occurred in its native form, and the mineralisation was in lodes dipping steeply. Previous to 1905 the occurrence of immense masses of rock, containing about 2% of copper in sulphide form, was known in Bingham Canyon, Utah, at Ely, Nev., and elsewhere, but it was not believed to be possible to exploit them profitably. The conception of profitable exploitation by taking advantage of improved methods and the prosecution of operations on a previously unparalleled scale was due especially to Daniel C. Jackling (b. 1869), of San Francisco. With modern developments it has been found possible to work ores containing little more than 1% of copper.

Steam Shovelling.—No detailed description is necessary, for the steam shovels and general methods are substantially the same as in any excavation work. In their application to the mining of copper-bearing ore, the latter is broken down in benches, a line of holes being churn-drilled back of the face, charged heavily with an explosive, and the ore blasted down in quantities of many thousands of tons. The steam shovel is moved along a track at the bottom of the bench and picks up the broken ore, transferring it to cars alongside. Excessively large boulders are broken up by block-holing and blasting, but the steam shovel can pick up very large pieces, its dipper being up to 9 cu. yd. in capacity. Shovels of 8 cu. yd. capacity weigh 325 tons and dig 300 cu. yd. (place measure) per hour. This method of mining is so cheap per ton of ore that it can be applied economically even when it is necessary to shovel away up to 200 ft. of worthless overburden in order to uncover 100 vertical ft. of ore. The process of removing the overburden, technically known as stripping, necessarily precedes the actual mining. The laying out of plans for the working of a mine in this way, and the figuring of the various factors, furnish complicated engineering problems.

Caving.—When the overburden is too thick, or is too thick with relation to the thickness of the ore deposit, mining by the caving system is adopted. In essence this system consists in opening permanent galleries under the ore body. Raises to the ore body are then made, and sub-galleries of relatively small size driven into it, with the purpose of so undercutting the ore body that its support by rock pillars is reduced to the minimum. Finally the pillars are blasted out, causing the superincumbent ore to settle in a great crushed mass. The crushed ore is then drawn off through chutes, previously prepared, into cars in the main galleries. This operation proceeds through the ore body section by section, the natural surface over the mines settling as the ore is drawn off. There are many modifications of this system of mining, but its application to large flat-lying ore deposits is substantially as above. Modifications of the caving system of mining are also applicable in many lode mines, when the lodes are of large size. It is a very economical system of mining owing to its reduced requirements for labour, explosives, timber, etc.

Flotation Process.—Copper ore as mined in 1925 contained generally only a small percentage of copper mineral, which was obtained by crushing the ore to such fineness as to liberate the mineral particles, and by separating these from the worthless gangue by mechanical processes, commonly performed by washing, in which advantage is taken of the difference in specific gravities. Although there had been great improvements in the process of ore dressing, the losses of valuable mineral continued relatively high up to 1910. In the flotation process advantage was taken of the discovery that when ore suspended in water was mixed with a small quantity of certain oils or other agents (the addition of oil being perhaps only 2 lb. per ton of ore), and was then subjected to violent agitation, the copper minerals (if sulphides) would rise to the surface in the form of a froth, while the worthless gangue would settle to the bottom. Separation in this way was possible at relatively low cost, and yielded a far higher percentage of the mineral than the older processes. The improvement might be generalised by indicating an extraction of 90%, compared with 65 to 75% previously. In recent years the use of additional chemical agents has developed the process of "selective flotation," whereby minerals of approximately the same specific gravity may be efficiently separated from each other.

Metallurgy.—Before 1910 the blast furnace and the reverberatory furnace were competitive choices for the smelting of copper ore. With the increasing fineness of the ore to be smelted, the leaning began to be definitely in favour of the reverberatory furnace, but with the advent of the Dwight-Lloyd sinterer, which enables fine ores to be agglomerated cheaply and efficiently, the blast furnace gained a new prestige. With the successful application of coal-dust firing, however, due especially to the work of David H. Browne at Copper Cliff, Ont., the reverberatory furnace obtained an unquestionable predominance, which it is likely to hold. The modern copper-smelting plant designed for the treatment of fine ore comprises roasting furnaces of the MacDougall type and very large reverberatory smelting furnaces. Before introduction of coal-dust firing, a furnace at Anaconda, Mont., 19 ft. by 112 ft., smelted 240 tons of charge, with one ton of coal per 4¼ tons of charge. By the new method a furnace 25 ft. by 144 ft. smelted 650 tons, and one ton of coal smelted seven tons of charge. For the smelting of coarse ore, especially of heavy sulphide, the blast furnace operated on the pyritic or the semi-pyritic principle still holds its place. These furnaces also are constructed of very large size. The Anaconda Co. attained dimensions of 72 in. by 1,044 in. at the tuyeres, but this is exceptional, the blast furnaces at most American works being something like 72 in. by 280 inches.

The converting of copper matte in a basic-lined vessel, long a

hope of copper metallurgists, was accomplished by W. H. Pierce and E. A. Cappelen-Smith at the works of the Baltimore Copper Smelting and Rolling Co. In 1909–10 the process was introduced in the works of the Garfield Smelting Co. in Utah. Subsequently it was found that the process was not limited to the Pierce-Smith horizontal converters, but could be applied to other forms of converters, both horizontal and upright. The main advantages of the basic over the acid converter are the decreased cost of lining (one basic lining for 2,500 tons of copper compared with one acid lining for 10 tons), greater air efficiency, ability to convert low-grade matte with a mixture of silicious ore, reduction of intermediate products, neatness and cleanliness of plant and decrease in danger from accidents. The basic converters are lined with magnesite. Their use became general and they reduced the cost of converting copper matte by more than 50%.

The existence of immense ore deposits of the porphyry type, but with the copper occurring as oxide or chloride which rendered the ore unamenable to mechanical concentration, directed renewed attention to the hydrometallurgical extraction of the copper of such ore. At Chuquicamata, Chile, lies the world's greatest known deposit of copper, its development being estimated at about 700,000,000 tons assaying about 2% copper. Exploitation of this was undertaken by the Chile Copper Co., an American Corporation. The copper occurs in the ore as brochantite contaminated with chlorides. E. A. Cappelen-Smith devised a process for the leaching of this ore with sulphuric acid, purification of the solution, and deposition of the copper by electrolysis, using magnetic anodes; in practice, however, anodes of ferro-silicon have been substituted. The copper cathodes are melted and cast into bars of grade equivalent to standard electrolytically refined copper. Production in 1924 was at the rate of 212,000,000 lb. per annum. At Ajo, Ariz., the New Cornelia Copper Co. also produced electrolytic copper directly from ore, from which the copper was first leached by sulphuric acid. Hydrometallurgical extraction of copper was also applied on a large scale for the treatment of tailings, *e.g.*, by the Anaconda Copper Mining Co., and by the Calumet and Hecla Mining Co., the latter extracting the native copper by means of ammonia, and precipitating the copper as oxide by distillation, with recovery of the ammonia. A similar process was employed for ore treatment at the Kennecott mine, in Alaska.

A later development in copper hydrometallurgy was the leaching of copper ore in place, which is being done by the Ohio Copper Co. in Bingham Canyon, Utah. The ore broken down by the caving system is flooded with water from the surface. Having dissolved a proportion of the copper the water is drawn off and the copper is precipitated by metallic iron. Although the extraction of copper by this method is low in terms of percentage, the cheapness of the method enabled the low-grade ore of this mine to be treated profitably.

General Economic Conditions.—Before the World War about 15 cents per lb. was regarded as an average market price for copper. The cost of production to the largest producers was about 10 cents per lb. With the demand for copper for military purposes the price ran up to about 32 cents per lb. at the end of 1916; but increased production began to show its effect in 1917 and in the latter part of that year the American Govt. fixed the price at 23½ cents. Mining, smelting and refining capacities were rapidly increased, and in 1917 American electrolytic refiners attained a capacity for the production of 2,800,000,000 lb. of copper per annum. The surplus supplies in the hands of the Governments at the end of the War led to the greatest accumulation of unsold copper in the history of the metal, and a bad economic situation developed which continued into 1921. By 1923 the copper industry had regained normality, but at a price inferior to that of pre-War.

Production.—Before the War the world's production of copper had risen to about 1,000,000 metric tons. In 1916–8 there

World's Production of Copper[1] (*In Metric Tons of 2,204·6 Lb.*)

Country	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
North America:—											
United States	525,529	646,212	881,237	872,065	879,026	548,677	576,450	216,295	464,459	684,029	742,997
Mexico	36,337	30,969	55,128	47,503	75,529	60,491	45,238	12,316	27,073	54,920	44,589
Canada	34,027	47,202	47,985	50,626	52,693	36,106	35,500	20,532	22,952	36,496	46,274
Cuba	6,251	8,836	7,816	10,313	12,337	9,974	6,796	7,802	10,694	10,853	11,560
Total North America	602,144	733,219	992,166	980,507	1,019,585	655,248	663,984	256,945	525,178	786,298	845,420
South America:—											
Bolivia	3,874	5,868	5,150	6,400	6,000	7,000	9,900	9,683	9,212	10,654	7,439
Chile	44,665	52,341	71,288	102,527	106,914	79,580	98,952	59,239	129,575	182,384	190,380
Peru	27,090	34,727	43,078	45,176	44,414	39,230	32,982	33,284	36,408	44,166	34,923
Venezuela	363	544	1,179	1,724	608	635	..	726	975	1,066	1,116
Total South America	75,992	93,480	120,695	155,827	157,936	126,445	141,834	102,932	176,170	238,270	233,858
Europe:—											
Austria-Hungary[2]	3,500	3,500	3,500	3,500	2,500	[2]647	1,585	4,173	4,581	4,833	4,051
France	10,067	882	1,287	1,001	623	873	1,559	2,173	2,902	8,193	5,000
Germany	25,000	25,539	24,796	28,632	15,101	15,775	17,255	19,000	17,000	17,000	19,500
Yugoslavia	4,443	3,200	5,000	11,200	6,000	1,209	2,436	3,970	5,222	6,837	8,145
Norway	2,859	2,826	1,614	1,810	2,856	437	556	5,725	9,615	8,000	9,900
Russia	31,938	25,881	20,887	16,000	..	..	..	..	2,000	2,000	3,300
Spain and Portugal	26,900	37,100	35,400	40,900	45,900	35,000	23,000	32,200	36,500	51,815	55,079
Sweden	4,692	4,561	3,181	4,540	3,785	4,030	1,627	1,329	61	4,700	2,800
Total Europe	109,399	103,489	95,665	107,583	76,765	57,971	48,018	69,570	77,881	103,378	107,775
Asia:—											
Japan	70,463	75,416	100,635	108,038	90,341	78,443	67,792	54,092	54,126	63,790	62,940
Other Asia	..	..	..	..	..	996	538	1,161	1,054	735	1,250
Total Asia	70,463	75,416	100,635	108,038	90,341	79,439	68,330	55,253	55,180	64,525	64,190
Australasia	38,667	37,709	39,885	36,564	44,722	16,441	26,605	18,932	12,478	18,139	14,253
Africa	27,033	31,300	39,815	42,656	31,064	31,350	30,580	38,557	52,816	72,948	104,055
Other countries	3,000	3,000	3,000	3,000	3,000	4,000	3,000	3,000	3,000	3,000	4,000
Grand Totals	926,698	1,077,613	1,391,861	1,434,175	1,423,413	970,894	982,351	545,189	902,703	1,286,558	1,373,551

[1] So far as possible, these statistics are based on blister copper, referred to countries wherein ore originated.
[2] After 1918, Austria only.

was an annual production of about 1,400,000 tons. After 1918 production was curtailed for several years, but in 1924 it approached the War-time maximum. Important new sources of supply are Chile and Peru, where American interests control the major part of the production, and the Katanga, which is under Belgian control. The table on p. 733 shows the world production of copper from 1914 to 1924.

The consumption of copper greatly increased after 1910, especially in the United States, owing mainly to electrical development. In the period 1922–4 the American consumption was at the rate of 12·19 lb. per person, compared with 8·09 lb. in the

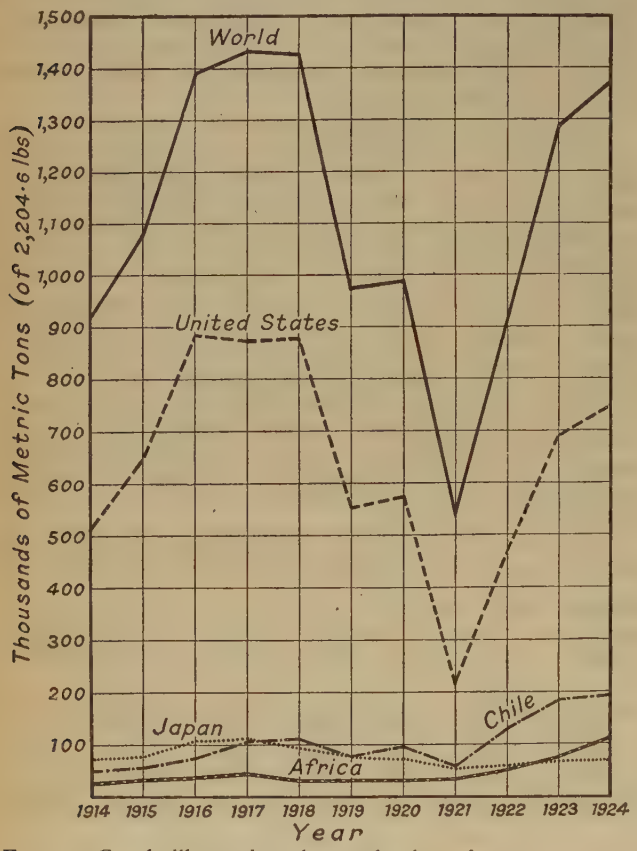

FIG. 1.—Graph illustrating the production of copper 1914–24. (*Note.* The African production is mainly from the Katanga province, Belgian Congo.)

period 1912–4. Corresponding figures for other countries were France, 6·81 and 6·33; Germany, 4·40 and 7·01; and Great Britain, 4·54 and 7·25.

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(W. R. I.)

COPYRIGHT (*see* 7.118).—A branch of law to which important additions have been made since 1910. As it has been impossible to deal exhaustively with so vast a subject in so limited a space, this article deals with the big principles of copyright, and, when it goes into detail, with that copyright property of the greater financial value.

I. INTERNATIONAL COPYRIGHT

International copyright can at the present time be divided into three parts: (1) the Berne Convention; (2) the United States; (3) The British Copyright Act, 1911.

Owing to the outbreak of the World War in 1914, many of the regulations surrounding the enforcement of the Berne Convention in the signatory countries were upset. When the Peace of Amiens was signed, certain stipulations were made as part of that treaty with regard to the signatories and the convention. In addition, countries were called into existence as separate entities which had never previously existed as such. The anxiety of these young independents to gather in the best literature from the older countries made the translation rights of considerable value. For these and other reasons it is essential to set out in fuller detail the main features of the Berne Convention, which is, after all, almost the first and certainly one of the most important of international conventions.

THE BERNE CONVENTION

In 1886 an Act was passed enabling the United Kingdom of Great Britain, its Dominions, Colonies and Dependencies, to join the Berne Convention, which had been settled by the representatives of most of the continental Powers in Sept. 1885. The central idea of the convention was very simple—work that was copyright in one of the countries of the union was copyright in the other countries of the union, but the duration of copyright could not exceed the duration in the country of origin. These provisions were added to by the Additional Act of Paris 1896, and by the Revised Convention of Berne signed at Berlin in 1908.

The first point of importance is the acquisition of the right to protection. Those entitled are set out in the following articles, namely, Article 2 of the Berne Convention; Para. 1, Article 2 of the Additional Act of Paris; and Articles 4 and 6 of the Revised Convention.

Berne Convention, Sept. 9 1886. Article 2.—Authors who are subjects or citizens of any of the countries of the union, or their lawful representatives, shall enjoy in the other countries for their works, whether published in one of those countries or unpublished, the rights which the respective laws do now or may hereafter grant to natives.

Additional Act of Paris 1896. Paragraph 1, Article 2, is the same as the above up to the words "their works." It then reads: "whether unpublished, or first published in one of those countries, the rights, etc., etc."

Revised Convention as Signed at Berlin Nov. 13 1908. Article 4.—Authors who are subjects or citizens of any of the countries of the union shall enjoy in countries other than the country of origin of the work, for their works, whether unpublished or first published in a country of the union, the rights which the respective laws do now or may hereafter grant to natives, as well as the rights specially granted by the present convention.

The enjoyment and exercise of these rights shall not be subject to the performance of any formality; such enjoyment and such exercise are independent of the existence of protection in the country of origin of the work. Consequently, apart from the express stipulations of the present convention, the extent of protection, as well as the means of redress secured to the author to safeguard his rights, shall be governed exclusively by the laws of the country where protection is claimed.

The country of origin of the work shall be considered to be, in the case of unpublished works, the country to which the author belongs; in the case of published works, the country of first publication; and in the case of works published simultaneously in several countries of the union, the country the laws of which grant the shortest period of protection. In the case of works published simultaneously in a country outside the union and in a country of the union: the latter country shall be considered exclusively as the country of origin.

By "published works" must be understood, for the purposes of the present convention, works copies of which are issued by a publisher. The representation of a dramatic or dramatico-musical work and the performance of a musical work shall not constitute a publication.

Article 6.—Authors not being subjects or citizens of the countries of the union, who first publish their works in one of those countries, shall enjoy in that country the same rights as native authors, and in the other countries of the union the rights granted by the present convention.

The second question concerns the subject-matter of the protection. This cannot be better set out than by quoting Article 4 of the Convention and Articles 2 and 3 of the Revised Convention, which is the latest dictum on the subject. Articles 12, 13 and 14 of the Revised Convention must also be quoted.

Berne Convention. Article 4.—The expression literary and artistic works includes books, pamphlets and all other writings; dramatic or dramatico-musical works and musical compositions, with or without words; works of design, painting, sculpture and engraving, lithography, illustrations, geographical charts, plans, sketches, and plastic works relating to geography, topography, architecture or the sciences in general; finally, every production whatsoever in the

literary, scientific or artistic domain which can be published by any mode of impression or reproduction whatsoever.

Revised Convention. Article 2.—Any production in the literary, scientific or artistic domain whatever may be the mode or form of its reproduction, such as books, pamphlets and other writings, dramatic or dramatico-musical works, choreographic works and pantomimes the acting form of which is fixed in writing or otherwise, musical compositions with or without words, works of design, painting, architecture, sculpture, engraving and lithography, illustrations, geographical charts, plans, sketches and plastic works relative to geography, topography, architecture or science.

Translations, adaptations, arrangements of music and other reproductions in an altered form of a literary or artistic work, as well as collections of different works. These works are protected as original works, without prejudice to the rights of the author of the original work.

Works of art applied to industrial purposes shall be protected so far as the domestic legislation of each country allows.

Article 3 includes photographic works and works produced by a process analogous to photography.

Article 12.—The following are specially included among the unlawful reproductions: Unauthorised indirect appropriations of a literary or artistic work, such as adaptations, musical arrangements, transformations of a novel, tale or piece of poetry into a dramatic piece, or *vice versa*, etc., when they are only the reproduction of that work, in the same form or in another form, without essential alterations, additions or abridgments; if they do not present the character of a new original work.

Article 13.—The authors of musical works have the exclusive right of authorising (1) the adaptation of those works to instruments which can produce them mechanically; (2) the public performance of the said works by means of these instruments.

Reservations and conditions relating to the application of this article may be determined by the domestic legislation of each country in so far as it is concerned; but the effect of any such reservations and conditions will be strictly limited to the country which has put them in force.

The provisions of paragraph 1 shall not be retroactive, and consequently shall not be applicable in any country of the union to works which have been lawfully adapted in that country to mechanical instruments before the coming into force of the present convention.

Article 14.—Authors of literary, scientific or artistic works have the exclusive right of authorising the reproduction and public representation of their works by cinematography.

Cinematograph productions shall be protected as literary or artistic works if, by the arrangement of the acting form or the combinations of the incidents represented, the author has given the work a personal and original character.

Without prejudice to the rights of the author of the original work, the reproductions by cinematography of a literary, scientific or artistic work shall be protected as an original work.

The above provisions apply to the reproduction effected by any other process analogous to cinematography.

Finally, the length of duration of the protection is dealt with. For this purpose Articles 7 and 11 of the revised convention may be quoted:—

Revised Convention. Article 7.—The term of protection granted by the present convention shall include the life of the author and 50 years after his death.

Nevertheless, in case such term of protection should not be uniformly adopted by all countries of the union, the term shall be regulated by the law of the country where protection is claimed, and must not exceed the term fixed in the country of origin of the work. Consequently, the contracting countries shall only be bound to apply the provisions of the preceding paragraph in so far as such provisions are consistent with their domestic laws.

For photographic works and works produced by a process analogous to photography, for posthumous works, for anonymous or pseudonymous works, the term of protection shall be regulated by the law of the country where protection is claimed, provided that the said term shall not exceed the term fixed in the country of origin of the work.

Article 11.—The stipulations of the present convention shall apply to the public representation of dramatic or dramatico-musical works and to the public performance of musical works whether such works be published or not.

Authors of dramatic or dramatico-musical works shall be protected during the existence of their right over the original work against the unauthorised public representation of translations of their works.

In order to enjoy the protection of the present article authors shall not be bound in publishing their present works to forbid the public representation or performance thereof.

In the recital above on the question of international copyright two important points have been omitted intentionally, namely, translation rights and protection as it affects those connected with the profession of journalism.

Translations.—The three paragraphs quoted below will show how translations are protected under the convention. The dates of publication of the original work, the dates of the adhesion of the signatories and of the dates of the original convention and its additions, are of considerable importance:—

Berne Convention, Sept. 9 1886. Article 5.—Authors being subjects or citizens of one of the countries of the union, or their lawful representatives, enjoy in the other countries the exclusive right of making or authorising the translation of their works until the expiration of ten years from the publication of the original work in one of the countries of the union.

For works published by instalments, the period of ten years shall not begin to run until the publication of the last instalment of the original work.

For works composed of several volumes published at intervals, as well as for reports or papers published by literary or learned societies or by individuals, each volume, report or paper shall be, with regard to the period of ten years, considered as a separable work.

In the cases provided for by the present article, and for the calculation of the period of protection, the 31st Dec. of the year in which the work was published is admitted as the date of publication.

Additional Act of Paris and Interpretative Declaration of May 4 1896.—Authors belonging to any one of the countries of the union, or their legal representatives, shall enjoy in the other countries the exclusive right of making or authorising translations of their works during the whole term of the right in the original work. Nevertheless, the exclusive right of translation shall cease to exist when the author shall not have made use of it within a period of ten years from the time of the first publication of the original work, by publishing or causing to be published, in one of the countries of the union, a translation in the language for which protection is claimed.

Revised Convention, Nov. 13 1908.—But the authors of unpublished works, being subjects or citizens of one of the countries of the union, and the authors of works first published in one of those countries, enjoy, in the other countries of the union, during the whole term of the right in the original, the exclusive right of making or authorising a translation of their works.

Emphasis is laid on these distinctions, as some nations have signed the original convention, some the original convention with the Act of Paris, some the revised convention with limitations. It is important therefore for an author to know the duration of his own property in other countries, but more important for the would-be translator to know the duration of translation rights in other countries. Certain journalistic work is not protected by the convention, as is shown by further quotations from the same source.

Berne Convention. Article 7.—Articles in newspapers or magazines published in any country of the union may be reproduced, in original or in translation, in the other countries of the union, unless the authors or publishers have expressly forbidden it. For magazines it is sufficient if the prohibition is made in a general manner at the beginning of each number of the magazine.

No prohibition can in any case apply to articles of political discussion or to the reproduction of news of the day or miscellaneous items.

Revised Convention. Article 9.—Serial stories, tales, and all other works, whether literary, scientific, or artistic, whatever their object, published in the newspapers or periodicals of one of the countries of the union, may not be reproduced in the other countries without the consent of the authors.

With the exception of serial stories and tales, any newspaper article may be reproduced by another newspaper unless the reproduction thereof is expressly forbidden. Nevertheless, the source must be indicated: the legal consequence of the breach of this obligation shall be determined by the laws of the country where protection is claimed.

The protection of the present convention shall not apply to news of the day or to miscellaneous information which is simply of the nature of items of news.

Certain work used for educational purposes cannot be made the subject of an action for infringement under the convention.

Berne Convention. Article 8.—As regards the liberty of extracting portions from literary or artistic works for use in publications destined for education, or having a scientific character, or for chrestomathies, the effect of the legislation of each country of the union and of special arrangements existing or to be concluded between them is not affected by the present convention.

Revised Convention. Article 10.—As regards the liberty of extracting portions from literary or artistic works for use in publications destined for educational purposes, or having a scientific character, or for chrestomathies, the effect of the legislation of each country of the union and of special arrangements existing or to be concluded between them is not affected by the present convention.

Members of the Union

The following countries are members of the Union:—

State	*Date of joining*
Germany	Dec. 5 1887
Protectorate Countries	Jan. 1 1909
Austria	Oct. 1 1920
Belgium	Dec. 5 1887
Brazil, United States of	Feb. 9 1922
Bulgaria	Dec. 5 1921
Denmark (with the Faeroes)	July 1 1903
Danzig (free town of)	June 24 1922
Spain (with Colonies)	Dec. 5 1887
France (with Algeria and the Colonies)	Dec. 5 1887
Great Britain	See below
Greece	Nov. 9 1920
Haiti	Dec. 5 1887
Hungary	Feb. 14 1922
Italy	Dec. 5 1887
Japan	July 15 1889
Liberia	Oct. 16 1908
Luxembourg	June 20 1888
Morocco (except the Spanish zone)	June 16 1917
Monaco	May 20 1889
Norway	April 13 1896
Netherlands	Nov. 1 1912
Dutch Indies, Curaçao, Surinam	April 1 1913
Palestine	May 26 1925
Poland	Jan. 28 1920
Sweden	Aug. 1 1911
Switzerland	Dec. 5 1887
Czechoslovakia	Feb. 22 1921
Tunisia	Dec. 5 1887
United Kingdom and all territories in which the Imperial Copyright Act, 1911, is in force other than Tanganyika Territory and as follows:—	
Guernsey, Alderney, and Sark	July 1 1912
Commonwealth of Australia	July 1 1912
Newfoundland	July 1 1912
Norfolk Island	July 1 1912
India	Oct. 30 1912
Papua	Feb. 1 1913
Jersey	Mar. 8 1913
New Zealand	April 1 1913
Union of South Africa	May 1 1920
Canada	Jan. 1 1924

Acts in Force Between the Union Countries

Berne Convention Revised from Nov. 13 1908

(*a*) Without Reservations:—

Germany	Bulgaria	Hungary	Monaco
Austria	Danzig	Liberia	Poland
Belgium	Spain	Luxembourg	Portugal
Brazil	Haiti	Morocco	Switzerland

(*b*) With Reservations:—

Denmark: Newspaper and review articles (Article 7 of the Berne Convention 1886, revised by the Additional Act of Paris 1896).

France and Tunis: Applied works of art (maintenance of prior stipulations).

Great Britain: Retroactivity (Article 14 of the Berne Convention 1886 and No. 4 of the closing Protocol, revised by the Additional Act of Paris 1896).

Greece: 1. Exclusive translation right (Article 5 of the Berne Convention 1886). 2. Newspaper and review articles (Article 7 of the Berne Convention 1886). 3. Right of representation performance (Article 9 of the Berne Convention 1886).

Italy: 1. Exclusive right of translation (Article 5 of the Berne Convention 1886, revised by the Additional Act of Paris 1896). 2. Right of representation with regard to translations of dramatic and dramatico-musical works (Article 9, paragraph 2 of the Berne Convention 1886).

Japan: 1: Exclusive right of translation (Article 5 of the Berne Convention 1886, revised by the Additional Act of Paris 1896). 2. Public performance of musical works (Article 9, paragraph 3 of the Berne Convention 1886).

Norway: 1. Works of architecture (Article 4 of the Berne Convention 1886). 2. Newspaper and review articles (Article 7 of the Berne Convention 1886). 3. Retroactivity (Article 14 of the Berne Convention 1886).

Netherlands: 1. Exclusive right of translation (Article 5 of the Berne Convention 1886, revised by the Additional Act of Paris 1896). 2. Newspaper and review articles (Article 7 of the Berne Convention 1886, revised by the Additional Act of Paris 1896). 3. Right of representation in regard to translations of dramatic or dramatico-musical works (Article 9, paragraph 2 of the Berne Convention 1886).

Sweden: Newspaper and review articles (Article 7 of the Berne Convention 1886).

II. UNITED STATES COPYRIGHT

The United States stands outside the International Convention, and in consequence has complicated enormously the question of international copyright. The Act of March 1909, with its amendments, governs its present position, but is so complicated in its enactments, and in many ways so badly drafted, that it is impossible to give more than an outline of its many requisitions.

The Act opens as follows:—

That any person entitled thereto, upon complying with the provisions of this Act, shall have the exclusive right—

(*a*) to print, reprint, publish, copy and vend the copyrighted work;

(*b*) to translate the copyrighted work into other languages or dialects, or make any other version thereof, if it be a literary work; to dramatise it if it be a non-dramatic work; to convert it into a novel or other non-dramatic work if it be a drama; to arrange or adapt it if it be a musical work; to complete, execute, and finish it if it be a model or design for a work of art;

(*c*) to deliver or authorise the delivery of the copyrighted work in public for profit if it be a lecture, sermon, address or similar production;

(*d*) to perform or represent the copyrighted work publicly if it be a drama, or, if it be a dramatic work and not reproduced in copies for sale, to vend any manuscript or any record whatsoever thereof; to make or to procure the making of any transcription or record thereof by or from which, in whole or in part, it may in any manner or by any method be exhibited, performed, represented, produced, or reproduced; and to exhibit, perform, represent, produce or reproduce it in any manner or by any method whatsoever;

(*e*) to perform the copyrighted work publicly for profit if it be a musical composition; and for the purpose of public performance for profit and for the purposes set forth in subsection (*a*) hereof, to make any arrangement or setting of it or of the melody of it in any system of notation or any form of record in which the thought of an author may be recorded and from which it may be read or reproduced: Provided, That the provisions of this Act, so far as they secure copyright controlling the parts of instruments serving to reproduce mechanically the musical work, shall include only compositions published and copyrighted after this Act goes into effect, and shall not include the works of a foreign author or composer unless the foreign state or nation of which such author or composer is a citizen or subject grants, either by treaty, convention, agreement or law, to citizens of the United States similar rights; And provided further, and as a condition of extending the copyright control to such mechanical reproductions, That whenever the owner of a musical copyright has used or permitted or knowingly acquiesced in the use of the copyrighted work upon the parts of instruments serving to reproduce mechanically the musical work, any other person may make similar use of the copyrighted work upon the payment to the copyright proprietor of a royalty of two cents on each part manufactured, to be paid by the manufacturer thereof; and the copyright proprietor may require, and if so the manufacturer shall furnish, a report under oath on the twentieth day of each month on the number of parts of instruments manufactured during the previous month serving to reproduce mechanically the said musical work, and royalties shall be due on the parts manufactured during any month upon the twentieth of the next succeeding month. The payment of the royalty provided for by this section shall free the articles or devices for which such royalty has been paid from further contribution to the copyright except in case of public performance for profit: And provided further, That it shall be the duty of the copyright owner, if he uses the mechanical composition himself for the manufacture of parts of instruments serving to reproduce mechanically the musical work, or licenses others to do so, to file notice thereof, accompanied by a recording fee, in the copyright office, and any failure to file such notice shall be a complete defence to any suit, action or proceeding for any infringement of such copyright.

Section 3.—That the copyright provided by this Act shall protect all the copyrightable component parts of the work copyrighted, and all matter therein in which copyright is already subsisting, but without extending the duration or scope of such copyright. The copyright upon composite works or periodicals shall give to the proprietor thereof all the rights in respect thereto which he would have if each part were individually copyrighted under this Act.

Section 4.—That the works for which copyright may be secured under this Act shall include all the writings of an author.

Section 5.—That the application for registration shall specify to which of the following classes the work in which copyright is claimed belongs:

(*a*) Books, including composite and cyclopaedic works, directories, gazetteers, and other compilations;
(*b*) Periodicals, including newspapers;
(*c*) Lectures, sermons, addresses (prepared for oral delivery);
(*d*) Dramatic or dramatico-musical compositions;
(*e*) Musical compositions;
(*f*) Maps;
(*g*) Works of art; models or designs for works of art;
(*h*) Reproductions of a work of art;

(*i*) Drawings or plastic works of a scientific or technical character;
(*j*) Photographs;
(*k*) Prints and pictorial illustrations;
(*l*) Motion-picture photoplays;
(*m*) Motion-pictures other than photoplays.

Provided, nevertheless, That the above specifications shall not be held to limit the subject-matter of copyright as defined in section four of this Act, nor shall any error in classification invalidate or impair the copyright protection secured under this Act.

Section 6.—That compilations or abridgments, adaptations, arrangements, dramatisations, translations, or other versions of works in the public domain, or of copyrighted works when produced with the consent of the proprietors of the copyright in such works, or works republished with new matter, shall be regarded as new works subject to copyright under the provisions of this Act; but the publication of any such new works shall not affect the force or validity of any subsisting copyright upon the matter employed or any part thereof, or be construed to imply an exclusive right to such use of the original works, or to secure the extension of copyright in such original works.

Unpublished works are protected by common law. Copyright is granted to citizens of the United States and to citizens or subjects of foreign nations which give reciprocal conditions to American citizens. The question of reciprocity is determined by the President of the United States, and is proclaimed by him from time to time. Copyright is secured by publication with the notice of copyright required by the Act affixed to every copy so published. Such copyright is confirmed by registration. Publication with notice of copyright is essential. Registration is necessary. To this rule there are two exceptions: (1) under clause 11 when copyright can be obtained for certain works not reproduced for sale—a lecture or similar production, a dramatic, musical or dramatico-musical composition, etc. The copyright is secured by the registration of copies, but such registration does not exempt the proprietor from further deposit under the other sections of the Act when copies are reproduced for sale. The chief, but not the only, reason for this clause is to give a statutory protection to performing rights. (2) Under sections 21 and 22, where, in the case of books published abroad in the English language, the Act demands that these books—with the exception of dramatic, musical or dramatico-musical works—shall be published from type set up in the United States or plates manufactured there, but in order to give the author of such books some chance he is allowed to deposit and register one copy of his original work at Washington within sixty days from its publication abroad, and is required to publish the work in conformity with the other requirements of the Act within four months from the date of such deposit. Such author, therefore, is allowed a period which may extend to nearly six months in order to conform with the requirements of the Act. He is bound to make a further deposit—when the book is published in the United States in accordance with the Act—of the copyright of the book so published in accordance with the clauses of the Act for the deposit of foreign books.

Clauses 12 and 13 cover the details required by the registration office. With regard to books by American citizens, two copies of the best edition must be deposited; by foreigners one copy only, but a certain latitude is allowed, subject to penalty if the deposit is not promptly made after publication. Under section 16 an affidavit has to be filed with the deposit of copies, and section 17 refers to the penalties for making a false affidavit. Section 18 deals with the form of the copyright notice, which should be either "Copyright" or the abbreviation "Copr.," with the name of the copyright proprietor, and if the work be a printed literary, musical or dramatic work the year in which the copyright was secured by publication. Certain works are excepted from this special form. Section 19 deals with the place where the notice is to be affixed in or on the copy or copies deposited.

The copyright endures for a period of 28 years, subject to a further period of 28 years on application by the author or his representatives, provided that the application for such renewal and extension shall be made to the copyright office one year prior to the expiration of the existing term.

Then follow a series of sections dealing with the penalties for infringement and for false copyright notice, for the importation of copies, and various regulations dealing with registration, the registration of assignments, fees, etc.

Section 62 should be quoted, as it contains two definitions:—

Section 62.—That in the interpretation and construction of this Act "the date of publication" shall in the case of a work of which copies are reproduced for sale or distribution be held to be the earliest date when the copies of the first authorised edition were placed on sale, sold, or publicly distributed by the proprietor of the copyright or under his authority, and the word "Author" shall include an employer in the case of works made for hire.

To put the legal statement in plain language, the owner of a copyright literary work which has been published in the English language outside the United States is allowed 60 days from the date of publication in which to file a copy of the work at Washington. Provided that he files the copy within this period he obtains from the date of filing an *ad interim* copyright for four months in which to publish the work in the United States from type set up there subject to the other technicalities of the United States Act. Publication with the copyright notice on every copy is the essential for securing copyright. Registration coupled with an affidavit of manufacture is necessary. The essential copyright notice has been set out above. If by chance the work is being published in the United States as the country of origin, then it must be published in Great Britain simultaneously, or the copyright in Great Britain is lost.

III. BRITISH COPYRIGHT

The greater part of the British law of copyright is contained in the Copyright Act 1911, which came into force July 1 1912. Copyright is defined in the Act as the sole right to produce or reproduce a work or any substantial part thereof in any material form whatsoever, or perform, or in the case of a lecture to deliver, a work or any substantial part thereof in public; if the work is unpublished, to publish the work or any substantial part thereof. Copyright includes the sole right:—

(*a*) to produce, reproduce, perform or publish any translation of the work;
(*b*) in the case of a dramatic work, to convert it into a novel or other non-dramatic work;
(*c*) in the case of a novel or other non-dramatic work, or of an artistic work, to convert it into a dramatic work, by way of performance in public or otherwise;
(*d*) in the case of a literary, dramatic or musical work, to make any record, perforated roll, cinematograph film, or other contrivance by means of which the work may be mechanically performed or delivered,

and to authorise any such acts as aforesaid.

It will be seen from the above definition that a work as soon as it is completed, whether published or unpublished, is the author's copyright. In other words, all literary and musical work is now the creature of statute.

Duration and Assignment.—The next important point under the statute is the duration of copyright. Section 3 of the Act states that, with some few exceptions, copyright endures for the life of the author and 50 years after his death. One important exception is that in the case of a published work anyone may publish the work in the last 25 years of the period, subject to the payment of a certain fixed royalty to or for the benefit of the owner of the copyright. The term of copyright in photographs is 50 years from the making of the original negative; and for works published after the death of the author 50 years from the date of publication.

Section 5 (1).—The Act clearly states that the author of the work shall be the first owner of the copyright. Then follow certain exceptions—(*a*) where in the case of an engraving, photograph, or portrait the plate or other original of which was ordered by some person for valuable consideration, the copyright shall belong to the person giving the order; and (*b*) where in the case of work done in the normal course of employment by an author who is in the regular employment of another the copyright in such work shall belong to the employer.

Section 5 (2).—After stating that the owner of the copyright may assign the right either wholly or partially and either generally or subject to limitations as to country, either for the whole term or for any part thereof, and may grant any interest

in the right by licence, the section continues: "but no such assignment or grant shall be valid unless it is in writing signed by the owner of the right in respect of which the assignment or grant is made or by his duly authorised agent." It must be added as a warning against the too strict interpretation of the section that the agreement to assign the copyright or grant a licence will be enforced however informal, and even if made verbally if valuable consideration therefor has been given or promised.

Publication.—In the marketing of copyright property certain advantages and privileges are dependent upon the date of publication, and it is important that the definition as set out in the Act should be quoted:—

> For the purposes of this Act, publication in relation to any work means the issue of copies of the work to the public, and does not include the performance in public of a dramatic or musical work, the delivery in public of a lecture, the exhibition in public of an artistic work, or the construction of an architectural work of art, but for the purposes of this provision the issue of photographs and engravings of works of sculpture and architectural works of art shall not be deemed to be publication of such works.

The performance of a dramatic or musical piece does not constitute publication, but the performing rights, only if the piece has been performed in public, run for the usual term of copyright, that is the life of the author and 50 years after his death. But in unpublished works which at the date of the author's death are still in copyright, and have never been performed, copyright shall subsist till publication or performance in public—whichever may first happen—and for a term of 50 years thereafter. If, therefore, a dramatic piece is performed in public during the life of the author, then the copyright runs for the author's life and 50 years afterwards. If the piece is performed in public after the death of the author, then copyright runs for 50 years after such performance; but as long as a literary, dramatic or musical work has not been published, and a dramatic or musical work has not been performed in public, copyright runs without time limit.

Infringement.—Copyright in a work shall be deemed to be infringed by any person who without the consent of the owner of the copyright does anything the sole right to do which is by the Act conferred on the owner of the copyright. No fair dealing with any work for the purposes of private study, research, criticism, review or newspaper summary constitutes an infringement of copyright. The usual civil and summary remedies are given, and there are special provisions with regard to works of joint authorship, posthumous works, government publications, reproduction on mechanical instruments. These are very complicated and cannot be set out in detail.

The Copyright Act of 1911 is of great importance, as Great Britain and Ireland, its Colonies and Dependencies, are bound by its rules and regulations. The majority of the Dominions have taken advantage of its regulations to pass their own legislation, but such legislation has been in every case along the lines of the Act of 1911, with slight alterations adapted to the domestic needs of each Dominion, and generally strengthening the power to take summary proceedings. Canada is the only Dominion whose Act has considerable alterations. The necessity for alterations in this case arose from its juxtaposition to the United States and the fact that the United States has never joined the Berne Convention; but the alterations in the Canadian law militate against its own citizens rather than against the citizens or subjects of those countries which are signatories to the convention in question. (G. H. T.)

CORELLI, MARIE (1864–1924), British novelist (*see* 7.143), died at Stratford-on-Avon April 24 1924.

CORFÙ (*see* 7.145), an island of Greece in the Ionian Sea. After the Greek victories in the first Balkan War of 1912, the Italian Govt. raised the question of "the channel of Corfù," seeking to push back the Epirote frontier of Greece as far south as possible, lest both sides of "the channel" should belong to the same state, and a naval base might thus be formed there. This argument, considered technically unsound by British naval experts, ignored the fact that Corfù was neutral.

In May 1914, there met in a Corfiote Hotel the Conference for the settlement of the dispute between Albania and the "autonomous Government of Northern Epeiros," which had risen against the inclusion of that district in the Albanian Principality. But the speedy outbreak of the World War rendered ineffective the decisions of the Corfù Conference (whose sittings coincided with the celebration of the jubilee of the union of the Ionian Is. with Greece). After the Serbian retreat across Albania, Corfù became an important position. Despite its neutrality and a Greek protest, the French landed there on Jan. 11 1916, followed by the first detachment of retreating Serbs four days later, and by Feb. 10 some 75,000 Serbian troops, soon followed by Montenegrin soldiers, had been landed in the island, whither on the previous day the Serbian Govt. had transported its seat and where, on Sept. 10, the Serbian Parliament met in the theatre. The mortality among the starved Serbian soldiers was considerable, and the islet of Vido still preserves, but in a state of great neglect, the graves of many Serbians who died "for justice and liberty." Corfù, however, will always be associated with the foundation of Yugoslav unity, for it was there, in July 1917, that the "Pact of Corfù" was signed, which proclaimed the union of the Yugoslavs.

Italian Nationalism had long coveted Corfù, and Italian schools were founded there to give gratis instruction to the Corfiotes. On Aug. 27 1923, the Italian delegate for the delimitation of the Albanian frontier, General Tellini, was assassinated at Kakavia, on the road between Joannina and Santi Quaranta. There was no proof whatsoever that the assassins were Greeks; but Signor Mussolini, the Italian Premier and Minister of Foreign Affairs, at once held the Hellenic Govt. responsible, and sent an Italian fleet to Corfù, of whose neutrality he was probably ignorant. Although Corfù was not a fortified place, and the "Old Fortress" was occupied by refugees and Armenian orphans, the fleet bombarded both it and the police school in the "New Fortress," firing a shell into the study of the (fortunately absent) British headmaster and killing 16 Greek and Armenian refugees and wounding 35 more. After exacting from Greece 50,000,000 *lire* as an indemnity, the Italians evacuated Corfù on Sept. 27. For the international handling of this dispute *see* LEAGUE OF NATIONS. Despite the feeling aroused against them by this high-handed action, the Italians celebrated in 1925 the centenary of the Italian Philhellene, Santarosa, by removing from Corfù the remains of the Venetian Admiral, Graziani, who died there in exile.

See *Documents Diplomatiques. Différence Italo-Grec. Août-Septembre, 1923* (Athènes, 1923); A. J. Toynbee's *Survey of International Affairs 1920–1923* (London, 1925), pp. 348 *et seq.* The full text of almost all the relevant documents are printed in *L'Europe Nouvelle*, Oct. 6 1923. H. Wilson Harris, *Italy, Greece and the League* (London, 1923); George Glasgow, *The Janina Murders and the Occupation of Corfu* (1923); S. P. Nicoglou, *L'Affaire de Corfu et la Société des Nations* (1925). (W. Mi.)

CORINTH, LOVIS (1858–1925), German painter, was born at Tapiau, in East Prussia, July 21 1858, the son of a tanner. He went to the school of art in Königsberg, painted in Munich under Ludwig Löfftz, stayed some time in Antwerp, and then studied for several years in Paris, in the Atelier Bouguerau of the Académie Julian. After a second visit to Munich he settled in Berlin, where, in company with his friend, Walter Leistikow, and also Max Liebermann, both painters, he became one of the main supporters of the Berlin Secessionists. The last years of his life he spent, for the greater part, in his cottage on the Walchensee in Bavaria, where some of his most beautiful pictures of still life and landscape were painted. Corinth died July 18 1925 at Zandvoort, Holland. One of the greatest personalities amongst German artists, he combined the vigour of the East Prussian peasant with the temperament of a Rubens.

His output was very considerable, and among his most famous pictures are his portraits of Graf E. Keyserling (1896), Pfarrer Moser (1899), Max Liebermann (1899), Peter Hille (1902), Konrad Ansorge (1904), Rudolf Rittner as Florian Geyer (1907), and of himself (1918). Corinth wrote: *Das Erlernen der Malerei* (1909); *Legenden aus dem Kunstlerleben* (1909); *Das Leben Walter Leistikows* (1910). See Alfred Kuhn, *Lovis Corinth* (1925).

CORK, Ireland (*see* 7.158), had a population in 1911 of 76,673. During the Sinn Fein troubles of 1919–20 there were serious riots

and many outrages in and near the city, and the ambushing of British soldiers led to incendiary fires as reprisals in Dec. 1920, in which the city hall and the Carnegie library were burnt. It was decided to start reconstruction of the municipal buildings at once. In 1920 many Irish prisoners tried to obtain their release by hunger strikes, and the Lord Mayor of Cork, Terence James MacSwiney, died as a result in October. His burial in Cork was marked by intense public grief, and a requiem mass was said in the cathedral. In 1924 the corporation was dissolved in consequence of its irregular proceedings and its functions carried on by commissioners appointed by the Free State Government.

CORMON, FERNAND (1845–1924), French painter (*see* 7.161), died in Paris March 21 1924.

CORNELL UNIVERSITY (*see* 7.169).—The total enrolment of regular students in 1925 was 5,698 (including 1,292 women). In addition, 2,113 students were enrolled in the 1924 summer session, especially for teachers, and 180 in the short winter course in agriculture. The number of professors, assistant professors, lecturers and instructors on the staff of instruction, research and extension was 857. The productive funds in 1924 were $19,900,000 yielding in the fiscal year 1923–4 an income of $1,039,000; the income from public sources was $2,304,000 and from tuition and other fees, $1,156,000.

Tuition in the state colleges was free to residents of the state. The grounds, buildings and equipment were valued at $8,635,000. The area of the campus was 359 ac., and that of the experimental farms adjoining the campus was 1,170 acres. The productive funds had more than doubled between 1911 and 1925. Under the will of Goldwin Smith, $683,000 were received in 1911 for the promotion of liberal studies, and from Jacob H. Schiff, in 1912, $100,000 for the promotion of studies in human civilisation; by a bequest of Col. Oliver H. Payne, in 1913, the medical college was endowed with $4,850,000; August Heckscher gave $500,000 in 1920 for the endowment of research; a bequest of $77,000 from Hiram J. Messenger became available in 1923 for lectures on the evolution of civilisation. In 1919–20 new endowment was pledged to the amount of $5,700,000 to increase teachers' salaries, and gifts from alumni for current expenses aggregated $1,000,000 by 1925.

During the years 1911–25 the university's physical growth continued; the state added eleven large buildings to the equipment of the state colleges and built a new armoury for the department of military science; George F. Baker, the New York banker, gave $1,500,000 for a laboratory of chemistry; gifts of $350,000 from Mr. Baker and $300,000 from Mrs. Russell Sage provided four residential halls for students; Mrs. Florence Rand Lang of Montclair, N.J., added Rand Hall (machine shop and electrical laboratory) to the College of Engineering; Mrs. Willard Straight of New York built a large hall to serve as a social centre for the university community.

The colleges of Civil and Mechanical Engineering were reorganised in 1920 as the College of Engineering, comprising the School of Civil Engineering, the Sibley School of Mechanical Engineering and the School of Electrical Engineering. In 1921–2 the College of Architecture added courses leading respectively to the degrees of Bachelor of Fine Arts and Bachelor of Landscape Architecture. The State Legislature in 1923 put the state agricultural experiment station at Geneva, N.Y., under the direction of the trustees of Cornell University, and in 1925 established the state College of Home Economics, which, up to that time, had been a department of the College of Agriculture.

The university library in 1925 contained 750,000 volumes. Among the important recent accessions were the Charles W. Wason collection of works relating to China and the Chinese, 9,399 vol.; the James Verner Scaife collection of books relating to the American Civil War, and the engineering library of the late Emil Kuichling, 2,093 vol., presented by Mrs. Kuichling. The Willard Fiske bequests have been described in three important bibliographies: *Catalogue of the Icelandic Collection* (1916), *Catalogue of Runic Literature* (1918), both compiled by H. Hermannsson, and *Catalogue of the Petrarch Collection* (1916), compiled by Mary Fowler. The results of the Cornell expedition to Asia Minor and the Assyro-Babylonian Orient were published in 1911.

In 1924 appeared the eighth volume of *The Cornell Studies in English*, founded in 1916. Several volumes have also been added to *The Cornell Studies in Classical Philology*, *The Cornell Studies in History and Political Science* and *The Cornell Studies in Philosophy*. The valuable law library numbered about 60,000 volumes. The law school publishes *The Cornell Law Quarterly*, established in 1915. Since 1909 the Governor of New York State has appointed five members of the university's board of 40 trustees; 15 are co-opted, and the alumni elect 10; others are *ex-officio* members. Since 1916 the faculty has sent three representatives to the board who sit as trustees, but without a vote. Andrew Dickson White, who, at the request of Ezra Cornell, drew up the original plans for organising the university and served as its first president, died at Ithaca, N.Y., Nov. 4 1918. President Jacob Gould Schurman resigned in June 1920, and Dr. Livingston Farrand was inaugurated president in Oct. 1921.

During the World War the university, in co-operation with the War Dept. conducted at Ithaca, N.Y., schools of military aeronautics, of aerial photography, for military artisans and a unit of the Students' Army Training Corps, and, at the medical college in New York, a school of röntgenology for officers of the U.S. Army Medical Corps. Many members of the faculty gave professional or technical service to the Government. About 7,000 students or former students of the university were in uniform; 216 died in the service; 147 were decorated for distinguished services or gallantry in action. (W. Pa.)

CORONEL, BATTLE OF.—On Nov. 1 1914 a naval battle to which this name is given was fought between a British cruiser squadron under Rear-Adml. Sir Christopher Cradock and a German squadron under Vice-Adml. Graf von Spee. Coronel is in Chile and the battle was fought about 41 m. to the west of it. The Germans sometimes call it the battle of Santa Maria from the name of a small island about 20 m. to the west.

Ships Engaged.—The British squadron consisted of the armoured cruisers "Good Hope" (flag, Capt. Philip Francklin, 1902, 14,200 tons with 2 9·2-in. and 16 6-in. guns, designed speed 23 knots), and "Monmouth" (Capt. Frank Brandt, 1903, 9,800 tons, with 14 6-in. guns, 23 knots); the light cruiser "Glasgow" (Capt. John Luce, 1910, 4,800 tons, with 2 6-in. and 10 4-in. guns, 25 knots); and the armed merchant cruiser "Otranto" (Capt. Herbert Edwards, with 4 4·7-in. guns, 16 knots). The German squadron consisted of the armoured cruisers "Scharnhorst" (flag) and "Gneisenau," both vessels of 11,420 tons, with 8 8·2-in. and 6 5·9-in. guns, speed 22·5 knots, and the light cruisers "Leipzig" (1906, 3,200 tons, with 10 4·1-in. guns, 22 knots), "Nürnberg" (1908, 3,396 tons, with 10 4·1-in. guns, 23 knots) and "Dresden" (1908, 3,544 tons, with 10 4·1-in. guns, 24 knots). In gunnery and weight of broadside the Germans were undoubtedly superior. Their large ships had been in commission for over two years and were in a high state of gunnery efficiency. On the British side the "Good Hope" and "Monmouth" were third fleet ships with obsolete control fittings. They had been lying empty in the dockyards and were manned by reserve men on the outbreak of war.

In the heavy weather prevailing at the time, it may be assumed with certainty that the "Good Hope" and "Monmouth" could not use their maindeck 6-in. casemates, which would reduce the British broadside to 2 9·2-in. and 12 6-in., with a weight of 1,960 lb., against the German 16 8·2-in., with a weight of 2,904 pounds. The old battleship "Canopus" (Capt. Heathcoat Grant, with 4 12-in. and 12 6-in. guns), another third fleet ship, had been sent out to reinforce the squadron; but, as her engines could not be relied on to do more than 14 knots, she had been relegated to escort work and was some 300 m. to the southward escorting two colliers when the action began. Both in guns and gunnery Cradock's ships were unequal to their task and this had been seen as early as Sept. 10, when orders were issued for the armoured cruiser "Defence" to proceed from the Mediterranean to reinforce Cradock. These orders were unfortunately cancelled by the Admiralty on Sept. 16.

Meeting of the Rival Squadrons.—Cradock left the lonely harbour of Vallenar (Chonos Archipelago, Chile, 45° 24′S., 74° 18′W.) with the " Monmouth " on Oct. 30 and proceeded north to find the enemy, leaving the " Canopus " to remedy engine defects and bring on colliers. The " Glasgow " which had gone on to Coronel, joined her at 1:30 P.M. on Nov. 1 some 50 m. west of Coronel. A heavy sea was running and the mail had just been drifted on board the " Good Hope " when at 1:40 P.M.[1] German wireless sounded loud and clear.

Von Spee had come from Masafuera, the last port of call on his long Pacific trip. The " Prinz Eitel Friedrich," an armed merchantman, had been sent into Valparaiso on Oct. 30 and he was cruising slowly just out of sight of land. At 3 A.M. on Nov. 1 he received by wireless news of the " Glasgow's " visit on Oct. 31 and steered south to intercept her.

Cradock made a signal to spread 15 m. on a line of bearing northeast by east (in order from west—" Good Hope," " Monmouth," " Otranto," " Glasgow ") course northwest by north 10 knots, to get in touch with the enemy. The line had not been

formed when the " Glasgow " and " Otranto " sighted smoke, and at 4:10 P.M. the former reported enemy armoured cruisers in sight, steering southeasterly. She turned at once to S65°W and the whole line began to close on the " Good Hope." The " Canopus," which had left Vallenar at 9:30 A.M. on Oct. 31, was 300 m. to southward, toiling along with her colliers in a heavy sea.

Von Spee had been steering south at 14 knots. The " Nürnberg " and " Dresden " had been detached to examine passing ships and the former was 25 m., the latter 12 m., in rear. At 4:17 when some 35 m. north of Coronel (36° 26′S., 73° 23′W.), the " Glasgow " was sighted to the west and the German cruisers turned and followed her, working up to full speed. It was blowing hard from south by east (Von Spee says south) and a heavy sea was running, hurling sheets of spray over the conning towers. The " Good Hope " was 26 m. west of the " Glasgow " when the Germans were sighted and turned to the east to join her squadron. The signal to form single line ahead went up at 5:17 and by 5:20 the British squadron was on an easterly course, the " Good Hope " leading, with the " Monmouth," " Glasgow " and " Otranto " in line ahead behind her. The enemy was about 11 m. away to the east, steering to the southwestward. Cradock altered course to the south about 5:30, while Spee some 11 m. off was steering southwesterly. At 5:34 Cradock altered his course four points (45°) together toward the enemy, evidently in order to close the range while the sun was still high enough to dazzle the enemy, but Von Spee turned away two points to port, and Cradock resumed his course to the south.

The Action Described.—Cradock was evidently determined to fight and about 6 P.M. he informed the " Canopus " of his intention to attack. The ships were then going about 17 knots. At 5:50 Cradock again turned in to reduce the range and again Von Spee turned away, biding his time and waiting for the sun to set. The " Otranto," with neither guns to fight nor speed to run away, asked if she was to keep out of range and, not getting a reply, drew out on the " Glasgow's " starboard quarter.

At 6:20 the sun had begun to dip and Von Spee increased speed to 16 knots and turned in to reduce the range. As the sun sank below the horizon at 6:30 it left the British ships silhouetted against a deep blood-red glow, whilst the German ships were barely visible against the night clouds gathering in the east. At 6:33 the range was 11,367 yards and the " Scharnhorst " opened fire. In spite of the heavy sea and spray, the first shot fell only 500 yards short. The third salvo hit the " Good Hope " between the conning tower and fore turret, setting a fire ablaze. The rest of the German squadron joined in, the " Gneisenau " opening on the " Monmouth," the " Leipzig " on the " Glasgow " and the " Dresden " on the " Otranto," though seas were breaking right over the light cruisers and pouring into their conning towers.

The " Good Hope " opened fire, but in the failing light the shots could not be seen and her fire was poor and ineffective. Cradock had turned toward the enemy and the range was falling rapidly. By 6:53 it was down to 6,600 yards. The " Monmouth " had opened fire with rapid salvoes, but the German gunners found the target again and again and by 7 P.M. the British cruisers were obviously in distress. The " Monmouth's " fore turret had been struck by a shell and after spouting fire had been blown overboard; she had yawed out of line to starboard at 6:50 and the " Glasgow," following in the " Good Hope's " wake, had to ease down to avoid masking her fire. Fierce fires had broken out in the " Good Hope " and were increasing in brilliance. It was growing dark. At 7:15 the " Good Hope " was losing speed; the range had closed to 5,000 yards. About 7:20 an armour-piercing shell struck her between the second and third funnels and a minute or so later a vast column of fire rose into the air as high as the mast head. The port after-guns fired a couple of shots, then all was silent. The explosion seems to have blown the ship in two, leaving her little more than a gutted hull, lighted by a dying glare. Thirty-five hits had been counted on her by the " Scharnhorst's " gunners.

Sinking of " Monmouth."—At 7:26 the Germans ceased fire; nothing could be seen of the British squadron but the occasional flash of the " Glasgow's " guns. The " Monmouth " had ceased fire at 7:20; she had got her fires under and at 7:35 turned to the westward. The " Glasgow," which had received five hits, followed her round, signalling to her at 7:40 to steer west, but badly down by the bows and listing to port the " Monmouth " turned north at 7:15 to get stern to sea. The moon had risen above the clouds and was sending a fitful light over the stormy sea. Von Spee had launched his light cruisers to attack and they were hot on the trail.

At 7:50 the " Glasgow " could see them coming up astern and, after signalling to the " Monmouth " to steer west, left the stricken field and lost sight of the enemy at 8:20 P.M. It was the " Nürnberg," which had been making frantic efforts to overtake her squadron, that found the unfortunate " Monmouth," listing so badly that she could not use her guns. The " Nürnberg " missed her with a torpedo and opened fire at 800 yards. She heeled gradually over and at 8:58 went down with her flag flying. Not a soul was saved from her or the " Good Hope." The "Glas-

[1] Time in Corbett, vol. 1, and in 12th ed. is the time kept by British ships and is half an hour behind the times here given, which are in Chilean time, five hours slow on Greenwich.

gow," working round to the southwest steered with the "Canopus" for Magellan Straits. The "Otranto" went round the Horn.

The British shooting was poor; the crews had had little time for training and the fire control equipment was obsolete. The "Scharnhorst" was hit twice by small shell with no casualties; the "Gneisenau" received four hits, one of which jammed the after 8·2-in. turret for a short time, and had two men slightly wounded. It would have been possible for Cradock, when the German squadron was sighted, to fall back on the "Canopus," but this would probably have meant the abandonment of the "Otranto"; Cradock was much disturbed at the refusal of the Admiralty to send him the "Defence," but from the first it seems to have been his definite intention to fight. When the enemy was reported he did not hesitate, but at once formed his battle line. He hoped no doubt to inflict some injury on the Germans who were far from any base of refitment and repair. His flag went down into the Pacific flying gloriously and any responsibility he bore lies buried fathoms deep. He fought his fight, checked Von Spee in his onward career and started the train of events which found its consummation at the Falklands. (*See* FALKLAND ISLANDS, BATTLE OF.)

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(A. C. D.)

CORPORATION: *see* COMPANIES AND CORPORATIONS.

CORSON, HIRAM (1828–1911), American scholar (*see* 7.204), died in Ithaca, N.Y., June 15 1911.

CORT VAN DER LINDEN, PIETER WILLEM ADRIAN (1846–), Dutch politician, until 1897 followed an academic career, mainly interesting himself in economics. In that year he became Minister of Justice and retained this post until 1901, when he was appointed a member of the State Council. In 1913 after the Social Democrats had refused to co-operate with the Liberal parties, Dr. Cort van der Linden formed an extra-parliamentary Cabinet which during the World War assumed the character of a national cabinet. In virtue of this he succeeded in bringing about a revision of the Constitution, which put an end to both the electoral "war" and the schools "war," which for half a century had dominated politics in the Netherlands. Bills were passed providing for proportional representation, universal manhood suffrage, which gave a prospect of extending the franchise to women. A bill was also passed by which denominational schools were placed upon an equal financial basis with public schools. After his Cabinet had resigned in 1918 Dr. Cort van der Linden was again appointed a member of the State Council.

COSGRAVE, WILLIAM THOMAS (1880–), Irish politician, was born in Dublin, and educated at a school of the Christian Brothers. His father, Thomas Cosgrave, was at one time a town councillor and poor-law guardian. William Cosgrave entered the grocery trade at an early age, and there was nothing in his life to indicate a career of importance. But, like most thoughtful young Irishmen who came of age about the turn of the century, he was attracted by the Sinn Fein movement. In 1913 he won a seat on the Dublin corporation in the Sinn Fein interest. Here he distinguished himself on the financial side and in 1916 was chosen chairman of the finance committee.

In 1913 he became a member of the Irish Volunteers, and when that body divided in Aug. 1914, he was with the minority who refused to follow John Redmond. At the Easter Rising, 1916, he was again in an extremist minority, for he joined the section which, against the order of Prof. MacNeill, then head of the organisation, went out to fight under Pearse. Afterwards, with other prisoners, he was detained at Frongoch in Wales until the general liberation in July 1917.

Mr. de Valera, having, immediately on his release, won a seat vacant in Clare, another vacancy soon occurred in Kilkenny city. Mr. Cosgrave was nominated and elected by a large majority. Re-elected in Dec. 1918, this time for Kilkenny co., he was a member of the first Dail Eireann which declared for an Irish Republic and was Minister for Local Government in the first Republican Ministry. During the struggle with the British, his task was to organise the refusal of local bodies to co-operate with Dublin Castle. Like all other members of this illegal ministry, he was the object of pursuit by the law and was more than once in prison.

During the debate in the Dail in Dec. 1921, on the newly signed treaty with Great Britain, Mr. Cosgrave's speech was one of the few that attracted attention. Later he became Minister of Local Government in the newly formed Provisional Government. In the summer of 1922 President Griffith, obliged to go to London for the negotiations concerning the treaty clauses, appointed Mr. Cosgrave as his deputy, and when, on Aug. 12, Griffith suddenly died and Collins was chosen President in his place, Mr. Cosgrave became acting chairman of the Provisional Government. Ten days later Collins was shot, and Cosgrave, a simple Dublin business man, was placed by force of circumstances at the head of a state fighting for bare life. Never was promotion more sudden or more accidental. Griffith and Collins had, in their different ways, a strong hold on the popular mind; Mr. Cosgrave was unknown as a personality and barely recognised as a name.

As soon as the newly elected Dail could be summoned, and it could meet only behind closed doors and strongly guarded entrances, he made clear his view that the day of individual leadership was over and team work must take its place. In that anxious period he left much of the work, especially the carrying of the draft constitution through the House, to younger and more brilliant subordinates. But he captained his team, and was always ready to shoulder responsibility. When tempers were roused he introduced a conciliatory spirit. He showed both breadth of view and a sense of humour, and endeavoured to make the Protestant minority at home in the Free State. The appointments made by his Govt., especially to judicial office and the first Senate, recognised merit irrespective of politics or religion.

As President of the Irish Free State he represented Ireland when she first appeared at a conference of the Dominions in Oct. 1923; and a month earlier he was welcomed as her first spokesman at the Assembly of the League of Nations. He saw the country pass from anarchy to a state of complete order. The Ministry of Finance, which he took over at the outset, was transferred in 1923 to Mr. Blyth who proved a success; the Ministry of Defence, which he took over in April 1924, in face of a threatened mutiny in the army, was handed over easily and without comment a few months later to a new minister, Mr. Hughes. In his political career Mr. Cosgrave was not ambitious. He never sought to thrust his personality into the forefront, but in Ireland, as well as overseas, he won a reputation for good sense and moral courage. (S. G.)

COST ACCOUNTING.—This term embraces methods of cost determination which are either a part of, or co-ordinated with, the general accounting of the enterprise as distinguished from estimates of costs not so controlled or checked. Cost-accounting methods have probably been developed more extensively in the United States than in any other country. This development has taken place mainly in the period since 1895, and it may be regarded as a natural phase of the general industrial development in that period. The same conditions which have stimulated the use of labour-saving methods and mass production have naturally lent new importance to the determination and analysis of costs, and have made it imperative that the substantial accuracy of the statistics of cost used shall be beyond question. This can only be assured by linking up cost statistics with general financial and accounting records and results.

In the problem of cost accounting there may be said to be usually three main objects to be achieved, three main classifications to be followed and three major considerations governing the scope of the methods to be employed. These nine elements are necessarily to some extent interrelated, and it may therefore be well to state them at the outset.

The main objects referred to are: (1) to afford a sound basis for selling policy; (2) to provide tests for operating efficiency; (3) to establish a basis for accounting records and financial policy. The classifications of cost are broadly: (1) labour,

(2) material, (3) overhead expenses. The character and scope of the methods to be employed must be determined largely by considerations of (1) speed, (2) accuracy, (3) expense.

The relative importance of the objects enumerated varies with different classes of enterprise. In the case of a builder, contractor or shipbuilder, or in the case of a plant capable of producing different types of products, a cost system may be of even greater value in the determination of selling policies than in producing operating efficiency. On the other hand, in the case of a plant producing standard articles for a highly competitive market, the value of a cost system may lie almost wholly in helping to secure manufacturing or operating efficiency.

The success of any cost-accounting system depends largely on correct judgment concerning the relative importance of the different elements of the problem in the particular case involved, and particularly on the success with which the naturally conflicting considerations of speed, accuracy and expense in the cost department are reconciled. If the cost system is to be of real service to those in charge of operations or sales, its results must be substantially accurate and sufficiently specific to enable those officers to localise waste and the responsibility therefor. Such results will, however, be of little value if in an attempt to secure accuracy the ascertainment of the results is unduly delayed, or an expense is incurred greater than the possible benefits to be derived from the greater accuracy ultimately secured. The recognition of this fact and the consequent resort to simpler, though perhaps less scientific and less meticulously accurate methods, have perhaps been the most marked characteristics of the development of cost accounting in the United States in recent years. The growth of interest in cost accounting, which began about 1895, was greatly stimulated by the consolidations which were effected about the year 1900.

Costings and Large-scale Production.—Among the results of these consolidations were the transfer of ownership on a large scale from persons immediately interested in the operations of plants to the general public, and also a transfer of the general direction from small groups of operating officers to boards of directors less intimately associated with actual operations. This change resulted in a demand for more frequent and more accurate reports of operating results as a guide to financial policies and for the information of those financially interested. In the development of methods to meet the new situation the importance of the purely accounting and financial uses of costs were not infrequently overrated.

Purely accounting uses of cost records have come to be viewed in a more accurate perspective, and accounting refinements and technicalities have been increasingly subordinated to practical usefulness. At the same time, remarkable results have been achieved in expediting the compilation of costs by careful organisation, so that to-day large corporations frequently have completed cost figures for a month available for the operating executives within three or four days of its close.

The accountant called upon to devise a system of cost accounting will be wise to regard the accounting uses of the system as entirely secondary, and to aim at making the system as valuable as possible to those controlling the policies and operations of the business. The sales manager, in fixing prices, must estimate costs in advance of sale, and the value to him of a system which records actual costs lies mainly in the check it affords on the correctness of his estimates, and the extent to which it permits and facilitates the use of actual costs of the past as a basis for estimates of cost in the future under changing conditions.

The operating or production manager's requirements are more extensive and more varied. He must be in a position to determine whether fluctuations in cost are due to conditions within the control of the management or not, and if so, to localise the responsibility. He must, for instance, be in a position to determine such questions as whether a higher cost of material at one plant than at another is attributable to less efficiency in purchasing, or to the use or the waste of more material, and how far apparent high costs of production are really costs of production, and how far they are attributable to lack of production, *i.e.*, to idle time and such causes. Every effort should therefore be made to frame a cost-accounting system so as to afford as much light as is practicable on manufacturing operations and to make that light available at the earliest possible moment.

Main Types of Cost Accounting.—Broadly, there are three main types of cost-accounting systems. The first undertakes to determine the cost for each *production order*, which may cover either a single unit of production where units are large, or a batch of units where they are smaller. The second takes account of costs by separate *processes or operations*—thus determining a unit cost for each process or operation and leaving the cost of any article produced to be determined by bringing together the costs of several processes or operations through which it passes. The third seeks to determine costs by *products or classes of products* and to compute the costs of the units produced by dividing the total costs incurred in producing similar units in any period by the number of units produced in that period. Multiple products from a common raw material, as in the case of petroleum and packing industries, constitute a separate and difficult problem.

An important question is the relation of the cost accounting to the general accounting records of the enterprise. From the standpoint of accounting technique the cost system, which forms an integral part of a general accounting system, possesses a unity and completeness which cannot be achieved in any other way. It is, however, easy to pay too great a price for this artistic completeness, and there has been a marked disposition to employ methods under which the cost accounting is less closely tied to the general accounting.

The value of cost figures is greatly enhanced by comparisons either with past achievements or with an "ideal" or standard of cost. Much attention has been given to methods of cost accounting in complex industries, based on standard costs for specific articles, processes or operations, supplemented by methods for adjusting these standard costs for changes in conditions, and for ensuring that the aggregate costs allocated as the results of these adjustments are in actual or substantial agreement with the aggregate costs incurred as shown by the general books. For discussion of the subdivision of costs, the reader must be referred to text-books. A warning may be given that accounting text-books are apt to overrate and engineering text-books to underrate general accounting and financial desiderata. In particular, the importance may be emphasised of avoiding use of a cost system in a way which would involve inventorying goods at more than true cost through the inclusion in costs of either (*a*) inter-departmental profits (and for this purpose wholly-owned subsidiary companies should be regarded as departments), (*b*) profits in the form of interest or otherwise, or (*c*) selling costs. All these items may, however, be included in appropriate ways in costs compiled for executive use in formulating policies.

Overhead costs per unit (up to the limit of economical production) decrease as the output increases, and vice versa. Sales may therefore be advantageous, even though they do not reimburse direct costs and a rateable proportion of overhead expenses. The cost accountant should therefore do all in his power, especially where profit margins are narrow, to segregate overhead costs, to analyse them and to interpret them to the executive, so as to ensure that they will be given due, but not undue, weight in the formulation of policies. The allocations of overhead costs are, at best, rough approximations, but much has been done to secure more accurate allocations by computing overheads for individual departments, machines or tools, by adopting bases of apportionment, more carefully selected and more closely related to the actual facts of production than previously, and in similar ways.

In some systems, standard rates of burden rather than actual rates are charged into cost, being credited to clearing accounts to which actual overhead expenses are charged. Where this is done, watchfulness and judgment in dealing with these clearing accounts are imperative. This is, however, only one illustration of the most important of all truths in cost accounting, that skill and judgment in applying, adjusting and interpreting cost methods in actual use are even more important than ingenuity in devising a system in the first instance (*see* BOOKKEEPING).

A. H. Church, *Manufacturing Costs and Accounts* (1917); Nicholson and Rohrbach, *Cost Accounting* (1919); G. C. Harrison, *Cost Accounting to Aid Production* (1921); L. R. Dicksee, *Fundamentals of Manufacturing Costs*. See also *Industrial Management* and other journals devoted to that and kindred subjects. (G. O. M.)

COSTA RICA (*see* 7.219).—A republic in Central America and a member of the League of Nations. Its area is 23,205 sq. m. and its population was estimated on Dec. 31 1923 at 498,435: no census had been taken since 1892.

Political History

In 1910 Ricardo Jimenez was chosen president by popular vote, but in 1914 recourse to the legislative branch was required for the election of Alfredo González. In Jan. 1917 González was forced out of office by Frederico Tinoco, who became the provisional chief of the Republic. A commission was appointed to draw up a new constitution, which was finally promulgated in June 1917. In April deputies were elected to a constituent assembly and a president elected, in accordance with the electoral law of Aug. 18 1913; Tinoco was proclaimed president from May 1917. In 1919 a counter-revolutionary movement under Julio Acosta took place; Tinoco resigned and Acosta became president. Following the entry of the United States into the World War, Costa Rica severed relations with Germany and finally declared war on May 25 1918.

The boundary dispute with Colombia, arbitrated by President Loubet of France in 1900, continued as a dispute with Panama and resulted in the White award in 1914. In 1921 Panama appealed to the United States Govt. against the award but was informed that it must be accepted. On Aug. 18 Secretary Hughes announced that Costa Rica need delay no longer in taking jurisdiction over the disputed territory and on Aug. 23 the Coto district was ceded by Panama. Costa Rica protested against the Bryan-Chamorro Treaty of 1916, alleging that it infringed her sovereign control over parts of the proposed Nicaraguan canal route. The protest led to a protocol, signed Feb. 8 1923, between Costa Rica and the United States, whereby the latter agreed to recognise the rights of Costa Rica in the San Juan river in event of canal construction. This protocol, however, was rejected by the United States Congress. In Oct. 1924 President Jimenez approved the Central American treaties signed at the Washington Conference of 1922–3, and in Nov. his Govt. ratified the General Treaty of Peace and Friendship (*see* Central American Union).

Education.—The school enrolment in 1923 was 41,277; in 1924, 38,672. Secondary, normal and professional schools have been established. Education during the post-War period received about 16% of the national budget. In Feb. 1925 a commission began the study of agricultural and vocational education in South America.

National Finance.—The budget showed deficits each year from 1914–21, totalling altogether over 27,000,000 colones. In 1922 revenue exceeded expenditure; in 1923 the surplus was over 1,500,000 colones. The internal debt on Dec. 31 1923 was 39,807,956 colones; the foreign debt consisted of gold refunding bonds, 1911, of £1,478,000. and the unpaid balance of the French loan, 1912, amounting to 32,269,500 francs.

Production and Trade.—Increased attention is being paid to agriculture, and a new department of school agriculture has been established. The chief products are coffee and bananas; the production of sugar is increasing in importance, while maize, cocoa, tobacco, rice and potatoes are also grown. Gold and silver mining rank next to agriculture. Few manufactures exist. The distillation of spirits is a government monopoly.

The value of imports declined during the period 1915–9, owing to the War and restricted shipping facilities. Exports, however, remained fairly steady, and consequently favourable trade balances were registered each year. The following table gives the value of exports and imports from 1914 to 1923:—

	Imports	Exports
	Lbs.	Lbs.
1914	1,554,033	2,235,272
Average 1915–9	1,121,000	2,209,000
1920	3,645,873	2,563,929
1921	2,390,600	3,095,548
1922	1,716,840	2,926,533
1923	2,013,353	2,640,321

Coffee and bananas represent over two-thirds of the total exports. Overseas trade is mainly with the United States and Great Britain. In 1923 59% of the value of total imports was from the United States and 16% from the United Kingdom. Of exports, 54% was to the United States and 38% to the United Kingdom.

There were 403 m. of railway in the country in 1925, 81 m. of which were state owned. Some 1,000 m. of roads existed, but only about 50 m. were suitable for motor traffic.

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COST OF LIVING.—Until recently the phrase "Cost of Living" was only used loosely by economists when the balance between movements of wages and prices was in question, but from 1914 onwards during the World War the need of a measurement of the rise of prices gradually resulted in making the expression prominent in industrial and statistical discussions. It has frequently been assumed that the term "Cost of Living" has a unique and definite meaning, and that accurate measurements can be applied to it, but in fact the meaning is vague and the statistical methods appropriate to it are complex and lead to results whose precision is not of a high order.

The phrase may be regarded as an abbreviation for "the cost in a defined region to persons of a defined social or industrial class of goods of a kind usually purchased at frequent intervals, by the consumption of which a certain standard of economic welfare is reached." We may usefully distinguish four cases:—(*a*) where the standard is a physiological minimum; (*b*) where some conventional or average budget of expenditure is taken and the cost of the items in it is measured at different times or places; (*c*) where the items are varied but the whole contents of the budget result in an unchanged standard of welfare; (*d*) where both the contents of the budget are modified and the standard is raised or lowered. Case (*b*) is that which has in recent years been the subject of measurement, but case (*c*) is that which is in reality appropriate to the problem of measuring or adjusting real wages.

I. GENERAL CONSIDERATIONS

The Physiological Minimum.—Attention was directed by Mr. Seebohm Rowntree (*Poverty, A Study of Town Life*, 2nd ed. 1902) to the cost of obtaining in York (England) and elsewhere food, clothing, heat, light and shelter sufficient for a family to maintain itself in health and efficiency for work, when all possible economy was practised, subject to the availability of commodities and the legal requirements for housing, decency, etc. The minimum of food was computed in relation to the quantity of calories, carbohydrates and protein calculated by Atwater and others as necessary for maintaining health and vigour under various conditions of life, and dietaries were drawn up which contained the necessary constituents at the minimum aggregate cost; to this cost was added the expenditure on clothing, fuel, cleansing materials, etc., and rent, which was found to be customary among persons in regular work at the lowest rates of wages for adult men. The most natural meaning of the cost of living is perhaps the cost of maintaining the minimum standard thus described.

The standard is, however, not scientifically definite; apart from questions as to the validity and applicability of the measurement by calories, it is clear that there must be a great difference between the amount of food necessary for work of low and of high efficiency; the Indian, Chinese and Japanese peasants live on a sparser diet and produce a lower output than English or American; definable points are where efficiency is a maximum (which needs a more liberal diet than that considered by Mr. Rowntree) where the value of additional efficiency exactly equals the cost of the additional food, etc., necessary (for whose ascertainment there are no observations); and Atwater's standard is in fact conventional (*see* Bowley, *Measurement of Social Phenomena*, chap. viii., 1915). If we drop the word "minimum" and speak of Mr. Rowntree's as a conventional standard for

demarcating poverty, we can properly measure the change in the cost of living at this standard (if the facts are ascertainable). The varying cost of the official civilian rations, computed in Germany *circa* 1919, gave a measurement similar to that described. The cost of Mr. Rowntree's standard, and one modified in the direction of ordinary purchasers by Bowley, was worked out for certain English towns in 1913 (*Livelihood and Poverty*, 1915 and in 1924) (*Has Poverty Diminished?* 1925). A legal minimum wage could be based on a standard thus defined, but in fact it is generally related to a higher conventional standard.

The Conventional or Average Budget.—The usual method of measuring the change of the cost of living during and since the War has been as follows: Detailed statements of expenditure having been obtained from a number of working-class households (in most countries at some date prior to 1914), an average budget is formed showing so many pounds of meat, bread, etc., with the prices and expenditure in considerable detail. The average prices of the same foods is ascertained from time to time, and the expenditure necessary to purchase the former quantities at the new prices is computed. The cost of living (so far as food is concerned) is then taken as having increased or decreased in the same ratio as this standard budget. In many countries a standard of the same kind is established for clothing, fuel, light, rent, cleansing materials and some other articles, and the cost of the aggregate, including food, is computed from time to time. The result obtained (if the process were complete) would be the relative cost of maintaining a defined standard constant in every detail. It is generally expressed as a percentage; thus if the costs were 25s. and 30s. at the two dates, the ratio is 100:120, the index number at the second date is 120 and the percentage increase 20.

This method cannot be carried out in its entirety for two reasons, namely, lack of information and change of quality of the commodities in the market. In most countries data of expenditure and prices are only obtained for principal commodities (meat, bread, etc.) and not for those on which little is spent (currants, pepper, etc.) or in which the unit is variable (fruit, vegetables, etc.); but unless owing to shortage of supplies there is a run on the articles not included, these omissions cannot affect the result significantly. In some countries expenditure is not known, but only prices, and then the resulting calculation is generally valueless; and in others currency has been so variable that the computation has been meaningless. In nearly all cases there is no sufficient knowledge of expenditure on clothing either in total or in detail, and it is often difficult to obtain adequate data for fuel and light or for miscellaneous items. The sums included in the calculations, in fact, account for only a part of ordinary household expenditure, but where most care has been given to the question the part is a large proportion of the whole. Classes of expenditure that are not strictly necessary, such as amusements, tobacco, alcohol, etc., are generally omitted, as are occasional expenses (doctors, purchase of furniture, etc.), but in some cases subscriptions to trade unions, etc., insurance payments and travelling to work are included. The miscellaneous expenses omitted become a larger proportion of total expenditure as we go up the scale of incomes.

The difficulty due to the change of quality of goods which has been so marked since 1914 is even more fundamental. Over any long period the actual constituents and quality of a pound of bread, a cut of meat, a pair of boots, change considerably, but from some points of view these gradual changes are not important. During the War, however, substitution of one commodity or ingredient for another was sudden and common, and the pre-War quality was unobtainable at any price, or if obtainable had a quite altered position in domestic economy. Consequently the prices included in the calculations were frequently not for the same things at different dates and the precision of the measurement was greatly diminished. After the Armistice there was some return to former qualities, but the change has been sufficient to undermine the foundation of the numbers, and a new basis is necessary.

It should be added that separate budgets ought to be formed (and in some countries have been formed) for different grades of income and for different classes of occupation, and also for single persons and for married persons with dependants.

The structure of the index numbers of the cost of living is shown most clearly by algebraic symbols. If $Q_1, Q_2, Q_3 \ldots$ are the number of units of the commodities in the standard budget, and $P_1, P_2, P_3 \ldots$ the prices per unit at the date taken as starting point, and we write $Q_1 \times P_1 = E_1$, $Q_2 \times P_2 = E_2 \ldots$ where $E_1, E_2, E_3 \ldots$ are the expenditures on the commodities, then $E = E_1 + E_2 \ldots = Q_1P_1 + Q_2P_2 \ldots$ is the whole expenditure at the first date on the standard budget. Let $p_1, p_2, p_3 \ldots$ be the prices per unit at a subsequent date; then $Q_1 \times p_1 = e_1$, $Q_2 \times p_2 = e_2 \ldots$ are the presumed expenditures, and $e = e_1 + e_2 + \ldots = Q_1p_1 + Q_2p_2 + \ldots$ is the whole expenditure. The ratio of the cost of the standard budget at the second date to that at the first, is $\frac{e}{E} = \frac{Q_1p_1 + Q_2p_2 + \ldots}{Q_1P_1 + Q_2P_2 + \ldots} = \frac{E_1r_1 + E_2r_2 + \ldots}{E_1 + E_2 + \ldots}$ where $r_1 = p_1/P_1$ (the price ratio for the first-named commodity at the two dates), $r_2 = p_2/P_2 \ldots$. The last expression shows that by this method the ratio of the costs of living is a weighted average in which the price ratios are weighted by the expenditures at the first date; hence we only need to know these expenditures and ratios, and not the actual quantities nor prices. In the official measurement in the United Kingdom only the quantities E and r are in fact used; this method is very convenient in dealing with rent (for which there is no natural unit of quantity) and with clothing (for which a general price ratio is obtained without any definition of unit). The general theory of weighted averages shows that a considerable roughness in the estimation of the smaller expenditures is smoothed out in the process of averaging, but that it is important to obtain precision in the case of large items, such as clothing, treated in a single entry, and rent. It is important, however, that the r's should be accurately known when they differ much from one another, and the quality of the commodities that are priced should be the same at both dates.

The index number for the second date is $\frac{e}{E} \times 100$, and the percentage increase is $\left(\frac{e}{E} - 1\right) \times 100$.

Variation in Detail on an Unchanged Standard.—It must be granted that when the cost of living is compared at two places or at two dates we ought not to assume that precisely the same quantities of the same commodities are purchasable in both cases, and in order to make a strict numerical comparison we need a test of equality of standard if not a means of comparing two standards. The problem so stated has not yet been completely solved. A measurement could be made on a strictly nutritive basis and the cost of purchasing in the most economic way the amount of calories (including the necessary protein) considered proper to health and efficiency could be ascertained in both countries or at both periods; but this would only give a theoretic solution, since it ignores the influence of custom and taste in diet, and, in fact, in developed countries relatively few people have been compelled to purchase their nutriment in the cheapest possible way. The actual practical question in England in 1921 was what was the cost of maintaining the pre-War standard of living in nutritive power and satisfaction or pleasure derived from food and clothing, allowance being made for changes in prices and available qualities. This statement introduces the vague word *satisfaction*, which it is not practicable to define exactly, though some mathematical methods based on economic principles have been suggested for ascertaining its equality in two cases.

One method would be to frame a new budget of goods obtainable and in fact purchased by housekeepers with the same skill of adjusting purchases to desires as in the case of the earlier budgets. This would mean obtaining from representative working-class women a budget which in their opinion would now give the same variety and pleasure as a selected budget of 1914, care being taken that the energy value is the same. The result would be a new conventional budget, the ratio of whose cost to that of the pre-War budget would give a rough measure of the cost of living (*cf.* Bowley, "Measurement of cost of living," *Journal of the Royal Statistical Society*, May 1919, p. 354; and "Cost of living and Wage determination," *Economic Journal*, March 1920, p. 117).

Another method was used in the British Board of Trade's investigation into the cost of living in the United Kingdom, United States, France, Belgium and Germany, which was initiated in 1905 (*cf.* official papers Cd. 3864, Cd. 5609, Cd. 4512, Cd. 5065, Cd. 4032). A comparison was made of the cost of living in the United Kingdom and in each other country on a double basis as follows: It was found that an English housewife purchasing in 1909 in the United

States a week's supply of food as customary in England, would have spent 38% more in the first-named country, the ratio of the costs of living being on this basis 100:138; on the other hand, an American housewife purchasing in England a week's supply of food as customary in the United States would have found her expenses reduced in the ratio 125:100 (Cd. 5609, pp. lxvi., lxvii.). If these ratios had been reciprocal either would measure the differences in the cost of living (so far as food is concerned); as it is, their divergence illustrates the want of definiteness in the problem.

Another method gives, perhaps, the most practical solution, though its adequacy can hardly be proved from theoretic conditions. Obtain typical budgets of expenditure at two dates; compile a new or mean standard of quantities which, item by item, are the averages of the entries in the budgets. Thus, if in one the consumption of 33 lb. of bread is stated, in the other 35 lb., enter 34 lb. in the mean standard; now find the cost of the mean standard at each date and take the ratio of these costs as the measurement of the change in the cost of living.

If all prices rose in the same ratio the methods now described would necessarily yield the same result; the need for choice arises from inequalities of increase, including the case where the goods are no longer in the market as one where the price is indefinitely great. Now if at one date purchases are made so as to maximise the satisfaction in the outlay of the week's housekeeping allowance, as we may reasonably assume, and prices rise irregularly, it is evident that somewhat less will be bought of the commodities which have risen most and more of those which have risen least if a maximum is still obtained, and that consequently the increase in the expenditure necessary to obtain the same satisfaction as before is less than the increase if exactly the same quantities had been purchased. For example, if oranges are doubled in price and bananas increased only one-half, more bananas and fewer oranges will be purchased.

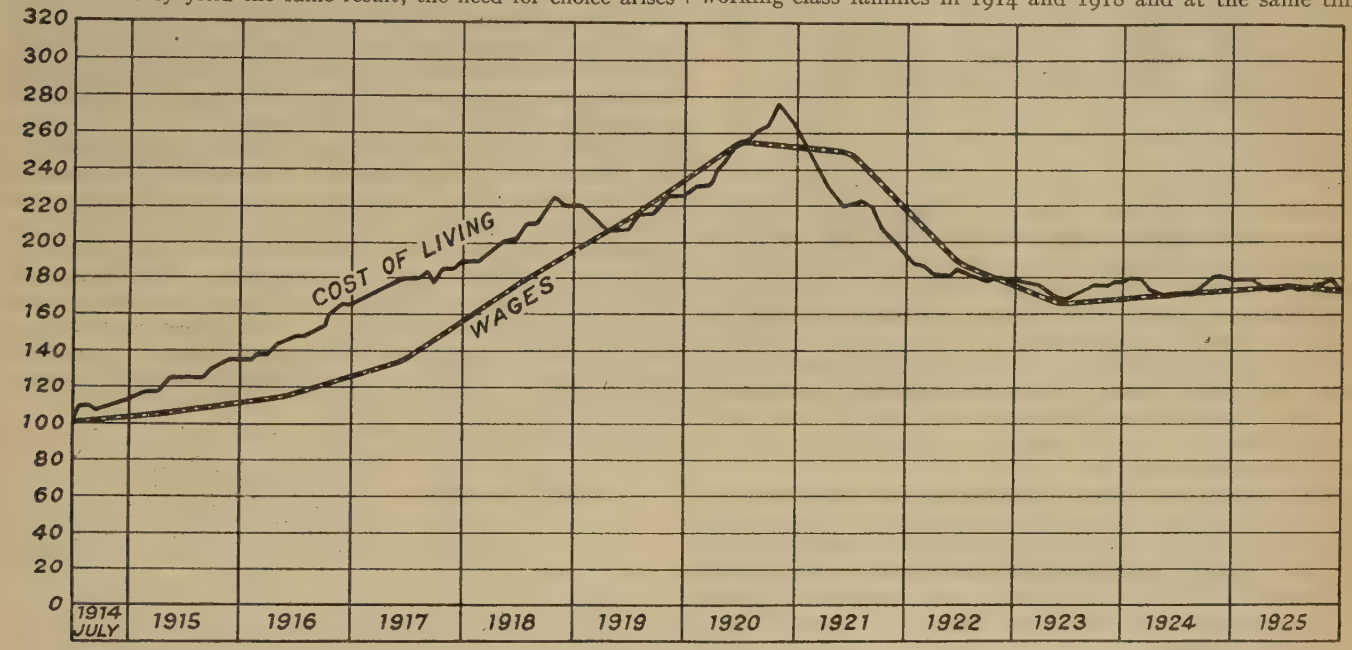

FIG. 1.—Diagram showing percentage changes in the Cost of Living from 1913 to 1925, and movements of time rates or piece earnings in Great Britain and Northern Ireland. The Cost of Living graph is based on figures given by the Ministry of Labour for the first day of each month. The Wages graph is based on figures given in the table in the article on WAGES (*q.v.*) for the normal week in July of each year from 1914 to 1925, and in Jan. 1926. In each graph, July 1914 is taken as equal to 100.

Variations in Content and in Standard.—The problem with which many countries were faced in 1920 and 1921 was in reality not that of preserving a standard of living on the level of 1914, but of adapting themselves to a lower average standard, whatever the fortunes of favoured classes. This may be illustrated by the arrangement of the salaries of civil servants in England in Feb. 1920. At that date the official measurement (on method *b*) of the increase in the cost of living over 1914 was 130%. The full increase of 130% was awarded to persons with a wage of 35s. weekly (£91 5s. per annum) or less, 60% was added to any excess of salary up to £200, and 45% to any excess over £200. Thus a man whose salary was £400 on the pre-War basis received an addition of £273¾ (130% on £91 5s. = £118⅝, 60% on £108 15s. = £65¼, 45% on £200 = £90), about 68% in all. This increment was increased or decreased by one twenty-sixth part for every complete movement of 5 points in the official index number averaged over certain periods. It appears to have been assumed on the one hand that the expenses of the middle class had not increased so much as indicated by the index number based on working-class expenditure, and on the other that the standard of living must be lowered—the higher the income the greater the fall.

A similar scale was adopted at nearly the same date for railway officials. We are thus led to consider a conventional standard of living which changes from time to time. When there is no reference to a physiological minimum, the cost of living may be regarded as the cost of maintaining the standard customary to the social or occupational class concerned at a given time and place. In this sense the cost of living of Chinese labourers is lower than that of the Americans, though they pay the same prices for commodities. When "cost of living" is used in this sense it should always be accompanied by a description of the standard attained. Thus the British Committee on the Cost of Living in 1918 (Cd. 8980) estimated the average expenditure of working-class families in 1914 and 1918 and at the same time reported on the change of standard. In some of the statistics quoted below a conception of this kind is involved in the figures.

II. CONDITIONS IN VARIOUS COUNTRIES

Great Britain.—In the United Kingdom the basis of the official measurement of the cost of living is that of finding the cost of a standard budget of expenditure at various dates (see *Report on Working-Class Rents and Retail Prices.* Cd. 6955 of 1913, pp. 299 *seq.* and *Labour Gazette*, Feb. 1921). The standard budget was obtained from a collection of 1,944 records of weekly expenditure made in 1904; the average weekly family expenditure was 36s. 10d., of this 22s. 6d. was spent on food, and of the food 18s. 6d. is accounted for in the standard used prior to the War. A somewhat altered basis was taken in 1914. Rice, tapioca, oatmeal, pork, coffee, cocoa, jam, treacle, marmalade, currants and raisins (the expenditure on all of which was about 2s. 1d in 1904) were omitted and fish and margarine added (an addition equivalent to 6d. in each case). It was assumed that, though prices had increased between 1904 and 1914, the relative expenditure (which alone enters into the computation) on the different commodities was unchanged; this assumption is too rigid but not unreasonable, and the facts otherwise known about price movements and consumption show that the error introduced is insignificant.

Relative importance being determined, the next step was to ascertain the movement of prices. Prior to 1914 the records were obtained exclusively for London, but it was shown (Cd. 6955, pp. 299 and 306) that from 1907 to 1912 the average movement

was very nearly the same in provincial towns as in London. From Aug. 1914 statements of prices were obtained for 650 towns and villages.

The index numbers of the cost of living, so far as food is concerned, were then obtained by the method *b* described above; prior to 1914, the year 1900 was taken as base, and the prices then equated to 100; from the beginning of the War July 1914 was taken as base.

The index number is in the form $100 \times (E_1r_1 + E_2r_2 + \ldots) \div (E_1 + E_2 + \ldots)$ where E_1, E_2 . . . are the expenditures on the separate commodities in the standard budget and r_1, r_2 . . . are the ratios of the prices at any particular time to the prices at the basic date. The values actually taken for the E's in 1914 were as in Table I., being proportional to the expenditure.

TABLE I. *Relative Importance of Foods*

Bread	50	Fish	9
Flour	20	Milk	25
Potatoes	18	Butter	41
British Meat		Eggs	19
Beef	24	Cheese	10
Mutton	12	Margarine	10
Imported meat		Tea	22
Beef	24	Sugar	19
Mutton	12		
Bacon	19	Total	334

There are certain weaknesses in the method. It is assumed without explicit evidence, that expenditure on meat was in the proportion 2s. on beef to 1s. on mutton, and that British and foreign meat were of equal importance, while the price ratios taken for meat are for four selected joints only; during the period 1915 to 1919, when the relative quantities available varied and relative prices were altered, these assumptions affect the index numbers. The weight assigned to margarine is arbitrary. The number of eggs consumed (about 12 per household per week) is based on summer records and is no doubt higher than the average for the year.

Rent, Clothing, etc.—Next in importance to food comes rent. The figure included in the index number allows for such increases for rates, repairs, etc., as are legally permissible and is accurate for persons who by remaining in the same house since 1914 have the benefit of the Rents Restriction Acts; the increase for those who have moved must have been very variable and for it no estimate is available.

The cost of clothing, which ranks next to rent in expenditure, is always very difficult to measure owing to the difficulty of defining the garments or stuffs purchased, and of assigning their relative importance in the budget, and also there was great variability in the qualities in the shops during 1914 to 1921. The difficulties can be understood by comparing the estimates and method of the Cost of Living Committee (*loc. cit.*, pp. 21–3) with those of the official index number described in the *Labour Gazette*, April 1921, pp. 178–9; the former found an increase of 96% between July 1914 and the summer of 1918, the latter reaches increases of 210% in June and 240% in Sept. 1918. The differences are partly attributable to the great variability of the increases among the articles in consequence of which the relative importance given to each has great effect, and in this respect the committee's measurement was the more systematic; and partly due to the difficulty of obtaining quotations for the same qualities of goods or in allowing for substitution. The question is too intricate to discuss here; it can only be suggested that the results have little precision, and that the process of obtaining an estimate based on a new budget in which modifications of custom are allowed for is even more necessary than in the case of food.

Fuel and light present little difficulty when a general average for the country is in question since the retail prices of coal and of gas are ascertainable. The variations from north to south in price and consumption and that between winter and summer are not very important, since where coal is dear, gas is used for cooking, and in working-class households one fire is necessary throughout the year for cooking and this also provides heat.

The official index number allows only one-twelfth of the weekly expenditure for all items not already included, or about 1s. 6d. per household in 1914. This sum is exhausted by cleansing materials with a very small margin for tobacco, newspapers, household replacements and fares. Insurance and trade-union subscriptions are not included, nor is alcohol.

The five classes of expenditure now named are combined in the following proportions, stated for clearness on the basis of a pre-War urban weekly expenditure of 37s. 6d. Food 22s. 6d., rent (including rates) 6s., clothing 4s. 6d., fuel and light 3s., sundries 1s. 6d. Here the proportions on food, rent and light rest on good evidence; that on clothing, for which the expenditures vary greatly according to the income and personnel of the family and for which there has never been a satisfactory investigation, is little more than a guess based on vague estimates; that on sundries is the residuum when other expenses are met and is probably too low.

The results for selected dates are as follows:—

TABLE II.
Official Measurement of Cost of Living in Great Britain

	Food	Rent	Clothing	Fuel and Light	Sundries	All Combined
Relative importances	60	16	12	8	4	100
July 1914	100	100	100	100	100	100
July 1919	209	(1)	(1)	(1)	(1)	205 to 210
Dec. 1919	234	(1)	(1)	185	(1)	225
July 1920	258	117	430	230	220	252
Dec. 1920	282	142	305	240	230	269
July 1921	220	145	290	260	210	219
Dec. 1921	195	155	255	230	200	199
July 1922	180	153	240	190	195	184
Dec. 1922	178	150	225	187	180	180
July 1923	162	147	220	182	185	169
Dec. 1923	176	147	220	180	180	177
July 1924	162	147	225	185	180	170
Dec. 1924	180	147	227	185	180	181
July 1925	167	147	230	180	180	173
Dec. 1925	174	148	225	180	180	177

The statistics are for the beginning of each month.
[1] Not stated separately at these dates.

TABLE III. *Index-Number of Retail Prices of Food, Expressed in the Currencies of the Countries*

	1914	1919		1920		1921		1922		1923		1924		1925	
	July	July	Dec.	July	Dec.	July	Dec.	July	Dec.	July	Dec.	July	Dec.	July	Dec.
United Kingdom	100	209	234	258	282	220	195	180	178	162	176	162	180	167	174
France, Paris[1]	100	261	285	373	424	306	323	397	305	321	365	360	404	421	463
Italy, Milan	100	310	395	445	535	506	567	492	513[2]	496	500	508	579	602	660
Switzerland	100	..	..	..	..	210	189	157	155	164	167	168	170	167	163
Netherlands, Amsterdam	100	210	199	217	208	185	152[2]	140	142	136	144[2]	138	150	148	145
Denmark	100	212	..	253	..	236	191	184	180	188	194	200	215	210	177[2]
Sweden	100	310	..	297	..	252	..	179	168	160	164	159	172	169	164
Norway	100	289	299	319	334	295	268	233	215	228	226	248	274	260	221
United States	100	186	193	215	175	145	147	139	144	144	147	140	149	159	163
Canada	100	186	199	227	200	148	148	138	140	137	145	134	142	141	161
British India, Bombay	100	..	..	188	..	174	176	160	157	148	152	151	156	152	151
South Africa	100	139	170	197	188	139	125	116	118	116	118	117	121	120	116
Australia	100	147	158	194	184	161	143	148	146	164	156	149[3]	148	156	156
New Zealand	100	144	155	167	179	164	150	144	139[2]	142	147	148	150	151	154[2]

[1] Fuel and lighting included. [2] These numbers refer to the Jan. following. [3] For June 1924.

It is probable that the increase in cost was exaggerated, at least to the end of 1920, owing to evasion of the higher prices by the substitution of cheaper articles, without lowering the general standard obtained. From 1921, however, supplies have been adequate and the final change in the composition of the budget can hardly have reduced the number effectively by more than five points. The winter is higher than the summer number, partly owing to seasonal dearness, partly owing to the assumption that eggs, etc., are bought in the same quantities winter and summer. On the average the July number is about 2% below the average for the year. For fine measurements this variation should be taken into account, but in fact the index-number is not precise within, say, five points, even for the most general purposes, and still less is it a perfectly accurate measurement of the change in the cost of living in particular localities or occupations.

Other Countries.—It is only possible in the space available to state without analysis the official statistics of the movements of retail prices of food. In other countries, the numbers are subject to the same want of precision as in the United Kingdom and are compiled in a similar way. They represent the cost of purchasing from time to time a defined and unchanged ration estimated as typical of pre-War working-class consumption. These numbers are currently summarised in the *Ministry of Labour Gazette* (London), the *Labor Review* (Washington), and the *International Labour Review* (Geneva) and for each country in its official publication.

The prices are, of course, strongly affected by the relative value of the currencies in the countries. The result of expressing them on a gold basis may be illustrated as follows, July 1920 being selected as near the date of the maximum of prices:—

TABLE IV.

Retail Food Index Numbers

	July 1920			July 1925		
	Index in Currency	Currency as % of par	Index in gold	Index in Currency	Currency as % of par	Index in gold
Great Britain	258	76·6	198	167	100	167
Paris	373	39·4	146	421	24·8	104
Milan	445	27·6	123	602	19·0	114
Amsterdam	217	85·5	185	148	100	148
Denmark	253	58·9	149	210	79	166
Sweden	297	79	234	169	100	169
United States	215	100	215	159	100	159

Thus, if an American had gone to Paris in July 1925 with $104 he could have converted them into as many francs as would buy the food that cost $100 in Paris in July 1914. In New York he would have needed $159 to purchase food that cost $100 in New York in July 1914. The great variation in the index from country to country, even after conversion to a gold basis, is noticeable. The increase is generally the less the greater the depreciation of currency. (*See* INDEX-NUMBERS; PRICES; WAGES.) (A. L. Bo.)

COSTUME (*see* 7.224).—The changes in women's attire since 1910 complete a development which began about the beginning of the century. A motor-car of 1910 is already a pleasing and reasonably shaped object in comparison with the first automobiles that appeared. But, by the side of a well-designed body of 1925, the coach-work seems clumsy and untidy. The development of women's clothes has been upon parallel lines. In 1900 the figure was distorted into a series of opulent curves. The unhygienic wasp waist made, as it were, the intersection of two ellipses, and the aim of the *couturier* was to emphasise the fullness of the bust and the hips, and the narrowness of the intermediate tract, while a similar contrast was effected on the arms by sleeves that billowed at the shoulders and tightened to a cuff at the wrist.

By 1910 the *Directoire* influence was firmly established. The arum lily had replaced the hour-glass as the model for a fashionable figure; the waist-line was high, but not pronounced, the hips were attenuated, and very long stays held the body in a gently curved mould over which the dress was tightly drawn. The hair was still puffed out, skirts still reached the ground, and enormous hats crowned the elaborate edifice. The effect did not suggest the real *Directoire* period so much as the still fashionable ornaments of the *Art Nouveau* style. In 1911 the bottom of the skirt was gathered tightly round the ankles in a hobble effect, and gradually the curves grew even less pronounced. The collar which had raised its palisade of bone and whalebone high all round the neck,

FIG. 1.—Silhouette of 1909–10.

FIG. 2.—"Peg-top" Silhouette of 1914.

disappeared at the front and, as if in compensation, rose higher at the back in the Medici shape. In 1912 the first appearance in western Europe of the Russian ballet introduced an oriental influence, better designs in ornament, and a new interest in strong contrasts of colour.

FIG. 3.—Straight and slender evening mode of 1925.

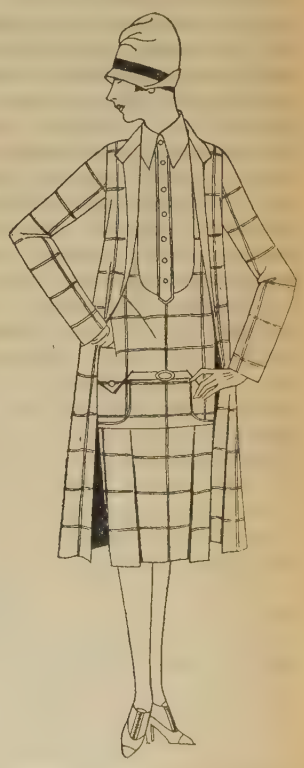

FIG. 4.—Typical day dress of 1925.

Although the so-called *Directoire* silhouette remained general, it was modified by the use of tiers and underskirts, and an unsuccessful attempt was made to make fashionable the Turkish trouser, and the panier. The trouser disappeared but the panier flourished, and in 1913 and 1914 the *Directoire* influence disappeared entirely to make way for a *Louis Quinze* silhouette. But skirts were becoming steadily shorter, and below the paniers they remained narrow. The very full skirt, suggestive of crinoline or farthingale, appeared about the same time in evening dresses, and under the name of *robe de style* has continued ever since. The tube-silhouette, which was afterwards to become general, first appeared, it is interesting to note, in the autumn following the outbreak of the War. Women were being called to do work previously done by men, and the tube reflected the fact.

Fashion and the World War.—But the time was not yet ripe. In 1915 the skirt still reached the boots and the high collar was still worn. But the petticoat began to disappear, the one-piece gown was worn, the waist was lower and shoes were less pointed. In 1916 the conical silhouette was general, being the woman's ideal to approximate to a walking sugar-loaf. The following year saw the success of the *tonneau* or barrel skirt, which, like a column, tapered at its head and base.

The effect of the War upon morals was being denounced; women had the audacity to show their ankles and evening dresses were cut at the back down to the waist. In 1918 the *tonneau* silhouette replaced the *tonneau* skirt and the waist entirely disappeared. In 1920 the short hobble skirt made walking difficult for the chic woman, but in the evening the *robe de style* gave her freedom to dance. A revival of late Victorian fashions produced a momentary taste for bustles, and the more lasting fashion of brushing the hair smoothly and tightly back from the forehead.

The next year saw sleeves disappear from evening dresses, and an increased vogue for the natural figure. Stays began to be discarded, and the straight line finally defeated the Edwardian curve. But it was not until 1923 that the tube-dress, the *cloche* hat, and the short hair arrived. With these, the modern woman presents a stream-line appearance like a modern motor-car. The exaggerated and meaningless ornaments have disappeared. Caprice is confined to a scarf round her neck, a flower on her shoulder, a handkerchief on her wrist, or a jewel on her hat.

The accessories of costume, on the other hand, have taken on a greater importance since 1910. A skirt which hardly reaches the knee makes stockings and shoes of the first importance. Against an unornamented costume the exact colour and shape of the handbag stand out with a boldness which makes its choice a serious affair. Attention is no longer dispersed over a hundred frills and laces, embroideries and buttons, but it is concentrated on a few crucial points. The dresses of 1925 were intended to clothe a woman who read modern books, listened to modern music, and looked at modern pictures. They reflected a new clearness in her sentiment, a new hardness in her intellect, and a new determination to live her life on equal terms with men. Her make-up was intended for adornment rather than disguise, and she attended to it in public. The *couturier* has to reach ever higher standards of excellence; he has ever to justify his modes upon aesthetic grounds. New materials are continually put forth by manufacturers, and the designs woven, printed, and embroidered upon them employ the most accomplished painters of the time. The costume of women is no longer a by-product; it is expressive of civilisation.

The Dress of Men.—During the same period men's clothes have changed comparatively little. Comfort and convenience have been more and more important. The starched collar has been increasingly replaced by the soft collar: brighter colours have been used, and, in the country especially, fancy has been given free play. If women in their neat and simple clothes, short hair, and straight silhouette have become boyish, men have allowed themselves to borrow from women, as witness the fashionable fancy wool pull-overs or jumpers. The differences between the sexes are no longer artificially exaggerated, and the clothes of both sexes reflect the free companionship which replaced the old flatteries, coquetries and artificial relationships. (D. T.)

COTTET, CHARLES (1863–1925), French painter (*see* 7.253), died Sept. 25 1925.

COTTON, SIR HENRY JOHN STEDMAN (1845–1915), Anglo-Indian administrator (*see* 7.254), died in London Oct. 23 1915.

COTTON, JAMES SUTHERLAND (1847–1918), British writer (*see* 7.255), died at Salisbury, England, July 10 1918.

COTTON (*see* 7.256).—Cotton, like all other important industrial commodities, has been profoundly affected by the economic disturbances of the World War and its aftermath.

I. PRODUCTION OF RAW COTTON

In 1911–2 the United States produced a cotton crop of 16,109,000 bales, with linters. This was the first time in history that the American crop had exceeded 13,750,000 bales; and the world cotton harvest was raised to 25,594,000 bales. The next year the American crop fell back to 14,091,000 bales and the world crop to 23,676,000 bales. A slight improvement in 1913–4 made the totals 14,614,000 bales and 24,422,000 bales respectively, but in 1914–5 the American crop established a record with a total output of 16,738,000 bales including linters, carrying the world total to 26,841,000 bales. The average world production for the five years 1910–1 to 1914–5 inclusive was 24,485,000 bales, of which the United States supplied an average of 60%. Egypt supplied an average amount approximating to 1,500,000 bales, falling to 1,298,000 bales in 1914–5, while in India, after a bad year in 1911–2, when production fell to 2,630,000 bales, the balance was restored by two good crops of over 4,000,000 bales in 1913–4 and 1914–5.

The years in which the effect of the World War was seriously felt, as will be seen from Table I., caused an almost universal restriction. The American crops remained under 13,000,000 bales and world crops nearer 20,000,000 than 21,000,000 bales. In 1919–20 the American crop fell to 11,921,000 bales, but this failure was compensated for by an unusually large Indian crop of 4,637,000 bales, which carried the world total for that year to just over 21,000,000 bales. The average world production for this cycle of five years was 20,593,000 bales, of which the United States contributed an average of 59%.

The following table illustrates the comparative steadiness of production during these first two cycles, as a contrast to the extreme fluctuations of the next five years, from 1920–1 to 1924–5:—

TABLE I. *World's Cotton Crops, 1910–1 to 1924–5*
(*In Thousands of Bales of 500 Lb., Approx.*)

Year	American[1]	Egyptian	Indian	Others	Total
1910–1	11,966	1,515	3,082	5,330	21,893
1911–2	16,109	1,485	2,630	5,370	25,594
1912–3	14,091	1,507	3,688	4,390	23,676
1913–4	14,614	1,537	4,052	4,219	24,422
1914–5	16,738	1,298	4,167	4,638	26,841
1915–6	12,013	961	2,990	4,465	20,429
1916–7	12,664	1,022	3,602	3,681	20,969
1917–8	12,345	1,262	3,200	3,274	20,081
1918–9	12,817	964	3,182	3,355	20,318
1919–20	11,921	1,114	4,637	3,475	21,147
1920–1	13,700	1,206	2,845	2,942	20,693
1921–2	8,360	972	3,570	2,858	15,760
1922–3	10,320	1,243	4,458	3,465	19,486
1923–4	10,811	1,306	4,129	3,824	20,070
1924–5	14,497	1,455	4,846	4,784	25,582

[1] Including linters.

It will be seen that after a good average year in 1920–1 production fell sharply in the following season to a low total of 15,760,000 bales. Thereafter there was a sharp recovery, at first much more marked in cotton fields outside the United States, but with that country coming to the fore again in 1924–5. The average world crop during this period was 20,318,000 bales, the United States proportion falling to 56%.

Two distinct causes were operating to cause these wide variations in the supply of cotton after the World War. One was the general industrial and financial disturbance which followed

the War. The post-War boom and slump, the fluctuations in the value of national currencies and in the relative prices of the staple commercial commodities, impoverishment of the population in large areas of the world, and the general feeling of political instability contributed to a restriction of the world's capacity to purchase and consume cotton goods. Thus in 1921, the carry-over of unconsumed American cotton at the end of the season amounted to no less than 9,944,000 bales. It was clear that the United States had produced in 1920–1 a comparatively large crop of cotton which, owing to the world-wide financial stringency, had only been partially consumed.

Prices.—The average price received by the American cultivator for the crop of 1920 was 15·89 cents per lb. of lint as compared with an average of 35·36 cents per lb. for the crop in 1919. The winter and summer of the 1920–1 season saw cotton quoted well below 15 cents in New York, and there were occasions when futures fell below 11 cents. In the circumstances, a restriction of acreage under cultivation in the United States was a natural economic development, and the area planted for the 1921 crop was no more than 31,678,000 acres. From about 1915 until the end of the 1920–1 season, the chief influence at work was a restriction of consumption, which, with varying force at different seasons, caused a restriction in the quantity of raw material produced in the United States.

The Boll Weevil.—From 1921 onwards, however, a second factor came into play, namely, the boll weevil, and up to 1925 the position was reversed, for the restriction in the size of the American crop imposed upon the world a severe limitation of the volume of consumption. In 1921–2, on a harvested acreage of 30,509,000, the yield per acre was only 124·5 lb. as compared with an average of 179 lb. in the previous 10 years. The total crop was only 7,978,000 bales (exclusive of linters) which was the smallest yield in the United States since 1895. The weather had been favourable to the spread of the boll weevil and it was estimated that pests had destroyed 109·1 lb. of cotton per acre. The next few years aroused a fear that as long as scientists could find no adequate cheap method of exterminating the boll weevil, the United States would continue to grow deficient crops, and that the deficiency would not be filled until large cotton fields had been developed in other parts of the world.

American Crops.—The history of the American crop during these post-War years can be illustrated by the following table:—

TABLE II. *The American Cotton Crop (Exclusive of Linters)*

	(In thousands of acres)			(In thousands of bales)		
	Acreage Planted	Acreage Harvested	Yield per Acre (lb.)	Total Yield	World Consumption	Balance of Production over Consumption
1921–2	31,678	30,509	124·5	7,978	12,488	−4,510
1922–3	34,016	33,036	141·3	9,729	12,388	−2,659
1923–4	38,701	37,123	130·6	10,171	10,926	−755
1924–5	42,641	41,360	157·4	13,639	13,256	+383
1925–6[1]	48,160	45,945	162·3	15,603	...	...

[1] December estimates.

Annual Averages

	1906–7 to 1910–1	1911–2 to 1915–6	1916–7 to 1920–1	1921–2 to 1924–5
Total Production (bales)	11,753,619	13,999,687	11,843,028	10,379,294
East of Mississippi river per cent of total	55·6	54·7	50·5	42·8
West of Mississippi river per cent of total	44·4	45·3	49·5	57·2
Exports from U.S.A. (bales)	7,550,292	8,944,586	5,733,688	5,686,964

(Note: Seasons ending Aug. 31 up to 1915. Thereafter July 31.)

The lowness of the yield per acre in the American cotton belt during the years 1921, 1922 and 1923 was to a considerable extent attributable to the ravages of the boll weevil (*q.v.*). When, in 1923–4, on a largely increased acreage the American crop only amounted to less than 11,000,000 bales, the future outlook was serious. As shown in Table II., American cotton was being consumed, in spite of high prices, at a rate which was considerably larger than production, and the reserves were disappearing at a faster rate than other cotton-growing areas could possibly be developed. The history of 1924 and 1925, however, shows that, although the boll weevil may remain endemic in the United States, the decisive factor is still the weather, while a contributory factor of some importance is the great and speedy expansion of acreage which has been proved possible. Rainy weather provides the most favourable conditions for the propagation of the weevil, but the combination of extremely low temperatures in winter and hot dry weather in summer, or even the latter without the former, has kept the weevil within bounds and has enabled the United States to grow large crops once more. The situation has not been entirely free from anxiety, for excessive droughts are destructive to the cotton plant as well as to the weevil, but both in 1924 and in 1925 the advent of rain has been in time to save the crop.

Effect of High Prices.—The victory over the boll weevil made the years 1924–5 a landmark in cotton history, for they removed the fear that the United States would be a dwindling factor in the production of raw material. The high prices which had been ruling since the crop failure of 1921 were an incentive to experiments in cotton-growing. There were obvious advantages to be gained by the dispersion of cultivation, so that unfavourable weather conditions in one part of the globe need not necessarily mean a calamity to 50% of the world's cotton harvest. Costs of cultivation also were becoming a serious matter in the United States and for the rest of the world. If cotton prices fell below producing costs in any one year, there was a general agitation to restrict the acreage placed under cultivation in the next year. American costs of cotton cultivation, owing to the generally high level of wages and the falling-off in the yield per acre, were higher than in most other cotton areas of the world. Consequently, throughout the tropical and sub-tropical belt, both state and private enterprise have been actively extending the cultivation of cotton. The actual results by the 1925–6 season were not commensurate with the effort made, but it was possible to foresee a time when the basis of cotton prices would be the average world cost of cultivation and not the average cost in the United States alone.

The incentive to grow cotton in order to reap the benefit of high prices has also been operative in the United States, where, owing to a high development of agricultural knowledge, of labour supply, of means of transport and of marketing facilities, progress has been much faster than in all other areas combined. Thus, while in 1921 the area planted under cotton in the United States was 31,678,000 ac., the 1925 area was estimated at no less than 48,160,000 ac., while in the same period the expansion of area actually harvested increased from 30,509,000 to 45,945,000 acres. Whether the United States will maintain this increase depends on the yield per acre, for since the world crops of 1925–6 are considerably larger than the potential consumption of the 1925–6 season, the prices ruling during the spring of 1926 may be too severe a test for the American grower.

World Production.—This increase in American acreage and harvest is an important matter when compared with the slowness of progress in other fields. Table III. shows the position in these countries from 1910 to 1924.

An increase from 10,306,000 bales in 1910 to 10,747,000 bales in 1924 does not appear very much. Russia, however, is a drawback to any compilation of progress made, and if the Russian figures are excluded there is an increase of more than 1,000,000 bales. It was clear in 1925 that these figures would increase in the near future, but the chief consideration is that the development of irrigation and transport services, etc., during the past few years is only beginning to show results. Egypt is the one

country where cotton cultivation may be regarded as approximately stationary, the production of a specialised type of cotton and the maintenance of a price premium over American qualities being considered of greater importance than an expansion of the total yield.

In India, the possibilities of a considerable enlargement in the production of a higher quality of cotton are considered promising. The problem of agricultural labour supply at a cheap rate does not arise, although the yield per acre is rather low. The two other main areas of prospective development are Africa and South America. The Sudan, Nigeria and Uganda are the chief producing countries in Africa outside of Egypt, and in all three large projects for irrigation and railway or road transport are under way. In the Union of South Africa and in Southern Rhodesia considerable interest is also being taken, and, in the absence of other crops showing an equivalent or larger profit, early progress is to be expected. In South America, the chief centres of cultivation are Brazil, Argentina and Peru. The last named is an established cotton producing country of some importance. The other two, however, are together probably the foremost potential fields of the world, providing the opportunities are properly exploited.

TABLE III. *World Production of Cotton Outside the United States (in Thousands of Bales of 478 Lb. Net) Estimates of the U.S. Dept. of Agriculture*

	India	Russia	Egypt	China	Brazil	Mexico	Peru	All other countries	Totals
1910	3,254	1,006	1,555	3,467	297	200	88	439	10,306
1911	2,730	969	1,530	3,437	300	160	96	441	9,663
1912	3,702	946	1,554	3,931	348	240	112	507	11,340
1913	4,239	1,026	1,588	4,000	397	205	133	515	12,103
1914	4,359	1,270	1,337	4,500	387	108	129	462	12,552
1915	3,128	1,512	989	3,000	282	95	113	378	9,497
1916	3,759	1,199	1,048	1,534	281	103	127	344	8,395
1917	3,393	634	1,304	2,092	345	135	125	345	8,373
1918	3,328	161	999	3,053	339	203	142	347	8,572
1919	4,853	81	1,155	2,599	506	199	155	415	9,963
1920	3,013	58	1,251	1,883	370	188	164	508	7,435
1921	3,748	43	902	1,517	505	147	157	357	7,376
1922	4,348	55	1,170	2,048	553	178	137	454	8,943
1923	4,247	321	1,213	1,992	576	136	212	663	9,360
1924	5,069	397	1,276	2,176	605	213	181	830	10,747

The Future.—The future of cotton-growing in these new fields, including the new cotton areas of the United States, must depend very largely on the course of prices, *i.e.*, on the maintenance of prices at a level which brings in a margin of profit after all costs of cultivation have been met. It is generally thought, however, that costs are much higher in the United States than in those areas where native tropical labour is available, but unfortunately no reliable comparative data exist. The United States Dept. of Agriculture is practically alone in making a detailed research into costs. An examination was made for 1923 of the results obtained by 2,519 widely dispersed cotton farms. Of these, 407 were estimated to present a reasonable return with yields averaging 124 lb. per acre. The average net cost of producing cotton on these farms was 22 cents per lb. of lint, and the average price received in that year was 30 cents. In subsequent years the improvement in the yield per acre would have reduced the costs, but it is not yet known whether the reduction in prices does not exceed the advantage gained. A price of 22 cents, however, is popularly regarded as adequate for most other cotton fields, although not holding out the prospect of large profits which has so far been the main stimulus.

There is therefore a certain correlation between the quantity of cotton produced, plus the reserve carried over from one season to another, and the prices ruling during the season. The history of prices during the period under review is shown in the table (IV.) of average seasonal quotations compiled by Prof. J. A. Todd.

Crop Forecasting.—A factor, however, which disturbs the correlation between price and cultivation is the system of crop forecasting which has been set up by the United States Dept. of Agriculture. Throughout the growing and picking season, *i.e.*, from June to Jan., the course of prices is governed by the official crop reports issued from Washington, and, starting as they do some time before the cotton plant has sprouted, there is often a wide variation between the early official indications and the final yield. The crop reporting system, as established by 1925, entailed a preliminary estimate of acreage planted and in cultivation on June 25, together with an estimate of the condition of the crop as expressed by a percentage of "normal" conditions for that date. From mid-July until the beginning of Nov., these condition reports are issued twice a month, accompanied by an indication of the prospective total yield as calculated at the date of the report, and accompanied also from the beginning of Aug. by the fortnightly ginning returns issued by the bureau of the census. The beginning of Dec. also brings a revision of the acreage estimate, together with an estimate of acreage harvested, which is again revised in the following June. The final ginning return is issued in March. The collection of crop information is elaborate, and probably as complete as can be expected under the circumstances. It works well in seasons when the conditions keep fairly close to the average condition of previous seasons but it breaks down when there is a wide deviation from the average. The frequency with which reports are issued, and the complicated method of compilation, has tended to exasperate the cotton market, and some change is looked for in 1926.

TABLE IV. *Liverpool Prices (Pence per Lb.)*

	American	Indian	Egyptian
	Fully Middling	No. 1. Good Oomra	F.G.F. Brown
1910–1	7·84	6·78	10·75
1911–2	6·09	5·44	9·56
1912–3	6·76	5·91	9·79
1913–4	7·27	5·62	9·45
1914–5	5·22	4·19	7·34
1915–6	7·51	5·79	10·42
1916–7	12·33	9·92	21·56
			F.G.F. Sakellaridis
1917–8	21·68	16·10	30·97
1918–9	19·73	17·15	27·85
1919–20	25·31	18·05	60·34
1920–1	11·89	8·21	30·24
1921–2	11·37	8·72	19·75
1922–3	14·92	10·25	17·29
1923–4	17·66	12·37	21·55
	Middling		
1924–5	13·76	11·04	29·82

II. CONSUMPTION

Turning from the question of supply to that of consumption, the first development to be considered is the growth of cotton manufacturing capacity. On this point accurate figures are available only for spinning spindles. Weaving capacity, as expressed in loom figures, is available for several countries, but in most of them only as an unreliable guess. The changes which have occurred since 1908 in the world distribution of cotton spindles are shown in Table V. The gaps do not indicate an absence of spindles but an absence of data.

The world's total grew from 128,923,000 spindles in 1908 to 161,363,000 in 1925. In Great Britain there was no considerable cotton-mill building between 1908 and 1925. The French figures were swollen in post-War years by the separation of Alsace-Lorraine from Germany, while the post-War Russian figures are deceptive in that a high proportion of the unemployed spindleage must be in a bad state of disrepair. The European and world totals for 1920 are not strictly comparable, as no allowance is made for the Russian spindles which must have been in operation in that year. Allowing for this discrepancy and for the destruction of spindleage in Russia, an examination of the above figures shows that the only important changes in Europe between 1913 and 1925 are territorial changes affecting France, Germany, Austria, Czechoslovakia, Poland and Russia. These changes are more important than mere alterations of nationality, for important industries have been separated, by means of tariffs, from the markets which they were built up to serve.

TABLE V. *Distribution of Cotton Spindleage*[1] *(000's Omitted)*

Countries	Aug. 31 1908	Aug. 31 1913	July 31 1920	July 31 1925
Europe				
Great Britain	52,818	55,653	58,692	57,116
France	6,731	7,400	9,400	9,428
Germany	9,883	11,186	9,400	9,500
Russia	7,855	9,213	. . .	7,246[2]
Italy	4,181	4,600	4,514	4,771
Czechoslovakia	. . .	. . .	3,584	3,471
Spain	1,850	2,000	1,800	1,813
Belgium	1,162	1,492	1,572	1,788
Switzerland	1,493	1,398	1,536	1,517
Poland	. . .	. . .	1,400	1,172
Austria	4,026	4,909	. . .	1,038
Holland	396	479	597	817
Sweden	390	534	670	555
Portugal	450	480	482	503
Finland	. . .	. . .	240	253
Denmark	78	90	117	78
Norway	75	75	73	58
Total Europe	91,388	99,509	94,077	101,124
Asia				
India	5,500	6,084	6,690	8,500
Japan	1,637	2,300	3,690	5,292
China	. . .	. . .	1,600	3,350
Total Asia	7,137	8,384	11,980	17,142
America				
U.S.A.	27,846	31,505	35,872	37,937
Canada	795	855	1,200	1,319
Mexico	. . .	. . .	720	814
Brazil	. . .	. . .	1,600	1,950
Total America	28,641	32,360	39,392	42,020
Sundries	1,757	3,200	250	1,077
Grand Total	128,923	143,453	145,699	161,363

[1] Doubling spindles excluded. [2] Only 4,203,056 actually in use.

Manufacturing Capacity.—For actual growth of manufacturing capacity, it is necessary to look further afield to regions which were encouraged to expand by the disturbance of shipping and Europe's concentration on war supplies between 1914 and 1918. Spindles in India increased from 6,084,000 in 1913 to 8,500,000 in 1925. Japan showed an increase from 2,300,000 spindles in 1913 to 5,292,000 in 1925, while a similar rate of progress was maintained by China. Amongst American countries, Canada expanded considerably, but the United States accounted for a larger increase than any other individual country in the world. The growth of the United States spindleage from 31,505,000 spindles in 1913 to 37,937,000 spindles in 1925, coinciding with the decline in the United States cotton crop, aroused the fear that the United States would soon be needing most of the cotton produced there, leaving only a negligible surplus for export. The development of the United States was also remarkable in that the growth of manufacturing capacity was located chiefly in the southern or cotton-growing states which, owing to natural advantages in freight, labour and power costs, raised a serious problem of competition for the older industry located in New England.

Manufacturing plant, however, is an illusory advantage for countries which are unable to use it. This failure to find full employment has been an important problem since the World War, but unfortunately no comparative statistics are available of the production of cotton cloth in the various countries of the world. The nearest approach to accuracy is to be found in the tables of cotton consumption on the following page. These are valuable for comparing the position of individual countries at different dates, but in comparing one country with another a generous allowance must be made for the fact that the finer the quality of production the smaller the quantity of raw material needed. Thus Great Britain, working full time in 1912–3, consumed 4,274,000 bales of cotton on 55,500,000 spindles, while the United States, with only 31,500,000 spindles, consumed 5,786,000 bales.

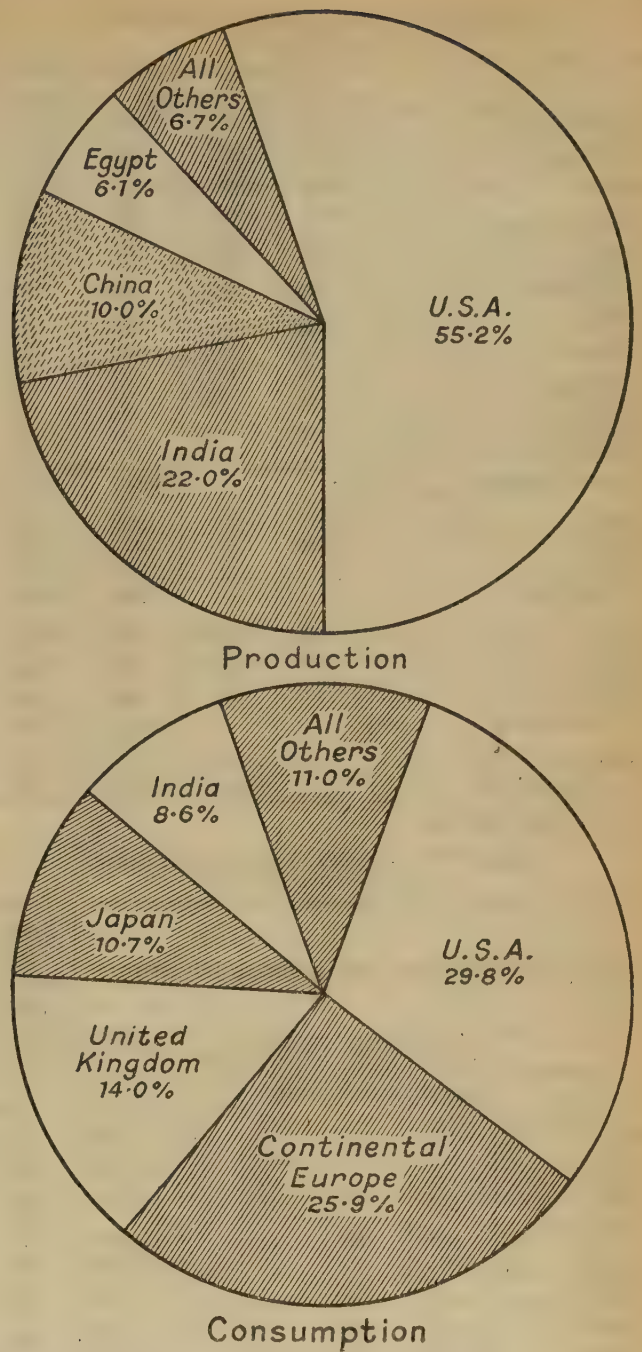

FIG. 1.—Total world production and consumption of Cotton. (Annual average 1922–3 to 1924–5.)

The annual averages compiled in Table VII. show that after ignoring the countries which have lost or gained territory the only countries which are on a lower plane of manufacturing activity are Great Britain, Italy and Scandinavia, but this reduction is sufficient to cause a slight diminution in the world total of average consumption. The most conspicuous instances of an increase in activity are afforded by the United States and Japan, while China would presumably figure in this list if pre-War statistics had been available. The small increase in India's average consumption can be explained by the irregularity of employment and the periodic over-production of cotton goods.

The decline in British consumption is largely due to the growth of manufacturing capacity in other countries, especially in countries like India and China, which, however, still provide the two largest individual markets for British cotton goods. The high costs of labour in Britain, the restriction of working hours, the financial disturbances of the post-War era and the high cost of raw material have also contributed to the restriction of an

TABLE VI. *World's Cotton Consumption*
(In Thousands of Bales)

	Season 1907–8	Season 1912–3	Season 1920–1	Season 1924–5
Great Britain	3,842	4,274	2,024	3,235
France	950	1,010	725	1,122
Germany	2,106	1,700	897	1,211
Russia	1,964	2,508	773	1,084
Italy	1,027	790	795	1,002
Czechoslovakia	..	..	260	484
Spain	343	358	297	352
Belgium	212	257	211	305
Switzerland	95	98	82	108
Poland	..	..	134	209
Austria	740	837	94	136
Holland	77	85	106	136
Sweden	88	114	71	83
Portugal	81	79	91	75
Finland	..	..	29	28
Denmark	21	25	11	18
Norway	11	11	7	10
Total Europe	..	..	6,607	9,598
India	2,195	2,177	2,243	2,440
Japan	1,024	1,589	2,122	2,459
China	(1)	(1)	1,072	1,610
Total Asia	..	..	5,437	6,509
U.S.A.	4,575	5,786	4,859	6,127
Canada	115	113	149	161
Mexico	(1)	(1)	120	193
Brazil	(1)	(1)	445	533
Total America	..	..	5,573	7,014
Sundries	708	1,121	39	173
Grand Total	20,174	22,932	17,656	23,294

[1] Included in sundries.

TABLE VII. *World's Consumption of Cotton*
(In Thousands of Bales)

Countries	Average of Five Seasons, Aug. 1 1920 to July 31 1925					Average of Five Seasons, Sept. 1 1908 to Aug. 31 1913
	American cotton	East Indian cotton	Egyptian cotton	Sundries	Total of all kinds	
Great Britain	1,982	117	373	250	2,722	3,858
France	736	143	84	62	1,025	985
Germany	778	211	41	23	1,052	1,737
Russia	134	..	16	568	718	2,229
Italy	584	250	41	11	886	910
Czechoslovakia	261	80	12	5	358	..
Spain	246	70	23	6	346	334
Belgium	130	126	4	6	265	227
Switzerland	55	8	30	1	95	93
Poland	145	32	6	10	194	..
Austria	70	42	3	1	117	822
Holland	79	23	..	1	103	83
Sweden	76	3	1	..	80	103
Portugal	48	..	2	33	82	69
Finland	30	..	..	..	30	..
Denmark	18	1	..	..	19	23
Norway	7	..	..	..	7	11
Total Europe	5,379	1,106	636	977	8,099	..
India	25	2,195	7	38	2,263	2,183
Japan	682	1,530	30	132	2,373	1,392
China	95	304	1	1,052	1,451	..
Total Asia	802	4,029	38	1,222	6,087	..
U.S.A.	5,575	20	144	84	5,823	5,128
Canada	158	..	1	..	159	122
Mexico	25	..	1	121	146	..
Brazil	..	..	..	501	501	..
Total America	5,758	20	146	706	6,629	..
Sundries	19	9	11	76	115	1,092
Grand Total	11,958	5,164	831	2,981	20,930	21,401

industry which is dependent largely on its export trade. In the meantime, the U.S. industry, with a prosperous and protected home market, has expanded, being dependent on the export trade only for the disposal of surplus production. Further expansion of manufacturing capacity, however, must necessitate greater attention to exports. In the interchange of cotton goods between nations, however, Great Britain maintains a long lead, although her position in several markets is seriously assailed by Japan and Italy.

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COTTON SEED: *see* OILS, FATS AND SOAPS.

COUÉ, EMILE (1857–1926), French psychotherapeutist, was born at Troyes, France, on Feb. 26 1857. From 1882 to 1910 he was a chemist at Troyes, and studied hypnotism and suggestion from 1901 onwards with Bernheim and Liébault. He then developed his own psychotherapeutical method of healing. In 1910 he established a free clinic at Nancy and there put his theories into practice. Coué's system of therapeutics deals principally with the power of imagination as opposed to that of the will and he claimed that by means of auto-suggestion ideas which tend to cause illness and disease may be eliminated from the will. He further claimed to have effected organic changes. Coué invariably stated with emphasis that he was not primarily a healer but one who taught others to heal themselves. His teaching and methods became widely known and he delivered lectures in England and the United States. His famous formula, "Every day, and in every way, I am becoming better and better," is now proverbial (*see* PSYCHOTHERAPY). He died at Nancy, July 2 1926. See C. Baudouin, *Suggestion and Auto-suggestion* (1920).

COUPERUS, LOUIS (1863–1923), Dutch writer, was born at The Hague June 10 1863 (*see* 8.728b). His early boyhood was spent in the Dutch East Indies, where his father was a prominent government official. His first novel *Eline Vere*, written under the influence of Tolstoy, appeared in 1889, and was followed by *Noodlot* (The Footsteps of Fate) in 1894 and *Extaze*, the first of his novels to be translated into English (1892). He next produced certain imaginative and idealistic works, such as *Majesteit* (1895) and several volumes of prose poems. The work by which he is best known to the English-speaking world is the series of "Books of the Small Souls," four novels entitled *Die Kleine Zielen* (*The Small Souls*), *Het Late Leven* (*The Later Life*), *Zielenschemering* (*The Twilight of the Soul*), *Het Helge Weten* (Eng. version *Dr. Adriaan*) which together with *Van Oude Menschen, de dingen de voorbijgaan* (*Old People and the Things that Pass*, Eng. version 1919) raised him to the first rank of European novelists. Couperus travelled much in Greece and Italy and embodied his classical researches in historical romances such as *De Berg van Licht* (*The Mountain of Light*), *De Komedianten* (*The Comedian*) and mythological romances such as *Dionyzos* (1905) and *Herakles* (1913), as well as volumes of essays, sketches and short stories. The greater part of his work has been rendered into English by A. Teixeira de Mattos. His historical novel *Iskander* (concerning Alexander the Great) appeared in 1920. He died at De Steeg, near Arnhem, Holland, July 16 1923.

COURTHOPE, WILLIAM JOHN (1842–1917), British writer (*see* 7.327), died at Wadhurst, Sussex, April 10 1917. A volume of verse, *The Country Town and other Poems*, with a prefatory

Memoir of him by A. O. Prickard, appeared in 1926. See also J. W. Mackail, *W. J. Courthope* (1919).

COURTNEY, LEONARD HENRY COURTNEY, 1ST BARON (1832–1918), British politician (*see* 7.328), died in London May 11 1918, when his title became extinct. His brother, William Prideaux Courtney, died in London Nov. 14 1913.

COURTNEY, WILLIAM LEONARD (1850–), British journalist, was born at Poona Jan. 5 1850 and was educated at Bath and University College, Oxford. He was elected fellow of Merton College in 1872 and of New College in 1876. In 1890 he left Oxford and joined the editorial staff of *The Daily Telegraph*, London, where he spent many years as literary editor and dramatic critic. He edited *Murray's Magazine* for a short time in 1890–1 and became editor of *The Fortnightly Review* in 1894. His numerous published works include *Studies on Philosophy* (1882); *Life of John Stuart Mill* (1889); *Kit Marlowe* (a drama in blank verse produced at the St. James's Theatre, London, in 1893); *The Feminine Note in Fiction* (1904); *The Literary Man's Bible* (1907); *The Soul of a Suffragette* (1913); *The Literary Man's New Testament* (1915); *Old Saws and Modern Instances* (1918); *The Passing Hour* (1925). He retired from editorial work on *The Daily Telegraph* in 1924.

COVENANT.—The Covenant of the League of Nations formed Part I. of the draft Treaties of Peace presented to the delegates of the German Empire at Versailles on May 7, and to those of Austria at Saint-Germain on June 2 1919. It was subsequently incorporated in all the Treaties of Peace with other belligerents. It was provided that these treaties should come into force as soon as they had been ratified by Germany and Austria respectively, and by three of the Principal Allied and Associated Powers. The Principal Allied and Associated Powers comprised the British Empire, France, Italy, Japan and the United States of America. The following articles embody (*in italics*) an amendment of Article 6, in force from Aug. 13 1924, and amendments of Articles 12, 13 and 15, in force from Sept. 26 1924.

THE High Contracting Parties,

In order to promote international co-operation and to achieve international peace and security—

by the acceptance of obligations not to resort to war,

by the prescription of open, just and honourable relations between nations,

by the firm establishment of the understandings of international law as the actual rule of conduct among governments,

and by the maintenance of justice and a scrupulous respect for all Treaty obligations in the dealings of organised peoples with one another,

agree to this Covenant of the League of Nations.

Article 1.—The original Members of the League of Nations shall be those of the signatories which are named in the Annex to this Covenant, and also such of those other States named in the Annex as shall accede without reservation to this Covenant. Such accession shall be effected by a Declaration deposited with the Secretariat within two months of the coming into force of the Covenant. Notice thereof shall be sent to all other Members of the League.

Any fully self-governing State, Dominion or Colony not named in the Annex may become a Member of the League if its admission is agreed to by two-thirds of the Assembly, provided that it shall give effective guarantees of its sincere intention to observe its international obligations, and shall accept such regulations as may be prescribed by the League in regard to its military, naval and air forces and armaments.

Any Member of the League may, after two years' notice of its intention so to do, withdraw from the League, provided that all its international obligations and all its obligations under this Covenant shall have been fulfilled at the time of its withdrawal.

Article 2.—The action of the League under this Covenant shall be effected through the instrumentality of an Assembly and of a Council, with a permanent Secretariat.

Article 3.—The Assembly shall consist of representatives of the Members of the League.

The Assembly shall meet at stated intervals and from time to time, as occasion may require, at the seat of the League, or at such other place as may be decided upon.

The Assembly may deal at its meetings with any matter within the sphere of action of the League or affecting the peace of the world.

At meetings of the Assembly each Member of the League shall have one vote and may have not more than three representatives.

Article 4.—The Council shall consist of representatives of the Principal Allied and Associated Powers, together with representatives of four other Members of the League. These four Members of the League shall be selected by the Assembly from time to time in its discretion. Until the appointment of the representatives of the four Members of the League first selected by the Assembly, representatives of Belgium, Brazil, Spain and Greece shall be members of the Council.[1]

With the approval of the majority of the Assembly, the Council may name additional Members of the League whose representatives shall always be members of the Council; the Council, with like approval, may increase the number of Members of the League to be selected by the Assembly for representation on the Council.[2]

The Council shall meet from time to time as occasion may require, and at least once a year, at the seat of the League, or at such other place as may be decided upon.

The Council may deal at its meetings with any matter within the sphere of action of the League or affecting the peace of the world.

Any Member of the League not represented on the Council shall be invited to send a representative to sit as a member at any meeting of the Council during the consideration of matters specially affecting the interests of that Member of the League.

At meetings of the Council, each Member of the League represented on the Council shall have one vote, and may have not more than one representative.

Article 5.—Except where otherwise expressly provided in this Covenant or by the terms of the present Treaty, decisions at any meeting of the Assembly or of the Council shall require the agreement of all the Members of the League represented at the meeting.

All matters of procedure at meetings of the Assembly or of the Council, including the appointment of Committees to investigate particular matters, shall be regulated by the Assembly or by the Council and may be decided by a majority of the Members of the League represented at the meeting.

The first meeting of the Assembly and the first meeting of the Council shall be summoned by the President of the United States of America.

Article 6.—The permanent Secretariat shall be established at the seat of the League. The Secretariat shall comprise a Secretary-General and such secretaries and staff as may be required.

The first Secretary-General shall be the person named in the Annex; thereafter the Secretary-General shall be appointed by the Council with the approval of the majority of the Assembly.

The secretaries and staff of the Secretariat shall be appointed by the Secretary-General with the approval of the Council.

The Secretary-General shall act in that capacity at all meetings of the Assembly and of the Council.

The expenses of the League shall be borne by the Members of the League in the proportion decided by the Assembly.

Article 7.—The seat of the League is established at Geneva.

The Council may at any time decide that the seat of the League shall be established elsewhere.

All positions under or in connection with the League, including the Secretariat, shall be open equally to men and women.

Representatives of the Members of the League and officials of the League, when engaged on the business of the League, shall enjoy diplomatic privileges and immunities.

The buildings and other property occupied by the League or its officials or by representatives attending its meetings shall be inviolable.

Article 8.—The Members of the League recognise that the maintenance of peace requires the reduction of national armaments to the lowest point consistent with national safety, and the enforcement by common action of international obligations.

The Council, taking account of the geographical situation and circumstances of each State, shall formulate plans for such reduction for the consideration and action of the several governments.

Such plans shall be subject to reconsideration and revision at least every ten years.

After these plans shall have been adopted by the several governments, the limits of armaments therein fixed shall not be exceeded without the concurrence of the Council.

The Members of the League agree that the manufacture by private enterprise of munitions and implements of war is open to grave objections. The Council shall advise how the evil effects attendant upon such manufacture can be prevented, due regard being had to the necessities of those Members of the League which are not able to manufacture the munitions and implements of war necessary for their safety.

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[1] The Second Assembly, Oct. 5 1921, proposed an amendment by which the following clause should be inserted between the second and third paragraphs:

"The Assembly shall fix by a two-thirds majority the rules dealing with the election of the non-permanent members of the Council, and particularly such regulations as relate to their term of office and the conditions of re-eligibility." This amendment had not come into force in April 1926.

[2] The number of members of the Council selected by the Assembly was increased to six instead of four by a resolution of Sept. 25 1922.

The Members of the League undertake to interchange full and frank information as to the scale of their armaments, their military, naval and air programmes and the condition of such of their industries as are adaptable to warlike purposes.

Article 9.—A permanent Commission shall be constituted to advise the Council on the execution of the provisions of Articles 1 and 8 and on military, naval and air questions generally.

Article 10.—The Members of the League undertake to respect and preserve, as against external aggression, the territorial integrity and existing political independence of all Members of the League. In case of any such aggression or in case of any threat or danger of such aggression, the Council shall advise upon the means by which this obligation shall be fulfilled.

Article 11.—Any war or threat of war, whether immediately affecting any of the Members of the League or not, is hereby declared a matter of concern to the whole League, and the League shall take any action that may be deemed wise and effectual to safeguard the peace of nations. In case any such emergency should arise, the Secretary-General shall, on the request of any Member of the League, forthwith summon a meeting of the Council.

It is also declared to be the friendly right of each Member of the League to bring to the attention of the Assembly or of the Council any circumstance whatever affecting international relations which threatens to disturb international peace or the good understanding between nations upon which peace depends.

Article 12.—The Members of the League agree that, if there should arise between them any dispute likely to lead to a rupture they will submit the matter either to arbitration *or judicial settlement* or to enquiry by the Council, and they agree in no case to resort to war until three months after the award by the arbitrators *or the judicial decision*, or the report by the Council. In any case, under this Article the award of the arbitrators *or the judical decision* shall be made within a reasonable time, and the report of the Council shall be made within six months after the submission of the dispute.

Article 13.—The Members of the League agree that, whenever any dispute shall arise between them which they recognise to be suitable for submission to arbitration *or judicial settlement*, and which cannot be satisfactorily settled by diplomacy, they will submit the whole subject-matter to arbitration *or judicial settlement.*

Disputes as to the interpretation of a Treaty, as to any question of international law, as to the existence of any fact which, if established, would constitute a breach of any international obligation, or as to the extent and nature of the reparation to be made for any such breach, are declared to be among those which are generally suitable for submission to arbitration *or judicial settlement.*

For the consideration of any such dispute, the Court to which the case is referred shall be the Permanent Court of International Justice, established in accordance with Article 14, or any tribunal agreed on by the parties to the dispute or stipulated in any Convention existing between them.

The Members of the League agree that they will carry out in full good faith any award *or decision* that may be rendered, and that they will not resort to war against a Member of the League which complies therewith. In the event of any failure to carry out such an award *or decision*, the Council shall propose what steps should be taken to give effect thereto.

Article 14.—The Council shall formulate and submit to the Members of the League for adoption plans for the establishment of a Permanent Court of International Justice. The Court shall be competent to hear and determine any dispute of an international character which the parties thereto submit to it. The Court may also give an advisory opinion upon any dispute or question referred to it by the Council or by the Assembly.

Article 15.—If there should arise between Members of the League any dispute likely to lead to a rupture, which is not submitted to arbitration *or judicial settlement* in accordance with Article 13, the Members of the League agree that they will submit the matter to the Council. Any party to the dispute may effect such submission by giving notice of the existence of the dispute to the Secretary-General, who will make all necessary arrangements for a full investigation and consideration thereof.

For this purpose the parties to the dispute will communicate to the Secretary-General, as promptly as possible, statements of their case with all the relevant facts and papers, and the Council may forthwith direct the publication thereof.

The Council shall endeavour to effect a settlement of the dispute, and, if such efforts are successful, a statement shall be made public giving such facts and explanations regarding the dispute and the terms of settlement thereof as the Council may deem appropriate.

If the dispute is not thus settled, the Council, either unanimously or by a majority vote, shall make and publish a report containing a statement of the facts of the dispute and the recommendations which are deemed just and proper in regard thereto.

Any Member of the League represented on the Council may make public a statement of the facts of the dispute and of its conclusions regarding the same.

If a report by the Council is unanimously agreed to by the members thereof, other than the representatives of one or more of the parties to the dispute, the Members of the League agree that they will not go to war with any party to the dispute which complies with the recommendations of the report.

If the Council fails to reach a report which is unanimously agreed to by the members thereof, other than the representatives of one or more of the parties to the dispute, the Members of the League reserve to themselves the right to take such action as they shall consider necessary for the maintenance of right and justice.

If the dispute between the parties is claimed by one of them, and is found by the Council to arise out of a matter which by international law is solely within the domestic jurisdiction of that party, the Council shall so report, and shall make no recommendation as to its settlement.

The Council may in any case under this Article refer the dispute to the Assembly. The dispute shall be so referred at the request of either party to the dispute provided that such request be made within fourteen days after the submission of the dispute to the Council.

In any case referred to the Assembly, all the provisions of this Article and of Article 12, relating to the action and powers of the Council, shall apply to the action and powers of the Assembly, provided that a report made by the Assembly, if concurred in by the representatives of those Members of the League represented on the Council, and of a majority of the other Members of the League, exclusive in each case of the representatives of the parties to the dispute, shall have the same force as a report by the Council concurred in by all the members thereof other than the representatives of one or more of the parties to the dispute.

Article 16.—Should any Member of the League resort to war in disregard of its Covenants under Articles 12, 13 or 15, it shall *ipso facto* be deemed to have committed an act of war against all other Members of the League, which hereby undertake immediately to subject it to the severance of all trade or financial relations, the prohibition of all intercourse between their nationals and the nationals of the Covenant-breaking State, and the prevention of all financial, commercial or personal intercourse between the nationals of the Covenant-breaking State and the nationals of any other State, whether a Member of the League or not.

It shall be the duty of the Council in such case to recommend to the several Governments concerned what effective military, naval or air force the Members of the League shall severally contribute to the armed forces to be used to protect the Covenants of the League.

The Members of the League agree, further, that they will mutually support one another in the financial and economic measures which are taken under this Article, in order to minimise the loss and inconvenience resulting from the above measures, and that they will mutually support one another in resisting any special measures aimed at one of their number by the Covenant-breaking State, and that they will take the necessary steps to afford passage through their territory to the forces of any of the Members of the League which are co-operating to protect the Covenants of the League.

Any Member of the League which has violated any Covenant of the League may be declared to be no longer a Member of the League by a vote of the Council concurred in by the representatives of all the other Members of the League represented thereon.[1]

Article 17.—In the event of a dispute between a Member of the League and a State which is not a Member of the League, or between States not Members of the League, the State or States not Members of the League shall be invited to accept the obligations of member-

[1] The Second Assembly, Oct. 4 1921, proposed that Article 16, paragraph 1, be amended to read:

"Should any Member of the League resort to war in disregard of its Covenants under Articles 12, 13 or 15, it shall *ipso facto* be deemed to have committed an act of war against all other Members of the League, which hereby undertake immediately to subject it to the severance of all trade or financial relations, the prohibition of all intercourse between persons residing in their territory and persons residing in the territory of the Covenant-breaking State, and the prevention of all financial, commercial or personal intercourse between persons residing in the territory of the Covenant-breaking State and persons residing in the territory of any other State, whether a Member of the League or not."

On Sept. 27 1924 the Fifth Assembly expressed the view that "it is no longer opportune for further Members of the League to ratify the said amendment" to Article 16, paragraph 1, and recommended "in place thereof" the following:

"The latter part of the first paragraph of Article 16 of the Covenant shall read as follows: 'Which hereby undertakes immediately to subject it to the severance of all trade or financial relations and to prohibit all intercourse at least between persons resident within their territories and persons resident within the territory of the Covenant-breaking State and, if they deem it expedient, also between their nationals and the nationals of the Covenant-breaking State, and to prevent all financial, commercial or personal intercourse at least between persons resident within the territory of that State and persons resident within the territory of any other State, whether a Member of the League or not, and if they deem it expedient, also between the nationals of that State and the nationals of any other State, whether a member of the League or not.'"

The Second Assembly, Oct 4 1921, also proposed to insert the three following paragraphs between paragraphs 1 and 2 of the original text:

"It is for the Council to give an opinion whether or not a breach of the Covenant has taken place. In deliberations on this question in

ship in the League for the purposes of such dispute, upon such conditions as the Council may deem just. If such invitation is accepted, the provisions of Articles 12 to 16 inclusive shall be applied with such modifications as may be deemed necessary by the Council.

Upon such invitation being given, the Council shall immediately institute an enquiry into the circumstances of the dispute and recommend such action as may seem best and most effectual in the circumstances.

If a State so invited shall refuse to accept the obligations of membership in the League for the purposes of such dispute, and shall resort to war against a Member of the League, the provisions of Article 16 shall be applicable as against the State taking such action.

If both parties to the dispute, when so invited, refuse to accept the obligations of membership in the League for the purposes of such dispute, the Council may take such measures and make such recommendations as will prevent hostilities and will result in the settlement of the dispute.

Article 18.—Every Treaty or international engagement entered into hereafter by any Member of the League shall be forthwith registered with the Secretariat, and shall, as soon as possible, be published by it. No such Treaty or international engagement shall be binding until so registered.

Article 19.—The Assembly may from time to time advise the reconsideration by Members of the League of Treaties which have become inapplicable, and the consideration of international conditions whose continuance might endanger the peace of the world.

Article 20.—The Members of the League severally agree that this Covenant is accepted as abrogating all obligations or understandings *inter se* which are inconsistent with the terms thereof, and solemnly undertake that they will not hereafter enter into any engagements inconsistent with the terms thereof.

In case any Member of the League shall, before becoming a Member of the League, have undertaken any obligations inconsistent with the terms of this Covenant, it shall be the duty of such member to take immediate steps to procure its release from such obligations.

Article 21.—Nothing in this Covenant shall be deemed to affect the validity of international engagements, such as Treaties of Arbitration, or regional understandings like the Monroe doctrine, for securing the maintenance of peace.

Article 22.—To those colonies and territories, which as a consequence of the late war have ceased to be under the sovereignty of the States which formerly governed them, and which are inhabited by peoples not yet able to stand by themselves under the strenuous conditions of the modern world, there should be applied the principle that the well-being and development of such peoples form a sacred trust of civilisation, and that securities for the performance of this trust should be embodied in this Covenant.

The best method of giving practical effect to this principle is that the tutelage of such peoples should be entrusted to advanced nations who, by reason of their resources, their experience or their geographical position, can best undertake this responsibility, and who are willing to accept it, and that this tutelage should be exercised by them as Mandatories on behalf of the League.

The character of the Mandate must differ according to the stage of the development of the people, the geographical situation of the territory, its economic conditions and other similar circumstances.

Certain communities formerly belonging to the Turkish Empire have reached a stage of development where their existence as independent nations can be provisionally recognised subject to the rendering of administrative advice and assistance by a Mandatory until such time as they are able to stand alone. The wishes of these communities must be a principal consideration in the selection of the Mandatory.

Other peoples, especially those of Central Africa, are at such a stage that the Mandatory must be responsible for the administration of the territory under conditions which will guarantee freedom of conscience and religion, subject only to the maintenance of public order and morals, the prohibition of abuses such as the slave trade, the arms traffic and the liquor traffic, and the prevention of the establishment of fortifications or military and naval bases, and of military training of the natives for other than police purposes and the defence of territory, and will also secure equal opportunities for the trade and commerce of other Members of the League.

There are territories, such as Southwest Africa and certain of the South Pacific Islands, which, owing to the sparseness of their population, or their small size, or their remoteness from the centres of civilisation, or their geographical contiguity to the territory of the Mandatory, and other circumstances, can be best administered under the laws of the Mandatory as integral portions of its territory, subject to the safeguards above mentioned in the interests of the indigenous population.

In every case of Mandate, the Mandatory shall render to the Council an annual report in reference to the territory committed to its charge.

The degree of authority, control or administration to be exercised by the Mandatory shall, if not previously agreed upon by the Members of the League, be explicitly defined in each case by the Council.

A permanent Commission shall be constituted to receive and examine the annual reports of the Mandatories and to advise the Council on all matters relating to the observance of the Mandates.

Article 23.—Subject to and in accordance with the provisions of international Conventions existing or hereafter to be agreed upon, the Members of the League—

(*a*) Will endeavour to secure and maintain fair and humane conditions of labour for men, women and children, both in their own countries and in all countries to which their commercial and industrial relations extend, and for that purpose will establish and maintain the necessary international organisations.

(*b*) Undertake to secure just treatment of the native inhabitants of territories under their control.

(*c*) Will entrust the League with the general supervision over the execution of agreements with regard to the traffic in women and children, and the traffic in opium and other dangerous drugs.

(*d*) Will entrust the League with the general supervision of the trade in arms and ammunition with the countries in which the control of this traffic is necessary in the common interest.

(*e*) Will make provision to secure and maintain freedom of communications and of transit and equitable treatment for the commerce of all Members of the League. In this connection, the special necessities of the regions devastated during the war of 1914–8 shall be borne in mind.

(*f*) Will endeavour to take steps in matters of international concern for the prevention and control of disease.

Article 24.—There shall be placed under the direction of the League all international bureaux already established by general Treaties if the parties to such Treaties consent. All such international bureaux and all Commissions for the regulation of matters of international interest hereafter constituted shall be placed under the direction of the League.

In all matters of international interest which are regulated by general Conventions, but which are not placed under the control of international bureaux or Commissions, the Secretariat of the League shall, subject to the consent of the Council, and if desired by the parties, collect and distribute all relevant information, and shall render any other assistance which may be necessary or desirable.

The Council may include as part of the expenses of the Secretariat the expenses of any bureau or Commission which is placed under the direction of the League.

Article 25.—The Members of the League agree to encourage and promote the establishment and co-operation of duly authorised voluntary national Red Cross organisations having as purposes the improvement of health, the prevention of disease and the mitigation of suffering throughout the world.

Article 26.—Amendments to this Covenant will take effect when ratified by the Members of the League whose representatives compose the Council, and by a majority of the Members of the League whose representatives compose the Assembly.

No such amendments shall bind any Member of the League which signifies its dissent therefrom, but in that case it shall cease to be a Member of the League.[1]

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the Council the votes of Members of the League alleged to have resorted to war and of Members against whom such action was directed shall not be counted.

"The Council will notify to all Members of the League the date which it recommends for the application of the economic pressure under this Article.

"Nevertheless, the Council may, in the case of particular Members, postpone the coming into force of any of these measures for a specified period where it is satisfied that such a postponement will facilitate the attainment of the object of the measures referred to in the preceding paragraph, or that it is necessary in order to minimise the loss and inconvenience which will be caused to such Members."

The Sixth Assembly, Sept. 21 1925, proposed that the following amendment should be made to paragraph 2 of the original text (which becomes paragraph 5 of the text as amended in 1921):—

"The words 'in such case' in the second paragraph of the original text of Article 16 of the Covenant shall be deleted."

None of these proposed amendments had come into force by April 1926.

[1] The second Assembly, Oct. 3 1921, proposed that Article 26 should be amended as follows:—

"Amendments to the present Covenant the text of which shall have been voted by the Assembly on a three-fourths majority, in which there shall be included the votes of all the Members of the Council represented at the meeting, will take effect when ratified by the Members of the League, whose Representatives composed the Council when the vote was taken and by the majority of those whose Representatives form the Assembly.

"If the required number of ratifications shall not have been obtained within twenty-two months after the vote of the Assembly, the proposed amendment shall remain without effect.

"The Secretary-General shall inform the Members of the taking effect of an amendment.

"Any Member of the League which has not at that time ratified the amendment is free to notify the Secretary-General within a year of its refusal to accept it, but in that case it shall cease to be a Member of the League."

This amendment had not come into force by April 1926.

COVENTRY, England (*see* 7.342), had a population of 128,205 in 1921, this figure showing a considerable increase since 1911. In 1923 the estimate was 131,200. The area of the borough is 4,147 acres. The normal engineering industries of Coventry were largely changed during the World War to the production of munitions, including aeroplanes, tanks and guns. Among industries established since 1910 are the making of artificial silk and of telephone and other electrical apparatus. Parliamentary powers were obtained in 1920 for the widening of several narrow streets and the construction of two new arterial roads in the centre of the city. A new council house, costing £100,000, was opened in 1920, and three branch public libraries in 1913; the tower of Holy Trinity Church and the Guildhall were restored. Coventry was created a separate diocese in 1918, the church of St. Michael being made the cathedral. Three new parishes have been formed in the city since 1910: St. Margaret, St. Barbara and Radford. A Roman Catholic church has been built in Harefield Road. Sir Thomas White's School and the Industrial School were acquired in 1910 for enlarging the hospital and housing the staff. In 1917 there was trouble over the activities of the shop stewards; and, in Nov. 1917, 50,000 workers went on strike. An effort was made to build a large number of houses on the Radford estate to the west of the city in 1925.

COWANS, SIR JOHN STEVEN (1862–1921), British soldier, was born March 11 1862, and commissioned in the Rifle Brigade, 1881. After early service in India, he graduated at the Staff College in 1892, and shortly after joined the newly formed mobilisation section at the War Office. Here he helped to lay the foundations not only of the mobilisation schemes—for future test in 1899 and 1914, but of his own mastery of detail and war organisation. In 1898 he supervised the transportation of the troops for the Sudan campaign, then, after a spell in the War Office at Aldershot, he became director of military education in India, under Lord Kitchener. In 1908 came his one brief spell in command of troops—the Bengal Presidency Brigade. In 1910 he returned home and was appointed director-general of the Territorial Force, and his success was rewarded by his advancement to quartermaster-general of the forces in 1912, his last post. This he held until 1919, the one continuous member of the Army Council throughout the War. His amazing energy and organising genius kept pace with his task, and the universal recognition of his success was aptly shown in his popular title of "The greatest quartermaster-general since Moses." In March 1919 he retired from the army and he died at Mentone on April 16 1921.

COWDRAY, WEETMAN DICKINSON PEARSON, 1ST VISCOUNT (1856–), was born at Shelley Woodhouse, Yorks., July 15 1856, and educated privately at Harrogate. He entered the family firm of S. Pearson & Co., contractors, ultimately becoming its head. Under him the firm greatly extended, undertaking many important contracts and acquiring large interests in Mexico and South America. In 1895 he was elected Liberal member for Colchester, holding his seat until 1910. In 1894 he was created a baronet, and in 1910 was raised to the peerage. He was in 1917 made president of the Air Board, and the same year was created a viscount. He was elected lord rector of Aberdeen University in 1918.

COX, JAMES MIDDLETON (1870–), American politician, was born near Jacksonburg, O., March 31 1870. After being educated in the common schools, he worked in a newspaper office, and for a short time was a country school teacher. Later he became a reporter on the Cincinnati *Enquirer*. In 1898 he purchased the Dayton *News* and five years later the Springfield *Press-Republic*, subsequently named the *Daily News*. In 1923 he purchased the Canton *Daily News* and the Miami (Fla.) *Metropolis*, which later became the Miami *Daily News*. From 1909 to 1913 he was a member of Congress for the Dayton district. He was Governor of Ohio 1913–5 and 1917–21. His career as governor was notable. Among the reforms introduced under his guidance were a workmen's compensation law; the elimination of the sweatshop; the establishment of a state industrial commission for dealing with questions of labour and capital; the provision of a minimum wage and a nine-hour day for women; mothers' pensions; a blue-sky law for protecting investors from unscrupulous promoters; the initiative and referendum; the establishment of a state tuberculosis hospital and the extension of safety devices on railways and in mines. He was energetic in suppressing violence in connection with strikes, his general policy being to hold local authorities responsible without recourse to the state militia. He favoured the abolition of the Federal inheritance tax, believing that the state alone should have jurisdiction over inheritances. He was a strong supporter of President Wilson's policies and especially of the League of Nations. He was charged with opposing prohibition, but repeatedly declared that all laws must be enforced. At the Democratic National Convention in 1920 he received the presidential nomination, but was overwhelmingly defeated by Mr. Harding, the Republican nominee. The electoral vote was 404 for Harding and 127 for Cox. The popular vote was 16,152,200 for Harding and 9,147,353 for Cox. The vote in Ohio, the home state of both candidates, was 1,182,022 for Harding and 780,037 for Cox.

COX, KENYON (1856–1919), American painter (*see* 7.353), died in New York March 17 1919. In 1910 he was awarded the medal of honour for mural painting by the Architectural League. In 1912 he published *The Classic Point of View*, being lectures delivered that year before the Chicago Art Institute. Other works are *Artist and Public* (1914, largely reprints from periodicals); *Winslow Homer* (1914); and *Concerning Painting* (1917).

CRACOW, Poland (*see* 7.359), had a population in 1921 of 181,700, of whom 152,590 were Poles. It is the capital of the province of the same name, the third city in Poland, and an industrial centre. A Ukrainian university, a mining academy and a fine arts academy have been inaugurated. Cracow is the seat of a Roman Catholic archbishop.

CRADDOCK, CHARLES EGBERT (1850–1922), American author (*see* 7.360), died at Murfreesboro, Tenn., July 31 1922. Her latest works were *Ordeal* (1912); *Raid of the Guerilla* (1912); and *The Story of Duciehurst* (1914).

CRADOCK, SIR CHRISTOPHER GEORGE FRANCIS MAURICE (1862–1914), British admiral, was born July 2 1862 at Hartforth, Yorkshire. He entered the naval service in 1875, and served in the Egyptian War in 1882 and the Sudanese Expedition of 1891. In 1900 he commanded the British naval brigade at the capture of the Taku forts and the relief of Peking. After Taku he was promoted captain and received the China Medal for gallantry. In 1910 he was promoted rear-admiral and in 1912 received the K.C.V.O. Early in the World War he was given command of a small British squadron in the Pacific, consisting of the cruisers "Good Hope" and "Monmouth," an armed merchantman and one light cruiser. On Nov. 1 1914 this squadron encountered five German warhips, the "Scharnhorst," "Gneisenau," "Leipzig," "Dresden," "Nürnberg." Though inferior in speed and gunfire he decided to attack, and the battle of Coronel was fought. As a result, the "Monmouth" was sunk and Adm. Cradock went down in his flagship, the "Good Hope," which was blown up while making for shore. (*See* CORONEL, BATTLE OF; FALKLAND ISLANDS, BATTLE OF THE.)

CRAIG, EDITH (1869–), British theatrical producer, daughter of Dame Ellen Terry, was born Dec. 9 1869. She made her first appearance on the stage at the Court Theatre during the run of "Olivia" and subsequently played many parts both in England and America. She studied at the Royal Academy of Music and at Berlin, and at one time was engaged in the making and designing of costumes for London productions. Later she was mainly employed in stage-management and play production, and in addition to her purely theatrical enterprises, she both produced and acted in a number of cinema plays.

Her brother, EDWARD GORDON CRAIG (born Jan. 16 1872), was educated at Bradfield College and the University of Heidelberg. His first stage appearance was at the Court Theatre, London, in "Olivia." He, later, went to live in Florence, where he devoted much study to the art of the theatre. He was a frequent contributor to *The Mask*, and his book, *The Theatre Advancing* (1921), is his most noteworthy contribution to the subject of the art of the stage.

CRAIG, SIR JAMES (1871–), Irish politician, was born Jan. 8 1871, a son of James Craig of Craigavon, Co. Down, a Belfast business man. Coming of pure Scottish stock, he was educated at Merchiston School, Edinburgh, and destined for a business career. This was interrupted by the South African War of 1899–1902, when he joined the Royal Irish Rifles. On his return from that war he was gradually drawn into politics, and after a first failure in Fermanagh he won back for the Unionist party one of the seats in his native county of Down in 1906. In and out of Parliament he was in the confidence of Sir Edward Carson, and when, in 1914, it was decided to offer armed resistance to what Ulster Unionists regarded as the threatened destruction of their rights of citizenship in the United Kingdom, he shouldered a prominent share of the work and the risk.

The World War brought a partial truce at home. Belfast was one of the best recruiting centres in the kingdom and Col. Craig devoted his energies to recruiting and organising the 36th (Ulster) Division. When the Coalition Govt. was formed in 1916, he was appointed Treasurer of the Household. In 1919 he was Parliamentary Secretary to the Ministry of Pensions, and in 1920 Financial Secretary to the Admiralty. When the Govt. of Ireland Act, 1920, came into force he resigned his office and his seat in the Imperial Parliament and became Prime Minister of Northern Ireland. In 1918 he was created a baronet, and in 1921 a Privy Councillor. The Govt., under Sir James Craig's leadership, promptly got to work, the Ulster Parliament being opened by the King in person in the spring of 1921. After a period of incendiarism and bloodshed unparalleled in Irish history, the Imperial Govt. agreed on a truce, and at a conference held in Downing street, "Articles of Agreement for a Treaty" were drawn up and duly passed into law by the Imperial Parliament in 1922 (*see* IRISH FREE STATE; IRELAND, NORTHERN).

Sir James Craig and the Northern Parliament promptly repudiated the conference and the treaty arising from it and continued to carry on the government of the six counties allotted to them by the Act of 1920. The Republican section of the Sinn Fein party, defeated in the Dail, also repudiated the treaty, and strife and bloodshed again broke out. The two Irish governments concerned succeeded, however, in restoring order, and when the country was once more at rest, a boundary commission, nominated by the Imperial Govt. and the Govt. of the Irish Free State (the Northern Govt. still standing aloof) was appointed and set to work late in 1924.

There followed a year of peace, during which an Education Act and a Licensing Act stand prominently to the credit of Sir James Craig's Administration. The Northern Govt. paid little attention to the proceedings of the commission, but when the time approached for the commission to deliver its award the situation again became acute. Several conferences were held in Downing street in which Mr. Baldwin, Mr. Churchill, Sir W. Joynson-Hicks and Mr. Amery on the one hand and Sir James Craig and Mr. Cosgrave, the Premier of Southern Ireland on the other, took part with the most satisfactory results. On the night of Dec. 3 1925 a comprehensive agreement was signed for the final and definite settlement of all outstanding differences, territorial or financial, affecting alike the relations between the two states in Ireland and Ireland and the United Kingdom. The agreement was promptly ratified by the Imperial Parliament and the Parliament of Northern Ireland and, after some heated discussion, by the Dublin Parliament also. Sir James Craig is entitled to claim that his firm stand for the integrity of Northern Ireland, as defined by the Act of 1920, has been crowned with complete success. (J. R. Fi.)

CRAM, RALPH ADAMS (1863–), American architect, was born at Hampton Falls, N.H., Dec. 16 1863. He was educated at the Westford (Mass.) Academy and the Exeter (N.H.) high school. He studied architecture and in 1889 opened an architect's office in Boston. Recognised as an authority on mediaeval architecture and an able advocate of the Gothic style, he was appointed architect for the cathedral of St. John the Divine, New York, in 1911, and consulting architect for the Washington and San Francisco cathedrals. He was professor of architecture at the Massachusetts Institute of Technology, 1914–21, and was the first chairman of the Boston City Planning Board, 1915–22.

His numerous writings include *Church Building* (1901); *The Ruined Abbeys of Great Britain* (1905); *Impressions of Japanese Architecture and The Allied Arts* (1905); *The Gothic Quest* (1907); *The Ministry of Art* (1914); *Heart of Europe* (1915); *The Substance of Gothic* (1916, Lowell lectures); *The Nemesis of Mediocrity* (1918); *The Great Thousand Years* (1918); *The Sins of the Fathers* (1919); *Walled Towns* (1919); *Gold, Frankincense and Myrrh* (1919); and *Towards the Great Peace* (1922).

CRAMP, CHARLES HENRY (1828–1913), American shipbuilder (*see* 7.363), died in Philadelphia June 6 1913.

CRANE, WALTER (1845–1915), British artist (*see* 7.366), died at Horsham, Sussex, March 14 1915.

CRANE, WILLIAM HENRY (1845–1922), American actor (*see* 7.367), died in Dublin, Ireland, April 29 1922.

CRAWFORD, 26TH EARL OF (1847–1913), British astronomer and orientalist (*see* 7.385), died in London Jan. 31 1913. He was succeeded as 27th earl by his son, DAVID ALEXANDER EDWARD LINDSAY (b. 1871). The latter published *Donatello* (1903) and *The Evolution of Italian Sculpture* (1910). As Lord Balcarres he was a Unionist M.P. from 1895 to 1913. In 1916 he was appointed President of the Board of Agriculture in Mr. Asquith's Govt., and he served under Mr. Lloyd George (1916–22) as Lord Privy Seal, Chancellor of the Duchy of Lancaster, and First Commissioner of Works, being admitted to the Cabinet in 1922.

CREDIT: *see* BANKING; CURRENCY.

CREWE, ROBERT OFFLEY ASHBURTON CREWE-MILNES, 1ST MARQUESS OF (1858–), English politician and man of letters (*see* 7.432), remained leader of the House of Lords till Dec. 1916. Though he was not Lord Granville's equal in the difficult task of endeavouring to win the peers' assent to unpalatable radical measures, he contrived, by his courtesy and charm, to retain their liking and respect throughout the critical period beginning with the Budget of 1909.

He succeeded Lord Morley at the India Office in Nov. 1910, and attended, as Secretary of State, the King and Queen on their visit to India in the winter of 1911–2. He was responsible for the high acts of policy announced at the Delhi Durbar; the removal of the capital of India from Calcutta to Delhi, and the reunion of the two Bengals under a governor-in-council. At the coronation of King George he was created a marquis. In the first Coalition Govt. he was Lord President of the Council, but he followed Mr. Asquith in declining to take office under Mr. Lloyd George and continued for six years to lead the independent Liberal opposition in the Lords. In Nov. 1922 he quitted active party politics, accepting from Mr. Bonar Law the post of British ambassador in Paris. In the anxious period of M. Poincaré's Ministry and the Ruhr expedition, when British and French policy became seriously divergent, his tactful diplomacy helped to prevent any actual breach of the Entente; and he acquired considerable authority in the Ambassadors' Conference.

CRICKET (*see* 7.435).—In 1911 cricket had not yet spread its tentacles so widely over the earth as it has done since the War. The game was, however, in a healthy condition. In England, Warwickshire, for the first time, won the championship, the whole season providing one long triumph for F. R. Foster, the Warwickshire captain, who headed both the batting and bowling averages of his county team. Another factor of the 1911 season was the bowling strength of the Gentlemen's side, through the medium of J. W. H. T. Douglas, F. R. Foster, P. R. Le Conteur and W. Brearley. The Gentlemen defeated the Players at Lord's by 130 runs, and drew with them at the Oval.

English Team in Australia.—The M.C.C. team which sailed for Australia in Sept. of that year and which C. B. Fry was invited to captain, was chosen with the greatest care, and was probably better balanced than any side England had previously put into the field. Unfortunately, C. B. Fry could not accept the committee's invitation and the captaincy devolved upon P. F. Warner. At this period the M.C.C. selectors were firmly of the opinion that it was time for youth to be served and, although the inclusion of 10 new choices was criticised, they stuck

to their policy of blending youth with experience. Hitch had only just attained his 25th year, while Foster, Woolley, Mead, Smith and Hearne were all under that age. Results justified the selection and four Test Matches out of five were won. To England's success the bowling of Barnes and Foster and, in a lesser degree, that of Douglas contributed, while Hobbs and Rhodes batted superbly. The Australian wickets were perfect, but these bowlers kept a superb length, and it was their pace off the pitch that really won the rubber. The Australians, themselves, endorsed the general opinion that Barnes is the greatest bowler on all wickets that cricket has yet produced. He had every good quality, spin, break both ways, flight, accuracy and consistency.

In the 1911 period, and particularly on the Australian tour, the English fielding was excellent. Smith kept wicket superbly, especially to F. R. Foster, his own county captain; Hobbs ran out 15 men during the tour, and Woolley made six catches in one test match in the slips. Hobbs and Rhodes were a tremendous asset to the side as first wicket batsmen. The former made three centuries in succession and stood out as the champion batsman of the world. It was noteworthy of a great partnership that they made many short runs and yet never needed to call each other.

Warner was laid low by a serious illness after the first match, and Douglas captained the side. The standard of English cricket at that time is perhaps best exemplified by quoting the complete record of the Australian tour, which was 18 matches played, 12 won, 5 drawn and 1 lost. On their return to England, moreover, the M.C.C. team played the Rest of England, at Lord's and beat them decisively by an innings and 10 runs.

The Triangular Tournament.—From the international point of view, the great feature of the 1912 season was the triangular tournament between England, Australia and South Africa. It was a season of wretchedly wet weather, and this to a large extent spoilt county cricket, which was further overshadowed by the greater event. The South Africans were not up to the standard of international cricket, and, to make matters still worse, a dispute arose between the leading cricketers in Australia and the Board of Control. The result was that neither Hill, Trumper, Armstrong, Ransford, Cotter nor Carter made the tour, thus robbing Australia of a great deal of her strength. England, as in the previous year, had a fine side, and although they did not once bat on a good wicket, their play was conspicuously better than that of their rivals.

C. B. Fry, the captain, got the very best out of his men, Hobbs was equally at home whatever the state of the ground and Rhodes came off against the Australians, but failed against the South Africans, this state of affairs being reversed in the case of R. H. Spooner. Barnes bowled as well as ever, but Woolley was undoubtedly the great all-rounder of the side.

Of the Australians Bardsley and Kelleway batted brilliantly in the Test Matches against the South Africans, while Macartney proved himself a master of nearly every scoring stroke. Whitty and Hazlitt were consistently successful as bowlers, and Matthews performed the unprecedented feat of bringing off a double bat trick against South Africa at Old Trafford, Manchester. Emery, a googly bowler, of the pace of J. T. Hearne, was, on his day and when he had struck his length, an absolute match winner. The South Africans, who lost five of their six Test Matches, had two fine bowlers in Pegler and Faulkner, the latter one of the greatest all-rounders in the history of cricket. These two were called upon to do nearly all the bowling, but received little support, nor could their batsmen cope with the bowling of Barnes. On figures, Nourse was the best of the South African batsmen, but, in point of technique, H. W. Taylor was his superior.

The Season of 1913.—Fine weather favoured the 1913 season. No Dominion teams toured England that year, so English county cricket came into its own, and the championship was won by Kent. The Players, captained by Rhodes, had a particularly strong side, comprising Hobbs, Tarrant, Mead, J. W. Hearne, Woolley, Quaife, A. E. Relf, Booth, E. J. Smith and Barnes. The Gentlemen's side was distinguished for the bowling of Simms and Falcon, and the all-round excellence of these two and Foster, Douglas, S. G. Smith and P. H. Fender.

The War Period.—The year of the outbreak of War, 1914, witnessed the centenary of Lord's ground, which had been moved 100 years before from where Dorset Square now stands. The centenary was celebrated by a match between the M.C.C. team, which had recently returned from a successful tour in South Africa, and the Rest of England, the latter winning easily by an innings. The Players defeated the Gentlemen at the Oval that year, but the feature of the match at Lord's when the latter took their revenge, was the wonderful bowling of Douglas, who was on continuously except for three-quarters of an hour. His analysis read:—

Overs	Maidens	Runs	Wickets
38·2	8	105	9

In the second innings he took four wickets for 67 runs. Partnered by Foster they were, perhaps, the finest pair of bowlers the Gentlemen have ever had.

Owing to the outbreak of the Great War the concluding matches in the county championship between Surrey and Sussex, and Surrey and Leicestershire, were not played. It was officially stated that the M.C.C. had decided to regard Surrey as the winners of the championship, in view of the fact that Middlesex offered no objection, as they might have done, on the grounds that Surrey had not completed their programme. The effects of the War were very far reaching. The game was played spasmodically behind the lines, and in the schools, but it must be remembered, however, that the standard of instruction could not possibly be maintained during the years of strife. Almost daily, good cricketers were falling upon the field of battle, while, at the best, others were being deprived of years of practice.

Cricket After the World War.—In 1919 the game was resumed and it is noteworthy of the post-War period that great progress has been made in Denmark and Holland, in which countries the school-boys are exceptionally keen. There is keenness in Belgium, too, where a flourishing club exists in Brussels. Perhaps as a result of the War and the British occupation, the game is being played by the Germans.

In England the crowds which attend important matches are both larger and more critical than they were in pre-War days. In Scotland the schools play cricket, and there has been a good deal of improvement owing to the tours of English teams. The furtherance of the game in Ireland has always provided an uphill task, but since the War the Irish have asked for more and better cricket. Dublin University is still the great stronghold of the game, but, unfortunately, the Irish schoolboy is not as keen on cricket as he might be. In Australia the enthusiasm is even greater than in England, witnessed by the fact that the crowds at the Test Matches in 1924–5 completely eclipsed all previous records. Generally speaking it may be said that since the War the sway of cricket has spread across all the earth, until it now flourishes in such widely separated countries as England and Australia, Hongkong and the West Indies.

The Season of 1919.—Luckily, for cricket enthusiasts, the post-War resumption of the game was blessed by a season of good weather. On the other hand, the imposition upon county matches of a two days limit of play was a risky proceeding, which might well have caused irreparable damage. The appearance in England of the Australian Imperial Forces cricket team was a godsend. They did much to combat the heresy of the new innovation, by allotting three days to each of their matches, the position being still further strengthened by the M.C.C. also refusing to countenance the two days idea. The Australian Imperial Forces team, at first captained by Kelleway, and subsequently by Collins, contained outstanding cricketers in Gregory, Taylor, Pellew and Oldfield.

Other distinctive features of the 1919 season were the batting of D. J. Knight and the bowling of Douglas. Both represented the Gentlemen against the Players at Lord's, where Knight

played two beautiful innings of 71 and 124 respectively, while Douglas took eight wickets for 49 runs in the Players first innings. For the Players, Hobbs proved himself to be as great a batsman as ever, scoring 120 not out at the Oval, 2 and 113 at Lord's and 120 at Scarborough, thus beating the record for these games which had previously stood to the credit of W. G. Grace. One feature was very noticeable; this, the bowling of the Players was not anything like up to pre-War standard.

The Season of 1920.—It was in 1920 that cricket really commenced its new lease of life. Middlesex secured the county championship, their victory over Surrey in the final match at Lord's being signalised by scenes of extraordinary excitement. At the beginning of Aug. the chance of Middlesex attaining championship honours had seemed small indeed; then they won nine matches in succession, one against Kent by five runs, and another against Yorkshire by four runs, and finally attained the honour by beating Surrey at Lord's.

England v. Australia.—Great as had been the English cricket recovery in so short a space of time, the Australians apparently were possessed of even greater powers of recuperation. The policy of the M.C.C. was to wait a while before sending teams abroad. But the Australians were insistent that an English side should visit them; and the M.C.C., much against their own wishes, consented to send a team to Australia at the end of the 1920 season. It was now seen that what has been said of the Players post-War bowling, in reality, applied to the whole country. The standard of English bowling, indeed, was considerably below that of the Foster-Barnes-Douglas period. The English side, moreover, had a long tail, and lost all five Test Matches to a fine Australian eleven. The main reason for Australia's pronounced superiority lay in their great batting strength and the possession of that wonderful all-round player, Gregory. Hobbs, Russell and Woolley batted finely for England, but the English bowling was weak and ill-supported in the field.

The Australians in England.—In 1921 the Australians returned the English visit. They won three out of the five Test Matches, the other two being drawn. England might have done better, but was forced to take the field without Hobbs and Hearne, the one out of action through illness, and the other through accident. In point of fact, Hearne did play through one Test Match, and Hobbs took the field at Leeds, but had to leave the ground almost at once, owing to a sudden attack of appendicitis. It was impossible to fill the places of two such players adequately; but, at the same time, it cannot be said that the selection committee made the best use of the material at their disposal. It seemed as if they had no definite policy; and, certainly, the elevens that represented England at Nottingham and Lord's were two ill-balanced sides, whose fielding was exceptionally weak. In the Fourth and Fifth Test Matches, England batted well on slow wickets.

On the season's form there can be no doubt whatever that the Australians were much the better side; they were, indeed, a great side. Their fielding, and this is saying a great deal, was probably better than that shown by any previous Australian eleven. Another great factor was the remarkably fine fast bowling of Gregory and MacDonald, cleverly controlled and applied by W. W. Armstrong, the Australian captain. Armstrong, himself, was invaluable as a bowler and every man on the side could bat. Bardsley, for the third time in his career, scored over 2,000 runs during an English tour. Macartney was really brilliant and, in connection with the fielding, the beautiful general efficiency and especially the throwing of Pellew, Bardsley and Taylor will be long remembered, as will the great work of Gregory in the slips. In justice to English cricket, however, it must be stated that, at that period, English batting was, speaking generally, guilty of a wrong method. Back play was overdone and the strokes required to meet certain types of bowling, such as the swerve and the googly, were applied, quite unnecessarily, to all types of bowling.

The Season of 1922.—The first indication of things having taken a turn for the better during the 1922 season was the fine cricket displayed in the Gentlemen and Players match at Lord's. None the less, there was a certain amount of anxiety felt in England as to the possible fate of the team, which the M.C.C. decided to send to South Africa that winter. In point of fact, this team, excellently led by F. T. Mann, had considerable difficulty in beating, on matting wickets, a South African side, which, on grass, would have been no match for them.

The West Indians.—In 1923 the West Indies sent over to England a notable side, under the captaincy of H. B. G. Austin, who has done much for the game in that part of the world. Batting was not the strong feature of the team, if one excepts G. Challoner, a player of the very highest class. Their main strength, indeed, lay in the fast bowling of Francis and John, who were not only really fast, but obtained their pace with a minimum expenditure of energy; and also in the brilliant fielding of Constantine at cover point. The team, at the end of their tour, achieved a decided triumph in running a very strong English eleven to a close finish at Scarborough. On the whole they created such a favourable impression that the M.C.C. were fully justified in sending out the strong team which left England in 1925 to take part in a series of matches in the West Indies.

The South Africans.—The following year the process of building up post-War cricket went on, but it was a poor side that South Africa sent to England, poor, that is, judged by the international standard. The bowling of the South African 1924 team was its weakest point, and it did not win a single Test Match. On the other hand, the great English batsmen, Hobbs, Sutcliffe, Woolley and Hendren, were quick to envisage the possibilities of their opponents' weakness and scored freely off them. England won the first three Test Matches with consummate ease, and it was only owing to rain that the other two resulted in a draw. It is significant of the disparity between the sides that in the first match A. E. R. Gilligan and Tate disposed of the South Africans for a total of 30 runs; Gilligan, the English captain, taking 6 wickets for 7 runs on a hard, true wicket.

The English Team in Australia.—The M.C.C. English team, which went out to Australia in 1924–5 under the captaincy of A. E. R. Gilligan, was a very good one, but not so well balanced as the team of 1911. Three leg break bowlers were included, but the team lacked a steady, medium pace, right hand bowler to give the necessary assistance to Tate, who had definitely proved his greatness in this department of the game during the two previous seasons. In this particular year the test teams were more evenly matched than would appear from the fact that the Australians won four out of the five Test Matches—incidentally, the Australian skipper also won the toss upon four out of these five occasions. There was, in fact, very little to choose between the English and Australian elevens. In the third Test Match at Adelaide, the English side was defeated by only nine runs, and in the second at Melbourne by 80 runs after Australia had scored 600 in the first innings.

The outstanding figures of the English side were Hobbs, Sutcliffe and Tate. The two first named batted magnificently, and created various new records. Of Tate the Australians themselves said that never since the days of Barnes had they seen so good a bowler on their wickets. Another respect in which the English eleven gained unstinted praise from their opponents, was for the fine fielding of the side in general, and the good wicket keeping of Strudwick in particular. As is stated in *Gilligan's Men*, written by M. A. Noble, "it was felt that English cricket had regained its old prestige."

The Australian side was well captained by H. L. Collins, its real strength being found in the fact that every single man was a batsman. One of the best batsmen in the Australian eleven was Oldfield, the wicket keeper, who went in number ten. Apart from the performances of Tate it may be justly said that both sides were weak in bowling. In W. H. Ponsford the Australians brought to light a remarkable young batsman, who, although said to be unsound in his methods, was, nevertheless, extraordinarily successful. He, indeed, had the satisfaction of scoring a century in each of his first two Test Matches.

It has already been said that the post-War attendances at cricket matches in England showed great improvement. In

Australia a like state of things prevailed. The attendances at the matches played by Gilligan's men broke all previous records, the venture turning out a great financial success for the M.C.C., who, since 1903, have always undertaken the management of these tours in Australia.

The Season of 1925.—The year 1925 will be remembered by cricketers as Hobbs' year. In it he beat the record number of centuries, *i.e.*, 126, previously held by W. G. Grace. Further, he scored over 3,000 runs and headed the averages. In addition to batting superbly, Hobbs fielded magnificently at cover point during the 1925 season, despite the fact that he was then in his forty-third year.

In 1925 Tate, in spite of having to do far too much work for his county, Sussex, was probably as good a bowler as ever; but, in point of merit, Macaulay, of Yorkshire, ran him very close. A survey of the personalities and performances of English cricketers during 1925 creates the impression that the country is well able to put a strong batting and fielding side into the field. The chief problem is to find another bowler to support Tate and Macaulay.

In 1926 the Australians sent a team to England, but a number of the earlier matches were spoiled by bad weather. The first test match, played at Nottingham, was a draw, only 50 minutes play being possible in the three days. The second test match, played at Lord's, was also drawn, but on this occasion it was the high scoring on both sides that prevented a definite issue. The immediate need of England seems to be a leg break bowler of the class of L. Braund of Somerset, while a fast bowler of the Lockwood or Richardson type would be invaluable.

BIBLIOGRAPHY.—P. F. Warner, *My Cricketing Life* (1921); G. L. Jessop, *A Cricketer's Log* (1922); E. H. D. Sewell, *The Log of a Sportsman* (1923); N. Cardus, *Days in the Sun* (1924); Lord Hawke, *Recollections and Reminiscences* (1924); J. B. Hobbs, *My Cricket Memories* (1924); A. C. Maclaren, *Cricket Old and New* (1924); M. A. Noble, *Gilligan's Men* (1925). (P. F. W.)

CRILE, GEORGE WASHINGTON (1864–), American surgeon, was born at Chili, O., Nov. 11 1864. After graduating from Ohio Northern University (1884), he studied medicine at Wooster University, taking the degree of M.D. in 1887, and later at Vienna, London and Paris. At first lecturer in histology 1889–90, he became professor of physiology in 1890 and professor of surgery at Wooster University from 1893 to 1900. He was professor of clinical medicine at Western Reserve University from 1900 to 1911, and was then appointed professor of surgery. During the Spanish-American War he served in Porto Rico (1898). He was made an hon. F.R.C.S. (London) in 1913. After America entered the World War he became major in the Medical Officers' Training Corps, and professional director (1917–8). He served with the British Expeditionary Force in France and was senior consultant in surgical research (1918–9). He was made lieutenant-colonel in June 1918, and colonel later in the year. He made important contributions to the study of blood pressure and of shock in operations. For his work in this field he received a gold medal from the National Institute of Social Sciences in 1914.

Among his works are: *Surgical Shock* (1899); *On the Blood Pressure in Surgery* (1903); *Hemorrhage and Transfusion* (1909); *Anemia and Resuscitation* (1914); *The Origin and Nature of the Emotions* (1915); *Man an Adaptive Mechanism* (1916); *A Mechanistic View of War and Peace* (1916); *The Fallacy of the German State Philosophy* (1918); and a *Physical Interpretation of Shock Exhaustion and Restoration* (1921).

CRIMINOLOGY (*see* 7.464).—The tardiness of the social sciences in bringing light to bear on the vital problems of modern society is strikingly illustrated in the definition under CRIMINOLOGY, vol. 7, "a new branch of social science devoted to the discussion of the genesis of crime," and the exposition and criticism of the views of the Italian savant, Cesare Lombroso. It seems incredible, but it is nevertheless a fact, that, prior to the publication of Lombroso's *L'Uomo delinquente* (The Criminal), which was given to the world in 1876, there had never been offered a serious, scientific approach to the study of the criminal. It is true that some 75 years earlier the Viennese physician and phrenologist, Franz Joseph Gall, then resident in Paris, had laid down the proposition that criminal tendencies were probably innate, and might be detected by the conformation of the skull, but his suggestion was not taken up by his disciples. There is no evidence that it was known to Lombroso.

The Positive School.—Lombroso's theory of the criminal as a sub-human anthropological freak, marked by anatomical and other "stigmata" and doomed by his nature to a criminal career, was at once accepted by a majority of students in Italy, and by scholars and writers of distinction in other European countries. Though subjected to weighty criticism, and though never received in any English-speaking community (due possibly, to the native resistance of what we call the Anglo-Saxon mind to ideas emanating from the other side of the Channel) it became, and for a generation remained, the dominant doctrine of European students of the problem of crime. The adherents of the doctrine, at first known as the Italian and later as the Continental School of Criminology, have, under the influence of its most eloquent and learned modern interpreter, Enrico Ferri, claimed the title of the Positive School.

But the central doctrine of these thinkers did not long stand in the unqualified form in which it was originally promulgated. Even Lombroso himself, before his death in 1909, had modified his views to the extent of admitting that the "born" anthropological criminals numbered perhaps not more than half of those committing criminal offences. These were the "true" criminals, the other half being made up of the victims of circumstances. These modifications of the original doctrine were the result partly of the researches and conclusions of some of Lombroso's immediate Italian disciples, such as Raffaele Garofalo and Enrico Ferri, but even more, perhaps, of the challenging writings of the Dutch publicist, William A. Bonger, who emphasised the influence of economic conditions, and of the French philosopher, Gabriel Tarde, and others, who attributed criminality mainly to the psychic impulse of imitation. While all these efforts, like the doctrine impeached by them, were vitiated by the aim of furnishing a single explanation of the extremely complicated and puzzling problem of the persistence of crime in an orderly civilisation, each and every one of them, nevertheless, made a contribution to the criminology of the future.

Absence of Physical Criminal Type.—It remained, however, for an English physician, Dr. Charles Goring, medical officer of H.M. Prison Service, to demonstrate the fallacy of the central assumption of the Italian criminologists. Adopting more rigorous methods of examination and measurement of inmates of the English prisons and correlating the results with similar examination and measurements of members of the law-abiding community, he proved conclusively that criminals, as a class, differ more widely among themselves than they do from the community outside and that the latter show the same "stigmata of criminality" that criminals possess. In his work, *The English Convict*, published in 1913, Dr. Goring announced, as an "inevitable conclusion" from his researches "that there is no such thing as a physical criminal type," a conclusion which is now accepted by every criminologist of standing. Dr. Goring's further conclusion, stated with equal positiveness, that "there is no such thing as a mental criminal type," while it is also generally accepted, rests upon no such satisfactory basis of evidence and may be regarded as open to contradiction.

Whatever may be the merits or the defects of the specific doctrine which will always bear Lombroso's name, his work has these outstanding merits: it first gave the study of the criminal a scientific basis and it powerfully stimulated technical as well as popular interest in the problem. Prior to his time there had been few to question the traditional view of the criminal as a wicked person deliberately and perversely choosing the evil rather than the good. Even the penal reforms with which the names of the Italian Beccaria and the English Romilly and Bentham are associated were inspired almost entirely by humanitarian motives. But since Lombroso's death the scientific study of the criminal and of the personal and social factors that are favourable to his development has been going on with increasing momentum.

American Progress.—Except in the field of penology, America was late in getting into the current of criminological thought. Here there were eminent prison reformers before Howard and Romilly, and the first American penitentiary, for better or for worse, became the model of the European convict prison. It is in the United States, too, that the most hopeful and daring experiments in the treatment of the convicted offender were undertaken. But it was not till the first decade of the present century that the scientific study of the criminal began to receive the serious attention of students of the subject. Teachers of the social sciences in several American universities incorporated the topic in their lectures and in 1909 the first American society for its study, The American Institute of Criminal Law and Criminology, was organised in the city of Chicago. It is worthy of note that the first half-dozen annual volumes of the *Journal* of the society are almost exclusively taken up with criminal law and its penological developments, while of the 160 pages of the last number of the *Journal* at hand (Nov. 1925), 93 are devoted to studies and methods of study of the delinquent.

The New Psychology.—This significant change of emphasis, which became apparent about 1915, was, perhaps, primarily due to the rapidly developing interest of the new psychology in morbid and defective mental conditions, an interest which has powerfully stimulated the growth of that branch of medical science now known as psychiatry (*q.v.*). The psychologist found his most interesting and revealing material for the study of the mind in the asylums or hospitals for the insane, and it was only a short step further to the study of similar abnormal types of personality in the prison, with the result that it is scarcely too much to say that in 1926 every psychiatrist is a criminologist. This development, which went on *pari passu* in England and on the Continent and which was, in fact, largely inspired by the writings of Freud, Jung and other European students, has, in recent years, become the dominant influence in criminological thought on both sides of the Atlantic.

Social Mechanism and Crime.—During the same quarter-century that has witnessed this extraordinary development of psychologic thought, the social sciences have been turning more and more from speculation and the discussion of general principles to the concrete study of the workings of the social mechanism. Particularly in America, where sociology is a highly favoured study, the science has been greatly enriched and is being in a measure reconstructed through the critical investigation of existing personal and social conditions. Thus we have "surveys" of cities and towns or of rural communities in which the social conditions which breed dependency and delinquency are brought to light, and "case-studies" of dependent families or of children "in trouble," through which the domestic or individual factors which lie back of the trouble are disclosed and analysed. Usually the psychologist with his mental tests or the psychiatrist, with his psychoanalytic apparatus and his interpretation of the reaction of the individual to his specific environment, is at hand to contribute his diagnosis to make up the sum of knowledge which the social worker requires. (*See* SOCIOLOGY.)

Present Attitudes.—From these combined influences three results of first-rate importance are already in evidence. The first of these is that criminology is less and less concerned with the identification and description of "the criminal" and more and more with the understanding of the individual offender; the second, that the principal emphasis is being laid, perhaps to an excessive degree, on the mental study of the delinquent; and the third, that the medical concept of treatment is by way of superseding the legal concept of punishment. The reference here is, of course, to the attitude of the criminologist and not of the public nor of the agencies of law enforcement, which cling to their idols. It is worthy of note how impervious the public and the courts are to the influence of criminological thought. Even the doctrines of Lombroso, during the generation when they were in the ascendant and commanded the allegiance of most continental students, made practically no impression on the criminal law or procedure of any European country. There is still too much diversity of opinion among criminologists as to the nature and causes of criminal misconduct to justify a confident statement of their views, but the following tentative summary may, perhaps, be ventured as representing the trend, if not a consensus, of opinion.

Relation to Sociology.—There is no criminal class except in so far as criminal misconduct has with certain individuals become habitual. Criminals are selected by force of circumstances (and here the economic factor comes into play) from the community at large. The insane, the mentally defective and the psychopathic stand the best chance of being so selected. It has been upon the whole a fortunate circumstance that, as outlined above, criminology has been adopted into the family of the social sciences. If this robs it of the independent status conferred upon it by its parentage, it has, on the other hand, enormously enlarged its range and utility. Crime now presents itself as only one of many inter-related social phenomena of a malignant character, such as the persistence of poverty, of widespread disease, and of mental disorder and defect. Criminology profits by, and it makes its peculiar contribution to, the study of each of these related disorders of the social body and, like the other social sciences, it furnishes a reflection of the state of health of the community in which crime is permitted to flourish.

Criminology in this later phase of its development, thus furnishes a solid body of knowledge as to the causative factors of delinquency, both the personal and the social, on which constructive efforts to abate the evil may hopefully be based. This analysis of the recent development of the science must record the great service that has been rendered by the American Institute of Criminal Law and Criminology, not only in the publication of its *Journal*, but even more, perhaps, by placing at the service of students in America and other English-speaking countries excellent translations of the leading criminological treatises published in foreign languages.

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(G. W. K.*)

CROATIA-SLAVONIA (*see* 7.471), since 1918 provinces of Yugoslavia (the Serb-Croat-Slovene State). Its area is 16,920 sq. m.; and the population (1920) 2,739,593.

The Struggle in the Dual Monarchy.—The triumphant vindication brought by the Friedjung trial to M. Supilo and his colleagues of the Serbo-Croat coalition (*see* FRIEDJUNG) gave a fresh incentive to the idea of unity throughout the Southern Slav provinces of Austria-Hungary. On April 3 1912 the Croatian constitution was completely suspended by royal decree and Cuvaj invested with far-reaching dictatorial powers. An attempt on his life by the student Jukić (Yukitch) June 8 was followed by still more reactionary measures, and on July 11 the autonomy of the Serbian Orthodox Church in Slavonia and Hungary was also suspended. The Cuvaj régime had a magical effect in furthering the movement for Yugoslav unity. Henceforward the Slovenes—Clericals no less than Progressives—began to take an increasingly active part in the Yugoslav movement. It was peculiarly unfortunate for Austria-Hungary that the Cuvaj régime should have been at its height when the Balkan League achieved its dramatic victory over the Turks. When Austria-Hungary mobilised, protests were heard on every side against the bare possibility of war with Serbia, which to the Yugoslavs would be a veritable civil war.

On Dec. 27 1912 Cuvaj was replaced by a colourless official, Dr. Unkelhäusser, who marked time until a fresh candidate for the post of Commissary or Dictator was forthcoming in the person of Baron Skerlecz (July 23 1913). This appointment at a

moment when Austria-Hungary was again contemplating war with Serbia naturally increased the ferment. On Nov. 30 Skerlecz was made Ban, the illegal decrees of Cuvaj revoked and general elections ordered—the fifth since 1906. The coalition maintained its majority, the Government only obtaining 10 seats; but though this time the Diet was allowed to meet, no attempt was made to satisfy Yugoslav aspirations or to solve the real issues at stake between Hungary and Croatia. More and more the situation in the south of the monarchy was allowed to drift. On the eve of war the university and middle school students had five or six newspaper organs of their own, in Zagreb, Vienna, Prague and elsewhere; and every shade of opinion was represented, from doctrinaire radicalism to revolutionary terror. The Bosnian group was the most extreme (*see* BOSNIA-HERCEGOVINA), but the unrest was quite as pronounced among the Croats as the Serbs, and was rapidly spreading to the Slovenes also, and even the Moslems, who were the last to be infected by nationalistic feeling. The Sarajevo murder on June 28 1914 was the sixth outrage in four years, and four of these took place in Zagreb.

The War 1914–8.—Immediately on the outbreak of the World War measures of extreme severity were taken by the civil and military authorities of Austria-Hungary throughout their Yugoslav provinces. The exact number of persons arrested or interned will probably never be known, but the Yugoslavs were regarded, and treated, as a hostile population. In Croatia alone was there even a semblance of constitutional government. The Diet of Zagreb was allowed to meet, and the Serbo-Croat Coalition pursued a policy of pure opportunism, avoiding any pronouncement on matters of high policy.

Meanwhile, a certain number of Yugoslav leaders had managed to reach foreign soil before the outbreak of war, and during the winter of 1914 constituted themselves as the Yugoslav Committee with its headquarters in Paris and London. Its two foremost leaders were Dr. Trumbić and M. Supilo (two of the makers of the Resolution of Fiume) and it also included Dr. Hinković (known as the chief advocate in the Zagreb treason trial, and Ivan Meštrović (Meshtrovitch), the sculptor. In Dec. 1916 the Yugoslav Committee issued a manifesto in favour of complete independence and unity with Serbia and the deposition of the Habsburgs; but at home in Croatia the coalition sent its delegations to the coronation of Charles as King of Hungary. By its compliance it obtained the appointment of its nominee Mihalović as Ban and was thus able to husband Croatian resources and on occasion to practise passive resistance. It accepted the *status quo*, but no amount of pressure could ever wring from it a disavowal of Trumbić and the exiles: and meanwhile by secret agreement the Croats and Slovenes of Dalmatia and Istria took advantage of the political amnesty and the resumption of Parliamentary life in Austria, to form a unified Yugoslav Club in close alliance with the Czechs, and to demand the union of all the Yugoslav territories of the monarchy in an independent state organism. The Declaration of Corfu, concluded on July 20 1917 between Pašić as Serbian Premier and mouthpiece of all Serbian parties, and Trumbić as President of the Yugoslav Committee, defined the lines upon which the three branches of the Yugoslavs desired unity and independence.

The Birth of Yugoslavia.—In Sept. 1918 Count Tisza, with the Crown's approval, visited Zagreb, Sarajevo and Dalmatia in order to win support for a Magyar solution of the Southern Slav question, but he was everywhere met with a blank refusal. On Oct. 1, encouraged by Bulgaria's surrender, the Czech and Yugoslav deputies in the Reichsrat demanded separate representation at the peace negotiations, and proclaimed their absolute right to decide their own future state allegiance. On Oct. 10 the Yugoslav National Council was transplanted from Ljubljana to Zagreb and strengthened by the inclusion of representatives of all parties. When a week later the Hungarian Govt. declared in favour of personal union and the Emperor issued a decree in favour of the federalisation of Austria, Korošeć (Koroshets), in the name of the Czech and Yugoslav clubs, unreservedly rejected this project and claimed that the future of both nations was an international problem which only the future Peace Conference could solve.

Henceforth the Yugoslavs acted independently of both Vienna and Budapest, and President Wilson's answer to Burián's Peace Note (refusing to negotiate save on the basis of a recognition of Czechoslovak and Yugoslav national claims) was the signal for open repudiation of Habsburg rule. Local committees were formed in Dalmatia and Bosnia, which recognised the authority of the Yugoslav National Council in Zagreb and in its name disarmed the troops pouring northwards from the broken Albanian and Macedonian fronts. As early as Oct 23 a Croat regiment disarmed the Magyar militia in Fiume and took possession of the town, and on the 28th the military command in Zagreb handed over its authority to the National Council. Next day the Diet proclaimed the independence of Croatia from Hungary and assumed control of Fiume. The arsenals of Pola and Cattaro were already in the hands of the insurgents, and the Emperor Charles, in the hope either of winning the favour of the new régime in Zagreb, or of throwing an apple of discord between it and the Entente, signed a decree on the 31st, making over the whole Austro-Hungarian fleet to the Yugoslav State. Before this fact could become known to the Entente a daring Italian officer swam into Pola harbour and blew up the flagship "Viribus Unitis" with the new Yugoslav admiral on board. The Entente insisted upon the surrender of the fleet into their hands, but meanwhile prescribed the frontier line of the secret Treaty of London as the line of occupation under the Austro-Hungarian armistice.

This was keenly resented by the Yugoslavs, as a violation of Wilsonian principles, and when the Italians proceeded to occupy Trieste, Istria, north Dalmatia, and some of the islands, a dangerous situation arose. The Zagreb Govt. urgently invited the assistance of the Serbian Army, which during the final advance contained a large proportion of Yugoslav volunteers. On Nov. 18 the first Serbian troops entered Fiume, and on the 23rd the Zagreb National Council, under pressure of events and alarmed at the equivocal attitude of the Entente towards the new state, proclaimed the union of the territories under its control with the kingdoms of Serbia and Montenegro, and invited the Prince Regent of Serbia to assume the Regency of the new state. This decision took formal effect on Dec. 1, when 24 delegates from Zagreb appeared before Prince Alexander in Belgrade and invited him to proclaim the union.

Croatia in the Yugoslav State.—The first Yugoslav Cabinet was constituted under Stojan Protić as Premier and the Slovene clerical leader Korošić as vice-premier: Trumbić became Foreign Minister and the other portfolios were divided more or less equally between Serbia and the new territories. The dignity of Ban of Croatia was at first retained, but centralist tendencies soon gained the upper hand in the new state, and it was abolished under the new constitution of St. Vitus' Day 1921, and the provincial administration gradually wound up. This was much resented in Croatia, and Trumbić and other Croat deputies voted against the constitution, but they were left in a minority owing to the fatal policy of abstention pursued by the Croat peasant party under Stephen Radić, which made it possible for Pašić to carry through his centralist designs and refuse a reasonable compromise. Radić's capitulation to Pašić in the summer of 1925 and his acceptance of office in a Radical Cabinet marked the triumph of the centralist idea, at least for the time, but it also put an end to the conflict of Serb and Croat as a party issue and so marked a notable stage in the consolidation of Yugoslavia. (*See* also YUGOSLAVIA.)

CROCE, BENEDETTO (1866–), Italian philosopher, was born Feb. 25 1866 at Pescasseroli, Aquila, of an Abruzzese family, the seat of which had been transferred to Naples by his grandfather. There Croce was educated at a Catholic school. In 1883, having lost both his parents in an earthquake, he went to live in Rome with his paternal uncle and guardian, Silvio Spaventa. He entered the university but did not pursue his studies there, returning to Naples in 1886, where he occupied himself for several years with researches into local history and antiquities. His con-

tributions to philosophy began with two essays (1893) upon the nature of history and the method of literary criticism the leading ideas of which he developed in two later papers in 1900 and 1904–5. Between 1896 and 1900 he published also a group of essays on points of Marxian economic doctrine. Shortly after, in 1902, he began the systematic exposition of his Philosophy of the Spirit, divided into Aesthetic, Logic, Philosophy of Conduct (Economics and Ethics) and Theory and History of Historiography. In 1903 he founded the journal *La Critica*, in which he reviewed the whole fine literature of Italy for 50 years, and later similarly reviewed its contributions to historical literature. During all this time he continued to publish a great number of important works on philosophy, European literature and history. His collected works in 1926 filled nearly 20 volumes. Though actively interested in educational administration, he never sought or occupied any university office. In 1910 he was nominated to the senate of the kingdom, and was Minister of Education in the Giolitti Cabinet (June 1920—July 1921).

Croce's Philosophy.—The philosophy of Croce, often erroneously classed as "Hegelian," had its avowed sources in the ideas underlying the literary criticism of Francesco de Sanctis, and, more generally and remotely, in those adumbrated in the *Scienza Nuova* of G. B. Vico, both like himself Neapolitans. More significantly, it arises from and perpetually returns to his own personal experience in his lifelong and multifarious activity as a student of literature and history. Here he finds himself in vital touch with concrete reality, and deliberately confines his reflections to the content of actual or enacted history with a view to its interpretation. Hence he has been led to assert the identity of concrete philosophy with history, and to define the task of abstract philosophy as the discovery and formulation of the immanent methodology of history. From the common domain of both he excludes any supposed realities which transcend experience, and abstains from speculations about such, as he also does about primal origins and ultimate ends. History as enacted and occurring and history as interpreting what is thus "given" he views as the work of one Spirit, which there expresses and embodies itself. In every part and moment of history that Spirit is wholly and indivisibly present and active. Its presence and operation are not confined to human history, but extend in all directions to the utmost bounds of experience. The Spirit which is thus omnipresent throughout the whole content of experience is indivisibly one, but its unity is also a quaternity, and it has in its structure four eternally distinct and distinguishable "grades," the ordered circle of which in its life or progress it perpetually traverses, so endowing or filling itself with experience and ever enriching its being. Its four functions in their conjoint exercise generate the contents of experience, within which we can and must distinguish four corresponding grades, stages, kinds or realms, the respective subject-matters of aesthetic, logical, economic and ethical theory, departments of philosophy, which together without addition constitute the whole of it.

In its total cognitive function this Spirit manifests itself as art, the first or "dawn" form of knowledge. In this grade it expresses itself in individual embodiments; in so expressing itself it at once creates and beholds what it creates, and has for its objects (which are also its works) whatsoever in experience presents a characteristic individuality. In its second cognitive grade, as logic or abstract philosophy, it expresses, brings to existence and view, and so knows whatsoever is universal. Uniting, as it cannot but do, both functions, and thus becoming concrete in history, it effects an *à priori* synthesis between what is individual and what is universal; in doing so, it wins actual understanding of the real and enters upon a course of knowledge which runs from sense-perception up to explicit history. The history which thus in history comes to be understood is wholly the work of the same Spirit in the exercise of its total practical function, which has two corresponding grades, in the lower or earlier of which it enacts what is individual, in the higher or later what is universal, or, rather again, in its actual or concrete exercise, enacts both in one, and so fills the stage of history with its deeds. Still more actually or concretely, it is active at once as making or creating and knowing or understanding its own history, which is its whole self. The only reality which can truly be called absolute is a history without beginning and without end, self-begotten and self-explaining.

The developments and applications which Croce gives to this fundamental doctrine are extraordinarily various, and often highly novel and even paradoxical. They have excited widespread interest and evoked abundant criticism and opposition. Against his critics Croce carries on a sustained and skilful polemic. He exercises an increasingly profound influence on the higher thought of his country and beyond it, and even those who most firmly dissent from his teaching acknowledge the daring originality of his philosophy, the patience and vigour shown in its systematic development, the literary dexterity displayed in its exposition and defence. To many it seems already to have established a place in the world of contemporary philosophy comparable with that occupied during a great part of the 19th century by the system of Hegel.

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(J. A. S.*)

CROCKETT, SAMUEL RUTHERFORD (1860–1914), British novelist (*see* 7.477), died at Avignon April 20 1914.

CROKER, RICHARD (1843–1922), American politician (*see* 7.481), died in Dublin, Ireland, April 29 1922.

CROMARTY (*see* 7.483).—The erection of defences at Cromarty was begun in 1912 and had made considerable progress by the outbreak of the World War. The port was used throughout the War as a coaling station and was one of the nine trawler stations under the control of the admiral of patrols. Cruiser squadrons, with their destroyer flotillas, used Cromarty as their base, and from Cromarty the "Invincible" and "Inflexible" started for the battle of the Falklands. One of the most serious naval disasters of the War occurred in the harbour of Cromarty on Dec. 30 1915, when the armoured cruiser "Natal" was destroyed by an accidental explosion.

CROMER, EVELYN BARING, 1ST EARL OF (1841–1917), British statesman and diplomatist (*see* 7.484). Lord Cromer's life was prolonged for nearly 10 years after his return from Egypt; and, in spite of enfeebled health he took an important share in political, social and literary movements at home. He was constant in his attendance at the House of Lords, and indefatigable in the work of its committees; he was a leading member of the free-trade section of the Unionist party; he was active in opposition to female suffrage, and in combating anti-vivisection propaganda. Besides publishing his two volumes of *Modern Egypt* (1911), he composed several addresses and pamphlets, wrote frequently for the periodicals, and from 1912 onwards was a regular contributor of signed articles and reviews of books to *The Spectator*.

When the British Protectorate of Egypt was proclaimed, he completed his history of the modern development of that country in a small volume entitled *Abbas II.* (1915), containing matter which it would have been indiscreet to publish so long as Abbas remained Khedive. While he was forward in promoting the study of oriental languages, his strongest affection was for the Greek and Latin classics with which he had only become acquainted in mature life; he became president of the Classical Society, and endowed a Greek prize for the British Academy.

In the critical period of which the main features were the Budget of 1909 and the Parliament Act of 1911, Lord Cromer played an energetic part. He failed to prevent the rejection of the Budget by the House of Lords; but he was successful in persuading moderate Unionist and cross-bench peers to counter the Die-hard movement, and to vote for the Parliament Act rather than force the Govt. to swamp the House of Lords by an unlimited creation of peers. It was in the performance of another patriotic

duty, during the World War, that he met his death. In spite of age and indifferent health, he accepted the laborious and insidious task of chairman of the special commission to inquire into the Dardanelles operations. The sittings occupied the autumn of 1916, and while engaged on the draft report he was seized in December with an attack of influenza. Before he had recovered he resumed the work of the commission, which completely broke him down. He died in London Jan. 29 1917. Seldom has there been a life more singly and successfully devoted to the good of his country. See Lord Sanderson, *Memoir of Evelyn, Earl of Cromer* (1917). (G. E. B.)

CRONJE, PIET ARNOLDUS (1840–1911), Boer soldier (*see* 7·501), died at Klerksdorp, Transvaal, Feb. 4 1911.

CROOKES, SIR WILLIAM (1832–1919), British scientist (*see* 7.501), died in London April 4 1919. He was given the Order of Merit in 1910.

CROQUET (*see* 7.502).—In 1920 the "either ball" law was first included in the Croquet Assn. Year Book, although it had been played and tested before that date. Since then all championships and competitions have been played under that law. Since 1922 No. 2 Setting has also been used. In this the turning peg is omitted, the winning peg is equi-distant from the four corners and the two central hoops are placed on the central line seven yards on either side of the winning peg. This has made the game more difficult than formerly, and with $3\frac{3}{4}$-inch hoops, peeling is not so easy as formerly.

The Croquet Assn., which has 200 clubs and some 1,600 associates in membership, is a large and growing body, and at its headquarters, Roehampton, and in different parts of England, tournaments under its auspices are held during every week of the croquet season, April to October. For many years an open championship and a ladies' championship have been carried on simultaneously, but in 1925 a men's championship was instituted, which was played for in one week with the ladies' championship and the mixed doubles championship, the open championship and open doubles championship being contested the following week. Another competition, the champion cup, which is competed for by the 10 best available players chosen by the council of the Croquet Assn., is played on the American principle, each competitor meeting each of the other competitors twice, thus playing 18 games in all. Great interest was taken in the Australian team which visited England in 1925. Three test matches were played comprising the best of three singles and doubles, England winning all three tests and losing only one double in the last match.

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(D. D. S.)

CROSSWORD.—This form of puzzle became very popular in the United States and Great Britain after 1923 and many daily and weekly newspapers made a feature of their crosswords, which were also used for advertising purposes.

The crossword begins as a diagram, of varying shape, divided into squares, some blank and others blacked over. Each of the blank squares is intended to contain a letter and each letter forms part of one or two words. The words read both downwards and across, so that most of the letters must form part of two words. The clues to the words are given and are numbered to correspond to numbers on the diagram. The aim of the solver is to find out the words from the clues, so that each letter fits in with the others. A glance at the illustration in the next column will make this clear.

The figure most commonly used is the square of 15, but other forms are frequently adopted. Some figures contain spaces arranged in uniform design, whilst others are irregular, the objection to the former being the necessarily more frequent introduction of certain words, the repetition of which in puzzle after puzzle becomes monotonous, *e.g.*, to take one initial only, EDEN, EGO, EKE, EM, EMU, ENA, ENO, ERA, ERIN, ERSE, ETON, EVA, EVE. When the puzzle is built up irregularly, it can more easily bear on a certain subject, topical or otherwise, and words containing 8, 10 or 12 letters, which are difficult to use if uniformity is a first consideration, may be introduced without any trouble.

The history of the crossword puzzle is comparatively modern. It probably originated in England, but very quickly lost favour because no definite rules of construction were observed. It was taken up more successfully in the United States, where it was

1 D	E	2 S	3 P	4 E	5 R	6 A	T	7 E
I	■	8 O	R	E	A	D	■	M
9 A	10 T	■	11 E	L	Y	■	12 S	I
13 P	R	14 A	Y	■	15 S	16 P	A	N
17 H	A	S	■	■	■	18 O	B	E
19 R	I	S	20 E	■	21 F	E	R	N
22 A	N	■	23 D	24 Y	E	■	25 E	T
G	■	26 I	D	E	A	27 S	■	L
28 M	O	N	A	S	T	E	R	Y

Fig. 1.—Example of regular crossword puzzle.

CLUES

Across	*Down*
1. Hopeless.	1. Connected with respiration.
8. Mountain nymph.	2. Thus.
9. Place where.	3. Spoil.
11. Cathedral city.	4. A fish.
12. Yes (Ital.)	5. Lines of light.
13. Entreat.	6. The present era (abbr.)
15. Nine inches.	7. Rising above others.
17. Possesses.	10. Runs on a railroad.
18. An order (abbr.)	12. Cavalry sword.
19. Get up.	14. Patient animal.
21. Elegant plant.	16. Wrote "The Raven."
22. Indefinite article.	20. Scandinavian mythology
23. Colour.	21. Exploit.
25. And (Fr.)	24. Affirmative.
26. Notions.	26. Preposition.
28. Abode of monks.	27. Point of the compass.

composed on certain stated lines, and the clues were less ambiguous. It is still open to improvement, especially in the definitions, which are often too meagre and too vague. The author, whose object is to entertain as well as to instruct, avoids as much as possible (*a*) technical terms, (*b*) obsolete words and provincialisms, (*c*) isolated letters—known as islands—which are surrounded by black squares on three sides and (*d*) the repetition of such threadbare words, as ADEN, ISIS, OASIS, OG, etc. The black spaces should not exceed 20% of the whole, and the definitions or clues should receive particular care, for on these chiefly depends the ease or difficulty with which the puzzle is deciphered. It should be remembered that the newspaper reader, who is not always gifted with the patience of the student, feels more satisfaction in finding the solutions than the author in constructing the problem. (E. Wi.)

CROWDER, ENOCH HERBERT (1859–), American soldier, was born in Missouri April 11 1859. He graduated from the U.S. Military Academy in 1881, and while detailed as commandant at the University of Missouri took the law course there (LL.B., 1886). He was appointed judge-advocate in 1895. He served in the Philippine Is. (1898–1901), was observer with the Japanese Army in Manchuria (1904–5), and was in Cuba as Secretary of State and Justice (1906–8). He was a delegate to the 4th Pan-American Conference in July 1910, and visited Chile on a special mission in Sept. of that year. He became judge-advocate-general in 1911. He was provost-marshal-general from May 1917 to July 1919, and as such had full

control of the U.S. machinery of conscription in the World War. He was re-appointed judge-advocate-general in 1919. Gen. Crowder was recognised as an expert in military law. In his book, *The Spirit of Selective Service* (1920), he describes the method whereby within 18 months after America had entered the World War 2,000,000 men were in France, almost as many more were in cantonments, and altogether no fewer than 24,000,000 had been registered and classified. He served as personal representative of Presidents Wilson and Harding in Cuba from Dec. 31 1920 to March 5 1923, on which latter date he became ambassador of the United States to Cuba.

CROWE, SIR EYRE ALEXANDER (1864–1925), British civil servant, was born at Leipzig July 30 1864. Educated at Düsseldorf, Berlin and Paris, he entered the Foreign Office in 1885, became counsellor of embassy in 1907, and assistant under-secretary of state in 1912. He was a British delegate at the second Hague Conference of 1907 and at the International Naval Conference held in London in 1908. He conducted the British case in the arbitration of 1911 regarding the recapture in France of the Indian agitator Savarkar, and was created K.C.M.G. Though his mother and wife were German, he was a vigilant critic of German foreign policy and before the War prepared an impressive memorandum for the Cabinet on the subject, whilst his scheme for seizing German shipping in British ports was adopted when the crisis came. He was one of the committee of six who drew up for Great Britain a draft convention of the League of Nations. He was an outstanding figure at the Paris Peace Conference and assisted Mr. Balfour, the British representative, to revise the treaty with Austria. He also rendered valuable services as a member of the Territorial Commission of the Conference. In 1920 he was promoted G.C.M.G. and became permanent under-secretary for foreign affairs. He died April 28 1925.

CROYDON, England (*see* 7.520), had an area of 9,012 ac. and a population of 190,877 in 1921. The Whitgift hospital or almshouse (1596) in the centre of the town, was only saved from destruction in connection with a road widening scheme in 1925 after a protracted dispute involving parliamentary action. The Government civil customs aerodrome, operated by the civil aviation department of the Air Ministry, is at Waddon, two miles to the southwest of Croydon town hall. It is officially known as the London Terminal Aerodrome, Croydon, and is one of the busiest air ports in the world (*see* AERODROMES). Three companies, Imperial Airways Ltd., the French Air Union and the Dutch K.L.M., operate direct regular services on well-organised air routes to several of the leading continental capitals, air connections to more distant European cities being obtained by special interworking.

CROZIER, WILLIAM (1855–), American soldier (*see* 7.520), was detailed in 1912 as president of the Army War College, and the following year was reappointed chief of ordnance with the rank of brigadier-general. He was made major-general and chief of ordnance, U.S. Army, in 1917, and major-general of the line in 1918. He was a member of the War Council, and in the discharge of this office was in France and Italy for the first half of 1918. For the remainder of the year he was commandant of the N.E. Dept., U.S.A., retiring from active service Dec. 31.

CRYSTALLOGRAPHY (*see* 7.569).—The geometry of the external forms of crystals has been completely worked out. The 32 crystal-classes differing from one another in their type and degree of symmetry and the six crystal-systems into which these classes can be grouped are now well established. The same is also true of the geometrical conceptions of the internal structure of crystals. There are 230 possible types of homogeneous point-systems, referable to 14 kinds of space-lattices. Attempts have been made to trace a connection between the internal structure of crystals and their chemical constitution. Here there is ample scope for speculation; but since 1912, when X-rays provided a new method of investigation, some real advance has been made. By this method it is possible not only to determine the internal structure of crystals, but also actually to measure the distances between the atoms.

Crystals consist of a homogeneous assemblage of particles, which are marshalled in certain definite ways. The grouping around any one particle (except those on the boundaries of the crystal) is the same as that around every other particle of the same kind. Further, the particles are arranged at regular intervals along straight lines. Throughout the structure there are

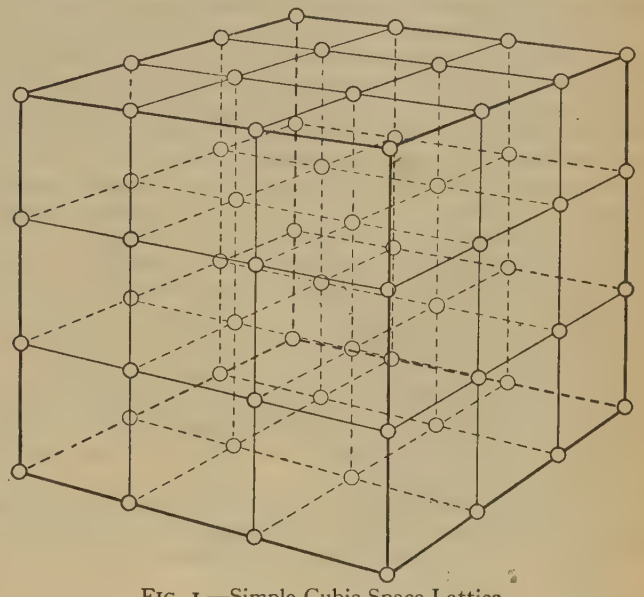

FIG. 1.—Simple Cubic Space Lattice.

several parallel sets of such lines, and these lie in several parallel sets of planes also at regular intervals apart.

An example of such a structure is the simple cubic space-lattice represented in fig. 1. Here the particles (all of the same kind) are placed at equal distances, say a, along parallel lines in three sets at right angles; the distance between the parallel lines in each plane and between the parallel planes of lines being also a. That is, the particles are situated at the points of intersection of a system of lines that form a square network or lattice in three dimensions. Or the structure may be regarded as a stack of small cubes each with a quarter of a particle at every corner; the four adjoining cubes at each corner then providing the whole particle. In this grouping, any one particle is surrounded by a set of 6 similar particles at distance a; further, it is surrounded by 12 particles at distance $\sqrt{2a}$ (*i.e.*, the diagonal of the square); and by eight other particles at distance $\sqrt{3a}$ (*i.e.*, the diagonal of the cube).

It is clear from fig. 1 that the three sets of lines are parallel to the edges of the cube, and that they lie in planes parallel to the

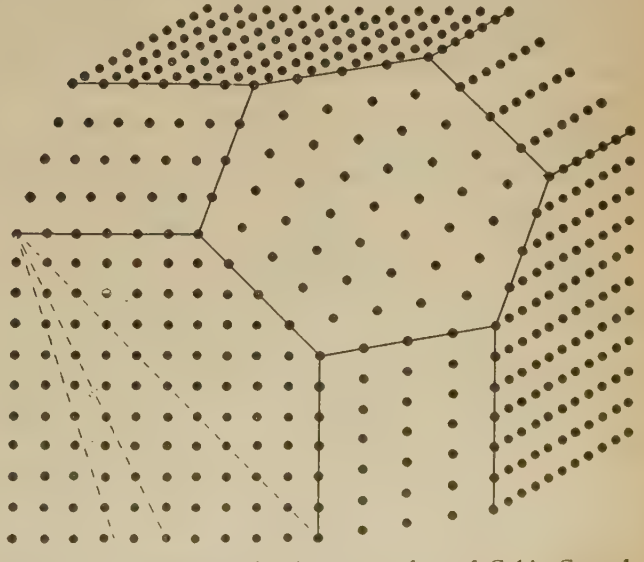

FIG. 2.—Arrangement of points on surface of Cubic Crystal.

faces of the cube. But the particles also lie in other sets of parallel lines, which fall in other sets of parallel planes. Certain of these additional lines and planes of particles are represented more prominently in fig. 2, which is drawn on a smaller scale with a larger number of particles (but to avoid confusion only those on the surface of the solid are marked). In this figure the three front edges of a portion of the main cube are truncated by planes of the rhombic-dodecahedron, and one corner has been cut off symmetrically by a face of the octahedron. (Since the octahedron face intersects both the cube and the rhombic-dodecahedron faces, its outline is hexagonal.) The several layers of particles parallel to any one of these faces are continuous over the other faces, although the particles themselves are ranged along lines of different directions. Hundreds of different planes of particles can, in fact, be traced out in such a structure; and these structure planes are parallel to possible external faces on the crystal. A close relation exists between the Millerian indices of these faces and the number of particles along certain lines in the corresponding planes. The dotted lines on the front cube face in fig. 2 represent the intersections or traces of such planes with the indices: (111), (211), (311), etc.; (221), (321), etc.; (331), (431), etc.; respectively for the lines from right to left. The seven planes of which the indices have just been given necessitate by symmetrical repetition the presence of 93 other structure planes, or, in all, 200 external crystal faces.

A study of fig. 2 shows that the spacing between the particles is not the same on each of the faces (allowance being made for foreshortening in the drawing; only on the front cube face are the particles represented at their true distance apart). On the cube faces the distances each way are, of course, a. On the faces of the rhombic-dodecahedron they are spaced at distance a in one direction, but along the second direction at right angles at distance $\sqrt{2a}$. On the octahedral face there is, instead of a rectangular grouping, a triangular and hexagonal pattern with the particles spaced at distances $\sqrt{2a}$ in three directions. Therefore the number of particles on each of the faces is not the same for equal areas. The network of particles is closer on the cube face than on the rhombic-dodecahedron, and more open on the octahedron. This " reticular density " of the different faces is important and is closely related to the cleavage of crystals. Minerals with cubic cleavage (*e.g.*, rock-salt and galena) would be expected to be of this structure.

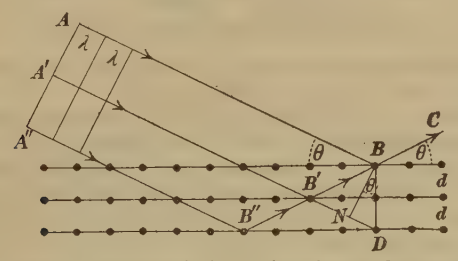

FIG. 3.—Reflection of X-rays by planes of particles.

In addition to the spacing of the particles in the planes, there are also to be considered the distances between the planes themselves. This can be represented by means of vertical sections through the structure perpendicular to the respective planes. The spaces between the cube planes is a, and the particles are also spaced at distance a; the pattern being, in fact, that on a cube face perpendicular to the first. The distance between the rhombic-dodecahedron planes is given by half the diagonal of the cube face, namely, $a/\sqrt{2}$. Here, however, the section-plane intersects lines of particles only in alternate rhombic-dodecahedron planes. The distance between octahedron planes is given by one-third the diagonal of the cube, namely, $a/\sqrt{3}$; and the particles are at distances $\sqrt{6a}$ apart along the traces of the octahedron planes, though only at distances a or $\sqrt{2a}$ across these planes.

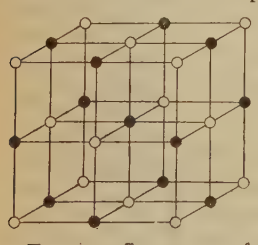

FIG. 4.—Structure of Rock Salt, or Galena (PbS).

There are two other types of cubic lattice. One of these has an additional point at the centre of each cube (this may be called the centred cubic lattice), and another has additional points at the centre of each face, giving the face-centred cubic lattice (represented by the white spots on the larger cube in fig. 4). The different relations afforded by these types need not be discussed here. But in the centred cubic lattice the greatest reticular density is in the rhombic-dodecahedron planes, whilst in the face-centred cubic lattice the particles are most closely packed in the octahedron planes. These would be expected to correspond to cubic crystals showing rhombic-dodecahedral and octahedral cleavage (*e.g.*, zinc blende and fluorspar) respectively.

Types of lattices other than the cubic are deduced by varying the distances of the particles along the different axes and by varying the angles between these axes, in a manner similar to that in which the six crystal-systems are deduced. In fact, the elements of the elementary cells of the lattice, namely, the ratios of their lengths and the inclination of their edges, are identical (except in certain cases) with the parameters $a:b:c$ and the axial angles α, β and γ deduced from the external crystal faces.

The " particles " referred to above may be crystal molecules, chemical molecules, or even atoms. They are represented in the diagrams as spots without committing ourselves as to their shape or size (in relation to their distance apart). Some authors represent them as spheres in contact with one another, regarding these as the spheres of influence of each atom. If the spheres are of equal size, the number of points of contact and the closeness of the packing will vary with the type of lattice. Or again, we may regard the particles (all of the same size) as completely filling space. In this case the particles in the simple cubic lattice will be cubes, each in contact with six other cubes; in the centred cubic lattice they are cubo-octahedra with 14 surfaces of contact; and in the face-centred cubic lattice they are rhombic-dodecahedra with 12 surfaces of contact.

The above outline of the geometrical structure of crystals has been necessary for the purpose of introducing the new X-ray methods of investigating the internal structure of crystals.

X-rays or Röntgen rays are propagated as waves in the same manner as rays of ordinary light, but are of much smaller wavelength. The very fine rulings of parallel lines (about 7,000 to a cm.) of diffraction gratings being of a magnitude (10^{-4} cm.) comparable with the wave-lengths of light, they produce well-known diffraction effects. It would be impossible to produce mechanically a grating which would be fine enough to diffract the much shorter X-rays. But it occurred to Dr. Max Laue, of Zürich, that the reticular structure of crystals would supply the necessary grating, since the distances between the atoms in the space-lattices are of the order 10^{-8} cm. In 1912 this idea was put to the test, with very surprising results. Plates cut from crystals parallel to certain faces were placed perpendicularly in the path of a thin pencil of X-rays, and beyond a photographic plate was exposed. The resulting photograph (known as a Laue photograph or radiogram, Röntgenogram or Röntgen pattern, or spot photograph) shows a larger central spot representing the direct rays, whilst surrounding it is a symmetrical pattern of smaller spots. The spots may also be shown directly by projection on a screen of fluorescent material. This pattern shows the same degree of symmetry as that on the crystal face. Thus a plate from a hexagonal crystal of beryl cut parallel to the basal plane (*i.e.*, perpendicular to the principal axis) shows a six-fold arrangement of spots symmetrical about six radial lines at 30°; whilst when the plate is cut parallel to a prism face of the same crystal, the spots are symmetrical about two lines at right angles.

The results obtained with these Laue photographs were at first explained as due to diffraction, but the problem is much more complex than diffraction by a single system of parallel lines in one plane, since we are here dealing with a lattice in three dimensions in which there are many series of lines in many planes. As explained by Sir William Bragg and his son, Prof. W. L. Bragg, in their book, *X-Rays and Crystal Structure*, 4th ed. (1924), it is

due to the amplification of waves reflected from successive layers of atoms within the crystal. In fig. 3 a beam of X-rays AB, $A'B'$, $A''B''$, all of the same wave-length λ, strikes at a glancing angle θ the planes of particles, the distances between which are d. They are reflected by successive planes as a single ray BC. Produce $A'B'$ to D (then BD is perpendicular to the planes) and draw BN perpendicular to $A'D$. Then, since $B'B = B'D$ and $AB = A'N$, the length of path of the ray $A'B'C$ is greater than that of the ray ABC by the distance $ND = 2d \sin\theta$. Similarly, $A''B''C$ is longer than $A'B'C$ by the same amount. If, now, this distance is equal to the wave-length of the rays, if $\lambda = 2d \sin\theta$,

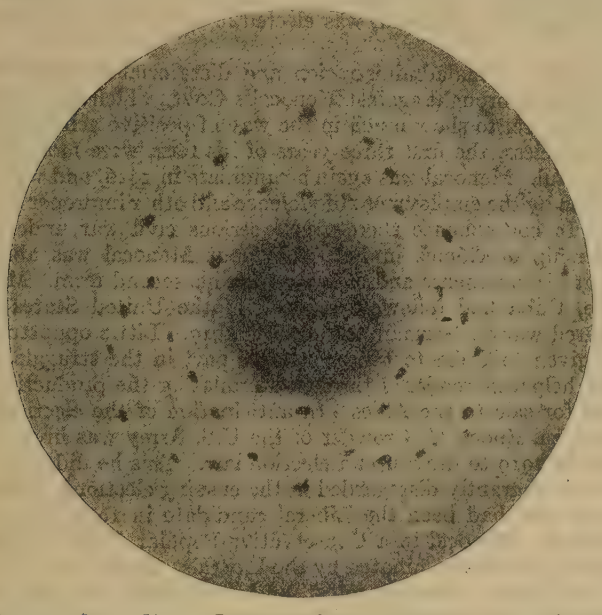

FIG. 5.—Laue X-ray Photograph Through the Basal Plane of Penninite.

the rays reflected by successive layers of particles will be vibrating in the same phase and their amplitudes will be added together. If the glancing angle θ be varied but slightly, the reflections from the millions of layers will vary in phase and they will mutually interfere. But at certain other glancing angles θ_2, θ_3, when $2\lambda = 2d \sin\theta_2$ or $3\lambda = 2d \sin\theta_3$, there will again be an accumulative effect, giving reflections of the second and third orders.

In the Bragg apparatus, called an X-ray spectrometer, homogeneous ("monochromatic") rays from an X-ray tube emerge through a narrow slit in a leaden screen and strike at a glancing angle the crystal plate mounted on a goniometer. The reflected beam enters an ionisation chamber containing sulphur dioxide or methyl bromide and connected with an electroscope. The crystal is slowly turned on the goniometer until a maximum effect is noted in the electroscope, when the angle θ is read. Plotting the readings of the electroscope against those of the goniometer, a curve (X-ray "spectrum") is obtained which shows a series of sharply defined maxima or peaks corresponding to reflections of the first, second and other orders. Knowing the wave-length of the rays, the distance between the planes of particles can then be calculated from the above fundamental equation; or, alternatively, knowing the spacing of the planes, the wave-length of the rays can be determined. As an example, rays from a palladium anticathode ("palladium rays") were strongly reflected from the cube face of rock-salt when the angle θ was 5·9°, 11·85° and 18·15°. Taking the spacing d between the cube planes of rock-salt as $2{\cdot}81 \times 10^{-8}$ cm., the wave-length λ is found to be $2 \times 2{\cdot}81 \times 10^{-8} \sin 5{\cdot}9° = 0{\cdot}578 \times 10^{-8}$ cm., or $2\lambda = 2 \times 2{\cdot}81 \times 10^{-8} \sin 11{\cdot}85° = 1{\cdot}154 \times 10^{-8}$ cm.

A third method of investigation was devised by P. Debye and P. Scherrer in Germany in 1916, and independently by A. W. Hull in the United States in 1917. Here a beam of homogeneous ("monochromatic") X-rays of known wave-length is transmitted through the finely powdered crystalline material, and the reflections received on a photographic film. The tiny crystal fragments are in all manner of orientations; and further to ensure all possible orientations in the aggregate, the tube containing the small amount of powder is rotated during the exposure. For structural planes with the spacing d there are bound to be some of the particles in the position shown in fig. 3 in which the equation $\lambda = 2d \sin\theta$ is satisfied; but these will be lying in all azimuths, *i.e.*, sloping away in all directions at the angle θ from the axis of the rays. The reflected rays will consequently lie on the surface of a cone, the angle of which is 4θ; and, instead of a single spot, a continuous series of spots forming a circle will appear in the

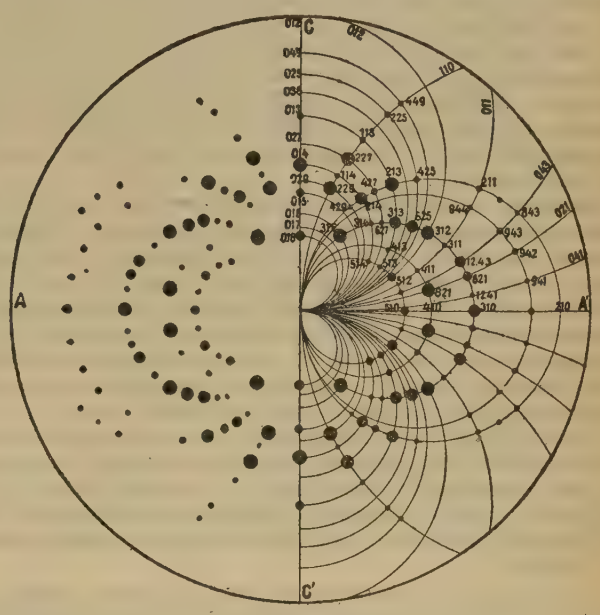

FIG. 6.—Stereogram of Laue Photograph of Anhydrite on the Face (010).

photograph. Similarly, in other fragments the same set of planes with spacing d may be inclined at angle θ_2 giving a second order reflection as required by the equation $2\lambda = 2d \sin\theta_2$, and producing a wider-angled cone concentric with the first. Further, other structural planes with spacing d_1 and inclined at other values of θ will be provided by other fragments, giving still other conical reflections. Since, however, the experiment is performed with rays of one wave-length, only certain values of d will satisfy the equation, so that the number of reflections is really limited. Since only the angles of divergence of the concentric conical sheaths are to be measured, only a narrow strip through the centre needs be photographed. This strip is made semicircular, in order to embrace a wide field of reflected cones. Knowing θ and λ, the equation gives, as in the Bragg method, the spacing d between the structural planes of the crystal.

Although the Debye-Scherrer method may be regarded as a modification of the Laue method, yet the results it gives are the same as those given by the Bragg method, namely, the spacing between the structural planes of the crystal. The Laue method gives other supplementary information, but ideas of structure are built up mainly on the spacing between the planes of particles. A large amount of experimental work on crystals of different substances has been done in this direction, and deductions have been drawn as to their probable atomic arrangement. In this place only one or two examples can be briefly considered,

Rock-salt (sodium chloride) crystallises as cubes and possesses a perfect cleavage parallel to the faces of the cube. Plates cut parallel to the faces of the cube (100), the rhombic-dodecahedron (110), and the octahedron (111), respectively, give by the Bragg method values for the spacing between the planes of particles in the ratio of $1{:}1/\sqrt{2}{:}1/\sqrt{3}$. These ratios are the same as those mentioned above for the simple cubic space-lattice (figs. 1 and 2), and the conclusion may be drawn that this represents the structure of rock-salt. The two kinds of atoms, sodium and chlorine,

may be placed alternately along the three directions, as shown in fig. 4. As so represented the structure may also be regarded as an interpenetration of two space-lattices of the face-centred cubic type, with the sodium atoms on one lattice and the chlorine atoms on the other. One lattice can be brought into the position occupied by the other by a parallel shift along a cube edge through the distance between two consecutive planes. The actual distance between the cube planes, and consequently also between the atomic centres, has been determined to be $2{\cdot}81 \times 10^{-8}$ cm., or rather more than a hundred-millionth of an inch. In the drawings, the scale of the lattice is enormously enlarged, and only an infinitesimal portion of the crystal is represented. Some idea of this may be conveyed by saying that if we took a cubic inch of rock-salt and represented the whole of the structure on the same scale as in fig. 4, the drawing would be rather more than 1,000 m. across. The same structure is also shown by galena (lead sulphide, PbS), the crystals of which also possess a perfect cubic cleavage; the two kinds of atoms shown in fig. 4 here represent lead and sulphur.

Examples of crystals with the structure of the centred cubic lattice are those of the metals iron, sodium, tungsten. The face-centred cubic lattice is represented by crystals of the metals copper, silver, gold, platinum. A special type of cubic lattice, known as the "diamond lattice," consists of another kind of interpenetration of two face-centred lattices. Particles belonging to one lattice are placed each at a centre of alternate sub-cubes in the other lattice, and a tetrahedral arrangement so results. Examples of this are diamond and zinc blende (ZnS).

Crystals of various substances are extensively used as radio-detectors in wireless telephony, but no satisfactory explanation of their action has yet been given. An essential character of crystals is a variation of many of their physical properties with the direction within the crystal—in other words, such properties are vectorial.

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CUBA (*see* 7.594), a republic in the West Indies and a member of the League of Nations. Area 44,164 sq. m. (including the Isle of Pines). Since 1909, when for the second time the management of Cuban affairs was turned back by the United States to the Cuban Govt., there has been a remarkable growth in the wealth and prosperity of the island. Population increased from 2,048,980 in 1907 to 2,889,004 in 1919. No fresh census was taken between 1919 and 1925, but estimates gave Cuba about 3,330,000 in the latter year, or over 60% more than in 1907. This increase was largely due to the rapidly advancing number of immigrants. While many represent a mere floating population who return to their own country within the year, a number remain permanently in the island. According to the census of 1919 there were only 65 persons per sq. m., in a country whose habitable area represents an unusually large proportion of the whole. The prosperity of the island is due mainly to its natural resources, but in part to the virtual underwriting of the republic by the United States, which has a right under the Platt Amendment to intervene in Cuba to maintain order, and also has some control over Cuban finances through the requirement that Cuba may contract no public debt beyond the capacity of the republic to repay, which virtually involves the consent of the United States.

I. POLITICAL HISTORY

José Miguel Gómez, who had been the candidate of the Liberals, became president on Jan. 28 1909, and remained in office until May 20 1913. His term was marked by a return to the traditional political evils of the former Spanish colony; but though the Government was corrupt the country prospered and public works were developed. Among a number of political disturbances the race war of 1912 was the most serious. This was a negro uprising in Oriente which, however, was quickly suppressed; a body of U.S. marines was landed for the protection of foreign nationals and their property. Owing to friction within the Liberal party the Conservative candidate, Gen. Mario G. Menocal, was elected in 1912 and took office in 1913.

Charges of maladministration and dictatorial methods were persistently brought against Menocal's Govt., which was unable, furthermore, to show much in the way of positive achievement. Nevertheless, the first three years of his term were moderately successful. Menocal was again a candidate in 1916, and won the election by the employment of violence and other improper methods. In consequence there was a serious civil war under the leadership of Gómez in Feb. 1917, but Menocal was able to defeat his opponents and entered upon his second term. Meanwhile, Cuba had followed the lead of the United States and declared war on Germany on April 7 1917. Little opportunity was given to Cuba to take an active part in the struggle, but great help was rendered through stimulating the production of sugar for sale to the Allies. In anticipation of the elections of 1920 Gen. Enoch H. Crowder of the U.S. Army was invited to Cuba in 1919 to draw up an election law. This he did, but the law was flagrantly disregarded in the ensuing elections. Alfredo Zayas, who had been the Liberal candidate in 1916, was now backed by Menocal in a Conservative-Popular alliance against Gómez, who was nominated by the Liberals. Zayas was successful but Gómez raised a protest, and new partial elections were called for at the suggestion of Gen. Crowder, who had been again sent to Cuba as the personal representative of the President of the United States. Gómez withdrew before they could be completed, claiming unfair methods of the Government, and Zayas had an easy victory.

Meanwhile, Cuba had enjoyed phenomenal prosperity in the "dance of the millions" of 1919, as it was called, but this was followed by a severe financial crisis in the depression of 1920–1. Despite the declaration of a moratorium in the payment of debts, many banks and other business concerns were forced into bankruptcy. Because of the financial difficulties of the republic the Government of President Zayas, who went into office on May 20 1921, was at first amenable to suggestions for reform made by the U.S. Government. A loan of $50,000,000 was approved by the United States and successfully floated in Jan. 1923, and financial conditions rapidly improved. The Cuban war loan of $10,000,000 was liquidated and the year 1922–3 closed with a surplus. But with the return of prosperity in 1923 President Zayas broke away from his advisers, and his political improprieties led to the formation of the Veterans' and Patriots' Assn., whose reform movement was badly mismanaged and failed in the abortive revolution of April–May 1924. Zayas would not indulge in the violence of his predecessor, however, and when he was defeated by Menocal, for the Conservative nomination, made a pact with Gen. Gerardo Machado, the Liberal candidate, to assist him against Menocal in the presidential election of 1924. Machado was victorious and assumed office on May 20 1925. During the Zayas administration the ownership of the Isle of Pines was decided in favour of Cuba.

Education.—Education called for greatly increased expenditure after 1909, but without commensurate beneficial results, because of political factors involved. It was stated that in 1924 53% of the population could neither read nor write. The University of Havana, with over 4,000 pupils, is tending gradually to model its curriculum on the pattern of universities in Europe and the United States. The university was thoroughly reorganised in 1923.

II. FINANCIAL AND ECONOMIC HISTORY

Under a law of Nov. 7 1914, a Cuban coinage system similar to that of the United States was introduced. American money is also legal tender and is in general use. The following table shows the national revenue and expenditure for 1913–4 and 1919–20 to 1925–6:—

	Revenue	Expenditure
1913–4	$37,940,200	$33,974,147
1919–20	91,308,314	91,726,152
1920–1	64,446,000	62,730,744
1922–3	53,628,800	54,852,102
1923–4	73,134,313	57,758,784
1924–5	68,500,000	61,672,169
1925–6	84,791,650	64,780,250

No detailed figures are available for 1921–2. The period 1923–6 showed a considerable surplus, which was applied to the reduction of the public debt. In 1925 Cuba had a foreign debt of about $87,000,000 and a domestic debt just under $12,000,000. In addition, the country has a floating debt of something like $14,000,000.

Production and Industry.—Sugar is the basis of Cuba's wealth. The crop, which in 1910–1 amounted to 1,379,609 tons, was 5,151,486 tons in 1924–5, or nearly a fourth of the world's total production. Between 1909 and 1925 the crop generally increased each year, but there were wide fluctuations in price. Sugar rose from a normal level of around 3 cents a pound, to as much as 5½ cents during the World War, and then to an inflated level of 22½ cents in 1920. In that same year the market broke, and the price fell to 3⅝ cents, rising again in 1923 to an average level of 4·9 cents. Heavy production in different parts of the world caused a fall in price to less than 3 cents in 1925. Many Cuban sugar estates are under control of American companies and in 1924 some 60% of the industry was in American hands: altogether the value of American investments in Cuban sugar approaches a thousand million dollars. The United States takes about 85% of the entire Cuban crop.

Cuban tobacco products are among the most highly regarded in the world, but the industry, though second in importance in the island, does not compare with that of sugar. The crop had a value of $82,289,686 in 1924. All other Cuban industries are insignificant by comparison with sugar and tobacco. In the War and post-war periods the market for molasses, a by-product of sugar, assumed considerable proportions. The climate and soil are favourable to fruit culture, notably citrus fruits, bananas, pineapples and cocoanuts, but the full possibilities of the industry have not been realised. The grazing industry has attained to some prominence, particularly in the province of Camagüey, where there were about 4,500,000 cattle in 1925. There are iron, manganese, copper and asphalt mines in the island, especially in Oriente; signs of oil have been reported over large areas. The henequen industry of Matanzas and sponge industry of Batabanó are locally important. The greater part of the capital in Cuban industries as a whole comes from the United States, which has a total investment of nearly $1,500,000,000. This compares with an investment of $80,000,000 in 1901. While most of the American money is in sugar, there are also large sums in tobacco, mining, fruit, railways, street-car companies, docks, electric light and power companies, telephone companies, banks, hotels, steamship lines and Cuban bonds.

Commerce.—Cuba exports all but a little of what it produces, and imports nearly everything it consumes, even including food products, which constitute some 35 to 40% of the total. Sugar makes up 85% or more of the exports in value, with tobacco 8 or 10%. The increase in the value of Cuban trade has been little less than phenomenal. In the period 1900-4 Cuba had an average annual volume of trade of about $136,000,000. This had reached a total of slightly more than $300,000,000 in 1914 and approximately $725,000,000 in 1924, the highest figure up to that time in Cuban history, except for the inflation period of 1919–20. In 1920 the volume of trade with the United States alone was $1,125,000,000, but value in dollars was hardly a correct index then. Cuban products enjoy a preferential tariff of 20% in the United States, while those from the United States get a concession of from 20% to 40% in Cuba. This is one of the reason for the dominant position of the United States in Cuban trade During the period of 1900–4 the average annual value of U.S trade was only some $101,000,000. Disregarding the abnormal figures for 1920, American commerce with Cuba had reached a total of $553,510,261 in 1924, or about 76% of the total. Cuban exports in 1924 were valued at $434,069,000 and imports at $290,525,585. During the period 1910–25 the balance of trade in favour of Cuba greatly increased.

Communications.—There are two principal railway systems in Cuba, which also control several lesser lines. The United Railways of Havana is an English company, which is the dominant factor in the west, while the Cuba Railroad, an American company, is in control in the east. The latter has greatly extended its sphere through acquiring virtual control of the Cuba Northern Railroad Co. in 1924. While the island is, on the whole, well served by railways, with some 3,250 m. in operation in 1925, the same cannot be said for the roads. Large sums were expended between 1909 and 1924 in roadbuilding, but with little benefit to the republic; at the beginning of 1925 the roads were generally in a bad state of repair. Direct steamship connection exists with numerous European and American ports, with frequent sailings, and there is a train service to the United States *via* a ferry from Havana to Key West. Air services for both passengers and mails are maintained between Havana and the United States.

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CUBISM: *see* PAINTING.

CULTURE: *see* ANTHROPOLOGY.

CULTURE CONTACT, PSYCHOLOGY OF (for PSYCHOLOGY, *see* 22.547).—Present-day psychology is less concerned with describing how and what a man thinks, feels and acts than with trying to understand the causes of his conduct. Every normal man's activities are to a large extent socially determined, and, whether he is aware of it or not, are directed towards the perpetuation and development of the complicated systems of culture characteristic of social groups. Consequently, the psychologist is as interested in culture problems as the ethnologist and the sociologist, and he has his own especial contributions to make towards the study of the growth, distribution, maintenance, and transformation of culture patterns.

Social Institutions.—No social group has ever been known which does not possess distinctive customs and institutions. These, and the tendencies which cluster about them, are, in fact, the characteristics that we use whenever we wish to give a psychological definition of any particular group. Such customs and institutions are constantly being elaborated or simplified; old features are built up into new patterns, or pass away. And the changes are never haphazard. They proceed according to certain principles. The discovery of these principles lays bare the secrets of the growth of culture, and for this and the formulation of the principles a psychological method of approach must be adopted.

The main, if not the only, general condition of mental and social development is that the individual or the group should come into contact with other individuals or other groups. The resulting clash of feelings, actions, ideas, customs and institutions is the great stimulus to change.

Modes of Contact.—But this consideration obviously does not carry us very far. Social contact may take several different forms. First, a number of people may migrate as a whole group, and, carrying with them all the features of their special culture, may find a new temporary or permanent abode. The customs and institutions of these immigrants will then mingle with, or perhaps even replace, those of the people to whom they have

come. The complexity of many of the characteristics of Australian and Melanesian culture has been attributed mainly to a series of group contacts of this kind, and illustrations of the same mechanism of diffusion abound in almost every part of the world.

Second, an individual may break away from his original home, and, attaching himself to an alien group, assimilate certain features of their peculiar culture. Later, returning home, he introduces the borrowed elements into his old group, and there, under certain circumstances, they will root and thrive. This is a mode of diffusion particularly characteristic of modern society, and it is constantly illustrated in changes of culture which are open to daily observation.

Contact and Borrowing.—The two cases must be distinguished. The first is "diffusion by contact," the second "diffusion by borrowing." Both occur at all stages of social development, but the second probably plays a larger and larger part as civilisation advances. In a third, intermediate, form of diffusion, groups living in close proximity and friendly relationship constantly intermix, with much resulting interchange of cultural elements. It is clear then that there is no safe argument immediately from similarities of culture to "diffusion by contact." We must study carefully the mechanisms by which "contact" or "borrowing" may be set to work.

Mechanisms.—These mechanisms can, no doubt, be partially described in terms of the sphere of culture affected, whether material or ceremonial: for instance, of external environmental conditions; of the relative numbers of the groups involved, and in other more or less purely objective ways. But at the basis of these are the attitudes and tendencies of the individuals and groups in question, and in these and their consequences psychology takes an especial interest.

First consider the case of "diffusion by contact." The consequences which ensue when two groups meet, each with its own relatively complete and characteristic institutions, customs and beliefs, depend directly upon the dominant *social relationship tendencies* which are brought into play. Among man's instinctive endowment are certain tendencies which are peculiarly social. The three most important of these are: assertiveness, submissiveness and a characteristic tendency best termed the tendency towards "primitive comradeship" which leads to a social relationship with much interchange but no assumption of superiority or of inferiority. These tendencies come to dominate a man's attitude towards his fellows, and get so built up into group life that they prominently determine a group's reactions to other groups.

Survival and Instability.—When two groups come into contact for any length of time, the one being markedly assertive, and the other markedly submissive, the culture of the first seems completely to displace that of the second. But frequently there is only a surface victory. The customs of the submissive group are merely driven underground. They persist in secret and burst out again unexpectedly in times of social unrest. The community produced is socially unstable, and liable to profound regressions.

If, however, the dominance of one group is less pronounced, and the submissiveness of the other less complete, many of the customs of the indigenous and of the incoming people persist for a long time side by side. An apparently bewildering complexity of cultures is produced. But in the end genuinely new and stable social patterns are constructed. Finally, where "primitive comradeship" is the dominant social tendency, a true blending of cultures is secured, and a cultural structure is evolved which contains elements from both sides relatively unchanged.

Control of Existing Culture.—By whatsoever route the stimulus to new cultural developments reaches a group—whether by contact or by borrowing—all imported material has to be fitted into some already existing cultural pattern, otherwise its position in the new group remains exceedingly unstable. For the deep-seated human tendency towards *conservation* is immensely strengthened by social grouping. Conservation is, however, always subject to control and direction by other tendencies, and is, consequently, selective in its operation. Most commonly of all it is controlled by impulses that immediately serve practical needs. Thus a group may cling very tenaciously to a food-seeking *ritual*, but be comparatively ready to change its food-seeking *instruments* for others which are in practice obviously more efficient. The operation of this principle of selective conservation means that even when systems of culture move as a whole they are practically never accepted as a whole. They must submit to the inertia of the culture patterns of their new homes. In the end it will appear as if they moved, not as a complex unity, but as elements "lifted" from a whole. The elements that persist are those which have direct practical utility, those which present obvious affinities to an already existing culture, and very often those which appear odd, disconnected, incidental and of small importance. To understand why, in a given social group, certain features of culture are jealously guarded from change, while others can be fairly easily displaced, a thoroughgoing intensive study is necessary, not merely of what reaction tendencies are operating in a group, but especially of how these tendencies are arranged.

Formation of New Patterns.—Because conservation is selective, any change successfully introduced into a community from without tends to produce eventually a new social pattern. But in addition to this, the normal individual and the normal group both show a genuinely constructive capacity. No idea received into a mental life, no custom accepted within a group, remains isolated. It has to be built into a structure with other ideas and with other customs, and the result is often peculiar to the individual or group concerned. No social psychologist has yet carried out a radical analysis of what is involved in social constructiveness. The problem is one for the future, but undoubtedly in this sphere particularly the initiative of prominent individuals *within* the group plays a most important part. Definite foresight and articulated purpose have a great deal less to do with the matter than has frequently been supposed.

The Individual.—When considering "borrowing" we picture a migrant individual who leaves his group and settles for a while in an alien social environment. Some features of his new setting will attract his attention and inspire his envy; others he will notice and then ignore; yet others he will fail altogether to detect. From the psychological point of view there are three groups of conditions which are particularly important in determining these responses. First, there are the group of instinctive tendencies which this individual possesses in common with all other human beings, which have their unique arrangement in every person. Second, there are that endowment of specific tendencies and that development of "interests" which mark off the migrant individual in question from all other persons. Third, there are the social traditions, customs and institutions of his own people, which, in fact, though they belong to the wanderer's native group, yet affect his conduct in the most direct manner. These all, coming into operation together, determine what he will "borrow."

Eventually the borrower returns to his own group. He may, of course, make no attempt whatever to introduce the borrowed material into his native society. He may continue to practise the alien customs, but then, as a rule, they will not make much impression, and will speedily disappear. He may, however, have the temperament of a propagandist, or be what is called "public-spirited," and if this is the case he will seek converts to the new ways.

Innovations.—Here again the fundamental social relationship tendencies are important. There is a "primitive comradeship" type of innovator. Such a person at once, though unwittingly, modifies the newly accepted cultural material in the direction of the traditional customs and institutions of his own group. He has a distinctive mode of propaganda, in the main persuasive, and working along the established lines of social organisation of his society. But in spite of this, as soon as his innovations attract notice they are almost invariably met with hostility from one party and with acceptance from another party. At once the borrower becomes a centre of social attention, and this reacts strongly upon his whole attitude and practice. He is now apt

to emphasise the difference between the new proposals and the old culture, and to join reformers who are more radical than himself. There frequently grows up a definite cleavage between the new and the old. Despite everything, however, the powerful conservative tendencies of the group will gradually give to the innovation something of the shape of the long-standing culture of the society concerned.

Special Groups.—Probably no new custom, however it may be introduced, makes social headway without the formation of a special group which takes the custom as its rallying-point. Any such group is apt to be rendered conspicuous in the eyes of the other members of the community. Thereupon it is subjected to precisely the same kind of socially initiated influences that, as we have seen, affect the individual borrower. Such a group tends to become relatively assertive, or dominant, in the society to which it belongs, and endeavours to increase its prestige. Then the customs and institutions which are the peculiar stamp of the group in question invariably undergo elaboration. At the same time the group may jealously protect itself from new-comers, guarding its secrets with care, and making entrance into its ranks difficult and perhaps dangerous. This is the typical condition for the growth of elaborate social culture.

Simplification.—Elaboration of culture, however, may carry the elements of its own decay. If it proceeds to extremes the special groups concerned are apt to become cut off from contact with the bulk of the people. Deterioration and simplification of culture invariably follow. This may be called "simplification by isolation."

On the other hand, a group formed about new customs may open its ranks widely, so that almost anybody who wishes can learn its secrets. This also leads to a deterioration of culture, and may be called "simplification by spreading." Simplification by isolation is a common fate of systems of ceremonial culture; simplification by spreading is more frequently found with material culture. It is an interesting fact that, as in the mental life of the individual, so in the social life of the group, a certain amount of conflict is the most general condition of constructive effort.

The special devices by means of which elaboration and simplification are secured are also, to a large extent, psychologically determined. For example, ceremonial practices, details and products of material art, artistic designs, songs, linguistic peculiarities and even details of social organisation travel more readily than the interpretations attached to them. Yet if retained in a new environment they must be interpreted. The interpretation given is often the work of some prominent individual. Details come from without, interpretations grow up from within a group, and a common interpretation of differing materials often aids greatly the construction of new cultural patterns. Reduplication and genuine conscious invention have their predisposing conditions, and their special functions in elaboration. Simplification may result from the fact that certain ideas, beliefs and practices may grow so strong in a community that they tend to absorb all others. The same general effect may follow unwitting omissions in copying or in imitation. Or *apparent* simplification may be caused by the repression of socially undesirable elements of a custom or institution through a conflict of groups or of social tendencies. Only the intensive study of particular groups and particular cultural problems can show exactly what has happened in any given case, and so disclose the principles which come into operation. Such intensive study contemporary psychology is beginning to undertake. A little has been accomplished, more remains to be done. No doubt the conclusions which have been reached so far will in the near future be corrected and supplemented.

BIBLIOGRAPHY.—The field of study dealt with in this article has been as yet but meagrely explored. A great amount of important material is to be found in monographs and special studies of particular groups. These are very numerous, and no attempt can be made to indicate here important works belonging to this class. For more or less general discussions see F. M. Davenport, *Primitive Traits in Religious Revivals* (1905); W. H. R. Rivers, *Kinship and Social Organization* (1914); F. J. Teggart, *Prolegomena to History* (1916) and *The Processes of History* (1918); R. R. Marett, *Psychology and Folk-Lore* (1920); F. C. Bartlett, *Psychology and Primitive Culture* (Cambridge, 1923); L. Lévy-Bruhl, *Primitive Mentality* (1923); M. T. Price, *Christian Missions and Oriental Civilisations, a Study in Culture Contact* (Shanghai, 1924); F. J. Teggart, *Theory of History* (1925). (F. C. B.*)

CUMMINS, ALBERT BAIRD (1850–), American politician, was born at Carmichaels, Pa., Feb. 15 1850. He was educated at Waynesburg (Pa.) College, studied surveying, and was at first engaged in railway work. He then took up law, was admitted to the bar of Illinois in 1875, and for three years practised in Chicago. In 1878 he went to Des Moines and ten years later was a member of the Iowa House of Representatives. He was chairman of the Republican State Committee (1892–6), candidate for the United States Senate in 1894 and 1900, member of the Republican National Committee (1896–1900) and a delegate to the Republican National Convention on four occasions. He was elected Governor of Iowa in 1902 and re-elected for two succeeding terms. In 1908 he was elected to the United States Senate to fill the unexpired term of Senator Allison, and was re-elected in 1909, 1915 and 1921. He opposed the nomination of Mr. Taft in 1912, but did not leave his party. He was specially identified with measures concerning trusts and railways, and took a leading part in drafting the Esch-Cummins Act, under which the Govt. in 1920 handed back to private control the railways of the United States.

CUNLIFFE-LISTER, SIR PHILIP (1884–), British politician, was born May 1 1884 at Ayton, Yorkshire. The youngest son of Lieut.-Col. Yarburgh G. Lloyd Greame, he assumed by royal warrant the name of Cunliffe-Lister in Dec. 1924. He was educated at Winchester and University College, Oxford, and was called to the bar in 1908. During the World War he served with the King's Royal Rifle Corps, attaining the rank of major. Elected Conservative member for Hendon in 1918, he quickly made his mark in Parliament as a speaker on commercial subjects. He was chairman of the Labour Committee of the War Cabinet, and served on other important government committees. He was Parliamentary Secretary to the Board of Trade and of the Overseas Trade Department in the Lloyd George Coalition Government till his appointment by Mr. Bonar Law as President of the Board of Trade in Nov. 1922. He held the same office in both Mr. Baldwin's administrations, and presided at the Imperial Economic Conference held in London in 1923, when he advocated the extension of Imperial Preference. He carried through Parliament measures for safeguarding particular British industries through protective tariffs.

CUNNINGHAM, WILLIAM (1849–1919), British economist (*see* 7.633), died at Cambridge, England, June 10 1919.

CUNNINGHAME GRAHAM, ROBERT BONTINE (1852–), British writer, eldest son of William Cunninghame Graham of Ardoch and Gartmore, was educated at Harrow. He spent much of his youth cattle-farming in the Argentine, and travelled widely in Paraguay, Mexico, Spain and Morocco. A Spanish grandmother made the Spanish language and national temperament singularly congenial, and his writings are throughout coloured by these early experiences. Cunninghame Graham sat as M.P. for North Lanarkshire from 1886–92, and took an active part in Labour politics, being closely associated with John Burns and Keir Hardie in their early days.

Characteristic of his varied writings, essays, travel notes, biography and stories are these: *Mogreb-el-Acksa* (1898); *A Vanished Arcadia* (1901); *Success* (1902); *Hernando de Soto* (1903); *Faith* (1909); *A Brazilian Mystic*, a life of Antonio Conselheiro (1920); and a biography of his ancestor, *Doughty Deeds of Robert Graham, 1735–97* (1925). See also L. Chaundy, *A Bibliography of the First Editions of the Works of Robert Bontine Cunninghame Graham.*

CURIE, MARIE (1867–), French scientist, the daughter of Professor Sklodowski, a Pole, was born in Warsaw Nov. 7 1867 and studied in Paris, taking a science degree at the university there. In 1895 she married Dr. Pierre Curie (*see* 7.644), the French physicist; and after working for several years at the École de Physique et de Chimie in Paris, she carried out highly important experiments on the radio-activity of uranium

compounds, a phenomenon discovered by Henri Becquerel in 1896. This research work led up to the epoch-making discoveries of polonium and radium. After years of arduous work (carried out in an abandoned shed with the most primitive equipment) Madame Curie succeeded in isolating pure radium salts. The Nobel Prize was awarded to her in 1903, in company with Dr. Curie and Becquerel; and in the same year she became a doctor of science.

On the tragic death of her husband in 1906, she succeeded him as professor at the Paris University and in 1911 was awarded the Nobel Chemistry Prize for her work on radio-activity. The Paris Radium Institute and the Warsaw Radio-activity Laboratory owe much to Madame Curie. During the World War she organised a valuable radiological service in the hospitals and later directed the Curie Laboratory in Paris. In 1921 President Harding, on behalf of the women of the United States, presented her in person with a gramme of radium in recognition of her great services to science. *See* RADIO-ACTIVITY; RADIUM.

CURRENCY (*see* MONEY, 18.694).—Currency means the media of payment. As usually understood, it includes money which is legal tender (*i.e.*, by which a debt may legally be discharged), and also bank notes which, though they may not be legal tender, pass freely from hand to hand. In business affairs, the predominant medium of payment is bank credit; a debt due from a banker is assigned from one creditor to another by a cheque or other instrument of transfer. A bank credit is not called currency, though sometimes a cheque is. A bank note is itself an instrument for transferring a bank credit.

The money of account is the unit in which debts (including bank credits) are measured. Whatever is legal tender must be expressed in terms of the money of account, in order to determine how great a debt it will pay.

Developments of Monetary Theory.—The quantity theory of money sets out to show how the value of the currency unit is determined. It used to be stated in the form that, other things being unchanged, the value of a unit of money is inversely proportional to the quantity of money in circulation. In other words the price level is directly proportional to the quantity of money in circulation. The theory is very often loosely stated in a fallacious form, omitting the condition "other things being unchanged." That condition can however be dispensed with if certain of the "other things" be introduced into the formula. The price level varies directly as the quantity of the means of payment and the rapidity of circulation, and inversely as the volume of transactions per unit of time. The means of payment of course include bank credit.

It is very commonly argued that post-War experience with the depreciation of paper currencies has confirmed the quantity theory. But it should be understood that the quantity theory states not merely that when the quantity of money increases prices will rise, but that prices will rise *in the same proportion* (subject to the necessary allowances). When the quantity of money changes, that usually in itself induces a change in rapidity of circulation. Once prices start rising, people spend their money more quickly; when prices are falling, they prefer to postpone their purchases. These tendencies accentuate the effects of either expansion or contraction in the supply of money and credit.

The quantity theory, in a form involving factors so unascertainable as the volume of transactions and the rapidity of circulation, has little direct application to practical affairs. The price level is in fact governed by the amount that people spend per unit of time, whether on consumption or on investment (for money saved is spent on the production of capital goods). What they have to spend (the total, that is, of incomes) may be called the consumers' income; what they do spend may be called the consumers' outlay. The stock of money and credit, representing the purchasing power which people have, but have not used, may be called the unspent margin. An increase or decrease in the unspent margin permits of a discrepancy between the consumers' outlay and the consumers' income, but this can only be so for a moment of transition. The consumers' outlay supplies the fund from which the greater part of the consumers' income is derived. People who produce or sell get their incomes from those who buy. It is easy to see how responsive markets and prices are likely to be to a change in the unspent margin. In a country with a banking system such a change is effected through the lending operations of the banks. The regulation of credit by a central bank (especially through adjustments of the bank rate or rediscount rate) is described in the article BANKING.

Monetary Movements and Unemployment.—Perhaps the most important development in currency theory in recent years has been the recognition of the intimate relation between monetary movements and unemployment. A contraction of credit, involving a rise in the purchasing power of the currency unit, that is to say a general fall of prices, is invariably accompanied (in an industrial community) by unemployment. It deters dealers in commodities from adding to their stocks and from giving orders to producers. The severity of the unemployment corresponds approximately to the magnitude of the monetary movement. Whenever credit is allowed to expand unduly, and prices rise, the value of the currency unit can only be restored at the cost of a credit contraction and consequently of unemployment. It is to guard against this, that a policy of price stabilisation has been advocated. If measures are taken to check any general rise of prices in time, the need for a contraction of credit to bring about a fall is avoided. The application of such a policy is not free from difficulty (especially in the measurement of the price level) and it cannot be put in operation mechanically and without the exercise of considerable discretion.

This policy received recognition at the Genoa Conference in 1922, in the form of a resolution in favour of international co-operation of the central banks of issue to regulate credit with a view to preventing undue fluctuations in the purchasing power of gold. Something approaching to it has been put into practice by the Federal Reserve Banks in the United States, since the influx of gold in 1922–4 made their reserve proportions inoperative and threatened an inflationary rise of prices. Prof. Irving Fisher has proposed a plan for stabilising the purchasing power of a currency by making the unit convertible into a variable amount of gold, to be increased as prices rise and decreased as prices fall (*see* DOLLAR STABILISATION). Mr. Keynes has proposed a plan of stabilisation which would dispense with convertibility into gold.

I. THE PRE-WAR PERIOD

The Gold Standard.—The years immediately preceding the crisis of 1914 saw the approaching completion of an evolution that had been in progress since 1872, the spread of the gold standard. The essential meaning of the currency system called by that name is that the monetary unit is equated to the value of a prescribed weight of gold. Since gold is a commodity with a world market, and its value at one place does not differ appreciably from its value at another, the currency unit of a country with a gold standard has a world value determined by its equivalent in gold (*see* EXCHANGE, FOREIGN). A gold standard may be maintained either (*a*) by the actual circulation of gold coin, the free coinage of gold and the free melting of gold coin, or (*b*) by the use of paper money convertible on demand into gold, or (*c*) by what is called an exchange standard, that is to say, paper money or token coin exchangeable, through a central bank or some other agency, into credits in other countries where the gold standard is maintained by one of the other two methods.

Gold coin circulated in England, France and Germany and in a few other countries, among which Egypt may be mentioned. Convertible paper money was the more prevalent plan, and it was often supplemented in practice by something very like an exchange standard. In Austria-Hungary, Russia and Greece the chief reliance was on the exchange standard. Several countries possessed token silver coins of unlimited legal tender (especially the five-franc pieces in the countries of the Latin Union, France, Italy, Belgium, Switzerland and Greece, and the standard dollars in the United States). These were a relic of the era of bimetallism, when there had been free coinage of both gold and silver. So long as the quantity of such coins in circulation

was limited, they did not disturb the functioning of the gold standard. In Spain the coinage of five-peseta pieces (though no longer free) had not been restricted to the necessary extent, and the gold standard had never been established.

United States.—The United States had a currency system bearing traces of a complicated history. Side by side with the legal tender United States notes, or "Greenbacks," and the bond-secured notes of the national banks, there circulated standard silver dollars and gold. But gold coin was not popular, and was little seen except on the Pacific Coast. In its place were used gold certificates. The gold certificate differs from a bank note in that it is not evidence of a debt, but a title to a specified amount of gold. The gold for which certificates are issued is held by the Treasury in trust. That does not mean that the holder of a certificate is entitled to receive the particular pieces of gold for which it was issued, but the certificates are covered by gold, dollar for dollar, and cannot be made inconvertible. Silver certificates are likewise issued against silver dollars. All forms of currency in the United States other than gold and gold certificates were in one way or another limited in amount. The expansion of the currency had to be provided for by imports of gold, and the stock of monetary gold in the country rose from $599,000,000 in 1896 to $1,890,000,000 in 1914.

In South America the abuses of paper money had been rife, but by 1914 the greater part of that continent was on the gold standard (in some countries after repeated devaluations). In the East silver remained the standard in China, but the Indian rupee had become a token coin skilfully maintained at a fixed gold value of 1s. 4d. by means of an exchange standard. The exchange standard had also been successfully applied to the Straits Settlements, the Philippine Islands and Siam.

II. THE WAR PERIOD

The Crisis of 1914.—The imminence and outbreak of the World War in July and Aug. 1914 paralysed the investment markets, the foreign exchange markets and the money markets of the world. The most liquid assets were frozen up. The machinery of payment ceased to function. The system, usual in European countries, which made a central bank of issue the ultimate resort of everyone in need of credit, gave a monetary character to the crisis. What was needed was the means of payment, and that could be supplied by the bank which had power to issue legal tender notes. But it could only be supplied if the bank were relieved of legal limitations upon its power of issue. Hence these limitations were everywhere relaxed. All over the Continent the convertibility of notes into gold was suspended. Reserve proportions and similar restrictions were removed or modified. Where notes below a certain denomination were not allowed (as in France where the smallest notes had been of 50 fr.) small notes were legalised.

In England there were no notes below £5, and currency notes for £1 and 10s. were hastily provided. Under the Currency and Bank Notes Act, passed on Aug. 6, they were issued by the Treasury, and were made legally current as if they were gold coins. They were not debts or "promises to pay," but a legal obligation was placed upon the Bank of England on behalf of the Treasury to exchange them on demand into gold coin. Bank of England notes, being debts, became payable in currency notes, but as the latter were convertible into gold coin, specie payments were not suspended. The feared shortage of currency did not occur, but the currency notes were issued in rapidly increasing quantities. The gold they displaced from circulation was accumulated in the banks and became available for export to meet the insatiable needs of the Government for payment for foreign supplies.

War Inflation.—So far as currency is concerned, the history of the War may be summed up in one word—inflation. Essentially what happened was that the belligerent governments found their liabilities outstripping the funds they could raise by taxation and by the borrowing of genuine investible savings. After exhausting every expedient, they were faced with the imperative necessity of payment, and rather than let their current liabilities get indefinitely into arrear, they practically printed paper money for the purpose of paying. In form the governments "borrowed" from the central banks of issue, and the central banks placed at their disposal in the first instance not actual legal tender bank notes, but a credit on current account. In continental countries the credit would be quickly drawn out in notes. In England, where cheques are more freely used, this would not necessarily be so, but deposits at the Bank of England count as cash to the money market and the banks, in practically the same way as notes. Credit expanded in proportion, and when notes were required they were issued. As the quantity of money in each of the belligerent countries grew, the value of its currency unit fell; in other words prices rose. The foreign exchanges likewise became adverse.

In England the maintenance of gold payments threatened to become a sham. The exchanges were slipping below gold parity. Had gold been free to move, enormous profits could have been made by exporting it, particularly to America, where the exchange fell at the end of Aug. 1915 to 4·50 (7½% below par). With insurance against war risks at sea wholly in the hands of the Government, gold could not in practice be exported without the consent of the Government. Attempts to get round this form of control would be met by powerful moral dissuasion from the Bank of England.

The Government indeed did not hoard the gold. Large quantities were exported on Government account, and France, Russia and Italy were required, as a condition of the financial assistance they received from the British Govt., to export part of their cherished reserves. Energetic measures were taken to provide resources both by borrowing in the American market, and by requisitioning American securities held by British investors and selling or pledging them in New York. By such means it was possible to support the exchange and maintain the pound at 4·76, or about 2% below parity.

But that did not mean that inflation was avoided. It was less in extent than among the continental belligerents, but the flood of gold that was let loose upon the neutrals brought about a depreciation of gold itself in comparison with commodities. By April 1917, when the United States entered the War, the wholesale index numbers showed that the price level in Great Britain was about double that of 1913. The rise in the United States was only 60%, but the exchange was still successfully pegged at 4·76.[1] Although France had abandoned the gold standard, the French exchange was also pegged, but at a level averaging about 10% below par, by advances from the British Government.

The financial strain of these arrangements, which threatened to become unbearable, was immediately relieved when the United States became a belligerent and placed liberal advances at the disposal of her associates. The pegging of the exchanges continued, and in 1918 was extended to include Italy. But meanwhile the United States in turn resorted to inflationary finance. The reserve requirements of the Federal Reserve system were modified (June 1917). A substantial part of the Government's financial needs was met by the creation of bank credits. The export of gold was prohibited (Sept. 1917). There ceased to be a world market in gold. There was even a partial demonetisation of gold, the three Scandinavian countries having suspended the laws providing for the free transformation of gold on demand into coin or credit. Spain also bought gold at a discount. Everywhere the foreign exchanges ceased to depend on movements of gold, and in comparison with some neutral currencies the dollar fell to a heavy discount (and with it of course the pegged exchanges).

The Russian exchange was never pegged. The financial and political weakness of the country was reflected in a lavish recourse to inflationary measures, and by the time of the Revolution of March 1917 the Imperial Bank had made advances to the State amounting to eight milliards of roubles. The rouble was quoted at 17 to £1 as compared with its par value of 9½. The depreciation of the exchange mattered comparatively little

[1] For the relation of the foreign exchanges to prices, *see* EXCHANGES, FOREIGN.

to a country which was almost isolated from the world, but the economic and administrative confusion was seriously aggravated by the unsound monetary position. Prices were three times as high as before the War, and such was the distrust of paper money that the peasants could not be induced to sell their produce. After the March revolution a complete monetary breakdown began. In the eight months which intervened before the Communist Revolution of Nov. the note issue was doubled, and prices trebled. The country had already been entangled in that vicious circle of inflation, which has since become so painfully familiar to Europe, before the early enthusiasm of the Soviet was directed to extirpating the use of money. Because the currency was utterly discredited, the Government could not raise money either by tax or loan, and because it was driven to print notes to pay its expenses, the discredit was continually aggravated. There was no longer a market in foreign exchange, but prices leapt up. By the middle of 1918 they were 100 times the pre-War level, and were rising as rapidly as ever.

In the rest of Eastern and Central Europe the extremes of monetary collapse were warded off as long as the pressure of war enabled the Governments to exercise rigourous control over every form of economic activity. Upon Germany and Austria-Hungary the War imposed an isolation which was eventually nearly as complete as that of Russia, and the foreign exchange market was almost deprived of significance. By the end of 1918 the German note issue was 33 milliards of marks or more than five times the stock of currency, in paper and coin, that had been in use before the War. Yet the mark was still worth 56% of its par value in terms of dollars. Prices had not risen anything like proportionally to the circulation, for nearly all staple commodities were rationed at controlled prices. The position was similar in Austria-Hungary.

III. THE COLLAPSE AFTER THE WAR

The cessation of hostilities brought release from a tremendous tension. Neither peoples nor statesmen were in the mood to deal with the abstruse technical problems of currency, however urgent the necessity. As a matter of fact the statesmen were as innocent as the peoples of any knowledge that such problems called for solution. They were too preoccupied with the overwhelming fact of victory or defeat (defeat in some cases complicated by revolution) to give much thought to anything else. They had been bewildered by the magnitude of the financial operations of the War, and the one conclusion established by experience appeared to be that everyone who had ever said that there was a limit to the amount of money that could be spent was wrong. In the first months after the Armistice demobilisation proved almost as costly as war. At the same time lavish public expenditure became the universal remedy for discontent. The high prices resulting from monetary inflation were attributed to every cause but the right one. The War-time expedients of rationing and controls broke down, for the discipline of War-time was no longer possible, and recourse was had to food subsidies. The subsidies, like all other increased expenditure, could only be provided by issues of paper money.

During the War each side had striven to cut off the other from receiving supplies from overseas. There was an extreme shortage of stocks of all natural products throughout Europe, and the new crops were short, owing to the insufficiency of labour and the scarcity of fertilisers. Europe, overflowing with money, was in desperate need of everything else. The moment communications were opened with those countries in America and elsewhere which were in a position to supply products so urgently needed, the redundant money in Europe began to be applied to buy these products. At once the weakness of the situation was revealed in a fall of the exchanges. Exporters in America and elsewhere hardly realised what was happening. Some were unwilling to remit home sums which they had received in depreciated currencies, and waited in the hope of an improvement. Others were induced to sell goods just because they would receive an apparently enormous price in a depreciated currency, which they hoped later on to exchange at or near par. But amid all these illusions there were always enough sceptics who turned the proceeds of sale into sound dollars without delay, and the value of marks, crowns, francs, lire in the foreign exchange market steadily fell.

That state of affairs lasted throughout 1919. In March of that year the pegging of the English, French and Italian exchanges had ceased. French and Italian paper money had been inconvertible since 1914, and the exchanges on those countries were free to vary. English currency notes on the other hand were convertible into sovereigns at the Bank of England, and, now that insurance against war risks was no longer required, there was nothing but moral pressure to prevent people from withdrawing gold from the Bank for export, and gaining thereby a large profit on exchanges. Despite the weighty recommendations of the Cunliffe Committee (*see* GREAT BRITAIN) the export of gold was prohibited. The melting of coin had been prohibited

Exchange Rates 1920–5 (in U.S. Cents)

	Par	Feb. 1920	June 1920	Nov. 1920	May 1921	April 1922	Feb. 1923	March 1924	Feb. 1925	Dec. 1925
Great Britain	486·66	338·19	395·14	342·60	397·85	441·49	469·08	429·06	477·24	484·98
Denmark	26·80	14·94	16·90	13·40	18·00	21·23	19·09	15·68	17·81	24·86
Norway	26·80	17·40	17·61	13·37	15·72	18·67	13·57	13·57	15·25	20·31
Sweden	26·80	18·76	21·85	19·15	23·41	26·07	26·61	26·30	26·94	26·79
Switzerland	19·29	16·55	18·22	15·55	17·86	19·45	18·80	17·29	19·25	19·30
Spain	19·29	17·53	16·56	12·89	13·42	15·54	15·67	12·76	14·22	14·18
Holland	40·20	37·38	36·12	30·17	35·60	37·94	39·53	37·06	40·17	40·19
France	19·29	7·05	7·95	6·00	8·38	9·24	6·15	4·68	5·28	3·74
Italy	19·29	5·51	5·94	3·60	5·31	5·37	4·82	4·28	4·11	4·03
Belgium	19·29	7·18	8·31	6·38	8·37	8·52	5·40	3·87	5·07	4·53
Germany	23·82	1·05	2·58	1·32	1·63	·35	·0038	22·0[1]	23·80[1]	23·81[1]
Austria	20·26	·369	·736	·312	·259	·013	·0014	·0014	14·06[2]	14·06[2]
Hungary	20·26	..	·644	·216	·489	·126	·0381	·0015	·0014	·0014
Poland	23·82	·794	·630	·279	·128	·026	·0025	([3])	19·18[4]	12·76[4]
Czechoslovakia	20·26	1·19	2·35	1·14	1·45	1·96	2·96	2·90	2·96	2·96
Yugoslavia	19·29	3·57	4·72	3·04	3·08	1·45	·97	1·24	1·62	1·77
Rumania	19·29	1·69	2·34	1·49	1·72	·73	·48	·52	·51	·46
Greece	19·29	12·22	12·06	9·03	5·62	4·47	1·17	1·63	1·61	1·29
Bulgaria	19·29	1·75	1·75	1·22	1·31	·69	·64	·74	·73	·73
Finland	19·29	4·40	4·87	2·23	2·19	1·94	2·61	2·53	2·52	2·52
Canada	100·00	84·10	87·89	89·09	89·71	97·89	98·91	97·06	99·86	99·96
Japan	49·85	48·47	57·49	50·81	48·46	47·56	48·44	42·90	39·08	43·19
India	..	47·28	40·82	29·68	26·73	28·66	32·28	30·19	35·73	36·64
China	..	161·00	106·05	78·83	68·27	73·94	71·82	70·00	75·26	75·68
Argentina	42·45	43·37	42·35	33·78	31·75	36·53	37·23	33·88	39·75	41·45
Brazil	32·44	26·14	25·67	16·57	13·67	13·81	11·57	11·60	11·27	14·17
Chile	..	21·75	20·80	14·06	12·03	11·85	12·27	10·12	10·84	12·16

[1] New marks, equal to 1,000,000,000,000 of the old. [2] Schillings equal to 10,000 kronen.
[3] 10·8 cents to 1,000,000 Polish marks. [4] Zloty, equal to 1,800,000 Polish marks.

since 1916. The link between gold and money in the London market being thus broken, it became possible for the sterling exchange on gold-using countries to vary as freely as that of the franc or the lira.

Since Sept. 1917 the export of gold from the United States had been prohibited, and at the Armistice the dollar still stood at a small discount (something like 5%) in relation to the principal neutral currencies. Freedom to import supplies urgently needed quickly depressed the currencies of the European neutrals. By June 1919 all of them except Spain were below par. In that month the prohibition on the export of gold from the United States was removed.

Thus the gold standard was restored in the United States. The moment seemed a favourable one. Inflationary Government finance had ceased. The Government securities held by the banks were being gradually disposed of to the public. Nevertheless there was an element of weakness. The abnormal exports to Europe were not being paid for, or were being paid for in depreciated currencies which the exporters hesitated to bring home. The gap in the American traders' cash resources had to be made good by borrowing from their own banks. The resulting stimulus to trade borrowing soon began to produce inflationary symptoms. Prices rose. The Bureau of Labour index number, having fallen from 203 in Nov. 1918 to 193 in Feb. 1919, rose to 233 in Jan. 1920. Enormous quantities of gold were exported to the few countries still in a position to receive it. By the end of 1919 the net exports of gold amounted to $300,000,000, chiefly sent to South America and the East; in Europe it went only to Spain. But the countries which still bought gold as currency (Spain, Japan, Argentina, Uruguay) were inevitably contaminated with the American inflation, and followed not far behind.

The Crisis of 1920.—Thus, when European currencies depreciated headlong, it was in comparison with a standard which was itself depreciating. The climax came at the beginning of 1920. In Jan. the Federal Reserve Bank of New York raised its rediscount rate to 6%. In the same month the American banks began to call in advances made to traders who were holding European currencies. The result was a convulsive collapse of the exchanges, which brought sterling for a moment down to 3·20, or 34% below par.

The table on p. 774 shows the exchange value of the principal currencies, in terms of American currency, for certain months from Feb. 1920 to Dec. 1925.

IV. GREAT BRITAIN AND THE UNITED STATES

The Process of Deflation.—The American currency system was in a state of transition at the time of the crisis of 1914. The Federal Reserve Act of 1913 established a central bank system. It created a new form of currency in the Federal Reserve notes, which are not legal tender but are convertible into gold and backed by a gold reserve of at least 40 per cent. In the United States, as in England, currency has long been altogether subsidiary to credit. The Federal Reserve system set up an agency capable of exercising the same sort of control over credit as the Bank of England.

This system was for the first time brought seriously into action to check the inflation of 1920. The English authorities acted first. Bank rate was raised to 6% in Nov. 1919. In Dec. a Treasury minute (an administrative instrument with no legal force) put a limit on the currency note issue. In April 1920 bank rate went up to 7%. At the end of May the New York Federal Reserve Bank raised its rediscount rate to 7%. There followed a precipitate fall of prices in both countries.

The subsequent course of events is best shown in tabular form in the next column.

The relation between the exchange and the relative price levels in the two countries illustrates the doctrine of purchasing power parity (*see* EXCHANGES, FOREIGN). Essentially the fall in American prices signified a rise in the value of gold, which thus appreciated 79% between May 1920 and Jan. 1922. The greater the value of gold, the greater the effort required to restore the

Date	Exchange	English Price Index	American Price Index	Remarks
May 1920	3·85	325·5	247	Climax of inflation.
Nov. 1920	3·43	286·9	196	Autumnal pressure.
Jan. 1921	3·74	245·9	170	..
July 1921	3·63	194·1	141	Fall of prices practically ended in America.
Jan. 1922	4·22	164·0	138	Fall of prices practically ended in England and rise started in America.
March 1923	4·70	160·0	159	Renewed credit restriction started in America.
June 1924	4·32	162·6	144·6	Credit expansion started in America.
March 1925	4·78	166·3	161·0	..
June 1925	4·86	157·6	157·4	..

pound to its former gold value. The reduction of prices by 50% in two years in England was only effected by keeping bank rate at 7% for 12 months (April 1920 to April 1921). It did not fall below 5% till Feb. 1922. The result was an intense depression of trade, which threw nearly 2,000,000 work-people out of employment. An equally severe depression appeared in America in the period of falling prices, but was dispelled by the expanding credit and rising prices of the period from Jan. 1922 to March 1923. Fluctuations in both countries in the following two years ended with the exchange close to par, with trade again active in America, and with 1,200,000 still unemployed in the United Kingdom.

Restoration of Gold Standard in Great Britain.—On April 28 1925 the Chancellor of the Exchequer announced that the export of gold would be free, and at the beginning of May was passed the Gold Standard Act, imposing on the Bank of England the obligation to sell gold bullion (in bars of 400 oz. troy) at the par price of £4 4s. $11\frac{5}{11}$d. per fine ounce (£3 17s. $10\frac{1}{2}$d. per standard ounce). The obligation to redeem currency notes in gold coin was repealed, and so was the free coinage of gold by the mint. Thus the Act provided for the free convertibility of pounds into gold in the form most convenient for the world market, but interposed a bar to the issue of gold coin for active circulation. Currency notes remained the principal legal medium of exchange, and Bank of England notes were convertible into currency notes. The substitution of Bank of England notes of £1 and 10s. for the currency notes, as recommended by the Cunliffe Committee, was contemplated at the end of 1925.

In the United States after 1921 the enormous imports of gold made the reserve proportions prescribed by the Federal Reserve Act quite inoperative, but the Federal Reserve banks prevented an inflation of the currency by holding idle a reserve some $1,500,000,000 in excess of the statutory requirements. The pre-War forms of currency remained in circulation. Gold certificates, however, were made legal tender in 1919.

V. THE EUROPEAN NEUTRALS

Norway, Sweden, Denmark, Holland, Spain and Switzerland, being neutral in the World War, escaped the worst extremes of currency collapse. Like England, they felt the stress of the exchange crisis in Feb. 1920, and their exchange rates then recovered. Like England, they failed to keep pace with the violent appreciation of the dollar, but their exchanges improved from the middle of 1921 onwards. The improvement brought some of them to parity. Sweden reached par in Nov. 1922, and remained there, except for a slight lapse in the winter of 1923–4. The Dutch florin touched par in Dec. 1922, but when sterling depreciated in 1923–4, took up a position between the dollar and the pound. Holland returned to the gold standard at the same time as England (April 1925).

Switzerland.—Switzerland was at par from Dec. 1921 to May 1922, and was overwhelmed by a grave trade depression. By reducing bank rate to $3\frac{1}{2}$% (March 1922) and then to 3% (Aug.) the Swiss brought about an expansion of credit, which raised their price index from 162 (April 1922) to 187 (April 1923), lowered their exchange from 19·45 (April 1922) to 17·55 (July 1923), and reduced the number of unemployed from 99,541 (Feb. 1922) to 22,722 (July 1923). The same depreciation of the dollar which raised sterling to 4·78 in the latter part of 1924 raised the Swiss franc again to par, but with no burden of unemployment.

Spain.—Spain was swamped with gold during the War and afterwards in 1919, despite half-hearted attempts to exclude it. Notes of

course were issued against the gold, and, being redundant, depreciated. She found herself in 1920 burdened with a gold reserve of 2½ milliards (£100,000,000) against a note issue of 4 milliards, although she had never pretended to have a gold standard. She did not attempt to maintain parity with gold, and, though prices fell in 1921, the fall was both smaller and more gradual than in England or America. She remains, as before the War, on a standard of paper and token silver, but with prices 90% above the level of 1913. The currency is about 25% below gold parity, but gold parity itself has no significance except in the gold contents of coins which do not circulate and of which there is no free coinage.

Scandinavian Monetary Union.—Denmark and Norway before the War belonged, with Sweden, to a Scandinavian Monetary Union (dating from 1873). The coins of each, both gold and silver, were legal tender in the others. During the War the Danish and Norwegian currencies had fallen below parity with the Swedish, and the Union had to be suspended. It was finally terminated in Feb. 1924.

The Danish exchange rose from 13·40 cents in Nov. 1920 to 21·54, or within 20% of par, in Aug. 1922. This huge rise meant a terrific fall in prices and very severe depression and unemployment. Denmark, like Switzerland, escaped from this condition at the cost of a rise in prices and a decline in the exchange. The price index rose from 176 in Aug. 1922 to 233 in July 1924. The exchange fell correspondingly to 16·05. Unemployment was by that time no more than normal. A 7% bank rate (imposed Jan. 1924) stopped any further rise of prices, and the same American credit expansion which brought sterling within reach of parity raised the Danish krone in Jan. 1925 to 17·81. The Government thereupon secured the adoption of a programme for the improvement of the currency aiming at a rate of 18·80 by Jan. 1927. Meanwhile the pressure of a 7% bank rate continued. Prices came down with a run, the index for Aug. 1925 was 168 or 28% below that for January. The exchange rose to 24·70. Unemployment began to increase again.

The movements in Norway were somewhat similar but not quite so marked. The rise in prices did not begin till March 1923, and was both more gradual and less in extent. The exchange, after rising from 16·68 in July 1922 to 18·67 at the beginning of 1923, was set back (partly by the stringency in America) to 13·51 in June 1924. Credit expansion in America brought it up again to 15·27 in Jan. 1925. As in Denmark, the pressure of 7% reversed the rise of prices, and brought the exchange up to 20.

VI. THE EUROPEAN BELLIGERENTS

France.—The French franc recovered somewhat after the exchange crisis of Feb. 1920 and, like other currencies, followed the lead of the dollar during 1921 at the cost of a precipitate fall of prices. Its fluctuations have otherwise been mainly due to political causes. When there was a prospect of a workable plan for securing payment of reparations, the franc rose; when friction developed with Germany or when German finances seemed in a worse tangle than usual, the franc fell. Serious weakness developed with the occupation of the Ruhr in Jan. 1923. The franc fell in Dec. 1923 to 5 cents, or well below the lowest level touched in 1920. In Jan. 1924, for the first time since the War, a loan was a failure, an ominous portent. Did not the fall of the *assignats* start with the failure of a loan? Despite the favourable prospect of reparations, the franc fell rapidly and reached 3½ cents in March 1924. Credits were hastily arranged in New York and London on the security of the gold in the Bank of France, and used to support the franc. It was forced up to 6·72 cents, and then let down again to 5 cents.

A new internal loan in the autumn was a very equivocal success, though issued at a price to yield 8½%. Difficulty was found in getting the floating debt (bills of three to 12 months) held. For a country which still had to find very large sums for the reconstitution of the devastated area, the situation was serious. Financial weakness was soon made painfully apparent by the increase in the advances from the Bank of France to the Government (an increase which infringed the law, and was desperately and vainly concealed for some months). The crisis was brought to a head by heavy maturities in July, Sept. and Dec. 1925. One Finance Minister after another failed to carry his measures, and the crisis was still acute in the first half of 1926.

Belgium.—The Belgian franc was till the autumn of 1925 closely linked with the French, partly through the intimate connection of the banking system of the two countries, partly through the similarity of their political interests in regard to reparations. In Oct. 1925 measures were taken to stabilise the Belgian franc at its then gold value (about 4½ cents), but this broke down in March 1926.

Italy.—The Italian currency has likewise followed the French franc, but less closely than the Belgian. The fall of prices in Italy in 1920–1 was less severe, the recovery of the exchange in 1921–2 less marked. The lira was for a time dragged down by the French currency crisis of 1925, but after Nov. of that year was approaching stability at a value of about 4 cents.

Germany.—Germany was till 1924 the principal storm centre of European currency disturbances. The collapse which brought the mark down to 1 cent in Feb. 1920 was followed by a recovery. In May, after the evacuation of Frankfurt by the French, it rose to 2·95 cents, and the average for June was 2·56. In 1919 the Government had been almost without resources. Revenue was a mere fraction of expenditure, a loan for a modest total was a failure; the deficit had to be covered by issues of paper money. But in Dec. 1919 and April 1920 Erzberger's new taxes came into operation, and for the moment German finances were on a relatively sound footing. The mark, it is true, fell steadily, and in July 1921 was worth only 1·30 cents. But it was the dollar that was rising, not the mark that was falling. The American price index fell from 247 in May 1920 to 141 in July 1921, while the German index fell from 1510 to 1430. The mark was a more stable unit than the dollar.

The Erzberger reforms practically balanced the ordinary budget, though time was still required to realise their full productivity. Reparation payments had not begun, but heavy payments for the armies of occupation threatened the equilibrium. The note issue rose from 50 milliards in May 1920 to 72 milliards in May 1921. But, if only confidence in the currency could be maintained, 72 milliards (equivalent to $1,200,000,000) was not an excessive supply of currency. The spring of 1921 brought the first demands for cash on account of Reparations. A schedule of payments was agreed (after some friction) in May.

The collapse started by that milliard was to bring the mark down to levels which strained the very language of arithmetic. Germany was required to make payments when the necessary funds had not been collected and could not be collected in time by tax or loan. The only resource was inflation, and the headlong depreciation of the currency destroyed the yield of the heavy direct taxes which were the corner-stone of the budget. For a year and a half this treatment was applied, and by Jan. 1923, when the French and Belgians occupied the Ruhr, a million marks were worth less than $150. Reparation payments being suspended, an attempt was made to stabilise the mark at a rate of $48 to a million or $\frac{1}{5000}$ of par, but it broke down in April and the final collapse ensued. By Aug. 18 a million marks were worth 24 cents, the par value of one mark. Three months later, in Nov., this was the value of a *billion* marks.

The value of incomes or long contracts fixed in money had long before evaporated practically to nothing. The problem was to accommodate the ordinary day-to-day transactions (especially the payment of wages) to a medium which lost on an average ⅔ of its value every week. In the final phase people reckoned in gold marks and stipulated for payment in paper marks at the exchange of the day. Public authorities and private employers began to issue irregular "emergency money," in the form of promises to pay, denominated in gold marks. This competition of the gold mark as a money of account was the final undoing of the paper mark. When liabilities were not fixed in paper money, there was no longer any motive for keeping paper marks on hand.

Credit, in the form of "emergency" tender, had thus prevailed over legal tender. So long as there was a basis for a money of account in which a debt could be calculated, credit could exist. Here was the way out of chaos. By decree was established on Oct. 15 a new bank of issue, the Rentenbank, the notes of which, expressed in "rentenmarks" were not legal tender, but were convertible into interest-bearing bonds of the bank expressed in gold. The new bank was provided with capital by means of a forced loan from industry and agriculture (the capital was not paid up, but was a mere guarantee).

The mere absorption of a new fiduciary currency provided resources which tided the Government over the critical period before the revenue began to yield on a gold basis. In the early months of 1924 the currency threatened to start falling again. This was not due to Government borrowings but to demands for credit for trade. Dr. Schacht, the new Governor of the Reichsbank, drastically restricted credit and saved the situation. It was soon found that the tax system in force was more than adequate to meet requirements, when the currency was in working order. The year 1924 saw the settlement of Reparations by the Dawes plan. The Reichsbank was reorganised. The billion-mark notes, that had been circulating alongside the rentenmarks, were replaced by the new Reichsmark notes at the ratio of one to a billion. The greatest currency collapse in history had become a thing of the past. Measures have been taken to mitigate the ruin of the rentier class, in some directions, by a valorisation measure, securing them a fraction of the gold value of former mortgages and debentures.

Austria and the Succession States.—Three states, Austria, Hungary and Czechoslovakia, had the old Austro-Hungarian crown as their sole medium of exchange in 1919. It circulated also in parts of Rumania, Yugoslavia and Poland. The first step was to put a stop to a state of affairs in which the Austro-Hungarian Bank was financing Governments in Vienna and Budapest by inflating the currency in all the other States. In Feb. 1919 Czechoslovakia and Yugoslavia closed their frontiers to the importation of bank notes, and required all those on their territory to be stamped with distinguishing marks. Thereafter only stamped notes were legal tender. Other States followed the same plan (Hungary not till March 1920). In the period following the exchange crisis of Feb. 1920 the countries of Central and Eastern Europe were greatly affected by German currency conditions. They had long been financially and commercially dependent upon Germany. The collapse of 1921 played havoc with all of them.

The first to emancipate itself was Czechoslovakia. It was the most industrially developed and was free from war burdens. The Finance Minister, Dr. Rasin, had already imposed heavy taxes, and

in 1922 was able to raise loans in London and New York. That made possible a restriction of the note issue, which forced up the exchange value of the Czech crown from 1 cent in Nov. 1921 to 3¾ cents in Aug. 1922. The price index fell from 1675 in Dec. 1921 to 1003 in Dec. 1922. The result, as in the countries which had accomplished deflation on a similar scale in 1920–1, was extreme trade depression and unemployment, the number of unemployed rising to 436,000 at the end of 1922. But the effort once accomplished, a slight relaxation became possible. The exchange was stabilised at approximately 3 cents, the unemployed were gradually absorbed, and by 1925 business and currency conditions were normal.

Austria was unable to recover by her own unaided efforts. The collapse of 1921 was intensified in 1922. The economic position of the country, a financial and commercial centre politically severed from the region it had been accustomed to serve, was precarious. Vague but onerous reparation liabilities were imposed upon it. At last the League of Nations intervened, and a scheme of financial reconstruction was adopted in Oct. 1922. Reparation liabilities were suspended and postponed. A loan was raised with an international guarantee, and a certain amount of financial control was imposed through a representative of the League. The crown was stabilised at a value $\frac{1}{14400}$ of the former gold crown, the new currency unit being the schilling, equal to 10,000 paper crowns (about 7d.).

Developments in Hungary were somewhat similar. A courageous attempt by Dr. Hegedüs to restore the finances in 1921 failed for lack of parliamentary support. A League of Nations reconstruction scheme was adopted in April 1924. Hungary had more financial strength than Austria, and by the aid of the support and control of the League was able to raise her reconstruction loan on her own credit without any guarantee. The Hungarian crown was stabilised at the same gold ratio as the Austrian. The new unit (Jan. 1926) is the pengö of 12,500 paper crowns (8⅝d.).

Rumania and Yugoslavia.—Rumania and Yugoslavia escaped from the extremities of currency collapse, but have not as yet stabilised their currencies. In the Austro-Hungarian provinces of Yugoslavia the stamped notes of the Austro-Hungarian Bank were replaced at the ratio of one dinar to four crowns. In Rumania it was necessary to replace not only crowns in Transylvania and other parts but roubles in Bessarabia. The change was effected in 1920, two crowns being taken as equivalent to one leu. The Rumanian leu (formerly the equivalent of a franc) remained comparatively steady after the beginning of 1923 at about $\frac{1}{40}$ of its par value. The Serbian dinar, after falling in Jan. and Feb. 1923 below one cent, gradually recovered to about 1¾ cents, or $\frac{1}{11}$ of par, and in 1926 showed signs of being stabilised at that value.

Poland.—Poland came into existence as a state with a bewildering variety of currencies. In Congress Poland (the old Russian Poland) an issue of Polish marks had appeared during the German occupation. To it were added German provinces with German marks, Galicia with Austro-Hungarian crowns, Russian provinces with all varieties of Russian roubles. Ultimately these were all replaced by Polish marks. Poland was involved during 1919 and 1920 in war with Russia, with no resources to meet the overwhelming burden of war budgets. The lavish issue of paper money caused a wild and rapid depreciation. By 1924 Polish marks were worth no more than 11 cents a million. As in Germany, a money of account based on gold (the *zloty* or franc) had already come into use, and in May 1924 a scheme of stabilisation was introduced with the issue of *zloty* notes by a Bank of Poland (one *zloty* was the equivalent of 1,800,000 Polish marks). It was not found possible to maintain the *zloty* currency at par, and by March 1926 it had fallen to about two-thirds of its nominal gold value.

Other European States.—The Baltic States, Finland, Estonia, Latvia and Lithuania, all succeeded in the post-War period in placing their currencies on a gold standard. Finland retained the Finnish mark, reduced in value from 19·30 cents to 2½. Estonia and Latvia evolved stable currencies from an amazing complication of different kinds of roubles and marks. Lithuania used the German mark till the collapse of 1923. Bulgaria, Greece, Portugal and Turkey have heavily depreciated currencies, but by the beginning of 1926 had not adopted definite measures of stabilisation.

Russia.—In 1918 there ceased to be a foreign exchange market in Russia, and, up to the introduction of the New Economic Policy in 1921, the policy of the Soviet was to dispense with money altogether as soon as practicable. Nevertheless, the issue of paper money in ever-growing quantities to meet the daily expenses of Government continued, and, when the return to a general use of money was decided on in the autumn of 1921, the depreciation was such that prices were 80,000 times the level of 1913. That far transcended any price index recorded up to that time elsewhere in Europe. A new "rouble of 1922" was introduced equal to 10,000 of the existing Soviet roubles, but this was a mere change of nomenclature, adopted for the convenience of shortening the figures. The process of depreciation continued unabated, and a new money of account was instituted in the form of a "goods rouble." Its value in paper roubles was officially fixed, at first from month to month and then at shorter intervals, according to the index number of prices, so as to represent the quantity of wealth which a rouble would buy in 1913. Wages and other obligations were fixed in goods roubles and paid in paper roubles at the prescribed value.

The use of a stable unit of account was followed up towards the end of 1922 by the issue of a stable paper money. Bank notes expressed in Tchervontzi (a tchervonetz being 10 gold roubles) were issued by the State Bank. These notes were neither convertible nor legal tender, but they were accepted by the State and came into use for payments in terms of the goods rouble, which was renamed gold rouble. The reference to gold was really a fiction. There was no market in gold, and the standard of value still depended on the index of prices. The tchervontzi were in practice convertible into Soviet roubles at the appropriate rate. Transactions in foreign currencies gradually grew up, but in view of the Government monopoly of foreign trade they were on an entirely artificial basis.

In March 1924 the system of concurrent circulation of two forms of paper money was terminated, and the tchervontzi became the sole currency. A Soviet rouble of 1923, equal to 100 roubles of 1922 and therefore to 1,000,000 of the earlier issues, had been introduced, and when the Soviet roubles were finally withdrawn 50,000 of these were exchanged for one rouble of the bank notes ($\frac{1}{50}$ of a tchervonetz). The ultimate depreciation was therefore in the ratio of 1 to 50 milliards. The tchervontzi therefore were the Russian currency at the end of 1925.

VII. JAPAN, CHINA, INDIA, ETC.

Japan.—Japan succeeded in maintaining gold parity in the critical year 1920. In fact a financial crisis in the spring of that year produced an acute stringency, which put the yen for a time at a substantial premium over the American dollar, and the consequent imports of over $90,000,000 in gold contributed to the monetary stringency in the United States in the autumn. In the succeeding years the yen was allowed to lapse a little. The earthquake of Sept. 1923, coming at a time when prices in America were falling, intensified the decline. At the end of 1924 the yen was 23% below par, but during 1925 the discount diminished to 10%.

China.—Chinese currency has remained throughout the storms and stresses of the War and post-War period securely based on silver. The apparent vagaries of the exchange were mainly due to fluctuations in the value of the European units in which they are calculated. When silver rose to 89½ d. per standard ounce in 1920, or about three times its pre-War price, that was less than the rise of other commodities. The subsequent fall in silver, and therefore in Chinese currency, was greater in proportion than the fall of prices generally. That was due, partly at any rate, to the displacement of a very large amount of silver coinage from Europe. In many countries the depreciation of the currency has been such that the current value of the subsidiary silver coin fell below the bullion value. Much was therefore privately melted, to be sold as bullion. Extensive recoinage schemes were also set on foot. The value of silver was lowered by the release of these fresh supplies.

India.—From 1898 to 1917 the Indian rupee was successfully maintained by means of an exchange standard at a value in sterling of 1s. 4d. But when the price of silver rose above 43d. a standard ounce, the rupee became worth more than 1s. 4d. as silver. This price was reached in 1917 and it became impossible for the Indian Government to undertake to supply rupees at 1s. 4d. The exchange was raised to 1s. 5d. and then 1s. 6d., and for a time a further rise was staved off because the United States undertook to supply silver at $1 a fine ounce (47d. per standard ounce) by withdrawing silver certificates and melting down the reserves of standard dollars (Pittman Act). But in 1919 and 1920, this resource being withdrawn silver soared, and the rupee rose at one time to 2s. 8d.

Its value in *gold* was about 48 cents (2s. at par). An attempt to fix it permanently at that value broke down in face of the appreciation of gold in terms of commodities. The powerful credit apparatus by which prices can be forced down in England or America does not exist in India. The rupee fell to 24 cents in 1921, and recovered as American prices rose, to 32 cents in March 1923. After a reaction the renewed expansion in America in 1924–5 brought it up to 36 cents, or about 1s. 6d. A Commission of Inquiry was appointed in 1925 to consider the future of the Indian currency.

South America.—Those of the South American states which were still on a gold standard in 1920 were quickly shaken off it by the fall of prices in the United States. Argentina saw her gold peso turn into another kind of paper peso in the fixed ratio of 100 to 44 to the old paper peso.

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CURRIE, SIR ARTHUR WILLIAM (1875–), Canadian soldier and administrator, was born at Napperton, Ont., Dec. 5 1875 and for some time was engaged in business in British Columbia. On the outbreak of the World War his natural bent for military affairs quickly brought him into prominence. He

commanded the 1st Canadian Div., 1914–7, and the Canadian Corps in France 1917–9. He gained the confidence of the English military authorities, and when Sir Julian Byng resigned his command of the Canadian troops Sir Arthur Currie was appointed in his stead. The manner in which he carried out his command marked him a military leader of unusual distinction. Currie was given the C.B. in 1915, K.C.M.G. 1917, K.C.B. 1918 and G.C.M.G. 1919; he was awarded the French Legion of Honour and the Croix de Guerre both of France and of Belgium, and was created Grand Officer of the Belgian Ordre de la Couronne. In 1920, after Sir Auckland Geddes (*q.v.*) had finally decided not to take up the principalship of McGill University, Montreal, on his appointment as British Ambassador to Washington, Sir Arthur Currie was elected to the post. (*See* CANADA.)

CURTIS, CHARLES GORDON (1860–), American inventor, was born at Boston, Mass., April 29 1860. He was educated at Columbia University (C.E., 1881; LL.B., 1883; M.S., 1907), and practised as a patent lawyer for eight years. He organised the C. & C. Electric Motor Co., and also the Curtis Electric Manufacturing Co., of which he was president. He invented a steam turbine of higher efficiency than the Parsons type with a new method of controlling speed, the land rights of which he sold to the General Electric Co. This corporation spent $3,000,000 in developing the patent, with the result that the Curtis steam turbine is widely employed both in electric power-plants and marine propulsion, being used in the U.S. and British navies.

CURTIS, CYRUS HERMANN KOTZSCHMAR (1850–), American publisher, was born at Portland, Me., June 18 1850. He sold newspapers when a boy, and in 1870 joined a Boston paper as advertising canvasser. In 1876 he went to Philadelphia and became publisher of *The Tribune and Farmer*, a weekly paper. In 1883 he established *The Ladies' Home Journal* and in 1891 organised the Curtis Publishing Co. In 1897 he purchased *The Saturday Evening Post*, which was a direct continuation of *The Pennsylvania Gazette*, founded in 1728 by Benjamin Franklin, and in 1911 he bought *The Country Gentleman*. *The Ladies' Home Journal* and *The Saturday Evening Post* attained a circulation of 2,000,000 each and probably carried more paid advertising than any other publications in the world. For this reason, although the cost of producing a copy of *The Saturday Evening Post* was many times its selling price to the public (5 cents), this magazine was highly profitable to the publisher. In 1913 he purchased *The Philadelphia Public Ledger* and in 1923 acquired *The New York Evening Post*.

See E. W. Bok, *A Man from Maine* (1923), and *The Boy Who Followed Ben Franklin* (1924).

CURTIUS, ERNST ROBERT (1886–), German scholar, was born at Thann, Alsace, April 4 1886. From 1913–9 he taught at the university of Bonn, from 1920–4 at Marburg, and in 1924 was appointed professor of French history and romance philology at Heidelberg. In 1914 he published *Ferdinand Brunetière, ein Beitrag zur Geschichte der französischen Kritik*. His work *Die literarischen Wegbereiter des neuen Frankreichs* (1919) is of importance in filling the large gap which the World War has made in the knowledge of the intellectual development of present day France.

Among his other works are *Maurice Barrès und die geistigen Grundlagen des französischen Nationalismus*; *Der Syndikalismus der Geisbesarbeiter in Frankreich* (1921); *Balzac* (1923); *Französischer Geist im neuen Europa* (1925).

CURZON OF KEDLESTON, GEORGE NATHANIEL CURZON, 1ST MARQUESS (1859–1925), British statesman (*see* 7.665), received an earldom, along with the viscountcy of Scarsdale and the barony of Ravensdale, as a coronation honour in 1911. He was conspicuous in that year first by his strong denunciation of the Parliament bill and of the Liberal attack on the House of Lords, and then by the leading share he took, in the final stage, in persuading the bulk of the Conservative peers to abstain from voting in the crucial division and so to permit the bill to pass rather than have their House swamped by hundreds of creations.

During the vehement party conflicts of the next two or there years before the World War he established his position as the chief lieutenant of Lord Lansdowne in the Lords. But much of his time and attention during the period of opposition was given to the affairs of Oxford University, of which he had been elected chancellor; and he promoted the cause of reform there by personal effort and by publishing a detailed memorandum on the subject. He had, moreover, a scholarly love for antiquities, and bought and carefully preserved from further ruin the ancient castles of Tattershall in Lincolnshire and Bodiam in Sussex, and eventually presented them to the nation.

With other Conservative leaders he joined Mr. Asquith's Coalition Cabinet in the summer of 1915, as Lord Privy Seal; and in that capacity he introduced the bill constituting the new Ministry of Munitions under Mr. Lloyd George, and took charge in the Lords of the Munitions of War bill which was to furnish that Ministry with its weapons. In these and other ways he gave proof of a determination to prosecute the War with zeal and energy. He accepted the presidency of the Air Board in May 1916 and in July became a permanent member of the War Committee of the Cabinet.

When Mr. Lloyd George formed his Ministry in Dec., he was called to a still more prominent position. Lord Lansdowne and Lord Crewe—the two leaders of parties in the Lords—both retired from office, and Lord Curzon became the leader of the House with the office of Lord President. He was chosen also to be one of the four ministers (the others being the Prime Minister, Lord Milner and Mr. Henderson) who constituted the War Cabinet, and were charged with the permanent daily conduct of the War. After the Paris Conference he took over the Foreign Office from Mr. Balfour, retaining his leadership of the party in the House of Lords.

As leader, though not able to claim the sympathetic touch and close familiarity with their lordships' idiosyncrasies possessed by some of his predecessors, he exhibited remarkable intellectual powers and oratorical capacity, and gradually established his ascendancy in the House. In the Foreign Office he found a specially congenial sphere, as he had throughout his life made a study of the external relations of the country, and had travelled extensively. But foreign affairs in the years immediately following the War were still dominated by the Prime Minister and the Supreme Council; and it was at meetings of the latter, which Mr. Lloyd George attended—at Paris, San Remo, Spa, Lympne and London—that a settlement, or at least a temporary salve, was found for recurrent difficulties.

When the Coalition fell in Oct. 1922, Lord Curzon remained at the Foreign Office in Mr. Bonar Law's and Mr. Baldwin's administrations, and on Nov. 8 he announced that it had been decided that the department should, as in former days, do its own work, subject only to the control of the Cabinet and the general supervision of the Prime Minister. During the ensuing 15 months he had to deal with several thorny problems, in which only moderate success was possible, and his treatment of them subjected him to repeated, if not always justifiable, criticism. He had first to straighten out British relations with the Nationalist Turks, who disregarding the Treaty of Sèvres had driven the Greeks out of Thrace and Asia Minor by force of arms; and he spent the winter of 1922–3 presiding over a European Conference at Lausanne, and employing all his resources of knowledge, skill, patience and courtesy in the vain endeavour to win Turkish consent to a satisfactory settlement. Ultimately, as renewed fighting was abhorrent to England and Europe, Turkey was allowed to retain all she had regained, with the addition of Constantinople. With Russian relations, Lord Curzon's second difficulty, he had more success. By sharp remonstrances in the spring and summer of 1923, based on the stipulations of the Trade Agreement of 1921, he obtained from the Russian Govt. the suspension of their open anti-British action and propaganda, and the removal of their incriminated officials at Cabul and Teheran.

But Lord Curzon's principal preoccupation was the relations of England, France and Germany. M. Poincaré, the French Prime Minister, in spite of serious British protests, embarked

in the winter of 1922–3 on the Ruhr expedition to exact reparations from Germany; and he continued and intensified the pressure throughout the year, accompanying it with the policy of encouraging Separatist movements in the Rhineland. Lord Curzon, who had begun by merely dissociating Britain from French action, while protesting that British policy was based on the Entente, gradually took up a position of decided antagonism; and finally in Aug. issued a note of severe condemnation, asserting the total illegality of the French movement. No remonstrances had any effect on M. Poincaré; but meanwhile Lord Curzon had encouraged Germany to make, in regard to reparation, offers of her own, which at first were so small as to provoke immediate rejection, but which eventually became sufficient to afford a basis for negotiation. Finally before he left office he had secured the consent of France and Belgium to an advisory committee of experts (in which the United States had decided to co-operate) to be appointed by the Reparations Commission. This developed under Mr. Ramsay MacDonald into the Dawes Committee, from whose report dated the improvement of European relations.

Lord Curzon had two serious disappointments in his last years, both of which he bore with dignity and in silence. The first was when, on Mr. Law's resignation from illness in May 1923, Mr. Baldwin, who had decidedly less experience and political eminence than himself, became Prime Minister, mainly because it was only in the House of Commons that the real opposition, the Labour party, could be encountered. The other was when Mr. Baldwin formed his second Cabinet in the autumn of 1924, and passed over Lord Curzon's claims to return to the Foreign Office, placing there instead Mr. Austen Chamberlain, who, as a previous leader of the whole party, was bound to receive special consideration. On the first occasion, Lord Curzon consented to take the chair at the party meeting which elected Mr. Baldwin to the leadership; on the second, he accepted the presidency of the Council, retaining of course the leadership in the Lords.

Lord Curzon's first wife, by whom he had three daughters, died in 1906, and in 1917 he married, as his second wife, Grace Elvina, widow of Alfred Duggan, of Buenos Aires, and daughter of J. Munroe Hinds, U.S. Minister in Brazil. He succeeded to the barony of Scarsdale on his father's death in 1916 and became a K.G. in the same year. He was created a marquess on the King's birthday in 1921. Never a strong man, he had forced himself throughout life by sheer will-power, in spite of serious physical disabilities, to do day by day more than a strong man's work; and in the early spring of 1925, his health suddenly broke down, and after a fortnight's illness he died in London on March 20. The first part of the funeral service was held in Westminster Abbey, where an immense congregation, including the foremost people of the country, gathered; the actual burial was at Kedleston, the family seat in Derbyshire. As he left no son, the marquessate and earldom became extinct; the viscountcy and barony of Scarsdale passed, with Kedleston, to his nephew; and his eldest daughter, Lady Irene Curzon, inherited the barony of Ravensdale.

After Lord Curzon's death two volumes by him were published, *British Government in India*, on the proofs of which he was engaged during his last illness. (G. E. B.)

CUSHING, HARVEY (1869–), American surgeon, was born at Cleveland, O., April 8 1869. He graduated from Yale University in 1891 and from the Harvard Medical School in 1895. After four years at the Johns Hopkins Hospital he studied abroad under Kocher at Berne, and Sherrington at Liverpool. On his return to Baltimore he held various positions in the department of surgery at Johns Hopkins University, becoming an associate professor in charge of cases of surgery of the central nervous system. He wrote numerous monographs on the surgery of the brain and developed the method of operating with local anaesthesia. His work on the pituitary body gave him a European reputation. He also made important contributions to the study of blood pressure in surgery. In 1911 he was appointed professor of surgery in the Harvard Medical School and surgeon-in-chief at the Peter Bent Brigham Hospital in Boston. From 1917–9 he was director of United States base hospital No. 5 attached to the British Expeditionary Force in France. In 1918 he was made senior consultant in neurological surgery for the American Expeditionary Force and held the rank of colonel in the Medical Corps at the close of the War. He wrote a *Life of Sir William Osler* (1925).

CUYPERS, PETRUS JOSEPHUS HUBERTUS (1827–1921), Dutch architect, was born May 16 1827 at Roermond, Holland. He studied under Viollet-le-Duc, and was inspired both by the Gothic and the Netherland style of the 16th century in building the Rijks Museum at Amsterdam (1877–85) and in restoring and rebuilding many Roman Catholic churches, town halls and other buildings. His chief merit however was that he awakened the interest of his countrymen in architecture and the decorative arts, and so prepared the way for Berlage, de Bazel and others who created the modern Dutch style of architecture. Cuypers received honorary degrees from the universities of Utrecht and Delft. He died March 3 1921.

CYANAMIDES (*see* 7.679).—The metallic cyanamides, of which calcium cyanamide, $CaCN_2$, is the only one of technical importance, are derivatives of dyanamide, H_2CN_2. In practice, calcium cyanamide is always formed by the action of nitrogen on calcium carbide. In 1892 Moissan showed that calcium carbide could be prepared easily and in quantity in the electric furnace, and in 1895 A. Frank and N. Caro (*Jour. Soc. Chem. Ind.*, vol. 27, 1908; *Trans. Faraday Soc.*, vol. 99, 1908; *Zeitsch. angew. Chem.*, vol. 22, 1909) began investigations on the absorption of nitrogen by metallic carbides which have led to the establishment of the modern cyanamide industry. Although pure calcium carbide does not absorb nitrogen even at 1,200°C. (Moissan), Frank and Caro found that technical carbides did so readily at much lower temperatures, probably owing to their impurities.

Formation of Cyanamides by Nitrogen.—By the action of nitrogen on metallic carbides, mixtures of cyanamides and cyanides are obtained, the proportions depending on the metal and on the temperature. The general type of the reaction may be illustrated by the case of calcium carbide.

$$CaC_2+N_2=CaCN_2+C \qquad (1)$$
$$CaCN_2+C=Ca(CN)_2$$

With alkali carbides, cyanide preponderates largely. With barium carbide about 30% cyanide and 70% cyanamide is obtained at 700°–800°C., whilst with calcium carbide cyanamide is practically the only product up to 1100° C. In all cases the proportion of cyanide increases with the temperature. These facts explain the formation of cyanide by fusing the mixture of calcium cyanamide and carbon with sodium chloride,

$$CaCN_2+C+2NaCl=CaCl_2+2NaCN \qquad (2)$$

Calcium Cyanamide.—The mechanism of the production of calcium cyanamide is by no means clear, in spite of numerous investigations. The chief difficulty in interpreting the results is the effect of impurities, always present in commercial carbide. If the reaction is according to equation (1), with three solid phases and a gaseous phase, a definite equilibrium pressure of nitrogen should correspond to a given temperature. Attempts to determine this equilibrium (Caro, Matignon, Thompson and Lombard) led to improbable or conflicting results; M. Le Blanc and M. Eschmann (*Zeitsch. Elektrochem.*, 17, 20, Jan. 1911) could not obtain reproducible values for the equilibrium pressures, and attribute this to (*a*) sublimation of cyanamide preventing its taking part in the reverse reaction; (*b*) alteration of the carbon rendering it inactive; (*c*) occurrence of side reactions, the effects of which could not be taken into account. They concluded that with impure carbide the system is divariant and that one of the phases is a melt of variable composition. Their results were confirmed by V. Ehrlich (*Zeitsch. Elektrochem.*, 28, 529, Dec. 1922), who, however, with nearly pure calcium cyanamide, free from carbon, obtained definite equilibrium pressures, which were much lower than the indefinite ones with impure cyanamide —carbon mixture for the same temperature. He concluded that

pure calcium cyanamide decomposes reversibly into calcium subcarbide and nitrogen,

$$CaCN_2 = CaC + N_2$$

and that his equilibrium pressures were for this reaction. He suggested the formation of commercial cyanamide in stages,

$$CaC_2 = CaC + C$$
$$CaC + N_2 = CaCN_2$$

The dissociation of the carbide into subcarbide and carbon had been previously assumed by G. Erlwein, C. Warth and R. Beutner (*Zeitsch. Elektrochem.*, 17, 177, March 1911) to account for their experimental results on heating calcium carbide, but Briner and Kuhne (*Jour. Chim. Phys.*, 12, 432) could not confirm this. To sum up, the mechanism of cyanamide formation has not yet been fully explained; the importance of this for the cyanamide industry is obvious.

Absorption of Nitrogen.—The rate of absorption of nitrogen by carbide has been much studied. Pure calcium carbide does not absorb nitrogen at 1,200°C. With commercial carbide (containing about 10% lime) absorption is rapid and complete at 1,050°–1,100°C. Below 1,000°C. the absorption is less rapid and is incomplete, the nitrogen absorbed tending to a limiting value, which is lower the lower the temperature. These limiting values do not represent true equilibria (Foerster and Jacoby). Pollacci found that the velocity of absorption is proportional to the nitrogen pressure up to two atmospheres, but that further increase of pressure makes little difference.

Many substances when added to calcium carbide lower the temperature at which nitrogen absorption begins and increase the velocity of absorption for a given temperature. The most important of these substances are calcium chloride (Polzenius) and calcium fluoride (Carlson). Many other substances, including lime, act similarly, and this explains the action of commercial carbide. The rôle of these additions has been investigated by G. Bredig, W. Fraenkel and E. Wilke, F. Foerster and H. Jacoby, Rudolphi, G. Pollacci and others (*Zeitsch. Elektrochem.*, vol. 13, March 1907; vol. 14, Sept. 1908; vol. 15, Nov. 1909; *Zeitsch. anorg. Chem.*, 54, 170), and has been connected with the lowering of the melting-point of the mass which they cause; but how this increases the velocity of absorption, whether by removing protecting layers of reaction products from the carbide, by allowing the nitrogen to dissolve in the liquid mass, or by other means, has not been settled. Reaction (1) is strongly exothermic. The heat of reaction is about 77,800 calories at 25°C.

Technical Production.—On the commercial scale a mixture of calcium cyanamide and carbon ($CaCN_2+C$) is produced by heating ground calcium carbide in an atmosphere of nitrogen to about 1,000°–1,100° C. The nitrogen is generally prepared by the fractional distillation of liquid air by the Linde or Claude process, and should be as free as possible from moisture, CO, CO_2 and especially oxygen, as these act on either the carbide or cyanamide and diminish the nitrogen content of the final product.

Discontinuous Process.—In the discontinuous process a vertical steel drum lined with firebrick is fitted loosely with a thick paper or thin, perforated, sheet-iron cylinder. Down the centre of the retort passes a carbon rod contained in a cardboard tube to separate it from the carbide. This rod is connected to an alternating current supply and is used as a heating resistance to start the reaction. The ground carbide is packed between the inner tube and the outer cylinder. The lid is luted on airtight. Nitrogen is admitted by a pipe through the outer casing. The charge consists of 300–800 kilos of carbide. A battery of such units is connected to the current supply. The heated carbon resistor starts the reaction at the centre. After a time the current is cut off as the reaction produces sufficient heat to maintain the charge at about 1,000°C. and so complete the reaction. The drums are allowed to cool, the contents ground and treated with sufficient water to slake the lime and decompose any uncombined carbide. The ground product is sometimes mixed with a little oil to render it dustless before packing in bags. The crude cyanamide, known as "nitrolim," "lime nitrogen," "kalkstickstoff" or "stickstoffkalk," contains 20–22% of nitrogen, corresponding to 57–63% of $CaCN_2$ and about 20% lime, 7–8% silica, iron oxide and alumina and 14% of graphitic carbon.

Continuous Process.—In one type of continuous furnace the carbide is packed in perforated metal boxes which are sent through a tunnel filled with nitrogen and heated, electrically or by external gas firing, to the necessary reaction temperature. Another common type is a vertical iron shaft lined with firebrick and divided internally into sections by shelves. The carbide is fed in at the top and heated by arcs between carbon electrodes. It meets an ascending stream of nitrogen and is made to fall slowly from shelf to shelf by scrapers until it is discharged at the bottom. In the Carlson process calcium fluoride is added to the carbide to increase the velocity of absorption and to lower the reaction temperature.

Uses of Nitrolim.—Nitrolim may be used directly on most soils as a nitrogenous fertiliser. When treated with water or steam under pressure it gives up practically the whole of its nitrogen as ammonia (*q.v.*):

$$CaCN_2 + 3H_2O = CaCO_3 + 2NH_3$$

The addition of alkali increases the yield of ammonia by diminishing the formation of polymers of cyanamide. By fusing a mixture of nitrolim, common salt and calcium carbide in an arc furnace sodium cyanide is produced by reaction (2) above.

By rapidly cooling the melt the reverse reaction is prevented and the cyanide preserved (*Chem. Met. Eng.*, 22, 265; *Can. Chem. and Met.*, 6, 129). By suitable treatment numerous organic compounds (urea, dicyandiamide, guanidine, etc.) may be prepared from cyanamide (*Jour. Ind. Eng. Chem.*, 5, 159). It also forms the basis of "ferrodur," used for case-hardening iron. The world's production (1918) was 668,800 metric tons.

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(J. KN.)

CYANIDES (*see* GOLD, 12.199).—The world's consumption of cyanides has increased by about 50% since 1910, and, owing to improvements in manufacture, the price is now 10 to 20% lower than that ruling in 1910–3.

Metallurgy.—The extraction of gold and silver from their ores is still the principal use of cyanides. Two grades of sodium cyanide (90% and 97% NaCN respectively) and, since 1916, an impure calcium cyanide containing cyanogen equivalent to 48 to 50% NaCN are in common use. While the principle of the methods employed is the same as before, the process is no longer regarded merely as a way of recovering gold which cannot readily be won by amalgamation. When the ores are very finely ground, so as to pass through gauze with 150 to 200 wires per in., the time needed to dissolve the precious metals is very much reduced, a more complete extraction is obtained (95% or more is not unusual), very dilute cyanide solutions, containing considerably less than 0·1% NaCN, can be employed and, finally, many ores formerly regarded as refractory can be treated successfully. The economic handling of finely divided ores presented difficulties which have only gradually been overcome. Each mining field has developed methods to suit the peculiarities of its ores and its own local conditions.

In general the ore is first crushed roughly in presence of cyanide solution; the mixture of ore and solution then passes to a tube mill for fine grinding. The pulp passes on to some form of hydraulic classifier which separates the coarser particles of ore and returns them to the tube mill for regrinding. The separation of the cyanide solution (which now contains the precious metals) is carried out either by settling and decantation or by filtration; in the most recent plants these operations are continuous. In the recovery of gold and silver from the cyanide solutions zinc dust is now often used in place of zinc shavings. The dust is stirred into the solution in suitable quantity and the precipitate of finely divided gold or silver which forms very rapidly is filtered off at once. The consumption of zinc is smaller and the bullion is recovered at shorter intervals than in the older process.

Control of Insects and other Pests.—The value of hydrocyanic acid as an insecticide was first recognised in 1886 by D. W. Coquillett, who used it in the control of scale insects on citrus trees in California. The methods of work were standardised by the investigations of R. S. Woglum in 1907–10 (*U.S. Dept. of Agriculture, Bureau of Entomology, Bull. 90*). In 1916, more than 1,300 tons of sodium cyanide were consumed in the fumigation of citrus trees in California alone (G. P. Gray, *J. Ind. and Eng. Chem.*, 10, 301, 1918) and the method is now practised in Florida, Porto Rico, Australia, Japan, South Africa, Spain and Italy. It was first tried on deciduous trees in 1894 in Virginia by Coquillett and in 1909 A. L. Quaintance (*U.S. Dept. Agriculture, Bureau of Entomology, Bull. 84*) showed that it was effective against the San José scale on apples; subsequently the fumigation of nursery stock, before planting, was made compulsory in several states of the United States.

Uses as Fumigant.—Hydrocyanic acid was first used for the destruction of vermin in the sleeping carriages of the Cape Government Railway in 1898 and its use for similar purposes spread so rapidly that the town council of Johannesburg found it necessary, in 1916, to draw up by-laws for the licensing of fumigators and for regulating the practice. Hydrocyanic acid was authorised as a fumigant in the United States Quarantine Regulations of 1910, but it was first used on a large scale for killing rats in ships, as a measure of plague control, at New Orleans in 1914; since then it has been used as a routine measure so that, for example, of 1,425 ships fumigated at the port of New York in the year 1921–2, all but 10 were treated with hydrocyanic acid. The method was first used in Germany in 1917 against weevils in a flour-mill, in Italy in 1919 against rats in granaries and in ships, and in Great Britain in 1922 for the fumigation of ships and greenhouses. (P. G. Stock and G. W. Monier-Williams, *Ministry of Health, Rep. on Public Health, No. 19.*)

In the fumigation of plants it is important to secure a concentration of hydrocyanic acid which will kill the insect pest without injury to the plant. Plants are more severely injured when they are exposed to sunlight than they are in the dark; fumigation is therefore done at night and at temperatures between 38° and 65° Fahrenheit. There is considerable variation in the susceptibility to damage of different plants; roses and sweet peas for example are easily burned, lemons are much less affected than oranges, and olives may even be fumigated in daylight.

In order to obtain the necessary concentration of gas, plants growing in the open are covered with a tent; the form in general use is an octagonal sheet of light, closely woven cotton cloth measuring usually from 36 to 45 ft. across. By means of two light poles this is drawn over the tree so that it hangs down touching the ground all round it. The distance round the bottom of the tent is then measured by a tape and the distance over the top of the tree read off from a scale which is painted on the tent itself; the quantity of cyanide required for an enclosure of the size defined by these measurements is then read off from a table which was constructed by Woglum (*loc. cit.*) as a result of his experiments. The table is based on the use of 1 oz. of potassium cyanide (or $\frac{3}{4}$ oz. of sodium cyanide) for 100 cu. ft. of enclosed space for trees 11 to 12 ft. high; smaller trees require rather more and larger ones less owing to the relatively greater or smaller leakage through the tent cloth. The exposure to the gas is usually one hour. In calculating the dosage allowance is also made for the kind of insect to be attacked; for example, the full dosage is needed for purple scale in California and for the "serpéta" in Spain, but a $\frac{3}{4}$ dosage suffices for black scale and about $\frac{1}{8}$ dosage for *Phleothrips oleae* on olive trees in Spain. The hydrocyanic acid is generated by mixing together sodium cyanide (1 oz.) concentrated sulphuric acid ($1\frac{1}{2}$ fluid oz.) and water (2 oz.). The water is placed in a 2 to 3 gal. stoneware jug, the sulphuric acid then added, within the tent, the charge of cyanide is then thrown in and the tent closed at once.

In more gas-tight enclosures, such as greenhouses, a smaller dosage is sufficient; $\frac{1}{2}$ oz. of sodium cyanide to 1,000 cu. ft. will eradicate aphides, in other cases a repetition of the treatment after a suitable interval may be needed, because the eggs and pupae are more resistent than the larvae and mature insects; most scale insects require about $2\frac{1}{2}$ oz. per 1,000 cubic feet.

In the fumigation of ships and mills modifications of the procedure are necessary owing to the larger quantity of gas required and the difficulty of protecting the operator from danger. The compartments to be treated are first closed as nearly as possible gas-tight; wooden barrels, placed so as to distribute the gas uniformly, are charged with water and sulphuric acid and the cyanide placed in hinged receptacles which can be tipped by means of wires communicating with the exterior. The holds, cabins, etc., are opened up 2 hours after generating the gas and several hours allowed for it to escape before anyone is allowed to enter; in calm weather ventilation is accelerated by a fan. The officer in charge finally makes an inspection, wearing an oxygen-breathing apparatus and carrying a cage of rats; if these are unaffected the ship is certified safe. There are several modifications of this method.

The necessity of handling strong sulphuric acid and difficulties in disposal of the poisonous acid residues have led to the introduction of pure liquid hydrocyanic acid. This was first manufactured commercially in California in 1917 and in South Africa in 1920. In California the liquid, which contains 2 to 4% water, boils at 27° C., and has density 0·7, is supplied in iron drums holding 100 lb. each. It is applied by means of a portable vessel, containing 17 to 21 lb., with attached hand pump. Each stroke of the pump delivers a measured quantity of the liquid to a spraying nozzle which is pushed into the tent. Another method passes the measured volume of liquid into a heated tube where it is vaporised and delivered into the tent as gas. In South Africa the liquid is put up in sealed glass tubes which are broken within the space to be fumigated.

Liquid hydrocyanic acid is unstable, more especially in presence of alkalis; it polymerises to a black substance resembling charcoal, with evolution of a considerable quantity of heat. As the speed of polymerisation increases with temperature the reaction may become explosive. (Walker and Eldred, *J. Ind. and Eng. Chem.*, 17, 1,074, 1925.) For this reason the transport and storage of liquid hydrocyanic acid are attended with risks which have contributed to confine its use to districts in which it is possible to distribute it from factory to consumer by motor transport. The usual dosage for ships, mills, etc., (in oz. NaCN per 1,000 cu. ft.) is:—for mosquitos 0·5, fleas 2·5, rats and mice 5, lice 10, bed bugs 5, with exposures of half an hour for the smaller quantities up to 2 hours for the larger. When liquid hydrocyanic acid is used 22 c.c. is equivalent to 1 oz. of sodium cyanide.

Case Hardening.—Since 1910 case hardening by immersion in fused sodium cyanide has come into use more especially in the United States and Canada. Mild steel absorbs carbon from fused sodium cyanide and is so converted, superficially, into steel which can be hardened by rapid cooling. The articles to be treated are suspended in a bath of fused sodium cyanide preferably diluted with sodium chloride or carbonate to contain about 50% of NaCN. The most suitable temperature is 850° C. The rate of penetration of carbon into mild steel is 1/100th in. (0·25 mm.) per hour, or about 50% more when 3% nickel steel is used. The rate of penetration is independent of the percentage of cyanide in the bath, but the carbon content, and therefore the hardness after quenching, increases with it. The method has great advantages for small, accurately shaped machine parts since surface oxidation and distortion due to uneven heating are avoided and the depth of case can be controlled very exactly. The operation is rapid, an immersion of 10 to 15 min. being sufficient in some instances.

Electro-plating.—Close-grained, adherent deposits of several metals, especially silver and gold, are obtained by the electrolysis of solutions of their double cyanides. Such solutions are now largely used for the deposition of copper, zinc and brass. Owing to the better adhesion and more even distribution of the coating it is claimed that a smaller quantity of zinc will prevent corrosion of iron when the zinc is deposited by electrolysis than when it is applied by the older dipping method. By the use of pure cyanides the baths are easily maintained at the strength suitable for rapid deposition of the metals.

The following baths are in use for "still" plating, expressed in oz. per imperial gallon of water:—Copper plating, sodium cyanide 3·9,

cuprous cyanide 3·75, soda ash 1·5, sodium thiosulphate 0·3; zinc plating, sodium cyanide 3·1, zinc cyanide 3·75, caustic soda 3·75, ammonium chloride 2·5; brass plating, sodium cyanide 5·6, copper cyanide 3·75, zinc cyanide 1·25, soda ash 1·5, ammonium chloride 0·4.

Flotation.—Intimate mixtures of the sulphides of lead, zinc, copper and iron with gangue often occur in nature. The separation of the minerals is done by agitating a mixture of the powdered ore, water and a little oil with air. A froth is formed in which the minerals predominate. G. E. Sheridan and G. G. Griswold (U.S. Patents 1,421,583 and 1,427,235 of 1922) have found that the addition of a small quantity of sodium cyanide and, preferably, zinc sulphate to the liquid, previously made faintly alkaline with soda ash, prevents the flotation of zinc sulphide and of iron pyrites without affecting the flotation of the sulphides of lead or copper. The iron and zinc may be separated by a second treatment in more strongly alkaline solution, the zinc alone floating. The process is already in use at several mines in North America.

Manufacture.—In 1910 cyanides were produced mainly (1) from sodium, ammonia and charcoal, (2) from the nitrogenous constituents of the sugar beet remaining after removal of the sugar, (3) from the hydrocyanic acid of crude coal-gas which was recovered as ferro-cyanide, a part of which was converted into sodium cyanide by fusion with sodium (*see* 22.529). Ferro-cyanides are now more economically made from cyanides, but the two first-mentioned processes continue to produce. In addition to these, processes are used in which the nitrogen is derived from the atmosphere. The most important of these is based on the Erlwein & Frank process (U.S. Patent 708,333, 1902), in which calcium cyanamide is fused with common salt. This process had been worked experimentally in Germany with little success. In 1916, it was installed at Niagara and improved by raising the temperature of fusion from 950° to 1,200–1,400° C., by adding calcium carbide in order to supply active carbon (the reaction is essentially $CaCN_2+C=Ca\ [CN]_2$) and by cooling the product rapidly so as to avoid the reversion of cyanide to cyanamide which occurs at 400–700 degrees. (U.S. Patents 1,282,395, 1918 and 1,282,405, 1918).

A product containing cyanide equivalent to 48–50% NaCN is obtained in this way which, under the name "aero cyanide" has found extensive use in the extraction of gold and silver and in the preparation of hydrocyanic acid for fumigation. Much of the cyanide in this material appears to be present as the calcium salt which is readily hydrolysed, $Ca(CN)_2+2H_2O=2HCN+Ca(OH)_2$. For this reason powdered "aero cyanide" has found some application as a fumigant where the residual lime is not harmful, since mere exposure to moist air liberates hydrocyanic acid. (T. E.)

CYCLE OF TRADE: *see* TRADE CYCLE.

CYCLING (*see* 7.682).—During the period following 1910 the evolution of the bicycle was not maintained, mechanical changes being less frequent and not so drastic as had been the case during the early pneumatic era. After 1918 interest in every branch of cycling increased to a marked extent, and this had its origin in the attitude taken up by the big cycle makers, who, desiring the freedom from trouble which mass production provides, discouraged invention and development and allowed design to stagnate.

Business Conditions.—Thus an opportunity arose for the assembler or small maker, generally an active cyclist himself, and invariably a working mechanic. Numbers of such men started in business, making a specialty of bicycles built to order and complying with the customer's own specification. These assemblers purchased parts from the various houses specialising on the production of fittings for the trade and built them up into complete machines. Under their aegis, supported by a growing demand from the large number of club riders of both sexes, the light roadster bicycle was evolved, a type which the large manufacturer had persistently ignored for more than a generation.

In addition to reducing the weight of his product, the small maker incorporated certain improvements which hard riders were quick to appreciate; among these were the drop-out rear wheel and the caliper brake, both of which, it is worth noting, were old ideas, the advantages of which had not been realised when they originally appeared on the market. The light-weight bicycle with small (26 in.) wheels gave cycling a new lease of life; contemporaneously with its advent came a movement to popularise rational dress among lady cyclists. The fashion of wearing short skirts, aided by the adoption of breeches, by the many women who took up agricultural work during the War, enabled the bifurcated garment to overcome the prejudice and to score an almost complete triumph over the skirt. To-day nearly 90% of club women and keen riders wear rationals for their more serious cycling, though skirts are retained for shopping expeditions and short journeys. Many wearers of rational dress use diamond-framed machines.

Officials of the big factories were somewhat slow to note the tendency of demand, and allowed the small makers to obtain a long lead in the production of light bicycles. Ultimately they began to realise the position, and many of them designed light and speedy models to compete with the locally built machines. These may now be procured from most of the large manufacturers, but the small assembler still enjoys the great advantage of being able to comply with the whims of his client, and the ability to build "to order" without undue interruption of his works routine. Another feature of the post-War period has been the revival of interest in tandem riding. This, again, has been fostered by the little maker with the encouragement of club riders.

Racing.—Road racing has flourished exceedingly. In Europe, America and Australia competitions are run on ordinary racing lines, the riders starting together, or, in the case of handicaps, in the order of their time allowance, the first man to finish being the winner. In Great Britain and Ireland the time trial system is in vogue, and has proved an extraordinary success. So great has the number of events become that, in 1922, the most prominent cycling clubs came together and formed the Road Racing Council, to which 38 clubs are affiliated, and which has compiled regulations for the conduct of road trials. The most popular distances are 25, 50 and 100 m., while several races at 12 and 24 hours are organised each year. One of the best things the R.R.C. has done for the sport has been to limit the number of entrants for any race run under its jurisdiction, and in the more important events not more than 100 riders may take part.

Track racing continues to enjoy great popularity in France, Germany, Belgium, Switzerland, Holland, Norway, Denmark, America, Italy and Australia, but in Great Britain, Spain, Norway, South Africa and certain other countries, the scarcity of up-to-date tracks prevents the development of this branch of the sport. The annual races for the championships of the world have been continued, the Union Cycliste Internationale having taken over the series which were inaugurated by its predecessor, the International Cyclists' Association. In 1921 the motor-paced race for the amateur title was dropped, and its place as a distance test was taken by a road race, the distance of which is usually from 100 to 120 miles. (H. W. BA.)

CYPRUS (*see* 7.695).—The population of the Island at the 1921 census was 310,709, about 19·4% being Mahommedans. On the outbreak of war with Turkey on Nov. 5 1914 Cyprus was formally annexed to the British Crown and became an integral part of the British Empire. In the proclamation then issued, it was announced that every Ottoman subject residing in the island would become a British subject unless he notified in writing within a stated period his desire to retain his Ottoman nationality. With the exception of a few non-Cypriote Turks temporarily residing in the island, all accepted British nationality, the Greek-speaking inhabitants with enthusiasm and their Turkish-speaking compatriots without demur. The change of status of the island, from being a dependency of the Ottoman Empire administered by Great Britain to being an integral portion of the British Empire, was effected quietly and without incident of any kind, and involved no material alteration in administration. The so-called "Turkish tribute" of £92,800 a year continued to be borne by the revenue, being termed the "Cyprus share of the Turkish debt charge."

The annexation was recognised by Turkey in the treaty of

Lausanne, 1923. Following the Cyprus (legislative council) order in council of Feb. 6 1925, the Island was formally elevated to the status of a colony on May 1 1925; the high commissioner was to be known after that date as the Governor. In the legislative council the non-Moslem representation was increased to 12, the council thus consisting of nine official and 15 elected members. The Greek-speaking Cypriotes for many years clamoured for Cyprus to be united to Greece, which they consider as their mother country; but Greece has not shown any great desire to encourage the agitation, and the British Govt. does not recognise the claim as well founded.

The Island's finances were placed on a sound basis in 1911 by fixing an annual grant-in-aid of £50,000 from the Imperial Govt. in substitution for the unsatisfactory arrangement previously in force, whereby the Imperial Govt. had year by year made good any deficit that might occur between revenue and expenditure.

During the World War Cyprus was used as a convalescent camp for the troops taking part in the Gallipoli operations, and it supplied large quantities of firewood and agricultural products, and numbers of mules to Egypt. A large prisoners of war camp was also founded towards the end of the War, accommodating thousands of Turkish prisoners from Palestine and elsewhere.

Economic History.—The history of Cyprus during the period 1910 to 1925 was one of slow but continuous progress. Under British administration, education and agriculture have made great strides. Commercially the island prospered, not only owing to its large export of caroub beans, agricultural produce and livestock, but also from its minerals. Asbestos is exported in large quantities, and the old Phoenician and Roman copper mines are worked chiefly for the by-products of copper, which, when exported on a large scale, form a profitable commodity. The railway which was built in 1907 from the harbour of Famagusta through the Mesaoria plain was extended in 1915 to Evrykhou at the foot of the western hills, and the island has been covered with a network of roads most of which are suitable for motor traffic. Reafforestation has been actively taken in hand by the administration, and legislative measures have been introduced for protecting the young trees from the ravages of goats, which in the past have been the cause of the destruction of an incalculable number of young trees. The forests are under the charge of a special department, with a staff of forest guards to protect the trees, prevent or deal with forest fires, and generally see that the sylvan produce of the island is developed to the best advantage. The hills in the western part are covered with valuable forests of pine and cedar, and roads are cut to hitherto almost inaccessible parts in order to facilitate the extraction of their valuable timber. A mail service is maintained between Egypt and Cyprus by subsidised steamers of the Khedivial Steamship Company, the voyage between Port Said and the island taking about 18 hours. These steamers connect at Port Said with the Peninsular and Oriental Co. and the journey from London to Cyprus can be performed in about seven days.

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(C. W. J. O.)

CYRENAICA (*see* 7.702) has an area of about 230,000 square miles. The population (1925 estimate) is 250,000, including 12,000 Europeans. The capital and chief seaport is Benghazi (population about 40,000). When in 1912 Italy succeeded Turkey in the sovereignty of the vilayet of Benghazi, it was officially styled "Cirenaica," by which name the region had commonly been known from ancient times. It was made a colony distinct from the adjoining vilayet of Tripoli (Tripolitania), but up to 1914, owing mainly to the opposition of the Senussi, the Italians had occupied little more than the coast region. During the Great War Italian occupation was reduced to the ports of Benghazi and Derna and a few other places on the Mediterranean, but from 1919 onward Italian authority was gradually extended. By an agreement concluded in Dec. 1925, Egypt ceded to Italy the oasis of Jaghbub, and the possession of that oasis, which the Italians occupied in Feb. 1926, enabled them to strengthen their hold on the hinterland.

The people—Arabs and Berbers—rear large numbers of cattle, sheep and camels, and there is considerable trade in livestock with Egypt. Excellent barley is grown, and is usually exported to Great Britain, where it is used for making whisky and beer. The total value of the external trade in 1923 was about £1,000,000. The greater part of the country is a barren desert. There were in 1924 20 m. of railway, part of a projected line to join Benghazi and Derma. (*See* Senussi.)

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CYTOLOGY (*see* 7.710).—The effect of the work done in cytology up to 1910 may be summarised as follows:—

The bodies of animals and plants are made up of units termed cells, which may be compared to the bricks in a wall. Each cell is composed of a viscid, semi-fluid material termed protoplasm, surrounded by an elastic membrane termed a cell wall. This wall is composed of cellulose in the case of the vegetable cell, and may acquire considerable thickness and firmness; in the animal cell it is almost always very thin, and never consists of cellulose, but appears to agree in composition with the protoplasm, of which it may be considered a condensation. There is reason to believe that in most, if not all, cases the cell wall is porous, and that adjacent cells are connected with one another by bridges of protoplasm.

Forms of Cellular Activity

The activities of living cells are manifested in four ways, viz.:—

(1) By movement, which takes the form of alternating contraction and expansion.

(2) By secretion, *i.e.*, by the production of definite substances which accumulate in the protoplasm, but which are finally extruded from the cell.

(3) By the transmission of stimuli, so that shocks or stimuli of various kinds applied to one cell result in movement or secretion in a different cell.

(4) By reproduction, which takes the form of the division of the cell into two daughter cells.

All these activities are dependent for their continuance on the consumption of a certain portion of the protoplasm; and if life is to persist and if the cells are to increase in number this waste must be repaired. This is effected by the taking in and assimilation of food; and this assimilation can only be carried out if there exists in the protoplasm a specially differentiated portion termed the "nucleus," which appears to be of rather different composition from the rest. For this reason it is customary to use the term "cytoplasm" for the extra-nuclear protoplasm.

Cells may be specialised for rapid movement or for the reception and transmission of stimuli or for secretion. Locomotor cells may be provided with freely projecting filaments, termed "cilia" or "flagella," which are capable of rapid vibration, and act the part of oars in propelling the animal, or their cytoplasm may contain threads termed "myonemes" or "muscular fibrils," which are capable of thickening and contracting; and these threads may be simple or cross-striped, *i.e.*, composed of alternate disks of singly and doubly refracting material; cells provided with these threads are termed "muscle-cells."

Cells devoted to the reception and transmission of stimuli are known as "nerve-cells" or "neurones." Those which are situated at the free surface of the animal, and which are provided with stiff processes of various kinds which are easily affected by stimuli, are known as "sense-cells." Those which are more deeply situated have, in place of the stiff processes, one or more root-like branching processes, known as "receptive dendrites." Stimuli when received are transmitted by outgrowths of the neurone known as "axons," and these axons, after preservation by fixing fluids, are seen to consist of a series of delicate fibres, the "neurofibrillae." The axon ends in a brush of root-like processes called "terminal dendrites"; these dendrites are in contact either with the receptive dendrites of another neurone to which they hand on the stimulus, or with a muscle-cell in which they cause contraction, or with a secretory cell in which they initiate secretion.

In the case of secretory cells the secretion may be fluid and poured forth at a free surface only, from which it is washed away by the currents of the circumambient medium. Of this type are the mucous cells, which give rise to the slime which lubricates the skin of earthworms, or the similar cells which produce the mucus inside the human mouth cavity. On the other hand the secretion may take the form of fibres or of another form of solid material and may be extruded from the entire surface of each cell so that the cell becomes in this way separated from its neighbours by masses of the secretion or, as it is now termed, the intercellular substance. Cells of this kind are known as "connective-tissue cells" and give rise to the various supporting tissues such as fibrous tissue, cartilage and bone.

The reproductive cells or "germ cells" are, as their name implies, cells which have the capacity of giving rise to a mass of cells out of which the body of a new individual is built up. They occur in many forms amongst the lowest grades of animals, *i.e.*, the Protozoa, but amongst the higher animals, or Metazoa, they are remarkably constant in general characters, exhibiting practically the same forms throughout the whole range of animals from the sponges to the human race. They appear under two types, viz.:—(1) a small, motile male cell, which consists mainly of a head, which is a con-

densed nucleus, to which is added a vibratile flagellum termed the tail; and (2) a much larger motionless female cell or egg, in the cytoplasm of which there are deposits of food material known as yolk. Normally a male cell must unite with a female cell before development can be initiated, but the eggs of many animals can develop without this union and are then termed " parthenogenetic." In other cases where union with a male cell normally takes place eggs can be stimulated to develop without previous union with a male cell, and these cases are termed " artificial parthenogenesis."

The Nucleus.—Turning now to the consideration of the nucleus, we find that this is frequently invisible in the living cell, but when it can be made out, it appears either as a clear vesicle (as in many eggs) or as a slightly more granular portion of the protoplasm (as in Amoeba). When, however, it is fixed and stained it exhibits a characteristic structure. It then appears as a vesicle containing a fluid termed the " nuclear sap," and bounded by a membrane termed the " nuclear wall." The sap is traversed by a network of threads known as " linin fibres," and adhering to these fibres—suggesting the arrangement of beads on a necklace—are a number of granules termed " chromatin " because they attract and retain the colouring matter of the staining fluid so strongly. In addition there are usually one or two rounded bodies termed " nucleoli," which also attract stain strongly, but these are apparently not composed of exactly the same chemical substances as the chromatin granules, and it is possible by the use of certain stains to colour them differently from the tint assumed by the chromatin.

We have already seen that assimilation or the building-up of fresh protoplasm is impossible in the absence of a nucleus. This is proved by dividing a uninucleate amoeba into two, when it is seen that the non-nucleate piece, though capable of movement, cannot digest or assimilate food and, after a short period of activity, dies.

The division of the nucleus always precedes the division of the cell, and this division is occasionally direct, *i.e.*, by the process of simple constriction into two, or much more frequently indirect, by the process termed " karyokinesis " or " mitosis." In this method the chromatin grains were believed to become aggregated into a continuous spirally coiled thread termed the " spireme," which then became segmented into a definite number of segments called "chromosomes." The chromosomes always appear in the same number in the same species at every division of the nucleus. Meanwhile the nucleolus or nucleoli disappear, apparently dissolved in the cell sap; and the nuclear membrane becomes dissolved, so that the cell sap is mingled with the cytoplasm; and then a small body termed the " centrosome," lying at the side of the nucleus in the cytoplasm, becomes discernible. The centrosome can occasionally be demonstrated lying at the side of the resting nucleus, but when it becomes visible in the process of mitosis it is seen to be in process of division into two.

The chromosomes at the same time appear to be split longitudinally, whilst from the daughter centrosomes, as they move apart, a series of filamentous rays are developed, some of which (" astral fibres ") extend out to the periphery of the cell, whilst others (" mantle fibres ") become attached to the halves of the split chromosomes, one fibre from each centrosome going to a corresponding half of the chromosome. When the centrosomes have reached positions at opposite ends of the nucleus the mantle fibres proceeding from them have constituted the mitotic spindle; certain other fibres appear running directly from one centrosome to another in the axis of the spindle, which are termed " spindle fibres," whilst the split chromosomes, under apparent tension of the mantle fibres, have assumed positions lying at right angles to the axis of the spindle, and constitute what is called the " equatorial plate."

By a continuance of the apparent tension of the mantle fibres the two halves of each chromosome are dragged apart from one another, and eventually one set of half-chromosomes becomes massed together in the vicinity of each pole of the spindle, that is, close to each daughter centrosome. Each of such sets of chromosomes constitutes a daughter nucleus. The chromosomes become longer and thinner and more entangled with one another until the initial stage of a linin network with adhering chromatin granules is re-established, and round this a new nuclear wall is formed. The stages leading to the segmentation of the spireme thread and the solution of the nuclear membranes are termed the " prophases of mitosis "; those leading to the establishment of the equatorial plate are termed the " metaphase." The stage involving the separation of the halves of the chromosomes is termed the " anaphase," whilst the steps leading to the reconstitution of the daughter nuclei are termed the " telophases " of mitosis.

In the fertilisation of the egg it is penetrated by the head of the spermatozoön, which carries with it a segment of the tail termed the middle-piece. The middle-piece is distinguished by its diameter from the thinner more distal part of the tail and it includes a centrosome which has been derived from the centrosome active at the last division of the sperm mother cell. Sometimes the distal part of the tail is left behind at the surface of the egg—sometimes it penetrates with the rest of the spermatozoön. In the latter case it remains passive in one cell of the embryo and is absorbed and is without influence on the hereditary potencies of the embryo, since it is never distributed to any but the one cell. All the paternal influence must be carried by the head, which is a condensed mass of chromatin; hence is derived the strong belief that not only is the nucleus the bearer of hereditary powers but that the chromatin is the element of the nucleus in which they are concentrated.

The spermatozoön head, once immersed in the egg, swells up and assumes the characteristic structure of a nucleus: it acquires nuclear sap and a nuclear wall and its chromatin becomes resolved into the same number of chromosomes as are present in the egg nucleus. It is then known as the " male pro-nucleus," whilst the egg nucleus is termed the " female pro-nucleus." The centrosome derived from the middle piece gives rise to an enormous aster with radiating rays which is termed the " sperm-aster "; the two nuclei approach each other, and the sperm-aster then fades out and is replaced by two asters each radiating from one of the daughter centrosomes which become connected by a spindle. The chromosomes of both nuclei are arranged side by side on the equatorial plate of this spindle: so that when the compound or " zygote " nucleus divides, equal portions of maternal and paternal chromatin are distributed to the first two cells of the embryo, and the same thing follows at every subsequent division of the growing embryo, so that paternal and maternal chromatin is distributed in equal amounts to every cell of the body.

The ripe germ cell consequently possesses only one-half the number of chromosomes which the ordinary body cell possesses. This number is termed the *haploid* number, whereas the normal number found in the ordinary cells of the body is termed the *diploid* number. At some time therefore in the history of the germ-cell, a reduction of the diploid to the haploid number must take place. The older view was that this occurred at one of the ripening divisions in consequence of the spireme becoming segmented into half the usual number of pieces: each of these pieces then exhibited a transverse split, which was regarded as an indication of the belated appearance of the full number: at the first maturation division, these halves were, however, supposed to be distributed to different cells, so that each daughter cell received only half the original number of chromosomes—this division was known as the " reduction division," or " meiotic division."

Since the chromosomes are usually invisible during the resting stage of the nucleus the question has been raised whether they retained their individuality throughout the whole growth cycle. Various considerations lead to the conclusion that their individuality is retained. In some cases where the number is very small, as in the cells of the nematode worm *ascaris*, the chromosomes or at least their ends can be detected in the resting nucleus: moreover the chromosomes are not all alike, but differ in size and shape from one another, and to each paternal one there is a corresponding maternal one of similar size and shape, and it seems unlikely that, if they vanished in the resting stage, they should reappear in exactly the same form at the subsequent mitosis. It has been surmised that this individuality in form and size was an indication of a difference in function in distributing the hereditary qualities, and Boveri's discovery that, when an echinoderm egg was entered by two spermatozoa, one alone fused with the female pro-nucleus whilst the other acted as an independent nucleus, so that at the first division the egg was divided into four cells, led to the same conclusion. For Boveri showed that under these circumstances an abnormal spindle was formed connecting all four daughter nuclei, and on this spindle the chromosomes were irregularly distributed: and that if the four resulting cells were separated and allowed to develop separately they developed abnormally; whereas Driesch had previously proved that it was possible to rear any of the first four cells into which a normally fertilised egg divides, if such a cell were separated from the rest, into a perfect larva of diminished size. Since an unfertilised egg has also been induced by appropriate stimuli (*see* EMBRYOLOGY) to develop into a perfect larva, the conclusion is inevitable that one complete set of chromosomes (maternal or paternal) is essential to the normal development, and that cells receiving fewer chromosomes than these cannot grow into normal embryos; hence every kind of chromosome has its appropriate function to play in growth.

PROGRESS SINCE 1910

We now turn to the great advances made since 1910.

About 1899 Hardy published his first paper in which he showed that the effect of the usual preservatives used in killing cells was to produce fibrous networks which had no counterpart in the living protoplasm, for exactly the same effect could be produced by the use of these same fluids on dead proteid: that in fact all colloid solutions, which he termed " sols," could be easily induced to pass into a semi-solid or "gel " phase in which the molecules were arranged in strings. From such networks the intervening fluid could be easily forced out, but by gently heating colloid solutions a different form of "gel " was produced, from which a pressure of several atmospheres failed to force the fluid out. In the first case the fluid contents were called the continuous phase, and the fibres the disperse phase—but in the second case the fluid is locked up in tiny droplets inside the semi-solid gelatine and then the fluid was the disperse phase and the gelatine the continuous phase.

This discovery led to great scepticism as to the existence in life of the various structures seen in stained protoplasm. Fresh attention was given to the study of protoplasm in the living state and a most ingenious instrument designed by Kite was used with effect by Chambers for this purpose. This was an excessively fine needle point of hard glass, bent at right angles to the glass tube from which it was drawn, fixed so that the point projected into a glass cell from the roof of which in a hanging drop was suspended the living cell or cells it was desired to explore. The needle could be manipulated by screws and the glass cell was mounted on the stage of a microscope. It was discovered that, generally speaking, the cytoplasm of a cell was a sol which was sometimes very thick and viscid and sometimes more fluid, but that the outer layer next the cell-wall was a gel, of which indeed the cell-wall might be regarded as an intensification. The various inclusions contained in the central cytoplasm, such as coloured granules, oil drops, etc.—could be freely pushed about by the needle. When, however, the nucleus of the cell approached mitosis, a change took place, and the astral rays were found to be strings of semi-solid material, as was also the mitotic spindle but no "mantle-fibres" could be detected in the living cell: the astral rays became connected with the peripheral gel surrounding the cell. On the other hand no centrosome could be detected in the living cytoplasm, but the sphere surrounding the centrosome was found to consist of fluid material which Chambers supposed to be squeezed out from the cytoplasm during the process of gelatinisation of the astral rays, and from it proceeded fluid rays visible as clear streaks in the living cell which alternated with the astral rays. When the spindle divided, its centre passed into the sol state, and this change propagated itself toward the poles as the two daughter cells separated from one another.

Examined in the same way, the cross-striped myonemes characteristic of the muscle-cells of arthropods and vertebrates turned out to be composed of alternate discs of gels of different consistencies; but no trace could be made out of neurofibrillae in the living nerve fibre, and the nerve-cell, *i.e.*, the body of the neuron containing the nucleus, when examined in the living condition, exhibited Brownian movement—*i.e.*, the granules pulsated under the impact of freely rolling molecules—a circumstance which proves it to be in the sol condition. On the other hand it should be recorded that Chambers found that the cytoplasm of the ganglion cells from the central nerve-cord of the lobster was a very viscid substance which could be pulled out into long threads without undergoing essential change. When pulled away from the nucleus a clear empty space appeared on the side of the nucleus in the direction of the pull, which was only slowly filled by inflow of the plasma from the two sides.

It will be observed that in living protoplasm the change from the sol to the gel condition is reversible and very frequently takes place and many of the phenomena exhibited by living cells will find their explanation in this circumstance.

The Brownian movement affords a criterion of whether protoplasm is in the condition of a sol or a gel, although not an absolute one, for Chambers has shown that a sol may be so thick as to prevent this movement, and yet it may be possible to move particles in it freely by means of the glass needle. Bayliss has shown that the actively moving pseudopodia of Amoeba show a vigorous Brownian movement, but that when they are caused to retract by electric shocks the movement ends, showing conversion of the material into a gel.

Side by side with these observations on living protoplasm have gone renewed observations on its structure by means of more refined fixatives and stains. It has been shown that many of the older preserving fluids which were used to differentiate the nucleus and especially the chromatin of the nucleus from the cytoplasm, had a destructive effect in dissolving out many of the constituents of the cytoplasm.

A more refined technique has demonstrated the existence of bodies in the cytoplasm termed "mitochondria," which take the form of fibres or, less frequently, of small oval granules. What their function in the life of the cell is has not been fully determined. Meves supposed them to be bearers of heredity, like the chromosomes, and described them as dividing into two at the division of the cell, the halves being distributed to the two daughter cells. Later researches by Gatenby have failed to confirm this. He finds that the mitochondria are irregularly distributed at all divisions. Besides the mitochondria another element of the cytoplasm known as the "Golgi apparatus" has come to light. It is so called because it was first described by Golgi in nerve-cells.

To see it properly it is necessary to use preserving fluids which contain osmic acid, followed by treatment with salts of silver. In young cells this apparatus takes the form of a wreath surrounding the centrosphere, or area of clear cytoplasm, which envelops the centrosome in the young cell—*i.e.*, in the cell just after it has originated by division of the mother cell. During the growth of the cell this wreath dissolves into smaller elements which become scattered throughout the cytoplasm interspersed amongst the mitochondria. These elements in their typical form consist of disc-like bodies made up of a substance which stains faintly, edged for half or more of their circumference by a rim that stains intensely black with the reagents which are used to differentiate the Golgi apparatus. The earlier observers failed to note the disc-like form of these elements and fixed their attention solely on the deeply staining rim, which they regarded as a rod, and to which they gave the name "dictysome," but Bowen has brought out clearly the real structure of these bodies. The fact that the Golgi apparatus reacts strongly with osmic acid has been held to prove that it must be partially made up of a substance allied to lecithin, which contains a fat group in the molecule.

The most interesting fact about both mitochondria and Golgi apparatus is that the elements of both increase in number by transverse division, and hence they cannot be regarded as food reserves, or temporary deposits of excreta, but are in some sense elements of the living cytoplasm.

Considerable evidence has been adduced to show that the Golgi apparatus is a secretory organ. In nerve-cells, it forms a network permeating the cytoplasm, but nerve-cells once formed never undergo division. In other cells, as already mentioned, it is at first concentrated round the centrosome adjacent to the nucleus and becomes dispersed throughout the cytoplasm as the cell grows older. Now Nassonov has shown that the fixing agents which are used to demonstrate the Golgi apparatus stain also the walls of the pulsating vacuoles found in freshwater protozoa. The vacuoles, as is well known, continually secrete and expel to the exterior a clear fluid. Wheeler in the egg of the dab and Nath in the eggs of scorpions have shown that the Golgi elements are closely allied to certain peculiar yolk globules which grow in connection with them. It seems clear that the Golgi elements secrete this kind of yolk which is termed Golgi yolk in order to discriminate it from other kinds of yolk. The function of the mitochondria is less clear, but they also appear to be connected with secretion. In the egg of ciona, Harvey has found that the yolk globules stain like mitochondria. Brambell has shown that in the eggs of the molluscs, limnaea and patella, the mitochondria swell up and secrete a kind of yolk sharply distinguished by its staining reactions from Golgi yolk.

In the formation of the spermatozoa of insects and molluscs the mitochondria and the Golgi apparatus play a very definite part which has been elucidated by Gatenby. The former give rise to a sheath surrounding the base of the tail which forms the middle-piece of the spermatozoön; the latter becomes largely metamorphosed into the "acrosome" or pointed structure which is attached to the front of the head of the spermatozoön, and plays the part of a spearhead when the spermatozoön reaches and penetrates an egg. The remnant of the Golgi apparatus migrates round the head and eventually forms a bead projecting from the tail which is eventually rubbed off. The middle-piece penetrates the egg, but undergoes no growth there: it remains embedded in one cell of the embryo and is eventually absorbed so that the mitochondria can have no function as bearers of heredity. In living cells particles resembling mitochondria and Golgi discs in their shape have been observed, oscillating in the typical Brownian manner, whence it is inferred that these bodies really exist as such in living protoplasm and are not merely artefacts produced by preserving reagents.

Nuclear Structure.—As regards advances in our knowledge of nuclear structure, we may note especially the demonstration of the presence of sex chromosomes in many animals. Already before 1915 the fact was known that in certain cases an odd chromosome was present in the ripening germ cells, that is, a chromosome which in one of the ripening divisions of the germ cells passed without dividing to one pole of the mitotic spindle. But Wilson showed that not only are such odd chromosomes found in the developing sperm cells of certain insects but that their presence is apparently related to the determination of sex. The odd chromosome sometimes divides longitudinally at the first maturation division, but at the second passes undivided to one pole of the spindle. Sometimes it migrates to one pole in the first division and divides longitudinally at the second: in either case its presence causes the formation of two types of germ cell, one possessing one more chromosome than the other.

In the case of these insects the ripening eggs are all found to possess the same number of chromosomes: and this number is equal to that found in the sperm cells which have the larger number. It is clear, therefore, that when the eggs are fertilised with the sperm, two types of fertilised egg should be found; one characterised by having one more chromosome than the other, and these eggs should give rise to animals all of whose cells should have nuclei with a number of chromosomes equal to those found in the fertilised egg from which each one arose. If we now examine the cells of the males, it is discovered that they have nuclei with the smaller number of chromosomes, whereas the cells of the female enclose nuclei with the larger number of chromosomes. Therefore it is clear that the male has been produced by the fertilisation of an egg by a spermatozoon devoid of the odd chromosome: whereas a female arises when an egg is fertilised by a spermatozoon containing this chromosome.

Wilson showed further that sometimes the odd chromosome has a mate with which it pairs, but which is much smaller than itself. This mate is denominated by Wilson the Y chromosome, whereas the large one which alone is present in the case of many insects is termed the X chromosome. In some cases, however, as in the fly, Drosophila, which has been the subject of so many genetic experiments, the Y chromosome is as large as the X chromosome and differs from it only in shape. The male germ cell which receives the Y chromosome gives rise to a male when it fertilises an egg, whereas that containing the X chromosome gives rise to a female. Still other modifications, which lack of space prevents us entering into, are recorded by Wilson. There has been a diligent search for these sex-chromosomes in the germ cells of other animals, and enthusiastic investigators have announced their discovery in the spermatids of echinoderms, vertebrates and even of man himself, but these cases cannot yet be taken as fully proved.

The earlier conception of the preparation for the mitotic division of the nucleus has been that the chromosomes became arranged in a continuous thread termed the spireme, which then became transversely segmented into the characteristic number of chromosomes. This conception has gradually been superseded by a much simpler one, viz., that the chromosomes persist as long looped threads during the resting stage of the nucleus and that these long, U-shaped filaments become shorter and thicker as mitosis approaches. To this change of view many workers have contributed, especially Agar and Hogben. The free ends of these U's are attached to a spot on the nuclear wall immediately outside which lies the centrosome. In the preparation for the reducing division of the germ cells, when the chromosomes first become distinguishable they are said to be in the "leptotene" stage. These leptotene threads then approach one another in pairs, and these pairs are termed "zygotene" threads. Each pair fuses to form a single thicker thread known as "pachytene," and *in this way the number of chromosomes becomes reduced to one-half.*

The interpretation, however, of the fusion of the lepotene threads to form thicker pachytene threads, as the process by which the diploid number of chromosomes is reduced to the haploid number has been disproved by the researches of Walker on the developing eggs of the newt. By adopting the precaution neglected by Agar and Hogben of simultaneously observing mitotic division in somatic and germinal nuclei he has shown that leptotene and pachytene threads occur in them all, that in the telophase of somatic mitoses each chromosome splits longitudinally preparatory to the next division, and that in the resting stage the nucleus contains *four* times the haploid number of chromosome threads. In the prophase of the next division these threads unite in pairs and restore the diploid number, but it is only much later when the chromosomes have become much shorter and thicker that the diploid number of so-called "monovalent" chromosomes fuse with one another to form the haploid number of "bivalent" chromosomes. This second pairing is the real "meiosis" or reduction. In meiosis it is true that the first union of two sister chromosomes often appears to take place by their ends (metasyndesis). The union of two sister chromosomes in the prophases of the reducing division is frequently termed "synapsis." We have avoided this term because it has also been used to denote the bouquet contraction of the chromosomes, but subsequently the connected pair swing round so as to be parallel with one another, and side-by-side union (parasyndesis) then takes place.

Hogben has shown that in the egg of the cockroach, formerly cited as an instance of the occurrence of metasyndesis, parasyndesis really takes place. In the pachytene stage the chromosomes become contracted and are often bunched together at one side of the nucleus so as to form a characteristic bouquet. Each chromosome is in the form of a loop, the two ends of which are attached to the nuclear wall on the side adjacent to the centrosome. The nuclear wall is then dissolved and the chromosomes fly apart—a process known as diakinesis. It is after diakinesis that true meiotic pairing takes place. The conjoined pair then begin to separate from one another as the prophase of the meiotic division passes into the metaphase, and this separation usually takes place first in the middle, so that the conjoined pair assume the form of a ring. Each half of the ring corresponds to one of the two original chromosomes, and these halves are dragged apart in the ensuing mitotic division. Most frequently each half shows a constriction in the middle of its length, which was formerly interpreted as a precocious appearance of the longitudinal division of the chromosome which is consummated in the second maturation division. For this reason the name "tetrad" has been bestowed on the shortened, thickened and partially split chromosome. Agar has shown, however, that in the vast majority of cases this constriction has no relation whatever to the splitting of the chromosome in the second maturation division.

Some modern theories of heredity assume that a chromosome consists of a linear series of rudiments, each of which has its particular part to play in the up-building of the embryo. A side-by-side pairing enables us to see how corresponding rudiments belonging to maternal and paternal chromosomes could be brought together: an end-to-end pairing would of course render such a process impossible. Artificial theories of this kind, however, receive no support from detailed study of nuclear division, for they demand that when two chromosomes pair, each should be capable of breaking in a complicated way so as to exchange pieces which "cross over" with its fellow. Such a process might have been conceivable when leptotene threads were regarded as chromosomes; it is inconceivable when it is recognised that in the real meiosis the chromosomes are short, thick rods. Moreover Chambers has shown that in life the chromosome is a gelatinous elastic rod, which cannot be conceived to be capable of breaking in the way in which the "cross over" theory postulates.

In the ripening of the egg very peculiar phenomena occur which have only recently received an explanation. The unripe female germ cells or oögonia show nothing peculiar in their mitosis, but during the prophases of the first ripening division an enormous increase in size of the egg cell takes place. The leptotene threads are at first clearly visible and can be seen to pass into the pachytene stage, but then they fade from view. The

nucleus becomes very large and gorged with nuclear sap, from which circumstance is derived the name, "germinal vesicle," which the older authors bestowed upon it. The nucleolus becomes large and conspicuous. At the close of the growth period the nucleolus has been completely dissolved; the nuclear wall disappears and the nuclear sap mingles with the cytoplasm; then the chromosomes can again be detected as minute tetrads which begin to arrange themselves on the mitotic spindle of the first ripening division. Now by the examination of specially favourable cases it has been shown that during this episode of growth the chromosomes swell up, become pressed against the nuclear wall and almost lose their capacity for absorbing stain. It seems to be clear that a chromosome consists of at least two substances —a framework which does not stain and an embedded material which stains intensely, and to which alone the name chromatin is, properly speaking, applicable, and that during the growth of the egg cell the framework swells up enormously. De Baehr has shown that in the male germ cells of the annelid *Saccocirrus*, a similar growth period exists, though it is of very much shorter duration than the corresponding period in the life of the female germ cell; but, short though it is, it is long enough to cause the chromosomes to swell up and temporarily fade from view.

The nucleolus or "germinal-spot" of the older authors, which is so conspicuous a feature in the unripe egg, has formed the subject of some most interesting researches. Hogben has shown that in the cockroach *Periplaneta* the nucleolus becomes vacuolated and that portions of it are extruded and that these can be recognised by their peculiar staining properties, scattered in the nuclear sap and even in the act of passing through the nuclear membrane. They can also be detected in the cytoplasm outside the nucleus. There seems to be no reasonable doubt that it is by this process of vacuolation and emission of pieces of itself that the nucleolus ultimately disappears.

Gatenby and Hogben have shown that in certain cases these emitted fragments may assume the appearance of nuclei, since they seem to secrete round themselves both nuclear sap and a nuclear wall. Ultimately they all disappear. Though it has not been possible to connect them directly with the formation of yolk spheres, yet it is an interesting fact that the beginning of this emission from the nucleolus often coincides with the first appearance of yolk spheres, and as we know by experimental evidence that the nucleus presides over assimilation, it is a reasonable hypothesis that the absorption of these pieces of nucleolus in the cytoplasm leads directly to the synthesis of yolk.

Nath by the comparison of the eggs of two genera of scorpions (Euscorpius and Palamnaeus) one with abundant yolk and the other with only scanty yolk showed that yolk formed by the Golgi apparatus is common to both, but that in Palamnaeus, where no nucleolar extrusion takes place Golgi yolk alone is present, whereas in the more heavily yolked eggs of Euscorpius additional yolk of a different character makes its appearance after the fragments of the nucleolus have passed into the cytoplasm and been absorbed. In these eggs no relation between what we may term nucleolar yolk and mitochondria has been traced. It has recently been asserted by Carleton that in ordinary tissue cells where the same disappearance of the nucleolus occurs as the cell grows, this is not complete—that a small kernel remains which can be stained in certain silver salts—and that this kernel takes its place on the mitotic spindle at the next division of the cell. This "nucleolinus," as Carleton terms it, becomes equally divided into two and the halves pass into the two daughter cells. If these observations should be confirmed we should have in the nucleolinus a part of the nucleus as permanent as are any of the chromosomes, the function of which was to form a centre for the synthesis of a mass of chromatin which constitutes the nucleolus and is destined to be emitted into the cytoplasm, where it no doubt profoundly affects metabolism and determines formation of cytoplasmic structures.

Parthenogenesis.—We have seen that the egg cell normally undergoes two ripening divisions, at the first of which the chromosomes are reduced in number by one-half. When the egg is fertilised by the spermatozoön not only is the full number of chromosomes restored by the addition of those brought in by the spermatozoön but the division of the egg is initiated by the centrosome which is carried into the cytoplasm of the egg along with the head of the spermatozoön. An interesting question now comes as to what happens in the case of those eggs which develop without fertilisation—or, as it is termed, "parthenogenetically."

Now parthenogenesis may be either artificially induced or it may be a natural event in the history of the species. If we take the case of "naturally" parthenogenetic eggs first, we find that a great deal of light has been thrown on the subject by the investigations of de Baehr. He took for his subject the plant-louse *Aphis palmae*, the eggs of which develop without the aid of the male throughout the summer. He shows that in these eggs the preparations for the reducing division occur. Out of the apparently irregular chromatin network leptotene threads differentiate themselves. These pair so as to form thicker pachytene threads —but then after diakinesis no further pairing takes place and the diploid number of chromosomes remains. Then the period of growth supervenes and the chromosomes become indistinct, but when they reappear in the metaphase they are in the full number and only one maturation division takes place at which all the chromosomes are longitudinally cleft. From these facts de Baehr draws the conclusion that the reducing division is suppressed and only the second maturation division takes place.

A somewhat different case is presented by the egg of the bee. The egg if fertilised gives rise to a female but if unfertilised grows into a male. In the latter case, of course, the resulting animal has in all its nuclei only the reduced number of chromosomes. When the male produces germ cells, the reducing division is suppressed. The nucleus of the spermatocyte enters on the prophases of mitosis and the cell divides, but one of the daughter cells is devoid of a nucleus and dies. The nucleus in the other cell goes back into the resting stage; and then, like the egg in *Aphis*, it enters on a single maturation division in which the chromosomes are divided longitudinally, and the spermatozoön has therefore the same number of chromosomes as that possessed by the nuclei of the tissue cells of the male, which is the reduced number as compared to the number in the nuclei of the cells of the fertilised female.

In still other cases, as in the eggs of the small crustacean *artemia*, the two ripening divisions may occur, but the first one can give rise to a nucleus which is not extruded as a polar body but remains in the egg and, reuniting with its sister nucleus, restores the full number of chromosomes.

Parthenogenesis can, however, be brought about in eggs which normally require fertilisation by the application of external stimuli. This stimulus in the case of the frog's egg may take the form of a prick with a needle. Under these circumstances an immense development of astral fibres takes place, centring on a particle lying adjacent to the egg nucleus, apparently a centrosome formed from this nucleus. This aster is speedily transformed into a short spindle with a radiating aster at each end of it. If this spindle lies near enough to the surface of the egg to initiate a division-furrow, parthenogenetic development may begin. It is interesting to observe, however, that the mitotic spindle formed by the nucleus of the unfertilised egg is only ½ of the length of the spindle formed by the fertilised egg; *the size of the spindle is directly related to the number of chromosomes.*

In the sea-urchin's egg the primary stimulus, which is usually momentary immersion in a fatty acid (such as butyric), only produces an aster on which the chromosomes are distributed, but which is unable to metamorphose itself into a spindle. If, however, the eggs are subsequently immersed in "hypertonic" sea water—that is, sea water in which the percentage of salt is raised above the normal amount, then one or more accessory asters are formed in the cytoplasm. Whence the particles arise which act as centrosomes for these asters has never been ascertained; that they have previously been emitted from the nucleus is a pure assumption. If only one accessory aster has been formed a mitotic spindle is formed between it and the aster which arises round the egg nucleus. On to this spindle migrate the chromosomes. A regular equatorial plate is formed, and division of the

nucleus and of the whole egg ensues and development is initiated. As the accessory aster is usually smaller than the primary egg aster, the two blastomeres into which the egg divides are of unequal size, and we thus learn that the size of the daughter cells into which a given cell divides is related to the relative sizes of the asters at the two poles of the spindle. It is indeed the growth of these asters that determines the division of the cell.

When a sea-urchin's egg is broken into fragments not only the fragment containing the nucleus but also those devoid of the nucleus may be entered by a spermatozoön, and, under certain circumstances, will develop into an embryo. Chambers has, however, shown that this is only possible if the fragmentation of the egg takes place after the nuclear membrane of the egg is dissolved and the cytoplasm has become permeated by the nuclear sap and that pieces of cytoplasm not reached by this sap will not develop even when entered by a spermatozoön.

Conclusion

From the foregoing sketch the reader will gather that the science of cytology had attained in 1925 an extremely interesting stage of development. New discoveries had poured in, the exact significance of which was not yet fully understood, and although we had glimmerings of light they serve rather to pose than to answer questions. The yolk, for example, which we had been accustomed to regard as much the same kind of substance wherever it was found, is seen to be a name for a series of complex substances formed by different cell-organs which differ from one another in their staining reactions and, in all probability, in their chemical composition, and which are present in different proportions in different eggs.

What is the meaning of the centrosome, and how is it related to the formation of astral rays? It cannot be detected in the living cell and yet the study of stained cells would lead us to regard it as a permanent cell-organ—typically outside and independent of the nucleus and, like the nucleus, handed on by division from a cell to the daughter into which it divided. Yet, as we have seen, it can be formed *de novo* in the cytoplasm by the action of hypertonic sea water—and Lillie has shown that it can be formed *de novo* from the nucleus. In the fertilisation of the eggs of the annelid *Nereis* the spermatozoön penetrates the egg membrane but slowly. Lillie centrifuged eggs in which the head had penetrated but in which the middle-piece with the centrosome were still left outside and he succeeded in tearing away the middle-piece altogether. After the cessation of the centrifugal force the mutilated head completed the penetration of the egg and developed a new centrosome by the emission of a particle from itself which was just as effective in forming the first spindle as the original centrosome.

The astral rays and the mitotic spindle are formed by the gelation of the cytoplasm; yet their formation is dependent on the activities of the chromosomes; for an unfertilised egg responds to stimulation not only by the production of an aster but by the resolution of its chromatin into chromosomes, and the length of the spindle which is formed is dependent on the number of chromosomes.

The nucleus must, in some way, control the growth of the cytoplasm, and genetic experiments suggest (*see* Genetics) that each type of chromosome has a particular function to play in the building-up of the embryo; yet the only emission from the nucleus which has so far been detected has been that of nucleolar matérial.

Finally, the constitution of living cytoplasm seems to be normally that of a thick colloid solution, which at times changes to that of the gel condition. It baffles our imagination, however, to conceive how a solution can be the seat of internal structure and how in particular a nerve cell, with all its inherited and acquired aptitudes or "engrams," can be in life nothing more than a thick syrup.

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CZECH LITERATURE (*see* 4.133).—The political efforts to vindicate and consolidate the national spirit were accompanied in the 'seventies and 'eighties of last century by a no less important endeavour to secure for the Czechs all the progressive acquisitions of Western Europe in the sphere of thought and creative art. Accordingly, to the writers of pronounced national tendencies—like Neruda, Čech, Sládek and Jirásek in Bohemia, Hviezdoslav and Hurban Vajanský in Slovakia—were added those who pursued purely artistic aims and who manifested a European outlook.

The New Group and Its Leaders.—That the members of this group, whom their opponents dubbed cosmopolitans by way of reproach, advocated the principle of "art for art's sake" was only a temporary self-deception; that by their predilections for the cultures of France, Italy and England they liberated Czech literature from the long tutelage of German influences was an undeniable service; that they extended the scope of subjects, ideas and imagery was a token of their artistic powers. They derived new inspiration from the sea, from graphic art, from feminine beauty; they learned to absorb the cultures of foreign

or exotic countries and of bygone ages and to imitate the metrical forms employed by them; they enriched the Czech poetical style with unprecedented verbal resources and obtained musical effects which had not hitherto been achieved in Czech verse.

Julius Zeyer (1841–1901), the elder of the two leaders of this group, was permeated by the Gothic spirit of the English pre-Raphaelites. In novels, short stories, epics and dramas, he evoked the exotic colours of the East and the romantic tales of the Middle Ages. His younger companion, Jaroslav Vrchlický (Emil Frida, 1853–1912) occupied two positions of equal significance in the literature of his nation. As a literary scholar of unrivalled erudition and as an adept at translation, this tireless worker made accessible to the Czechs all the chief products of Romance poetry from the time of the Renaissance onwards. As a poet with the prolific qualities of a Lope de Vega, he was the author of a whole library of lyrics and epics as well as of dramas and stories. By nature he was a hedonist with predilections for classical antiquity and the Renaissance, but life awakened in him an instinct for suffering, sorrow and the Christian scale of values. As a pupil of Victor Hugo he dreamed of a huge epic of humanity, conceived on evolutionary and humanitarian lines, half picturesque, half rhetorical in style, but this gigantic task was carried out only in fragments and in feverish haste, its progress having been interrupted by his lyric compositions, the melodious utterances from the depths of a spirit overwhelmed but also purified by the visitations of destiny. The incisive influence of Vrchlický left its traces on the whole of Czech poetry during the eighties and nineties of the 19th century and his followers were numerous. Of them may be mentioned Jaroslav Kvapil (b. 1868), a master of stagecraft, who as a poet is distinguished by beauty of form.

A violent reaction from Vrchlický is represented in the early works of scholarship and criticism produced by T. G. Masaryk, who later devoted himself wholly to politics. The new tendency was given the not altogether appropriate name of realism. Against the cult of personality it placed the social consciousness, against the charm of art the serious occupation with public questions, against the interest in form the exclusive criteria of ideas and subject matter. It continued the process of emancipation from German influences, but it preferred the English and the Russians to the French. It disregarded the Renaissance and identified itself with the religious reformation. It imposed upon authors the duty of studying the life around them, not merely on the surface, but in accordance with the ideas underlying it and of expressing the results of their observations in plain, concise language without adornment or rhetoric.

The chief poet who followed these principles was Josef Svatopluk Machar (b. 1864). He began with love poetry and political or social verses, the pitilessly analytical spirit of which is provocative rather than satisfying. His striving after an objective attitude led him to a versified epic of mankind. This consists of fragmentary poems, the best of which are concise and graphic, but the general tone of the work is dry and didactic. To his influence can be traced the work of a great political poet, Petr Bezruč (Vladimír Vašek, b. 1867), the author of only one book, the fiery spokesman of the Silesian miners, who is equally sincere whether enunciating the anguish of a dying race or rallying the victims of social injustice to defiance.

Realism and the Reaction.—Realism in Czech prose was satisfied mostly with the search for human documents and with the depicting of remarkable types. More rarely it illuminates the complex questions affecting the social structure. This applies particularly to the village novel, which was then much in vogue. Two writers of the older generation must be mentioned here. The Slavophil author Josef Holeček (b. 1853) returned, by way of his interest in the Yugoslav heroic legends and Russian orthodoxy, back to the Czech peasant, from whose stock he himself was descended. In a novel which consists of several volumes and which is written with great verbal skill, he depicted the old Czech peasant virtues in an idealistic light. Teréza Nováková (1853–1912), a very complex feminine personality, achieved an understanding of the spirit of the people slowly, but she then discovered that the moody highland peasants, whom she knew, were, at bottom, animated by a moral and religious fervour which attained an almost tragic intensity. In her stories the idealism of the conception is coupled with a realism of treatment.

Jan Herben (b. 1857) and Alois Mrštík (1861–1924) wrote chronicle-like narratives, rich in incident, from which an invaluable knowledge of Moravia can be obtained, and the racy tales of Martin Kukučín (M. Bencúr, b. 1860) render the same service for Slovakia. They are surpassed by Karel V. Rais (b. 1859) whose sensitive sketches from the Krkonoše (Giant Mountains) district are distinguished by the economy of their structure. Considerable success was attained by the novel of city life, notably with a Prague setting. Ignát Herrmann (b. 1854) revealed a richly humorous vein in his descriptions of lower middle-class life in Prague. M. A. Šimáček (1860–1913) gave first-hand accounts of factory-life, for the sociological aspect of which he showed a sound instinct. F. X. Svoboda (b. 1860), who was of rural origin, but who became acclimatised to Prague, handled feminine psychology with poetical understanding, and his novels, written with an abundance of impressionistic imagery, generally centre upon some phase of moral or family tradition. All these authors, however, were thrown into the shade by the crude naturalist K. M. Čapek-Chod (b. 1860). With an unbridled instinct for grotesque effects and pessimistic mockery, he portrays present-day Prague in a wealth of ruthless but faithful detail.

From the beginning of the 20th century there was a manifest decline in realism. This transition to a more spiritualised art is associated with the name of F. X. Šalda (b. 1867), the creator of modern Czech criticism and a scholar who is, fundamentally, a poet. The change was first exhibited in lyric poetry which has always formed the leading feature of Czech literature. In the case of Antonín Sova (b. 1864), a master of melody and metaphor, his whole work reflects the reactions of an altogether unusually sensitive temperament to the solitude of nature, to its own emotions and to the social phenomena of modern life.

This sensitive reaction to the internal and external world is found also in the work of such diverse poets as Jiří Karásek ze Lvovic (b. 1871), who has written elegiac verses of impeccable form and decadent subject-matter, Stanislav K. Neumann (b. 1875), eloquent and barbaric in his advocacy of unfettered instincts, who extols rustling forests, flowing waters, amorous women and turbulent multitudes and Karel Toman (Antonín Bernášek, b. 1877), admirably concise and suggestive in his melodious, profoundly emotional verses. This sensitiveness forms only one of the elements in the personality of Otakar Březina (Václav Jebavý, b. 1868), whose lyric poetry is prompted by a cosmic consciousness and exhibits a unique inventiveness of metaphor. In hymn-like poems, which are remarkable on account of their elaborate design and brilliant imagery, the poet, whose life is spent in philosophical seclusion, extols the flight of the soul through the universe to God and its return thence to the everyday world, clutched by myriads of praying and toiling hands. His influence is seen in the work of Otakar Theer (1880–1917), who in the end subordinated his sensual temperament to fertile ideas concerning will and suffering, eternity and God, patriotism and moral liberty. Viktor Dyk (b. 1877), a poet who occupies a place apart, is closely attached to his nation as a living entity which has uplifted him from nihilism and imparted a fervid charm to his simple and epigrammatic diction.

Prose Fiction.—In prose fiction the new sensitiveness made its appearance as a strengthening of the picturesque element, and later as an enhanced feeling for the subtleties of psychology, together with a close and sometimes exaggerated cultivation of style. It was on such lines as these that Vilem Mrštík (1863–1912) dealt with the unfettered destinies of youth, Růžena Svobodová (1868–1920) with the sorrows, yearnings and dreams of modern women, Karel Sezima (Karel Kolář, b. 1876), with the tragic aspect of everyday life in small towns. Here also a reference should be made to Fráňa Šrámek (b. 1877), ecstatically revelling in the beauty of the world and celebrating in luminous prose the grief and enchantment of youth. More

recently, however, the tendency of the Czech novel has been towards a simplification as regards style and emotional content and it shows signs of becoming richer in ideas. Inspiration is also being derived from the facts of science, and there is an obvious return towards realism. Thus, Anna Maria Tilschová (b. 1873) is remarkably precise in analysing the decadence of urban society, while Karel Čapek (b. 1890), a whimsical philosopher of the commonplace, combines phantasy with warmth and delicacy of sentiment.

Drama.—Although the drama has always formed the height of Czech literary ambitions and although the handsome National Theatre, ever since its establishment in 1883, has been regarded as the supreme artistic institution, Czech drama did not thrive in the desired manner. Several of the authors who have already been mentioned tried their hands at writing for the stage. Vrchlický produced scenic poems, the subject-matter of which was derived from myths and history; Jirásek dramatic chronicle-plays from Czech history or based upon legends and village life; F. X. Svoboda realistic dramas from the life of the contemporary bourgeoisie. But it is only quite recently that the Czech drama has developed greater briskness and a sense of reality, both as regards the problems chosen and the language in which they are treated. Jaroslav Hilbert (b. 1871) and František Langer (b. 1882) are skilful psychologists in the modified realistic manner. Arnošt Dvořák (b. 1880) handles historical subjects with picturesque elaboration, Karel Čapek is a bold contriver of scenic utopias beneath whose satirical grimace is concealed the heart of an humanitarian.

Scholarship.—In Czech scholarship the closest connection with literature was maintained by writers on linguistic and historical subjects ever since the time of the national revival. In the 'eighties and 'nineties a new direction was given to Czech grammatical research by Jan Gebauer (1838–1907), who constructed a systematic history of the Czech language upon the strictly logical basis of the extensive material which he had collected. František Bartoš (1837–1906), a Moravian, supplemented this structure by compiling and analysing the Moravian dialects. Midway between philology and history stands Jaroslav Vlček (b. 1860), the founder of modern literary history and particularly successful in tracing the ideas underlying the age of enlightenment. In history Jaroslav Goll (b. 1846), an expert in critical method, trained three distinguished figures in the realm of historical research: Josef Pekař (b. 1870), who exhibited originality of mind whether he investigated economic history, the problem of popular legends or the question of the national revival; Josef Šusta (b. 1874), whose main subject was the history of Western Europe, on the background of which he outlined the development of the Czechs in a new light; and finally, Václav Novotný (b. 1869), who is profoundly versed in the religious Reformation.

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CZECHOSLOVAKIA (Československo or Československá Republika), an independent Republic in Central Europe, which took over the heritage and continues the tradition of the ancient kingdom of Bohemia (*see* 4.121), came into existence as a result of the revolutionary action of the Czechoslovak people during the World War and the break-up of the Austro-Hungarian monarchy. The frontiers of the republic were fixed by the peace treaties of Versailles, St. Germain and Trianon, and by the decision of the Conference of Ambassadors on the question of Teschen (*q.v.*) in July 1920.

Area and Population.—The territory of the Republic extends along the 50th par. of lat. N. and between the 12th and 25th deg. of long. E., in a long strip bordering on Germany and Poland in the W. and N., Rumania in the E., and Hungary and Austria in the South. It embraces the lands of the old Crown of Bohemia (Bohemia, Moravia and part of Silesia), the Slovak territory of former Hungary, and the autonomous territory of Carpathian Ruthenia. The area of the Republic is 54,877 sq. m., of which Bohemia covers 20,333 sq. m., Moravia and Silesia 10,438 sq. m., Slovakia 19,148 sq. m. and Carpathian Ruthenia 4,958 square miles.

The population of the Republic in 1921 was 13,617,172 (Bohemia 6,670,582, Moravia and Silesia 3,335,152, Slovakia 3,000,870, Carpathian Ruthenia 606,568); 8,760,937, or 65·51% of the inhabitants, were Czechs and Slovaks; 3,123,568 (23·36%) Germans; 745,431 (5·57%) Magyars, and 461,849 (3·45%) Ruthenes; the remainder (2·11%) being composed of Jews (180,855 or 1·35%), Poles (75,853 or 0·57%) and others (0·19%).

I. CONSTITUTION

The Czechoslovak State is a democratic Republic with an elected President at its head. The territory of the Republic forms a single and indivisible unity, within which the territory of Carpathian Ruthenia is granted the widest possible autonomy compatible with the integrity of the Republic. Territorial changes require a sanction of a constitutional law which, like an amendment to the constitution, or declaration of War, has to be passed by three-fifths of all members of both Houses of Parliament.

Parliament.—Legislative authority is exercised by Parliament elected by universal, equal, secret and compulsory suffrage, based on the principle of proportional representation, and consists of two chambers, a Chamber of Deputies of 300 members, elected for six years, and a Senate of 150 members, elected for eight years. The franchise for the Chamber of Deputies is open to all citizens without distinction of sex who are over 21, that for the Senate to all citizens over 26; all citizens are eligible to the Chamber of Deputies when they have reached the age of 30, and to the Senate when they have reached 45 years of age. Members of both chambers possess parliamentary immunity, but may be handed over to the ordinary courts by resolution of the House to which they belong. Parliament must sit twice a year. Cabinet ministers, who need not be members of Parliament, may participate in the meetings of either House and on the request of either House must attend its session.

Both chambers enjoy the right of initiative, and Government Bills may be first introduced in either House. Only finance and army bills must be introduced first in the Chamber of Deputies. A measure passed by the Chamber of Deputies becomes law despite an adverse decision of the Senate if the Chamber of Deputies adheres to its original decision by an absolute majority of all its members. It is also the Chamber of Deputies alone that by a vote of no-confidence can compel the resignation of the Government. Thus the Chamber of Deputies, as the more fully representative of the popular will, possesses great powers, being enabled in certain cases to carry through its legislation in face of the opposition of the Senate. The Senate plays the part of an organ of supervision, and acts as a check on too hasty or too loosely drawn-up legislation. During the period when Parliament is not sitting, a permanent commission of 24 members (16 from the deputies and 8 from the senators) sits to enact urgent measures which have temporarily the force of law. They lose their validity unless confirmed within two months by the Parliament which subsequently meets.

Powers of President.—The President of the Republic is elected in a joint session of the two Chambers. His period of office is fixed at seven years, and he may be re-elected at the end of his first term for a second period of seven years. For a third term, however, he cannot be elected until after the expiration of seven years from the conclusion of his second term of office. This restriction does not apply to the first president—President Masaryk. The President, as head of the State, represents the State in its relations with other States, negotiates and ratifies international treaties (some of them after the affirmation of parliament), receives and appoints diplomatic representatives, declares war with the previous consent of Parliament and submits to parliamentary approval treaties of peace; he is the commander-in-chief of the armed forces of the Republic; he appoints and dismisses Cabinet ministers, and convokes, prorogues and dissolves Parliament; he signs all laws enacted by Parliament and has the right to return with his comment any measure enacted by it; such a measure can become law only if repassed by an absolute majority of members of each of the two Houses, or by three-fifths of all the members of the Chamber of Deputies. He appoints higher officers and officials of the State, exercises the right of reprieve and is not answerable at law for his official acts. He is amenable to law only on a charge of high treason, in which case he can be impeached by the Senate upon an indictment found against him by the Chamber of Deputies; if found guilty his only punishment is the loss of his office and permanent disqualification for Presidency.

Law and Civil Rights.—The judiciary is separated from and independent of the administration. The judges are independent in the exercise of their functions and are bound only by law; they are appointed permanently and cannot be recalled.

In respect of civic rights the Constitution guarantees all citizens of the Republic full equality before the law and equal civil and political rights, whatever be their race, language, or religion; no privileges due to sex, birth or occupation are recognised; the Constitution further guarantees full personal freedom, inviolability of domestic rights and of the mails, freedom of the press, the right of free assembly and association, and of the expression of opinion by word, writing or print, freedom of scientific research, of instruction, of conscience and religious creed; all religious confessions are equal before the law; wedlock, family and motherhood are placed under special protection; special provisions of the Constitution protect the

rights of language, religious and racial minorities, to whom it guarantees the maintenance of their schools, and prohibits every manner of forcible denationalisation. All persons residing in the Republic are guaranteed complete and absolute security of life and liberty without regard to origin, nationality, language, race or religion. All these guarantees and rights are protected by the Supreme Administration Court, which enforces the legality of public administration. A Constitutional Court decides whether laws promulgated by Parliament are in harmony with the character of the Constitution. An Electoral Court decides upon the validity of disputed elections or forfeiture of seats and other questions relating to Parliamentary or elected bodies.

Administration and Justice.—For the purposes of political administration the Republic has been divided into administrative subdistricts, the heads of which are appointed by and directly responsible to the central Government. Local civil government is carried on by parish, district, urban and municipal councils elected by popular vote.

The tribunals of the Republic are the Supreme Court of Justice, which sits at Brno and is the court of final appeal both in civil and criminal cases, two high courts sitting at Prague and Brno respectively, 33 provincial courts and 410 district courts, all of which possess jurisdiction in both civil and criminal cases. Commercial cases are dealt with by the ordinary courts, except at Prague, where a special commercial court sits. Litigation in mining matters is conducted before special benches attached to the district courts in mining districts. In large industrial centres there are also industrial courts to deal with disputes between employers and employees. (J. Cr.)

II. RISE OF THE REPUBLIC

Czechs and Slovaks in the Dual Monarchy.—The political frontiers of Europe at the beginning of the 20th century concealed the previous history, the actual life and the natural tendencies of the small nations in Central Europe, as well as the whole of the long cultural process by which these nations arrived at their racial consciousness in the course of the 19th century. The problem of nationality in Central Europe, and particularly in Austria-Hungary, became more and more acute as the process of national revival advanced, notably in the revolutionary period of 1848. The Poles and Czechs awoke to the knowledge of historical state rights and all nationalities felt the right to self-determination, the right to an independent existence with political autonomy which would ensure a free development of national individuality.

The leading German circles in Austria endeavoured to maintain their hegemony over the non-German nations in the Empire and neglected the possibility of solving the nationality problem in the spirit of federalism with equal justice for all. They arrived at an agreement only with the Magyars (1867) on the basis of dualism, the purpose of which was to secure domination over the Slav-Latin majority for the Austrian Germans in the Austrian portion of the Empire and for the Magyars in Hungary. To ensure this it was necessary that the Dual Monarchy, ruled over by an aristocratic German-Magyar minority, should ally itself with German imperialism and become the aider and abettor of its plans.

In spite of the honest endeavours of the Austro-Hungarian nations to reach a settlement within the framework of a federalistic and democratic Austria, in spite of the fact that even the Habsburgs on several occasions acknowledged the Czech state rights, in spite of several attempts to make the nationality problem in Austria-Hungary an international problem, in spite of the great cultural and economic advance made as the result of resolute efforts on a small scale, and in spite of certain successes of the positive policy in linguistic and political matters, the Czech nation, though possessed of a political consciousness, and with it also the other Central European nations, entered the 20th century subjected to a foreign régime, the domination of the Germans, the German-Austrians and the Magyars. Other nations were still the vassals of the absolutist Eastern empires of Russia and Turkey.

It was partly the wars of liberation in the Balkans, but especially the World War, which brought about a radical improvement in this state of affairs and caused revolution in the whole Central European zone of small nations, thus bringing the political aspect of Europe more in accordance with its ethnographical aspect, and completing in that zone the profound internal process which had been in preparation for centuries.

The Outbreak of War 1914.—The Czech nation, which in consequence of the Thirty Years War had been deprived of its political independence, had never abandoned the idea of recovering it, and in the 19th century did much to remove the far-reaching traces which the severe anti-Reformation régime of the Habsburgs had left in its organism. Having successfully withstood the absolutist pressure of Germanisation in Bohemia, Moravia and Silesia, while its Slovak kindred were slowly succumbing to the Magyarising endeavours of the Hungarian State, it clearly saw that the outcome of the World War would have a decisive effect upon its existence. By its traditions, its sympathies and its whole political outlook the Czech nation was on the side of Western European democracy and Slavonic Russia and Serbia against the central autocracies for whom the Czechs were called to fight. Open protest or revolution was impossible owing to the presence of great numbers of German and Hungarian troops on Czech territory, and also to the clear knowledge of the hopelessness of any direct revolutionary action, and direct political action was equally impossible

owing to the suspension of the Austrian Parliament, of which the fear of the Czech attitude was one of the main causes. The opposition of the Czech nation, therefore, assumed the form of passive resistance, the passing over of Czech troops in great numbers to the Allies, and secret organisations, the purpose of which was to prepare for the decisive moment. The brunt of the Czechoslovak revolutionary movement was, however, borne by the political exiles who, having escaped abroad at the beginning of the War, began to carry on in the Allied and neutral countries an extensive anti-Austrian action of a diplomatic propagandist and military character, which aimed at achieving independence for the Czech and Slovak territories.

Prof. Masaryk and the Western Powers.—The necessity for systematic action abroad, and mainly in Western Europe, was soon realised by Prof. Masaryk, the leader of the small Realist party, who, as a member of Parliament and of the Austro-Hungarian delegations, had for many years past—especially during the Bosnian annexationist crisis—been an opponent of reactionary Austria and especially of its provocative and dishonourable foreign policy. As early as the autumn of 1914 it was clear to him that the War would not be decided on the Russian front, but in the West, and that it would last longer than was imagined by those who, guided by Slavonic sympathies, relied mainly on the strength of Russia. Apart from friendly relations with France, and relations and sympathies with Russia which had developed before the War as a result of the political, economic, but mainly cultural co-operation with the Slavonic nations expressed in the neo-Slavism of Dr. Kramář, Czech political leaders had no concrete arrangements with foreign countries for the eventuality of war. Prof. Masaryk could therefore only make use of the modest bonds of sympathy and friendship with the countries in Western Europe.

Accordingly in 1914 he got into touch with his French and English friends in the course of two journeys to Holland, of which he availed himself for supplying the earliest information to official, especially British, circles. His journey to Italy in Dec. 1914 was also intended to be of an informative character. Being warned on returning by way of Switzerland, where he continued to study the situation, that the Austrian police had orders to arrest him on his return, Masaryk decided to remain abroad and to organise the Czech campaign against Austria-Hungary, keeping, as far as possible, in continual touch with the underground activities at home concentrated in the "Maffia," a secret society which originated from the clandestine meetings of Czech politicians and their friends. The aim of his action was to make known to public opinion and political and official circles in the Entente countries the claims of the Czechoslovak nation, and to make the Czechoslovak question a subject of diplomatic negotiations on the part of the competent official circles of the Entente, which would effect its solution on international lines.

Organisation outside Austria-Hungary.—For this purpose Masaryk proceeded to organise Czechoslovak settlers or residents abroad in order to make use of their resources and their influence in favour of his programme, and particularly to obtain a financial basis for his action and for direct armed intervention against Austria in the ranks of the Entente. When the Czechoslovaks abroad were joined by a large number of Czechoslovak soldiers who crossed over to the Allied side, it was possible to consider the formation of special military units and a separate Czechoslovak army within the framework of the Allied armies.

In all the Entente states there were spontaneous organisations of Czechs and Slovaks for the purpose of actively supporting the Allies in the struggle against the Central Powers. In Russia, at the very beginning of the War, there came into existence what was known as the Czech brigade, a body, however, which was more propagandist than military in character. In France large numbers of Czechs joined the Foreign Legion and many Czechs entered the army in England and Canada. In the latter country they consisted largely of volunteers from among the Czechoslovak settlers in the United States, which were then still neutral. But the Czechs and Slovaks of America soon had an opportunity of doing important work, particularly in taking upon themselves the major part of the financial burden of the campaign. This had great moral significance, because it made the Czechoslovak movement independent of financial help from the Allies. Matters were made easier by the circumstance that Russia and France very soon adopted a relatively favourable attitude to the Czechoslovaks, who nominally were subjects of an enemy State, and by this concession they gained freedom of movement and organisation.

The Struggle against Austrophilism.—There were, however, certain obstacles. These were due partly to the fact that the number of capable workers abroad was very small; then, too, it became more and more difficult to keep in touch with the Czechs at home, as the severity of the persecution carried on by the Austro-Hungarian Govt. increased.

One extremely serious obstacle was the circumstance that the European public as a whole was unacquainted with Austro-Hungarian conditions in general and the Czechoslovak problem in particular, and also that at the beginning the Czechoslovak revolutionary movement did not meet with sufficient comprehension on the part of official circles in the Entente states. In the political public opinion of Western Europe Austria-Hungary was regarded as an element in the maintenance of European equilibrium. The Czechoslovak problem was looked upon as being an internal problem of the Dual Monarchy, which certain circles in the Entente were unwilling to alienate by formulating the final and extreme war aims, endeavouring rather to isolate Austria-Hungary from Germany and thus weaken the latter, who was regarded as the sole culprit in bringing about the world catastrophe.

Up to the moment when Austria-Hungary collapsed it was necessary to fight against Austrophilism, which was powerful both in the neutral states as well as in the Allied countries and Russia. It was also necessary to struggle against the intensive Austrophile propaganda, by revealing the pseudo-constitutionalism and minority rule which were the true foundations of Austria-Hungary.

The Formation of Foreign Committees.—The year 1915 resulted in a mobilisation of resources and the distribution of work for the Czechoslovak movement abroad, rather than in any positive successes. Masaryk inaugurated an open struggle against Austria-Hungary in the spirit of humanitarian and democratic ideals on the occasion of the Hus celebrations in Switzerland, and he prepared for further activities in the Press and by lectures. Up to the arrival of Dr. Beneš in the autumn of 1915 the headquarters of this work were in Switzerland, but after the arrival of Dr. Beneš and of the agrarian deputy Josef Durich, who left Bohemia with the knowledge and support of Czech political circles there, Masaryk chose London as his seat of action, while Beneš as secretary of the central foreign committee proceeded to Paris with Štefánik, the Slovak scientist, who served as an aviator in the French army. Durich was entrusted with the task of concentrating the work that had hitherto been accomplished in Russia by means of a unified Czech committee.

Steps were very soon taken to form a Czechoslovak foreign committee for the purpose of carrying on a united struggle against Austria. This idea was indicated by Masaryk in a circular addressed in March 1915 to a number of persons in the Czechoslovak settlements abroad and on Nov. 14 1915 the committee issued a manifesto, signed by Masaryk and Durich, by the leaders of the Czech colonies in the Entente states and notably also by the Czechs and Slovaks in America. This was the first official pronouncement by the Czechs abroad against Austria-Hungary, in favour of the Entente, and of the independence of the Czechoslovak state. This manifesto, which had also the approval of the Czechs in Austria-Hungary, was issued at a moment when not only was the result of the War not decided but the situation for the Allied states was not altogether favourable. At the beginning of Jan. 1916 the foreign committee was transformed into a National Czech Council, the president of which was Masaryk, the vice-president Josef Durich, and the general secretary was Dr. Beneš. The Slovaks were represented on

this Council by Gen. Štefánik. The first political success of the campaign came on Feb. 3 1916, when Masaryk obtained a verbal promise from M. Briand, the French Prime Minister, that France would support the Czechoslovak endeavours to secure state independence.

The Czechoslovak Legions.—Considerable success and marked progress were achieved by the Czechoslovak movement in Jan. 1917, when the Allies in their reply to President Wilson's note on the peace conditions included the liberation of the Czechoslovaks from foreign rule among their chief war aims. In Russia the Czech brigade, referred to above, had in the meantime made further developments and, what was equally important, the diverging tendencies among the Czechs there achieved a singleness of purpose in Aug. 1916 by the agreement at Kiev which recognised the National Council in Paris as the supreme authority, Durich becoming its representative in Russia. In June 1916 the Tsar consented to the release of the Slav prisoners of war, but at the instigation of Stürmer, supported by the Tsaritsa, the consent was withdrawn at the beginning of August. In Oct. an independent Czechoslovak division in the Russian army was sanctioned but scarcely a month later this concession was also withdrawn. The Russian revolution of March 1917 did not bring any immediate advantage to the Czechoslovak movement there, and in particular it did not facilitate the recruiting of additional troops for the Czechoslovak brigade from among the prisoners of war. The Russian general staff at first gave permission for this to be done, but this was soon afterwards revoked. It was not until the Czech regiments distinguished themselves at Zborov on July 2 1917 that Kerensky was induced to restore the concession which had been revoked. Unfortunately the Russian army was already in a state of collapse and the Government of the March revolution was only short-lived. As early as March 1917 negotiations were opened with France for the transport of Czechoslovak soldiers and prisoners of war to France. An agreement to this effect was concluded between the French Govt. and the Czechoslovak National Council, and by a decree signed by President Poincaré on Dec. 19 1917 an independent Czechoslovak army was established in France; its constitution was completed on Feb. 7 1918 by a special agreement signed by Dr. Beneš and M. Clemenceau.

In Russia, where in the meantime Masaryk had taken charge of the Czechoslovak movement, having left England in May 1917, the establishment of the first independent Czechoslovak body was reached during the interim government in Oct. 1917, while in Aug. 1917 the Russian branch of the Czechoslovak National Council floated a revolutionary loan of 20,000,000 francs to carry on the Czechoslovak movement.

Developments Within the Dual Monarchy.—In Bohemia in 1916 the Austrian persecution reached its culminating point and in June of that year Dr. Kramář, Dr. Rašín and their associates were condemned to death. Under the military and police pressure no public political life was possible there. It was not until towards the close of 1916 that an attempt was made to unite the Czech parliamentary deputies and parties in a Czech League and in the National Committee. After the death of Francis Joseph, which strengthened the position of the independence movement, this solidarity on the part of the Czech politicians was particularly effective. It was however still impossible to issue any public manifestos, and any that existed could not show any disloyalty to the dynasty. For this reason the official manifesto of the Czech League on the occasion of the Allied reply to President Wilson's note could be used by the Austrophile propaganda abroad.

The effect of the Russian revolution was that the later manifestos of Czech circles, while still very cautious, were of a more open character. Thus the May manifesto of the Czech authors and the proclamation of the Czech deputies on May 30, at the first meeting of the Reichsrat in Vienna, demanding the transformation of the Austro-Hungarian Monarchy into a federative state with equal rights for the various nationalities, are indications of this tendency. The latter proclamation contained a claim for a Czech state and Slovakia, and it was signed by all the Czech deputies, especially the Czech social democrats, whose representatives at the Socialist Peace Congress at Stockholm in June 1917 advocated the right of self-determination and a demand for a sovereign Czechoslovak state within a Danubian federation.

The Czech Legions in Siberia.—The autumn Bolshevik revolution, the Armistice following it and, above all, the peace of Brest Litovsk, complicated the situation of the Czechoslovaks and the recognised Czechoslovak units of the Russian army (an army corps with two infantry divisions including a reserve brigade and two brigades of artillery). Masaryk had already announced the Czechoslovak policy there as one of neutrality and non-intervention in Russian affairs, and on Oct. 9 1917 he had obtained a promise from Gen. Dukhonin that Czechoslovak troops would not be used for the internal affairs of Russia. On the principle of armed neutrality it was arranged with the Bolsheviks that the Czechoslovak troops should be transported via Vladivostok to France and the first detachment was despatched at the beginning of November. In France in Feb. 1918 the National Council had organised among the Czechoslovaks there a system of general conscription for the Czechoslovak legions. At the same time the representatives of the Czechoslovak armies left France for Italy, where in April 1918 an agreement was reached between Orlando and Gen. Štefánik for organising legions among the numerous Czechoslovak fugitives there on the Russian model.

The nucleus of the Czechoslovak army in Russia withdrew from the Ukraine towards the east, covering its departure by means of successful encounters with the Germans, notably at Bachmach (May 1918). At that time the Czechoslovak army corps in Russia had already been proclaimed as a part of the French army, and from Muraviev, the Soviet Commander-in-Chief, it received a guarantee of armed neutrality and unhindered passage to France. This clear relationship between the Czechoslovak command and the Bolsheviks conditioned by the rejection of any plans aiming at intervention against the Bolsheviks, was complicated by the lack of loyalty shown by the Bolshevik Govt. which during the transport of the Czechoslovak divisions demanded their partial and even their complete disarmament. The branch of the National Council in Moscow vainly endeavoured to avoid a conflict, which was rendered more acute by the incident at Chelyabinsk with the local Soviet in the second half of May 1918, by the internment of the representatives of the National Council at Moscow and the instruction issued by the Soviet authorities and Trotsky for the forcible disarmament of the Czechs. At the end of May hostilities began between the Czechoslovak troops and the Bolsheviks. Gen. Gajda's division succeeded in gaining possession of 1,700 versts of the long railway track between Chelyabinsk and Marinsk. Čeček's western division at the same time occupied Penza, Samara and Ufa, and at the beginning of July joined Gajda's eastern division, which soon afterwards occupied the whole of the railway line as far as Irkutsk and gained possession of the Baikal and Chita railway.

Towards the end of Aug. the main Siberian line, measuring over 8,000 km., was in the hands of Czechoslovak troops, who also had taken Ekaterinburg, as well as Simbirsk and Kazan on the Volga. Masaryk, who in March 1918 left Russia and arrived in May in America, opposed all idea of armed intervention in Russian affairs, for which some of the Allied statesmen would have used the Czechoslovak legions. When, however, what was intended to be a peaceful march towards the sea was thus, contrary to the wishes of the Czechoslovaks, transformed into armed conflicts with the Bolsheviks, and the front was once more turned westward against Bolshevik Russia.

Masaryk was obliged to take advantage of his stay in Washington to ask America and the rest of the Allies for military and material help for the Siberian legions, who were suffering especially from lack of equipment. The Entente promised its support for this plan and on Aug. 2 the Japanese Govt. issued a declaration of military intervention in favour of the Czechoslovaks, while the day afterwards the Allied governments decided at Washington, notably by an American-Japanese

agreement, to grant the military and material assistance asked for by Masaryk. The military help promised by the Entente was not forthcoming, with the exception of a small Japanese contingent, but abundant quantities of supplies and equipment were given. The victory of the Czechoslovak troops on the Volga and in Siberia caused a sensation in the Allied states, so that the Czech success had a considerable moral significance and denoted the strengthening of the Czech cause. What made the Czech achievement particularly valuable was that it had prevented the Soviet Govt., and thus also Germany, from obtaining the keenly desired contact with the Siberian supplies of raw materials and foodstuffs, and also that the vast numbers of German prisoners of war in the Siberian camps could not be used for strengthening the German army. As an example of the appreciation which the work of the Czechoslovak legions met with among the Allies, reference may be made to a telegram of Lloyd George on Sept. 11 1918, in which he thanked the National Council for the inestimable services rendered by the legions to the Allies.

Recognition by the Powers.—Great Britain had previously, in a pronouncement of Lord Robert Cecil on May 22 1918, officially recognised the right of the Czechoslovak nation to complete independence. When on May 29 1918 the Govt. of the United States approved the anti-Austrian resolution passed by the Congress of Oppressed Nations in Rome, which had been organised in April of that year by Dr. Beneš on the initiative of Prof. Denis, the War Council at Versailles associated itself with this American proclamation, while the Prime Ministers of France, England and Italy, and indeed of all the Allied nations, declared their sympathies with the Czechoslovak and Yugoslav aims for liberation. At the same time the British Govt. announced its willingness to recognise the National Council as the leading body of the Czechoslovak movement and also of the army that was fighting on the side of the Entente. The first country to grant actual recognition in this sense was France (June 29 1918), the Government of which recognised the right of the Czechoslovak nation to independence, and the National Council as the supreme body controlling general interests and as the first basis of the future government. On June 30 President Poincaré with the representatives of the French Cabinet handed over the colours to the 21st Czechoslovak regiment at Darney, and on the following day the British Govt. expressed its agreement with the speech made by President Poincaré on this occasion.

About the same time a second, supplementary agreement was reached with Italy concerning a Czechoslovak army within the framework of the Italian army and the Government of the United States in its pronouncement identified itself with the complete liberation of all branches of the Slav race under German and Austrian domination. Congress then passed an amendment to the emigration law which guaranteed the Czechoslovak legionaries in the United States an undisturbed return there as American volunteers in the Allied army. About 50,000 Czechs and Slovaks then offered themselves as volunteers for the army of the United States, apart from those in the Canadian army and in France. By a declaration on Aug. 9 the Government of Great Britain recognised the Czechoslovaks as an Allied nation, the three Czechoslovak armies as a single Allied army carrying on regular warfare against Austria-Hungary and Germany, and the National Council as the supreme body controlling national interests, a trustee of the future government and the supreme authority over the army. On Sept. 3 1918 the British Govt. recognised the future Czechoslovak Govt. upon the basis of the National Council and negotiated a convention with the National Council concerning an army and diplomatic relationships on the basis of the analogous international position of Serbia and Belgium. On the same day a similar recognition was obtained from the American Govt. (recognition of a state of war between Czechoslovakia and Germany and Austria, the National Council a *de facto* Government directing the military and political affairs of the Czechoslovak nation; government relations with this *de facto* Government for carrying on warfare against the common enemy), and on Sept. 9 1918 the recognition of the Japanese Govt. in the same sense was obtained.

The success of this intensive diplomatic struggle for independence, carried on partly from Paris by the headquarters of the National Council, partly by Masaryk at Washington, and achieved to a considerable extent through the merits of the Czechoslovak legions, was promoted in no small degree by the resolute action of the Czech political leaders in Austria-Hungary itself. Important in this respect are the manifestos of the Czech deputies on May 6 1918, the vow made by representatives of all sections of the nation on April 13 1918 that the struggle for Czech independence should not cease until the final victory, the May celebrations of the National Theatre at Prague which were attended by representatives of other oppressed nations in Austria, especially the Yugoslavs, Poles and Italians—all this enhanced the movement abroad, which in the autumn of 1918 was reaching its final goal. On Sept. 28 1918 the French Govt. reached an agreement with the National Council with regard to the position of the Czechoslovak nation in France and bound itself to establish a Czechoslovak State within the historical frontiers. On Oct. 1 1918 Great Britain entered into direct diplomatic relationship with the National Council as a Czechoslovak governing body. On Oct. 3 Orlando issued a parliamentary proclamation in favour of Czechoslovak independence.

Declaration of Independence.—Finally, on Oct. 14 Dr. Beneš notified the Entente States of the establishment of an interim Czechoslovak Govt. in Paris in accordance with the decision of the President of the National Council on Sept. 26, and Dr. Beneš as Minister for Foreign Affairs was appointed the first Czechoslovak Minister to the Entente States. This interim Czechoslovak Govt. was recognised by the French Govt. on Oct. 15, and by the Italian Govt. on Oct. 24, while on Oct. 18 1918 the interim Govt. itself proclaimed the independence of the Czechoslovak nation by a declaration dated at Washington. On the same day President Wilson rejected the Austro-Hungarian peace offer of Oct. 7 on the ground that since the issue of his Fourteen Points (*q.v.*) on Jan. 8 1918 the Govt. of the United States had recognised a state of war between the Czechoslovaks and Austria-Hungary, and intimated to the Austrian Govt. that it should apply to the National Council which had already been recognised as the *de facto* Govt. of the Czechoslovak nation.

By a manifesto of the Emperor Charles on Oct. 16, announcing the transformation of Cis-Leithan provinces into a union of national states on the basis of nationality, without, however, touching upon the question of the non-Magyar nationalities in Hungary, Austria-Hungary vainly endeavoured to meet Wilson's reply. In Bohemia even before this reply had been published the socialist parties, especially in the rural districts, had attempted to proclaim a republic on Oct. 14. Wilson's reply was published in Austria-Hungary on Oct. 21, and within a week, notably through the collapse of the army, all the conditions were furnished for the capitulation of Austria-Hungary which took place in the night between Oct. 27 and 28. On Oct. 24 the Czech deputies had already obtained permission from the Emperor to proceed to Geneva for the purpose of conferring with Dr. Beneš there. The National Committee at Prague, however, did not await their arrival, but drew its own conclusions from the Austrian capitulations and on Oct. 28 by its first law proclaimed the independence of the Czechoslovak state, taking into its hands the administration of the Czech territories without encountering any considerable opposition from the army or from the authorities. Two days later, on Oct. 30, by a manifesto of the Slovak National Council at Turčanský Sv. Martin, Slovakia pronounced itself in favour of Czechoslovak unity.

Oct. 28 remains the symbol of the national liberation from the centuries of Habsburg bondage, although the actual transformation was carried out early in the subsequent days by an agreement between the Government of the Czechoslovak state in Paris and the National Committee, which took over all the commitments of the former. The conferences at

Geneva also gave the renewed State its definite form of a democratic republic. On Nov. 13 the National Committee issued an interim constitution and a day later there was a meeting of the Czechoslovak National Assembly constituted in accordance with the proportional numerical strength of the individual political parties, containing 256 (later 270) members, of which 44 were Slovaks. There were no Germans among them, the German representatives having refused participation. At this first meeting of the National Assembly Masaryk was unanimously elected the first President of the Czechoslovak Republic and on the basis of the interim constitution the National Assembly elected its first Government. The Prime Minister was Dr. Kramář, the Foreign Minister Dr. Beneš and the Minister for War Gen. Štefánik. On Dec. 21 the President returned to Prague, and his inaugural message pronounced in the National Assembly on the following day and containing a concise survey of the Czechoslovak movement for independence abroad and a plan for the further consolidation of the republic, concludes the revolutionary period and begins the constructive period of the State. The Peace Conference had yet to define only a few details of the relations of Czechoslovakia to its neighbours and to the other members of the comity of nations. (T. G. M.)

III. THE POLITICAL HISTORY 1918–1925

The Kramář Ministry.—The first Czechoslovak Ministry consisted of 17 members, of which four belonged to the Agrarian party, three to the Czechoslovak (national) Socialists, three to the Social Democrats, three to the National Democrats, one to the People's party and one to the Slovaks. MM. Beneš and Štefánik were non-party. During its eight months of office, the Government had to maintain the integrity of the national territory, to keep the administration working and to defend the interests of the country at the Peace Conference. Further, it had to face the problems arising out of the economic difficulties of the period, especially as regards provisioning, and out of the international situation of the new state. It dealt with all these tasks successfully.

First, it quickly put down the attempted insurrections in the German-speaking districts of Bohemia and Moravia, which had attempted to unite with Austria. In Slovakia there were grave difficulties owing to the departure of most of the Hungarian bureaucrats, the hostility of the Magyar and Magyarophile elements of the population and to the fact that the frontiers were not yet regulated. On Dec. 10 1918 the Government passed a law authorising emergency measures to be taken in Slovakia, and sent further Šrobár as Minister of State with plenipotentiary powers to maintain order. On Feb. 1 1919 the Slovak Govt. was formally installed at Bratislava. After the Communist party came to power in Hungary (Feb. 4 1919) there were further grave complications. The Hungarian Communist troops invaded Slovakia, which Czech troops were occupying. They were repelled with the help of the Allies, who, as a result of this episode, fixed a provisional line of demarcation which was maintained without great change when the frontier was finally traced on June 12 1919. Similarly in Těšín (Teschen) the situation was grave owing to the conflict with the Poles, who had occupied part of this territory. The Czech Govt. in its turn occupied Těšín and there were conflicts attended by bloodshed. The Peace Conference had to intervene. An armistice was concluded on Feb. 19 and the dispute was referred to diplomatic negotiations (*see* TESCHEN).

Financial and Social Legislation.—The population was exhausted after the War, and the dismemberment of Austria-Hungary gave rise to further difficulties. The Government was obliged to purchase grain and flour for the population abroad; and to contract loans for this purpose. Rašín successfully accomplished the task of rendering Czechoslovakia fiscally independent of Austria-Hungary at the earliest possible moment. The law of Feb. 25 1919 ordered the bank notes in circulation to be stamped, a Banking Office to be established, and a loan in gold, silver and foreign currency to be raised to form a reserve of metal as a basis of the new currency. It was thus possible to carry through quite smoothly a currency reform which saved the country great crises and accelerated its economic and financial recovery.

Two further important reforms of strongly democratic tendency were carried through by the Kramář Cabinet. The Local Franchise Act gives all citizens, without distinction of sex, who have passed their 21st year and have been settled for at least three months in their community the local and municipal franchise. The agrarian reform was designed to satisfy the land hunger of the small peasants and at the same time to stop emigration and repair to a certain extent the injustice inflicted by the wholesale confiscations of landed property, and distribution to a foreign nobility, after the Battle of the White Mountain, 1620. The parliamentary commission entrusted with working out this reform completed its work on April 16 1919. The law in its final form (*see* LAND TENURE) was the result of a compromise between the socialists and the other parties. It was followed by a certain number of legislative measures, notably the Act of May 27 1919 which laid down the distribution of the ground to small holders.

The social legislation passed during this period shows very clearly the influence of the socialist groups (the two Socialist parties and the Progressives forming a bloc for this purpose). Socialism was very strong at the time throughout Europe, and the Socialist bloc exercised great influence in the National Assembly. Among the principal social measures may be mentioned the eight-hour day, which was adopted on Dec. 19 1918 and came into force Jan. 13 1919, the Act on unemployment benefit (Dec. 10 1918), the Act on insurance against sickness (May 10 1919), the Act on the protection of tenants (Dec. 27 1918) and various measures dealing with the housing crisis, etc.

In the sphere of public instruction great care and considerable credits were devoted to education, particularly in Slovakia, where it had to be completely reorganised, since formerly it had been merely a docile instrument in the hands of the Hungarian Govt., which used it to denationalise the Slovak population. The material and legal status of the body of teachers was ameliorated (Act of May 23 1919 which places the status of the teachers on a par with that of civil servants); popular instruction was developed (Act of Feb. 7 1919 on free popular courses). In higher education, the Act of Jan. 20 1919 established a second Czech University at Brno (Brünn) which the Czechs had often demanded unsuccessfully from the Austrian Govt. and the Act of June 27 established a University at Bratislava. The question of the separation of Church and State was not solved; a step was taken towards laicising all education by the Act of April 10 1919, which laid down that the office of teacher is open to any citizen without distinction of creed. The Act of Feb. 20 1919 forbade the use of the authority of the Church for political agitation.

The Kramář Cabinet stood for good will and tolerance among the parties and in fact accomplished important social and democratic reforms. Yet the rise of socialism at the time in Czechoslovakia, as in the rest of Europe, strengthened the moral position of the socialist bloc in the National Assembly, and made apparent the disproportion which existed between the number of socialist representatives in Parliament and the real force of Socialism in the country. The realisation of this disproportion troubled relations between the Socialists and the bourgeois parties and led the former to agitate for immediate municipal elections which would allow the two camps to measure their true forces. This discontent further provoked trouble in May 1919 in Prague and in the provinces on account of the high cost of living, and led to the resignation of the two National Democrat members of the Government, which brought with it that of the entire Government.

The First Tusar Cabinet.—The municipal elections of June 15 1919 clearly showed that the composition of the Government and of the National Assembly did not correspond with the real numerical importance of the different parties. Thus, the national democrat group which had hitherto had 46 deputies and four ministers only obtained 256,336 votes or 12% of all votes

cast, while the Social Democrat party obtained 934,801, the Czechoslovak Socialists 484,743 and the Agrarians 637,013. The Cabinet accordingly resigned and on July 8 1919 President Masaryk appointed a second Cabinet under M. Tusar, a leader of the Social Democrats. The new Government represented a coalition of the parties which had been most successful in the elections. Besides Tusar (Minister President) it included three other Social Democrats, four Czechoslovak socialists, four Agrarians and two Slovaks, M. Beneš retaining his portfolio.

The Government, in presenting its programme, declared its intention of carrying on the policy of the preceding Cabinet and pursuing the work of national consolidation especially in Slovakia where order had to be re-established after the invasion of the Magyar troops. Further, it would attempt to create conditions which would make it possible for the Czechoslovaks to collaborate with the racial minorities in general and the German minority in particular; it would carry forward the economic policy of the preceding Government by developing good commercial relations with foreign countries, by balancing the budget and making important fiscal reforms, notably by instituting a capital impost; and it would pursue a progressive educational and social policy. It laid especial weight on the necessity of carrying through the agrarian reform, setting up workmen's chambers and establishing a complete system of social insurance. In general the new Government reflected the advanced tendencies of the Czechoslovak and European labour movement of the day.

During the period of office of Tusar's Cabinet Czechoslovakia consolidated her international situation. The interests of the country were successfully defended at the Peace Conference. On Sept. 10 1919 the Treaty of St. Germain with Austria had been signed and on the same day the so-called " little treaty " of St. Germain, which guaranteed the rights of minorities in Czechoslovakia. Under the guidance of M. Beneš commercial relations were developed between Czechoslovakia and her neighbours. The relations between Austria and Czechoslovakia soon became friendly and the ground was prepared for future political agreements.

The economic consolidation of the country was still impeded by great difficulties, which obliged the Government to have recourse to fresh loans. By the Act of April 10 1919 the Government was authorised to contract a loan of 179 million dollars from the United States, 54 million dollars of which were devoted to the purchase of foodstuffs and 100 million to currency reform. On Oct. 4 1919 a second internal loan of 880,000 crowns was voted and in Feb. 1920 a third internal loan (lottery) to revive production. By the Act of Oct. 7 1919 the Government readjusted the payment of civil servants; thus involving an expenditure of 600 million crowns. This new burden, to which others were soon added, (grants to the unemployed, to war invalids, etc.,) made clear the necessity of proceeding without delay to an extensive fiscal reform, and in particular of carrying through an extraordinary impost on capital. This question, which had been the subject of bitter struggles in the preceding Cabinet was only definitely settled in April 1920; when the levy on capital and on increases of capital was imposed. The State budget for 1920 provided for 10,416,175,920 crowns expenses, and 7,750,770,773 crowns revenue, a deficit of 2,665,405,147 crowns.

The Tusar Cabinet pushed forward the agrarian reform actively. The Act of July 11 1919 established a " land office "; other measures regulated the principles of the methods of reform, especially the distribution of the expropriated lands, which, since they were not devoted solely to the benefit of private proprietors, but also to that of co-operatives, thus showed a compromise between the agrarian and socialist points of view. As regards social policy, the Government passed an Act on children's labour; an Act granting a credit of 500,000 crowns for cripples and the survivors of deceased soldiers; an Act which gave workmen employed underground a share in the control and profits of mining enterprises; a further law set up local and works councils in the mining industry and thus marked the first stage in a whole branch of new legislation dealing with the share of workers in the control and profits of industrial enterprises. This Act was soon supplemented by others on courts of arbitration in the mining industry, on the regulation of wages in the metallurgical industry and on home work. In other fields may be mentioned legislation dealing with public libraries, the organisation of the so-called " economic " popular schools, marriage-law reform, the abolition of the prohibition of married women teachers and military organisation.

The most important task of Tusar's Cabinet was the elaboration of the constitution. In view of the attitude adopted by most of the German population it was resolved that this should be voted by the revolutionary National Assembly, rather than by a nationally elected parliament. A special commission elaborated its general principles and its text. Several points—the question of a second chamber, of the separation of Church and State, of the system of military organisation and especially of the incorporation of the language laws in the Constitution gave rise to vehement debate before the constitution was finally adopted on Feb. 29 1920.

The chief question which Tusar's Cabinet left unsolved was that of the German minorities, which remained in unrelenting opposition to the State. Nor were all the problems which arose in Slovakia wholly settled. Early in 1919 the People's (Catholic) party led by Father Hlinka developed tendencies hostile to the State. The internal situation was further troubled by a grave crisis within the Social Democrat party. In Jan. 1920 an oppositional group, the " Marxist Left " formed within this party, and, yielding more and more to the influence of communist propaganda, opened a violent campaign against the Governmental policy of the right wing. The efforts of the Social Democrat party to check this movement failed, and the campaign grew in violence after the return of M. Smeral, the leader of the dissentients, from Moscow in the spring of 1920.

The General Elections.—The general elections were held on April 18 1920 for the Chamber of Deputies and on April 25 for the Senate. The number of Deputies was fixed in accordance with the Constitution at 300, and of Senators at 150. Elections were not held in the districts of Těšín, the frontiers of which were not yet definitely regulated, and of Užhorod in Sub-Carpathian Russia, which was not yet fully in occupation of Czechoslovakia. Accordingly, only 281 Deputies and 142 Senators were elected. The Czechoslovak parties obtained 199 seats in the Chamber of Deputies and 102 in the Senate (Social Democrats 74 and 41; Agrarians 40 and 20; Catholic People's Party 33 and 18; Czechoslovak Socialists 24 and 10; National Democrats 19 and 10; Small Traders six and three; Independent Socialists three and none); the German parties 72 seats in the Chamber and 37 in the Senate; the Magyar and mixed Magyar-German parties 10 and three respectively. The Czechoslovak parties obtained 68·6% of the votes cast, the Germans 25·6%, the Hungarians 0·5%, the German-Magyar 4%, the Jewish parties 1·3%. Of the Czechoslovak votes cast 50·6% went to the Socialist and 49·4% to the " bourgeois " parties.

The Second Tusar Cabinet.—The results showed that the Socialists and Agrarians commanded a majority in the country. Tusar therefore again received a mandate to form a Cabinet. The new Ministry was completed on May 25 (although remodelled before the autumn session). It was composed of seven Social Democrats, including the Premier, three Czechoslovak socialists, three Agrarians and two non-party specialists (Engliš for Finance and Hotowetz for commerce); Dr. Beneš, who again took the portfolio of Foreign Affairs, was elected on the list of Czechoslovak socialists.

Assembling in May, the new National Assembly, in joint session of both Chambers, re-elected M. Masaryk as President of the Republic by 284 votes out of 411. On June 1 the new Cabinet read its programme, which envisaged an advanced democratic and social policy. Appealing to the German representatives, M. Tusar declared that if the two nations had hitherto failed to co-operate, this was not due to the fault or the wishes of the Czechoslovak majority, but to the attitude of the Germans themselves. The reply of the German bourgeois

parties, however, which was repeated in a modified form by the German Socialists, showed their intention of persisting in their negative policy towards the Republic. The German problem remained as far as ever from a solution.

Tusar's second Cabinet had a difficult task, since its majority was very weak (144 votes out of 281 in the Chamber). It was opposed on the Left by the Communist elements of the Social Democrat party, and on the Right by the National Democrat party and by the conservative wing of the Agrarians. The National Democrats criticised the Cabinet's policy in its handling of the Těšin policy and the bill on the conversion of the Austro-Hungarian War Loan bonds, which the Government proposed to honour up to 75% of their nominal value, while the Conservative Agrarians chiefly opposed the Government's action in maintaining State control over the sale of the principal foodstuffs. The bill on the Austro-Hungarian War Loan was finally adopted by a small majority, while the harvest was commandeered for the benefit of the State by virtue of a decree.

The Cabinet secured the adoption of a Treaty with Austria which made provision for the protection of the minorities and regulated the question of rights of citizenship. Parliament then adjourned until October. Before it reassembled, important changes had taken place in the political situation. The crisis in the Social Democrat party reached its climax. A Party Congress had been convoked for Sept. 25; the Left wing, which was coming more and more under the influence of the Third International, opened a violent campaign in the hope of securing the majority in the party and of obtaining the adherence of the Congress to the Communist International. In view of this assault, the executive committee of the Social Democratic party met on Sept. 14 and it was decided that the party's representatives in the Government should tender their resignation. This decision was due both to the fact that the Social Democrat ministers now represented only a fraction of the party, and to the necessity of restoring to the group its entire liberty of action in view of the impending struggle. The resignation of the Social Democrat ministers was approved and that of the Cabinet was accepted by President Masaryk on Sept. 15 1920.

The Černý Cabinet.—On the same day M. Černý, the head of the provincial administration of Moravia, was entrusted with the formation of a Cabinet which could continue the policy of the resigning Government. MM. Beneš, Engliš and Hotowetz retained their portfolios in the new Government, the rest of which was composed of high public officials. This temporary arrangement was unavoidable in view of the composition of the National Assembly, as it was not possible to form a majority without the Social Democrats. The only solution was, then, a non-party Cabinet, backed by the Czechoslovak groups, including the majority of the Social Democrats. The last-named party had in fact determined on a radical solution of the Communist difficulty by forcing the extremist elements to leave the party and form an independent group. This division of the party brought with it a split in its parliamentary representatives, 26 members of which formed a new group. The strength of the opposition thus rose from 82 to 108 deputies, while the bloc of the parties of the old majority was reduced to 118 and the total of the Czechoslovak national parties to 173. This new division showed that government was not possible without the support of all the Czechoslovak groups. The Černý Cabinet then prepared the way for a stable parliamentary government which was to follow it after the end of the year, resting like it on this larger majority. A new organisation, the Council of Five (Pětka), composed of the leaders of the five Czechoslovak parties of the coalition (Social Democrats, Czechoslovak Socialists, National Democrats, Agrarians and People's Party), was formed to ensure contact and organise collaboration between the Government and the majority. The mission of the Pětka was to reconcile the divergent interests of these parties and to bring them into line with the interests of the whole. Thanks to this institution the situation of the Cabinet, which had been coldly received by public opinion, was alleviated, and it was able to carry through its most important and urgent tasks.

The chief obstacle in the way of the Černý Govt. was the Communist party, which had launched out on a violent campaign of agitation among the working classes, and was attempting to create trouble in the country. The Government took strong measures to ensure public peace and order. In Dec. 1920 the Communists, on the pretext of the restoration of the People's House, of which they were in occupation, to its legitimate proprietors, the Social Democrats, proclaimed a general strike, which was to prove the commencement of graver troubles. The Government did not hesitate to put down the movement with all the necessary severity. This policy had good results. The Communist party, which towards Christmas had given its open adhesion to the Third International, understood the lesson and attempted no further disturbances. From this moment onward the Communist movement in Czechoslovakia began to wane, a fact which was due partly no doubt to general international influence, but partly to the firmness of the Černý Government.

The budget for 1921 was adopted without difficulty. It was less easy to regulate the question of fiscal reform, but it was essential to do so if the equilibrium of the budget was to be attained. The problem of victualling the country was equally complex. It was only in June, after long and difficult conversations, that it was finally solved. To carry through the fiscal reform the Government proposed to increase the rate of the turnover tax, to introduce a succession duty and a duty on water power, to raise the rate of the income tax and the tax on profits. The representatives of industry and commerce and the National Democrat party raised numerous objections to the various measures proposed, particularly to the increase of the turnover tax. All efforts to overcome this opposition failed. M. Engliš, the author of the proposed reforms, resigned on March 4 1921. He was succeeded by M. Hanačik, whose efforts, however, were no more successful. This parliamentary session lasted, with certain breaks, from the end of May to the beginning of August. A number of bills were adopted by Parliament—homologation of foreign insurance companies; a commercial and customs agreement with Yugoslavia; an increase of unemployment benefit; a convention with Germany regarding rights of citizenship, etc. The opposition of the Germans in Czechoslovakia grew more and more violent, and led finally to their leaving Parliament and declaring their intention to abstain in future from any collaboration in the work of the legislature. Meanwhile the fiscal reform, after many vicissitudes, had at last been adopted by the Pětka. It was passed quickly through the Chamber in the last days of the session, simultaneously with the law of expropriation of the property of the Habsburgs and a bill relating to the organisation of industrial works councils, which satisfied Socialist claims.

M. Beneš' Government.—The Černý Cabinet lost its *raison d'être* as the Communist danger grew less, and with it the necessity of a close contact between Parliament and the Government. Further, if the delays incurred in treating various problems were in part attributable to the diversity of interests in the parties forming the majority, it appeared that these divergences could be better reconciled by a parliamentary government. In Sept. 1921 the Czechoslovak Social Democrat party, after a year of work and internal consolidation, declared itself ready to resume the responsibilities of government. The Černý Govt. therefore retired, and on Sept. 27 the decree was issued ordering the formation of the new government. The Government majority included the five great Czechoslovak parties, and also enjoyed the support of the minor Czechoslovak parliamentary groups, so that it could thus command a secure majority of 180 votes in the Chamber against the 78 of the National minorities and the 25 Communists. M. Beneš became Premier, his Cabinet included three Social Democrats, three Agrarians, two Czechoslovak Socialists and one National Democrat. The Premier, who also acted as Foreign Minister, and the Ministers of Finance, the Interior and Slovakia, were non-party men. M. Beneš' appointment was in general well received; the German press and deputies regarded it as a hopeful symptom.

The programme of the new government, which was first

announced on Oct. 18, was one of firmness, consolidation, economy and administrative reforms at home and abroad; the general principles of preceding governments were to be carried further. In the debate which followed, Father Hlinka, the leader of the Slovak Catholics, declared his confidence in the Government. The Germans maintained their attitude of opposition, but their spokesman hinted at a possible future collaboration.

The Government remained in office from Sept. 26 1921 to Oct. 7 1922. The foreign situation during this year was particularly full of incident, including the second attempt at restoration (Oct. 20 1921) of the ex-King Charles in Hungary, as a result of which Czechoslovakia commenced mobilisation (*see* HUNGARY), the conclusion of a political convention with Poland (Nov. 6 1921), which, however, remained unratified (*see* LITTLE ENTENTE), of a treaty of guarantee and arbitration concluded on Dec. 16 1921 at Lány (Lana) with Austria (*see* AUSTRIA), the Conference of Genoa in March and April 1922, the negotiations for the expansion and strengthening of the Little Entente and the difficulties arising out of the fresh financial collapse in Austria in 1922. These questions preoccupied the attention of the Government somewhat to the exclusion of internal affairs. The internal economic situation was difficult and the cost of living high, both for general reasons and owing to the sudden rise of the Czech crown. There were serious labour troubles, such as the miners' strike of Feb. 1922 and the strike in the metal industry in May 1922.

The position of the Pětka in regard to the Government caused difficulties, now that the abnormal situation which had justified its establishment had passed away; and a further difficulty was caused by the desertion of the 12 representatives of the Slovak Catholics to the opposition on account of the Government's refusal to open three new Catholic high schools in Slovakia. As regards the question of the racial minorities, Beneš' Cabinet achieved no more than an indirect result by provoking a split within the German bloc, which divided it into a number of heterogeneous parties. The Government passed, however, numerous legislative measures, including the Acts for the encouragement of building, for the suppression of the Foreign Trade Office, for the revision of cost of living bonuses to State employees and those dealing with co-operative societies, the prohibition of the sale of alcoholic liquors to young persons, emigration, prevention of venereal disease, the teachers' status, etc.

Among economic measures may be mentioned the British loan of Jan. 1922, the purchase of the Rakovnik-Louny railway company, the modification of the customs tariff, the Act on the source of the pre-War public debt, the recasting of the duty on sugar, the Act on the issue of subsidiary coinage. Of special importance were the agreements reached with foreign countries, including the convention with Austria relative to the demarcation of the Austro-Czechoslovak frontier, the commercial and navigation treaty with Italy, the agreement respecting Czechoslovak traffic via the port of Trieste, the economic negotiations with Germany, the commercial treaty with Austria and the convention with Germany for mutual judicial assistance. The good results of the work of the Beneš Cabinet were shown in the increase of Czechoslovakia's prestige, the rise of her currency from 10 to 17 silver centimes—at which rate it was stabilised—and the internal consolidation, which was attested by the calm with which the country received the mobilisation of Oct. 1921.

The history of the Beneš Cabinet so conclusively proved the feasibility of a concentration Cabinet that when it resigned, on Oct. 5 1922, the system was maintained on an even broader basis. The new Ministry was formed on Oct. 7, its head being M. Švehla, leader of the Agrarian party and one of the most influential members of the Pětka.

The Švehla Cabinet.—The new Cabinet consisted of five Agrarians (including the Premier), five Social Democrats, three Czechoslovak Socialists (including M. Beneš, who retained the portfolio of Foreign Affairs), two members of the People's Party, and two National Democrats (including M. Rašín, who again took the Ministry of Finance). Its programme was presented on Oct. 24 in the form of three exposés by M. Švehla, M. Beneš and M. Rašín respectively. It proposed to retain, not only the general principles but also certain concrete points of the preceding ministry. Its financial policy was to stabilise the exchange, to assure a good financial administration, and to balance the budget by means of reduction of expenses. The tax on coal was to be reduced; the impost on increases of capital alleviated; the fiscal régime reformed; public works undertaken to combat the housing crisis; the agrarian reform completed; a system of social insurance and a number of economic measures carried through. The budget was voted without much difficulty in the autumn session. The Government then presented a bill dealing with the salaries of public officials. Based on the hypothesis that the stabilisation of the currency would result in a general fall of prices, this bill envisaged an increase of the basic rates of payment but a reduction of the various bonuses. It became law on Dec. 15, but was destined to involve the Government in grave difficulties, as the economic situation, and especially the maintenance of the level of prices, upset the calculations underlying it. On Jan. 5 1923 M. Rašín was assassinated by an unbalanced young man of anarchistic tendencies. Among the consequences of this crime, which shook the country, was the resignation of the Government on Feb. 18. The gulf between the Government parties and the Communists grew wider than ever. A bill for the protection of the Republic became law on March 6.

The autumn session of 1923 was devoted mainly to the discussion on the budget, which, thanks to the adoption of numerous economies in matters of public finance, showed a reduction of 3,000,000,000 crowns on that of 1922. The tax on coal was reduced, as promised, and the impost on capital below 50,000 crowns was lowered.

In consequence of a violent campaign opened by the Communists against the Government coalition regarding the management of the Government distillery, the majority parties brought forward a bill during the spring session of 1924 to the effect that cases of slander by the Press should be transferred from the competence of the civil to that of the criminal courts. The debates on this bill provoked violent scenes. Finally, a bill amending the press law was brought forward and carried. Other measures passed during this session included an Act reducing the peace establishment of the army; an anti-profiteering Act; an Act abolishing entails; and another on the institution of a national bank.

The Question of Agricultural Tariffs.—The chief object of parliamentary discussion in 1924 was, however, the question of customs tariffs on agricultural produce. The Agrarian party demanded that these tariffs be reintroduced, and attempted to make the question dependent on that of the Social Insurance Bill which had been introduced by the Government in 1923 and had now passed the committee stage. In order to ensure success, it obstructed the ratification of the commercial treaties. The divergence of opinion on the tariff question between the Agrarians and Social Democrats for a while endangered the existence of the Coalition. On Sept. 16 1924 the Social Insurance Bill was voted by both Chambers, and the question of the tariffs on agricultural produce was postponed in the hope of reaching a compromise between the parties. The budget for 1924, in which revenue and expenditure balanced, was passed; but the conflict on the tariff question broke out afresh. In April 1925 it provoked a real crisis in the governmental majority. The Social Democratic deputies refused to allow this question priority of treatment, demanding a debate on the bill to establish social insurance for independent workers, on which the application of the Social Insurance Acts already voted depended. On April 24 they declared that they would not oppose the application of protection to agricultural produce in cases where the price of such produce was lower than the costs of production. This formed a platform for future settlement. On June 13 the executive committee of the Social Democratic party accepted this principle in a resolution which, for the first time, envisaged the possibility of an appeal to the country. The bill for the establishment of social insurance for independent workers was brought forward on May 22 and adopted by both Chambers.

A fresh crisis was caused by the departure of the Apostolic Nuncio, Mgr. Marmaggi, on the day of the national festivities in honour of Jan Hus, and by his action in protesting to the Government on account of their participation in these festivities. The Czechoslovak Socialist party now brought up again the question of the separation of the Church and State, in which it was opposed to the other groups of the coalition. One of the Czechoslovak Socialist ministers resigned, thus complicating the situation and making the idea of new elections more probable than ever.

The Chamber met on Sept. 18 to discuss the budget estimates, which, for the first time, provided for a surplus of revenue. The budget was passed (the Germans abstaining), but the Chamber was unable to carry through a bill which introduced a slight amendment in the electoral system (dividing Prague into two constituencies). It was obliged to abandon the rest of its programme. The two Chambers were dissolved on Oct. 16, and new elections for both fixed for Nov. 15.

Second Švehla Cabinet and Second Cabinet of Officials.—The results of the elections brought about a considerable rearrangement of the strength of the parties of the coalition. The People's party gained greatly, the Agrarians to a lesser extent, the Social Democrats were weakened, mainly because Communist candidates split the labour vote. The National Democratic party was also weakened. In general, however, the five coalition parties did not lose their ability for government, especially as they were joined by the Traders' party as a sixth member, which almost made up for the losses which they had sustained. The detailed results were as follows: Agrarians 45 deputies and 23 senators, Communists (comprising all the nationalities) 41 and 20, Czechoslovak People's party 31 and 16, Czechoslovak Social Democrats 29 and 14, Czechoslovak Socialists 28 and 14, Slovak People's party 23 and 12, National Democrats 13 and seven, Traders' party 13 and six. Of the German parties, the Nationalists elected 10 and five representatives respectively to the two Houses, the Agrarians 24 and 12, the Social Democrats 17 and nine, the National Socialists seven and three, the Christian Socialists 13 and seven; four and two Magyar Christian Socialists were elected and one Polish representative, while two Jewish parties failed to obtain a mandate.

On Dec. 9 Švehla's second Cabinet was formed, its constitution being as follows: Agrarians four, Social Democrats three, Czechoslovak Socialists three, Czechoslovak People's party three, Traders' party one, National Democrats one. Two places were occupied by non-party ministers, one of these being Dr. Engliš, the Minister of Finance. This coalition Government, however, resigned on March 16 1926 owing to differences between the Social Democrats and the Agrarians, chiefly on the outstanding question of agricultural tariffs. On March 18 another Government of officials came into power. Of the former Cabinet, office was still held by Dr. Engliš, and Dr. Beneš, who was thus able to maintain a continuity in his important office as Foreign Minister. As in the case of the first Government of officials, the Prime Minister was J. Černý. (K. S.*)

IV. ECONOMIC HISTORY

Distribution of Population.—39·56% of the population of Czechoslovakia are occupied in agriculture; 33·87% in industry and 10·66% in commerce; the remainder in the civil and municipal services, liberal professions, etc. The percentage distribution by provinces is as follows:—

	Industry	Agriculture
Bohemia	40·99	29·69
Moravia	38·15	35·27
Slovakia	17·60	60·60
Ruthenia	10·56	67·64

Agriculture.—The climate of Czechoslovakia occupies a position between the moderate maritime climate of western Europe and the extreme continental climate of eastern Europe. The annual rainfall of about 25 in. is advantageously distributed throughout the seasons, a full two-thirds occurring in the spring and summer months.

The following table shows the division of the total area of the country in 1924:—

	%	Hectares
Arable land	42·04	5,907,000
Permanent meadows	9·87	1,385,000
Gardens and orchards	1·05	147,000
Vineyards	·13	17,000
Pastures	8·58	1,201,000
Forests	33·17	4,652,000
Fishponds and lakes	·56	78,000
Waste and building land	4·60	648,000
Total		14,035,000

The annual output of timber from the forests is estimated at 15,000,000 cu. metres, a large part of which is exported.

Sugar beet, corn and high-grade barley for beer-brewing are cultivated in the low-lying areas, while in the more elevated regions the cultivation of potatoes, rye and oats predominates; the high lands, except those covered by forests, are used for growing fodder crops or for grazing. Of the total amount of arable land 14.5% is under rye, 14·3% under oats, 11·5% under barley, and 10·3% under wheat. Maize is cultivated only in the low-lying areas of the southeast to an extent comprising about 2·7% of the total arable area. Some 17% is taken up with potatoes and sugar beet, which form the basis for the highly developed distilling and sugar industries.

The productivity of the soil varies considerably. Thus, in the west, where there is a high technical standard in agriculture, the productivity often exceeds the general maximum figures for Europe as a whole. But in the eastern areas (Slovakia and Carpathian Ruthenia) the productivity is much lower. The following table shows the average productivity for the whole of Czechoslovakia during the period 1922–4:—

	Yield per hectare quintals
Wheat	15·5
Rye	15·0
Barley	15·9
Oats	14·4
Potatoes	108·8
Sugar beet	255·9

The most important agricultural products of Czechoslovakia as regards the international markets are sugar beet, barley, which is exported partly in the form of malt, and the hops of Žatec (Saaz).

The distribution of cattle, which forms 75% of the total number of animals, exhibits similar variations. Productivity decreases from west to east, and while in the western regions there are 62 head of cattle per sq. km., a figure surpassed in Europe only by Denmark, Belgium and Holland, the number per sq. km. in the eastern areas is considerably less; the average for the whole republic is 52 head per square kilometre.

The prominent position occupied by Czechoslovakia among the most progressive agricultural States is due to the high standard of Czechoslovak agriculture. The technical equipment of agricultural colleges receives very careful attention from the Government, and there is also a very close co-operation between those engaged in agriculture and the home industries which are based upon agricultural activity. Before 1914 the total value of the agricultural output was estimated at about 2½ milliard gold crowns. In spite of the losses occasioned by the War the yield in 1925 was equal to that of the pre-War period. The foreign trade balance of agriculture is favourable to the country, if the export of products derived from agricultural industries (sugar, beer, alcohol) is included. In the production of barley, potatoes, oats, beer, alcohol, sugar and fruit, there is an ample surplus for export purposes. One of the important items in this respect is also the export of timber produce. The chief debit items occur in wheat, maize and cattle (meats and fats).

Agrarian Reform.—The Act of Parliament of April 16 1919 gives the State the right to take over for partition estates in so far

as they exceed 150 hectares of arable land, or 250 hectares of land of any other category, indemnification being based on the average value between 1913–17. Elaborate provisions are made for the various eventualities likely to arise in the application of this reform, which is supervised by a department specially established for the purpose and known as the Land Office. The total area affected by this Act was 926,817 hectares. By the end of 1924, 654,710 hectares had been taken over and redistributed, 470,327 being agricultural land and 184,383 other land, mostly forest, of which half passed into the possession of the State. Of the agricultural land, 52% was allotted to small farmers, 21% to persons of various occupations, and 25% to landless peasants. During 1925 a further 253,000 hectares were distributed, and 203,490 hectares remain to be dealt with. The class of farmers owning medium farms in Czechoslovakia has been substantially strengthened by the Land Reform Act.

Minerals and Mines.—The mineral wealth of Czechoslovakia is of great importance. The most important items are pit coal and lignite. The former has its chief centres in the Ostrava-Karvinná coalfield, which is connected with the German and Polish coalfields of Upper Silesia. In addition, there are the coalfields of Kladno and Plzeň. The output of pit coal in 1924 was 14,359,401 metric tons and the number of workers employed was 73,000. Lignite is found in northwestern Bohemia, at the foot of the Ore Mountains. The output in 1924 was 20,507,178 metric tons and the number of workmen employed was 46,000. Coal is an important article of export, pit coal and coke being exported mainly to Austria and Hungary, and lignite to Germany. On the other hand, pit coal is imported from Germany and Poland, particularly for certain areas of northeastern Bohemia, Moravia and Slovakia.

Iron ore is obtained chiefly in Bohemia and Slovakia, but it is inadequate for the native iron industry, and accordingly about one-half of the total amount used is imported, chiefly from Sweden. Other metallic ores found include lead, manganese, antimony, cobalt, wolfram, silver and small quantities of gold (the annual output of pure gold is from 100 to 300 kilos). The uranium ores of Jáchymov, from which radium is obtained, are of great value. Extensive salt deposits exist, about 140,000 metric tons being obtained annually from Carpathian Ruthenia. Graphite of a high grade quality is also mined and forms the basis of a highly developed lead pencil industry. Crude mineral oil is obtained in small quantities, the yield being about 1,000 cisterns annually.

The abundance of excellent porcelain raw materials, particularly of kaolin, is of great importance both for home industry and for export purposes. The annual yield is about 400,000 tons, obtained chiefly from western Bohemia and southern Moravia. Under the heading of mineral wealth should be included also the numerous mineral springs, which have not only resulted in an extensive export trade in mineral waters but have exerted a large influence upon the development of such famous Czechoslovak spas as Karlovy Vary (Carlsbad), Marianské Lázně (Marienbad), Františkovy Lázně (Franzensbad), Poděbrady, Luhačovice, Pištany, etc. Systematic attention is being devoted to the exploitation of water-power resources, together with a systematic process of electrification, and large steam-driven central power stations have been erected. (V. B.*)

Industrial Development

Industry.—It has already been pointed out that the agricultural products of Czechoslovakia provide the raw materials for important agricultural industries. The most important of these is the old-established sugar industry, which is carried on in some 170 sugar refineries; by 1925 the pre-War output had been equalled, *i.e.*, more than 14,000,000 quintals of beet sugar annually, of which quantity about 10,000,000 quintals were available for export. In the manufacture of beet sugar Czechoslovakia occupied in 1925 a position second only to that of Germany, and its exports exceeded those of any other country. The beer-brewing industry has attained a world-wide reputation by reason of the excellent quality of its products, notably Pilsen beer. Alcohol (annual production 400,000 hectolitres), starch, coffee substitutes (chicory), preserved fruit and vegetables, fruit juices, confectionery, cheese and ham industries are also of importance.

The abundance of coal and the presence of iron ore have provided the necessary conditions for the development of the metallurgical industries. In 1923 there were 34 foundries in Czechoslovakia; the quantity of crude iron manufactured in 1925 was 8,200,000 quintals, in the preparation of which 13,500,000 quintals of iron ore were used, 7,000,000 quintals being obtained from abroad. There are 16 steel works, with 50 foundries and an annual output of about 2,000,000 tons. The annual capacity of the rolling-mills is estimated at 1,000,000 tons of rolled goods. The iron industry is mainly located near the bituminous coal districts. The development of the metal industry is closely connected with the progress of agriculture and the development of the various agricultural industries, which have resulted in an increased demand for agricultural implements and machinery, as well as for machinery for sugar refineries, breweries, distilleries, etc. The metal industry has been extended to numerous other branches, and among its products are boilers and steam engines, steam and water turbines, pumps, compressors, benzine and naphtha motors, bridges, cranes, railway engines and waggons, motor-cars, lathes and other special machinery and equipment. This highly developed industry, the products of which are now exported all over the world, employs about 150,000 workers.

The glass, porcelain and pottery industries also depend mainly upon the home supply of raw materials. The number of glass works is 140 and the number of workmen employed is nearly 30,000. All kinds of glass goods are produced, from ordinary glass bottles to plate and chemical glass. In addition, there are about 70,000 workers, who in their own homes make glass jewellery and beads which are known under the generic name of Jablonec (Gablonz) ware. Crystal, ground and coloured Bohemian glass, all of high-grade quality, is largely exported to all parts of the world. The manufacture of porcelain is concentrated mainly in western Bohemia. It occupies about 15,000 workers, and with it is associated an extensive pottery industry, which produces bricks and other building accessories, paving-stones and tiles. The large forest areas provide the raw material for the timber, paper and cellulose industries. The chief timber products are furniture of all kinds, the best known of which is bentwood furniture, barrels, building materials, frames, railway sleepers, pit props, walking-sticks, whips, pipes, etc. Basket ware, brushes, buttons, toys and musical instruments are also produced. The paper industry comprises 60 paper works, 38 cardboard works, 27 cellulose works and 80 timber planing works. A great part of the output is exported. The surplus output of paper is utilised in the production of paper goods, bags, cigarette holders, etc.

The textile industry, which occupies about 270,000 workers, is highly developed. The cotton group employs about 3,600,000 spindles and 130,000 mechanical looms, the woollen 1,200,000 spindles and 37,000 mechanical looms, the flax 285,000 spindles and 17,000 looms and the jute about 35,000 spindles and 3,500 looms. There are also 53 silk-spinning mills, with 14,000 looms. The raw materials forming the basis of the textile industry are obtained entirely from abroad, with the exception of small quantities of flax and wool, while the products of the industry represent about one-third of the total exports of the country. Among its special products are cotton and woollen fabrics, carpets, blankets, lace and embroidery, clothing, underwear and head-gear. The leather industry, which is making great progress, obtains about 80% of its raw materials from abroad. It also plays an important part in the export trade of Czechoslovakia, its main products being boots, shoes, gloves and small miscellaneous leather goods. The intensive agricultural activity of the republic also accounts for the development of the chemical industry, the chief products of which are artificial manures, glue, explosives, varnish, soap, candles, oils and the products of the dry distillation of wood, matches, blacking and ink. The lead pencil industry, based upon the abundant home supplies of

high-grade graphite is one of the standard export industries, while matches, blacking and ink are also produced.

Communications and Transport.—The total length of railways is 13,549 km.; 9,125 km. are State railways, 4,135 km. are private lines carried on by the State, and 289 km. are private lines under private management. These railways, forming a direct connection between the systems of western and eastern Europe, are very important, both as regards passenger and goods traffic. The waterways are also important factors. The Vltava (Moldau) internationalised from Prague onwards, and the Labe (Elbe) from Mělník onwards, form the route to the North Sea, where the chief harbour for Czechoslovak trade is Hamburg. The Danube (*q.v.*), which is internationalised from Ulm, connects Czechoslovakia with the Black Sea. The Oder (*q.v.*) is not yet navigable as far as the Czechoslovak frontiers, but it nevertheless plays an important part in the transport of Swedish ore to the Czechoslovak iron industry in the Ostrava basin. The total length of navigable waterways is 418 km., of which 206 km. are represented by the Elbe and Vltava, and 172 km. by the Danube. Of the total foreign trade in 1923, 7% of the imports and 8% of the exports were carried by water. The following table shows the total amount of goods carried in this way:—

	Elbe tons	Danube tons
Exports	798,341	118,428
Imports	271,425	81,533

The Elbe is used chiefly for the transport of coal, timber, agricultural produce and the products of the agricultural industries; the Danube for the export of timber, and the import of cereals from the Danubian States.

In 1924 there were 4,557 post offices and 20,540 km. of telegraphs, representing a total length of 125,726 km. of wire. The total length covered by the local telephones was 16,338 km. and of the inter-urban 13,854 km., the number of call stations being 10,870. Prague is an important aviation centre, and is a station on the air route Paris-Prague-Constantinople, which has a branch line to Warsaw. An internal aviation route runs between Prague, Bratislava and Košice.

Foreign Trade.—The large export and import trade of Czechoslovakia required it to build up a system of commercial treaties with foreign powers. The guiding principle of Czechoslovak trade policy was that of the most-favoured-nation clause. Upon this principle it constructed its whole system of agreements, which it supplemented by means of tariff conventions for customs purposes. A custom tariff of the former Austro-Hungarian Empire, drawn up in 1906, was adapted to the changed economic conditions by means of a system of co-efficients and became the basis of Czechoslovak customs policy as far as not replaced by any new items. The tariff agreements concluded with France, Italy, Austria, Poland, Greece, Spain and Belgium led to a reduction of from 50% upwards in the customs rates applicable to more than two-thirds of the industrial products. It was also an important feature of the trade policy of Czechoslovakia that, having in view the best interests of international trade, it regarded the system of import and export licences introduced immediately after the War as being only temporary, and as conditions became more and more consolidated the application of the system was gradually reduced.

Trade agreements or tariff conventions concluded by Czechoslovakia with various countries are as follows:—

1920: Switzerland, Germany, Bulgaria, Yugoslavia and France.
1921: Italy, Rumania and Austria.
1922: Russia, the Ukraine, Latvia and Portugal.
1923: The Netherlands, Lithuania, Great Britain, France, Norway and the United States of America.
1924: Denmark, Italy, Iceland and Austria.
1925: Greece, Sweden, Poland, Austria, Spain, Turkey, Bulgaria, Japan and Belgium.

The table at the top of the next column shows the value of the foreign trade of Czechoslovakia from 1920 to 1925.

	Imports	Exports	Credit Balance
	Millions of crowns		
1920	23,384	27,569	4,185
1921	22,433	27,312	4,879
1922	12,696	18,086	5,390
1923	10,222	12,573	2,351
1924	15,855	17,035	1,180
1925	17,594	18,799	1,205

In 1924 the imports were cotton and cotton goods, wool and woollen goods, flax, hemp, jute, wheat and flour, live cattle, fats and tobacco. The chief countries of origin and the percentage of the total supplied were the Danubian States (*i.e.*, Austria, Yugoslavia, Bulgaria and Rumania) 19%, central and northern Europe (Germany and Poland) 39·8%, western Europe 18·5%, and other countries 22·7%. The principal exports were sugar, cotton goods, woollen goods, flax and jute products, timber, coal, glass, iron goods, fruit and vegetables, leather and leather goods, porcelain and pottery. The chief foreign markets and the percentage of the total taken were the Danubian States 36·9%, central and northern Europe 22·8%, western Europe 20·6%, other countries 19·7%. (J. Dv.)

V. FINANCE AND CURRENCY

In no other department of the State activities was there so energetic an endeavour to ensure the independent existence of the new republic as in that of finance and currency. In this respect there was a two-fold aim: to achieve an equilibrium of the State finances and establish a stable currency. The following are the chief figures from the State budgets for the period 1923 to 1926 (in millions of crowns):—

	Receipts	Expenditure	Special programme of public works
1923	18,812	19,377	3,000
1924	16,391	16,994	2,229
1925	9,301	9,574	1,319
1926	10,086	10,070	..

The great difference between the budget for 1925 and that for 1926 lies in the fact that from 1925 onwards such State concerns as railways and the tobacco monopoly were to be managed upon a business basis, separate from the State administration. They appear in the budget only as a final figure after the balance has been drawn of all receipts and expenditures. Thus the budget for 1926 was not burdened by investment items; such items, amounting to 871,000,000 Czechoslovak crowns, are included in the ordinary budget as items necessary for the purpose of interest and amortisation. The main sources of State receipts for 1925-6 are estimated as follows (in millions of crowns):—

		%
Direct taxation	2,086	(20·7)
Tax on Turnover and Luxury Tax	1,606	(15·9)
Tax on Consumption	1,332	(13·2)
Customs receipts	808	(8·0)
Stamp dues and fees	1,534	(15·2)
Monopolies and State undertakings	1,165	(11·6)
	8,531	(84·6)

	Kč
Public Debt.—The total Public Debt of Czechoslovakia on July 31 1925 was	30,540,724,334
Amount assigned for the funded internal debt (interest 3½ to 6%)	16,045,462,152
Short term internal loan (interest 5¼ to 6%)	6,757,794,000
Foreign debts in various currencies (according to the rate of exchange on July 30 1925)	4,478,468,181
Debt arising from the peace treaties	3,259,000,000

Of the above mentioned funded debt, amounting approximately to £95,843,000, the sum of £30,070,000 forms the share of the pre-War debt of the former Austro-Hungarian Empire which was taken over by the Czechoslovak Republic, while the sum of £47,167,000 represents the capital State expenditure during the period 1919–25 incurred by railways, telegraphs, telephones, high roads, etc. Similar capital expenditures are also covered partly by the foreign debts and the short term loan, while the

remainder represents expenditure incurred in the maintenance and repatriation of Czechoslovak troops who were fighting for the Allies, as well as expenditure incurred immediately after the War for the benefit of the population, which was still suffering from the effects of the War. The above list includes the State debts as far as they can be specified. Whether Czechoslovakia will be called upon to make payments under Art. 208 of the Treaty of St. Germain and Art. 191 of the Treaty of Trianon, or to make payments designated as a liberation contribution, had not been settled in 1925.

Currency.—One of the most important acts of the first Government of Czechoslovakia was the establishment of an independent currency early in 1919. For this purpose it was decided to collect and stamp all the bank notes of the Austro-Hungarian Bank, which were then circulating upon Czechoslovak territory, as well as the deposit accounts in Czechoslovak branches of the Austro-Hungarian Bank, totalling about 10 milliard crowns. During the process of stamping, about 2·7 milliard crowns were retained as a compulsory State loan in order to reduce the amount of paper money in circulation, and the stamped bank notes were declared to be state notes with a face value in Czechoslovak crowns. At the same time a temporary bank of issue was established under the title of "Banking Office of the Finance Ministry." The stamped bank notes were later replaced by independent State notes in equal proportion. In order to defray the value of the uncovered State notes and the deposit accounts taken over from the Austro-Hungarian Bank, a tax on capital was levied, the estimated yield of which was 7·5 milliard crowns. Of this sum nearly 5 milliards had been paid off by the end of 1925. The value of State notes in circulation is strictly defined by law. The Banking Office, which is managed by a board of directors appointed by the Finance Minister, is not permitted to grant the State any loan, either direct or indirect. The general post-war financial and economic difficulties, the chaotic condition of the currencies in the neighbouring States, and the comparative ignorance of Czechoslovakia abroad, caused the exchange rate of the Czechoslovak crown to fluctuate up to 1922, although the financial administration continued to pursue sound principles. From the year 1922, however, the exchange rate of the crown was stabilised at about 100 crowns to $3 (U.S.). Thus, as a result of the energetic and judicious currency policy inaugurated by Dr. Rašín, the Czechoslovak crown maintained its stability and its relatively high exchange value at a period when the currencies of the neighbouring States were hopelessly unstable and depreciated. This caused Czechoslovakia to be described as "an island in a sea of inflation."

As a result of three years of stabilisation it was decided to change the banking office, during 1926, into a Joint Stock Bank of Issue, known as National Czechoslovak Bank, with a share capital of $12,000,000, which may be increased to $15,000,000. Of this amount one-third has been taken over by the State, although it will not have more than one vote at the general meetings. The aim of the bank is to issue bank notes and maintain the currency at the exchange level of the years 1924–5. This level is represented by the rate of 100 crowns to $2.90–$3.03 on the New York Stock Exchange, and brings Czechoslovakia into line with the countries possessing a gold exchange standard. To begin with, there will be a 20% gold covering, but this will be increased 1% per annum for a period of 15 years until it reaches 35%.

Banking and Credit.—Amongst the oldest financial institutions existing upon the territory of the present republic were the communal savings banks. As a result of the development of industry, notably about the middle of the 19th century, these were followed by deposit banks, and as agriculture continued to progress a number of co-operative institutions were established in the rural districts. Savings banks, the activity of which is strictly defined by special regulations, numbered 373 at the end of 1925. On Dec. 31 1919 their total book deposits amounted to 5,326 million Kč., a sum which at the end of 1924 had increased to 11,454 million Kč. There are also 153 district agricultural deposit banks in Bohemia which are similar in character. Their total deposits amounted to 829 million Kč., which had increased to 2,122 million Kč., by the end of 1924. These establishments are guaranteed by the district authorities. As a result of the co-operative law of 1873, a number of credit co-operative societies on what is known as the Kampeličky or Raiffeisen system were founded in the rural districts. By 1925 the number had reached 3,965; their total funds amounted to 1,346 million Kč. at the end of 1919, and 3,265 million Kč. at the end of 1924. The same law provided for municipal deposit banks, of which there are 1,539, with deposits amounting 2,388,000,000 Kč. in 1919 and 6,840,000,000 Kč. in 1924.

Czechoslovakia contains 33 banking establishments with a share capital of 914,000,000 Kč. at the end of 1919, and 1,871,000,000 Kč. at the end of 1924. The reserve funds at these respective periods amounted to 378,000,000 Kč. and 1,032,000,000 Kč. Their total deposits amounted to 1,224,000,000 Kč. in 1919 and 6,587,000,000 Kč. in 1924. There are also 164 smaller banks of this description in Slovakia and Carpathian Ruthenia, whose total deposits amounted to 1,137,000,000 Kč., and 2,214,000,000 Kč. in 1919 and 1924 respectively. In addition, there are nine banks other than those with share capital, whose deposits amounted to 300,000,000 Kč. and 1,723,000,000 Kč. in 1919 and 1924 respectively. In all cases the Czechoslovak banks began on a small scale, collecting their deposits from all parts of the country and from all classes of the population. They take an active share in the establishment of industrial and commercial concerns.

The financial and credit organisation of Czechoslovakia is supplemented by a State-managed postal cheque office in Prague. In 1924 there were 81,507 deposit holders, whose total claims amounted to 1,953,000,000 Kč. The total transactions concluded in 1924 involved a turnover of 165,289,000,000 Kč. The most important of the Czechoslovak insurance companies are those dealing in life insurance and in insurance against fire, hail and other damage from the elements. The transport insurance companies are less developed, a circumstance which is due mainly to the inland position of the country. Czechoslovakia contains 14 mutual insurance companies, 21 joint stock insurance companies, and four companies controlled by public authorities. (V. P.*)

BIBLIOGRAPHY.—The fullest account of Czech activities before and at the outbreak of the War is contained in the *Urteilsbegründung des k.k. Landwehrdivisionsgerichtes Wien gegen Kramář, Rašín und Genossen* (Vienna, 1916), which is, however, much too bulky for the ordinary reader. A short but tendencious account based on the above is given by F. Wichtl, *Dr. Karl Kramarsch, der Anstifter des Weltkrieges* (Vienna, 1918); see also H. Friedjung, *Das Zeitalter des Imperialismus* (Berlin, 1922); R. W. Seton Watson (Scotus Viator) gives the Slovak case in *Racial Problems in Hungary* (London, 1908); good accounts of the Czechoslovak movement in Austria Hungary are given in O. Bauer's *Die österreichische Revolution* (Vienna, 1923); and S. Fischel's *Der Panslawismus* (Vienna, 1918). For the revolutionary movement during the War, *see* T. Masaryk, *L'Europe nouvelle* (Paris, 1918); also *Die Weltrevolution* (Berlin, 1924); W. Tobolka, *Diplomatické dokumenty o československém státu* (Paris, 1918); also *Česká politika za světové války* (Prague, 1922); also *Masaryk osvoboditel* (Prague, 1922); J. Červinka, Našina Sibíři (Prague, 1920). For constitution and history since 1918 *see* Národní Shromáždění Československe-Mezinárodní Informační Služba Parlamentní, *Z cizích parlamentů* (Prague, 1920, etc.); *Ústavní zákony Československé Republiky. Pro potřebu Národního Shromáždění vydalo Predsednictvo N. S.* (Prague, 1920); *Lois constitutionnelles de la République Tchécoslovaque* (Prague, 1920, etc.); H. Rauchberg, *Bürgerkunde der Tchechoslowakischen Republik* (Reichenberg, 1922); A. Rašín, *Financial Policy of Czecho-Slovakia during the first year of its history.* Economic and Social History of the World War (Oxford, 1923); E. Beneš, *Five Years of Czechoslovak Foreign Policy* (Prague, 1924); *see* also Státní Uřad Statistický, *Manuel Statistique de la République Tchécoslovaque* (Prague, 1920, etc.); J. Císař and F. Pokorný, *The Czechoslovak Republic. A survey of its history and geography, its political and cultural organisation, and its economic resources* (London, 1922); S. Papánek, *La Tchécoslovaquie* (Prague, 1923); J. Gruber, *Czechoslovakia* (New York, 1924).

CZERNIN, OTTOKAR, COUNT (1872–), Austro-Hungarian statesman, was born on Sept. 27 1872, and became in Feb. 1912 a member of the Austrian Upper House, attaching himself to the Constitutional party. His speeches, in which he advocated a vigorous internal and external policy, made a great sensation.

In Oct. 1912, he went as Austro-Hungarian minister, to Bucharest. His dispatches published in the " Red Book " show that, even at that time, he was of opinion that the secret treaty signed by King Charles with the Triple Alliance was nothing but a " scrap of paper," and that in an international war Rumania would only be induced to take the side of the Central Powers by far-reaching concessions at the expense of the Habsburg Monarchy. After the outbreak of the World War he sought even at a cost to win over Rumania to the side of the Central Powers. But his efforts proved fruitless, because the leading Hungarian statesmen would not agree to Rumanian demands, involving the cession of Hungarian territory. For a long time Czernin succeeded in persuading Rumania to remain neutral. At the end of 1916 he became Minister for Foreign Affairs in succession to Count Burian.

Czernin was, and remained, a decided advocate of the view that the Central Powers could not obtain so crushing a victory over the enemy in the field as to be able to dictate the conditions of peace. Therefore, from the day of his taking office down to his resignation, he consistently maintained that, even at some sacrifice, they ought to seek the conclusion of a peace which should preserve to them their position as great Powers. Czernin did not indeed contemplate the conclusion of a separate peace with the enemy, but as against German statesmen he insisted that Germany also, especially on the questions of Belgium and Alsace-Lorraine, would have to reconcile herself to concessions. By gloomily painted pictures of the military, political and economic situation of Austria-Hungary he sought to influence the German Emperor and the German High Command, and succeeded in awakening sympathy with his peace ideas among the members of the German Reichstag.

Czernin was not only cognisant of the peace negotiations which the Emperor Charles opened with England and France through his brother-in-law, Prince Sixtus of Parma, but he approved of them. He knew nothing, however, of the wording of the letter of March 24 1917 in which the Emperor Charles spoke of his willingness to support the " just demand " of France for the return of Alsace-Lorraine by any means and by the use of his whole personal influence with his ally. But he himself was simultaneously engaged in trying to influence German statesmen in the same sense, promising, in the event of their making sacrifices in the West, to compensate them in the East, chiefly by the acquisition of Polish territory. But his efforts, then and later, broke down on the determination of the German army leaders to obtain a military decision.

During the negotiations at Brest Litovsk from Dec. 1917 to March 1918 the opposition between the views of the Austro-Hungarian delegation, led by Czernin, and the German delegation became strikingly manifest. In the negotiations leading up to the convention between Russia and the Quadruple Alliance, signed on March 3 1918, Czernin took a conspicuous part. A few weeks earlier, peace had been concluded at Brest Litovsk with the newly founded Republic of the Ukraine. The fact that Czernin, in order to secure this " bread peace " had ceded to Ukraine the district of Chelm, to which the Poles laid claim, aroused the most violent resentment among the latter, and led to unsparing attacks upon him by the Austrian Poles. In the beginning of April 1918, his position was no longer tenable. The immediate cause of his resignation on April 15 1918 was the conflict between him and the Emperor Charles over the " Sixtus letter."

BIBLIOGRAPHY.—For Czernin's activity in Bucharest and in the World War see his *Im Weltkriege* (1919). His dispatches from Bucharest are printed in the Austro-Hungarian " Red Book," *Diplomatische Aktenstücke betreffend die Beziehungen Oesterreich-Ungarns zu Rumänien, 22 Juli 1914 bis 27 August 1916*. A favourable view of Czernin's attitude in the " Sixtus affair " is taken by Count August Demblin in *Czernin und die Sixtus Affaire* (1920); the standpoint of Prince Sixtus is represented in *Prince Sixt de Bourbon: L'offre de la paix séparée de l'Autriche* (1920).

D'ABERNON, EDGAR VINCENT, 1st Viscount (1857–), British diplomatist, was born at Slinfold, Sussex, Aug. 19 1857, the youngest son of Sir Frederick Vincent, 11th Bart., of Stoke D'Abernon, Surrey. He was educated at Eton and entered the army, but in 1880 was appointed private secretary to Sir Edmond Fitzmaurice, then commissioner for Eastern Rumelia. In 1882 he was sent to Constantinople as the representative of Great Britain, Holland and Belgium on the council of the Ottoman public debt, of which in 1883 he became president. In 1883 he went to Cairo as financial adviser to the Egyptian Govt., remaining there until 1889, when he returned to Constantinople as governor of the Imperial Ottoman Bank, a post which he resigned in 1897. In 1887 he received the K.C.M.G. Sir Edgar Vincent entered Parliament in 1899 as Conservative member for Exeter, but lost this seat in 1906. In 1914 he was raised to the peerage as Baron D'Abernon, and during the World War was chairman of the Central Liquor Control Board. From 1920 to 1926 he was ambassador to Germany and in that capacity did much to pave the way for the Locarno Pact. In Jan. 1926 he was made a viscount.

DACCA, UNIVERSITY OF.—The creation of the University of Dacca was due to the desire of the Govt. of India to provide increased educational facilities for the Mussulmans of Eastern Bengal, to set up a new residential and teaching type of university and to relieve the congestion of the (affiliating) University of Calcutta. After reports from a special committee in 1912 and the Calcutta University Commission in 1919, it was opened on July 1 1921. The university has fine buildings, inherited in part from the former Govt. of Eastern Bengal and Assam, in part from the Dacca Colony, founded in 1841 and an estate of nearly a square mile, with large playing fields, three residential halls, well equipped chemical and physical laboratories, and residences for the staff. The constitution is similar to that of the English provincial universities, but on the residential side it is more akin to Oxford and Cambridge. There are about 85 teachers and 1,500 students (1926); research is carried on in all the departments and a high standard is maintained in the examinations. The library contains about 44,000 volumes.

DAHN, JULIUS SOPHUS FELIX (1834–1912), German historian (*see* 7.734), published the final volume of *Die Könige der Germanen* in 1911. He died at Breslau Jan. 3 1912.

DAHOMEY (*see* 7.734).—This French colony extends from the Gulf of Guinea to the Niger, and includes a much greater area (41,302 sq. m.) than the old kingdom of Dahomey. The last ruling chief was deposed in 1911. The population in 1925 was estimated at 1,000,000. Europeans number about 800. Some 65% of the natives inhabit Lower Dahomey, which is but one-third of the area of the colony. The principal railway runs from the coast at Kotonu, parallel to the Nigerian frontier, to Savé (162 miles). Thence a metalled road, over 300 m. long, connects with the Niger at Mladekali. Palm oil and palm kernels remain the chief source of wealth. Oil palms cover an area of about 600,000 acres. Maize is a growing export from the colony. (*See* West Africa, French.)

DAIL EIREANN: *see* Irish Free State.

DAINGERFIELD, ELLIOTT (1859–), American painter, was born at Harper's Ferry, Va. (now W. Va.), March 26 1859. He received his early education at Fayetteville, N.C., and went to New York City in 1880 to study art. He exhibited first at the National Academy of Design in 1880. Among his best known pictures are "Christ Stilling the Tempest" and "Slumbering Fog," in the Metropolitan Museum, New York City; "Storm Breaking Up," in the Toledo Museum; "The Child of Mary," in the National Gallery, Washington; "The Midnight Moon," in the Brooklyn Museum; "The Valley of the Dragon," in the Chicago Art Institute. He executed the beautiful mural decorations in the Lady Chapel of the church of St. Mary the Virgin, New York City.

DAIRYING (*see* 7.737).—Modern scientific research has led to remarkable progress in the technical side of dairying. Agriculture, physiology, veterinary medicine, physics, chemistry, biology, bacteriology, mechanics, alimentation and sociology have been drawn upon in turn, with the results already seen at the last international dairying congress at Washington (Oct. 2–10 1923), at the international cattle breeding congress at Scheveningen (Aug. 28–Sept. 4 1923), and at the international dairying congress in Paris (May 17–19 1926).

The following are some of the sections in which progress can be reported:—

Milk Recording.—The keeping of careful records as to the quantity and quality of the milk produced has inaugurated a new era in the improvement of dairy herds. The system was first put into practice in Denmark, Germany, England, Holland, Switzerland and the United States, but an enquiry undertaken by the International Institute of Agriculture shows that it has become general in progressive agricultural countries. The work of the milk and butter recording societies has facilitated the decision of certain very important points with regard to the selection of breeding animals. The study and analysis by Gowen, Kroon, Frateur, Leroy, White, Per Tuff, Van de Plank and others of the data given in the herd books has made it possible to state definitely:—

1. that the production of milk and butter does not increase indefinitely with the increase in the ration, but reaches a fixed maximum according to the individual capacity of the animal;
2. that the fat content of the milk of a given cow remains constant during her entire milking period;
3. that hereditary milk and butter yielding qualities are compatible with the production at an early age of a well developed frame bearing meat of good quality;
4. that these qualities are transmitted to the following generation, by the male equally with the female, and that it is therefore possible to produce a breeding bull, which would be the sire of a line of milk and butter givers; and
5. that if rationing is carried on on scientific lines, the animals with mediocre yields may be eliminated from reproduction, and those with high yields selected and bred in to carry on the herd.

Heredity.—The evolution of ideas on the doctrine of variation and selection has brought out the extreme importance of the individual in selection and the necessity of careful investigation of his or her qualities both from the point of view of breeding and rearing and from that of heredity. By this must be understood the estimation of the points of an animal, of their value from the breeding point of view and of the measure in which the hereditary disposition towards those points can be transmitted with certainty to the descendants, together with the probable reaction of this hereditary disposition to environment. Careful consideration must therefore be given to:—

1. the animals as individuals;
2. the information to be had with regard to their heredity, and their milk production; and
3. the following up and the appraisement of their descendants.

In this manner there has been created a new system of improving our dairy herds; *i.e.*, selection according to the results furnished by milk-recording, the examination into ancestry and the estimation of progeny. Thus arises the importance of the information derived from pedigrees. This question of the herd books has been closely studied by Wibbens, Baashuus, Jessen, Seymour, Marcq, Jaroslaw, Krizenecky, Peters, Van Damme and by many American investigators, who have gone carefully into the available information and figures. It would seem desirable that these herd books should be kept on an international system, so that the information given with regard to individual animals should be as complete and recorded as much on the same lines as possible.

A close study of the Mendelian theories has decisively proved that a hereditary disposition towards most of the different morphological and physiological qualities remains an independent factor in the development and that, by a fixed law, the

new hereditary attributes introduced by a cross undergo in the following generation a sort of segregation. This leads to a conclusion which is very important from the point of view of animal breeding; *i.e.*, the theoretical possibility of a systematic combination of characteristics and qualities formerly diffused among different races and different hereditary types. We realise, in short, the possibility and even the most practicable method of creating by means of crosses, new hereditary types, and even new races.

It has also been proved that the method of reproduction by in-breeding, leads automatically to the increase of hereditary predisposition and that it results in the definite fixing of the desired strain. The undesirable consequences of in-breeding which show themselves particularly in the new bovine races, and in those in which it has not formerly been practised, may be immediately neutralised by the introduction of an out-cross. With regard to the various tables or notations employed to determine the intensity of the in-breeding, Wright's coefficient of reproduction is probably the best, since it shows the exact stage of in-breeding reached.

Feeding.—The researches of Fjord, Hansson, Nills, Fingerling, J. Wilson, Barron Morrison, etc., have made it possible to compare in detail the different systems of estimation from the point of view of production, of the various constituents of a given ration. The Scandinavian unit of nutrition, the starch equivalent of Kellner and Armsby's therms, must all be taken into consideration in any attempt to arrive at the essential nutritive value of a food-stuff. It has been proved that the productive value of a ration does not depend only on the animal and on the kind of production required, but also on the amount of assimilable protein, minerals and vitamines which the food contains. It is also influenced by the dietetic action of the particular blend, its flavour, its composition and by the quantity of the daily ration, as compared with the amount normally necessary to support life. The figures into which the intrinsic value for ration are translated are thus merely mean figures, which show the relative value, taking into account the kind of production that is required.

The discovery made by C. Eykmann and A. G. Voderman of the connection between the composition of decorticated rice and multiple neuritis in poultry and that between the composition of decorticated rice and beri-beri; that of Axel, Holst and Fröhlich with regard to the connection between scurvy and the diet; that made by Hopkins, McCollum, Wendel and Osborne concerning fat and water soluble factors (vitamines); the work of Hart, Mueller, Zilva, Golding, Drummond, Steenbock, Eckles, etc., on indispensable growth factors; and, finally, the discovery (to which the Germans Zuntz, Voeltz, Morgen, Windheuser and Ohlmer materially contributed) that the amino-acids derived from albuminoids are not interchangeable, have contributed to a new and important chapter in the science of dietetics.

New facts have also been brought to light with regard to the value and the effects of mineral substances, especially with regard to the metabolism of calcium. This latter discovery is due to the work of Browning, Forbes, Eckles, Meigs, Carry, Hart, Steenbock and Humphrey. This fresh information has directed attention to what are known as deficiency diseases. They have received much attention and can now be successfully dealt with. There should also be noted the progress made in the study of the food values of the various forage plants, the increase of knowledge with regard to the economic and physiological value of ensilage, and the question of electrified ensilage which has been specially studied in Germany by Kinzel, Kuckler, Schieblich, Schweizer, Mueller, etc.

Diseases.—Many diseases have been studied and important progress made towards their prevention and cure. Deserving of special mention are the researches of Theiler on trypanosomes, and sarcoptes, coccidiosis and diseases transmitted by ticks, those of F. S. Jones, J. Nathan, Frost, Nocard, Guillebeau, Savage, Smith and Brown, on diseases of the udder and their transmission by milking machines.

In the struggle against bovine tuberculosis in particular, important progress has been made almost everywhere, and especially in the United States. It has been proved that by means of public or private tuberculin tests (temperature tests, cuticle tests, eye tests, eyelid tests and intradermal tests) together with the isolation and slaughter of reacting animals and the disinfection of cowhouses, bovine tuberculosis can be slowly but surely conquered.

Mention should be made of a new method of treatment which has been studied for several years, galacto-therapy, or treatment by the milk itself, subcutaneously injected. It has been tried in numerous diseases, such as wasting fevers of cattle and pigs, gangrenous coryza, mammary affections, actinomyiosis or wooden tongue, and arthritis in foals. The injection is preferably made into muscular tissue, and the dose varies according to the species of the animal. It seems probable that its action is due to the fact that it introduces a foreign protein, which raises the proportion of disease-resisting elements, increases the number of leucocytes, and produces an important modification in the general internal economy. This new departure opens a fresh chapter in veterinary practice and in that department of medicine entitled colloidaltherapy (Dr. Windel and pupils).

Dairy Bacteriology and Biology are the two sciences which have most recently come to the assistance of the dairy industry. Their practical application is inseparable. The work of Gorini, Harthel, Burri, Orla Jensen and others has shed further light on the mammary microflora, their location in the parenchyma, their particular type, their qualitative and quantitative properties, their parasitic nature and their importance from the point of view of cheese making. There should also be mentioned the work of Orla Jensen on the systematic classification of the bacteria-producing lactic acid, that of F. S. Rettger, on the same organisms in relation to the type *Bacillus acidophilus*, the remarkable progress made as a result of the use of pure cultures in the manufacture of cheese, fermented milk, butter, etc., the work of Gorini on the regulation of the fermenting processes in cheese, and the influence of the lactic acid-forming bacteria on its ripening.

In conclusion, we must refer to the evolution of scientific knowledge concerning refrigeration, sterilisation, pasteurisation, the preservation of milk by concentration and by a drying process, the work of lactic ferments, mycoderms and oidiums, both in fresh milk and during the cheese-ripening process, and affections of milk, butter and cheese.

Physiology.—In this section of dairy science, important progress has also been made, by the work of Porcher, Terroine, W. H. Jordan, F. D. Fuller, C. H. Eckles, Isaachsen and many others on the physiology of milk secretion and the mammary gland. Lesne, Vagliano, Stepp, McCollum, Osborne and Mendel have inquired into the vitamine content of milk. They have shown that the mammary gland has not the power to compose vitamines synthetically but extracts those contained by the feeding stuffs provided for the animal, and that the food given has a great effect on the composition of the milk from this point of view. They have also demonstrated the properties of vitamines, the amount of their resistance to heat, to outside air, to light, to long keeping and the value from the point of view of vitamine-content of boiled, sterilised, pasteurised, condensed, dried and homogeneous milk. Researches into the varieties in the quality of dried milk and into the fat content of milk have, in various ways, afforded new and valuable data for the students of dairying technique. *See* AGRICULTURE; FARM.

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DALCROZE, JAQUES: *see* JAQUES-DALCROZE, ÉMILE.

DALEN, GUSTAF (1869–), Swedish inventor, was born at Stenstorp Nov. 30 1869. After passing his examination as an engineer at Göteborg in 1896 he completed his studies at Zürich. On his return home he invented hot-air turbines, milking and other machines. In 1906 he became chief engineer to the Gas Accumulator Co., which was exploiting in Sweden the French invention of dissolved acetylene. In 1909 he was appointed managing director of this company and then succeeded in composing a product called "Agamassan" which has the property of absorbing acetylene without any danger of explosion. Dalen's cleverest invention was what is called Solventil, which when placed in a fire kindles it automatically when twilight sets in and extinguishes it at daybreak. By a further series of inventions he perfected his discovery of "Agamassan" and in 1912 was awarded the Nobel Prize for physics. During an experiment in 1913 he became blind in consequence of an explosion, but nevertheless he continued to conduct his experiments.

DALLAS, Tex., U.S.A. (*see* 7.769), grew to a population of 158,976 in 1920, of whom 24,023 were negroes and 8,801 foreign born; in 1925 the estimate of the Census Bureau gave 194,450, to which the suburbs within a six-mile radius would add about 50,000. The area increased from 16 sq. m. in 1910 to 23 sq. m. in 1920, and 26 sq. m. in 1925. With the completion of Lake Dallas, a reservoir covering 10,444 ac. which will impound 63,000,000,000 gal., Dallas will have a water supply sufficient for a city of 1,000,000 inhabitants. Beginning about 1915, natural gas was available from Oklahoma and Northern Texas. A Union station was opened in 1916. In addition to 10 trunk lines and several local steam railways, there were (1925) six electric inter-urban lines, operating 258 trains a day over 352 m. of track. By 1925 business had again reached the war-time level, and the city was taking on a metropolitan appearance from its new buildings. The annual value of the jobbing business was about $700,000,000 compared with $125,000,000 in 1910. The value of the factory products was $26,959,000 in 1909; $93,650,000 in 1919; $92,188,697 in 1923. The joint "chest" of the non-sectarian philanthropic agencies amounted in 1925 to $458,421. Southern Methodist University, established in 1915, had by 1925 reached an enrolment of over 2,000. Dallas is the seat of a Federal Reserve Bank.

DALMATIA (*see* 7.772), since 1918 a province of Yugoslavia. Its area is 4,662 sq. m. and the population (1921) 621,429.

Dalmatia under Austrian Rule.—Since 1903 there had been a very marked growth in the national sentiment in Dalmatia. The Dalmatian Croat leaders, Trumbić, Supilo and Smodlaka played the leading part in bringing about the resolution of Fiume (Oct. 4 1905)—that *rapprochement* between Croat and Serb which all the efforts of Budapest and Vienna failed to destroy. With the coming of universal suffrage for the Austrian Reichsrat (1907) the Dalmatian deputies became more vocal in Vienna, allied themselves with the Slovenes and Czechs, and by constant interpellations drew attention to the scandalous conditions in Croatia under Rauch, Tomašić and Cuvaj (*see* CROATIA). The Italian deputies from Dalmatia also joined in protesting against the Zagreb treason trial. The improved relations between Slavs and Italians were illustrated by the former's appeal to Vienna for the recognition in Austria of degrees taken by Dalmatians at Italian universities.

During the same period publicity was thrown upon the neglected economic and social conditions of Dalmatia, which, owing to the political jealousies between Budapest and Vienna, remained without any railway connections with the north. The province was very inadequately supplied with primary schools, and had been seriously injured in its fishing and wine trade by Vienna's customs concessions to Italy. Poverty and isolation produced a high rate of emigration, and though the population only amounted to 635,000 in 1910, no fewer than 67,000 persons had left the province in the preceding 30 years, going mainly to Chile, Argentina, California and New Zealand. In 1902 and 1907 the Austrian Govt., under Christian Socialist influence, made special grants in aid of Dalmatian industry and education; but the root of the evil was hardly touched, and it was not till the Balkan War transformed the whole situation that the Austro-Hungarian general staff, for strategic reasons, insisted upon a railway connecting the main Zagreb-Fiume line through the Luka to Knin and Spalato (Spljet). This line was, however, only opened to traffic in 1925.

In 1912 Dalmatia was the scene of lively demonstrations in favour of the Balkan allies, and the Austrian authorities resorted to drastic press confiscations, and dissolved the municipalities of Spalato and Sebenico (Šibenik). This led to a monster meeting of protest in Zara, attended by almost all the deputies and delegates from the municipalities, when the Clerical leader, Dr. Drinković, openly declared that "in the Balkan sun we see the dawn of our day." By 1914 the tension was hardly less in Dalmatia than in Croatia and Bosnia, while there was still greater unanimity in favour of the Yugoslav ideal.

On the outbreak of the World War the leading Yugoslav intellectuals of Dalmatia (*e.g.*, the deputies Smodlaka, Čingrija, Tresić, Drinković and many priests, advocates and doctors) were arrested and interned, some being even used as hostages and forced to accompany railway patrols, under the threat of instant death in case of sabotage by the population. All the municipal councils in Dalmatia (with the solitary exception of Zara, which had an Italian majority) were dissolved at an early stage in the War. Political life came to an absolute standstill, but in the winter of 1917–8 an underground revolutionary movement steadily gained strength.

Incorporation in Yugoslavia.—On Feb. 1 1918 a mutiny placed the fleet and most of the strategic points in the Bocche di Cattaro for three days at the mercy of a revolutionary committee. The leader, Antun Sesan, flew over to Italy for help, but was held in arrest, and Austrian ships from Pola were able to suppress the movement. Early in Oct., however, a still more widely organised plot was prepared, and its spokesmen, the Czech Štěpánek and the Croat Giunio, crossed the Adriatic in a sailing boat with instructions to communicate with Marshal Foch and arrange with him the date for an insurrection. Had not they in their turn been held in custody for over three weeks by the Italians, and debarred from all intercourse with the Czech and Yugoslav national committees, the Allied fleets might have been in control of Dalmatia a fortnight before the Italian offensive was actually launched, and events might have taken a very different turn. At the close of Oct. a national committee was formed in Spalato which recognised the supreme authority of the Yugoslav national council in Zagreb, but made itself responsible for local order in the province and disarmed the Austrian and Hungarian troops as they retired northwards from the Albanian front. A very dangerous situation arose when Italian naval forces occupied northern Dalmatia and the islands, and some of D'Annunzio's followers tried to execute a raid upon Trogir (Traù) and Spalato. A conflict was averted very largely by the tact of the American admiral. By the Treaty of Rapallo between Italy and Yugoslavia (Nov. 12 1920) the whole of Dalmatia was assigned to the latter, save for the capital, Zara, and a small enclave round it. Under the new centralist constitution of 1921 the provincial autonomy was abolished. (*See* YUGOSLAVIA.) (R. W. S.-W.)

DAMASCUS (*see* 7.784).—Prior to the World War, Damascus was the headquarters of the IV. Turkish Army, and after the outbreak of hostilities became the base of the Turkish and German forces operating in Palestine and on the east bank of the Suez Canal under General Liman von Sanders. On Oct. 1 1918 the city fell into the hands of the Egyptian Expeditionary Force under Lord Allenby and the Arab troops of the Emir Feisal. The advance on Damascus was a purely cavalry operation, and at the city itself no resistance was made to the British and Arab troops. By Sept. 30 the Australians had worked round the north; the desert column was lying to the west; and the Arab force was at the southern outskirts of the city. Most of the Germans and Turks, after severe quarrelling, had already left.

During the night of Sept. 30 troops of the Australian Mounted Division and the advanced guard of Feisal's force had made their way into the city, and both claimed to be the first to set

foot in Damascus. The formal entry was made at 6 A.M. on Oct. 1 when a British detachment and part of the Arab army marched through the streets. About 7,000 Turks surrendered to the Allied forces. On Oct. 3 Feisal made his official entry into Damascus, and this he did, according to ancient custom, by riding furiously through the streets with a large number of kinsmen, to the accompaniment of a *feu de joie* and the piercing shouts of the Arab population. After the formal occupation the Allied troops were withdrawn and an Arab administration under Feisal was set up. Sukry Pasha El Ayyubi, senior descendant of Saladin, was appointed head of the administration of the city.

Feisal and the French.—When in Nov. 1919 General Gouraud was nominated French high commissioner for Syria, the Feisal régime in Damascus was strongly antagonistic to the French and productive of much disorder. Raiding and pillaging were encouraged and public money was misappropriated. Finally, on March 7 1920, Feisal was elected King of Syria by a so-called General Syrian Congress, while the material opposition to French influence increased and the Arab army steadily grew in numbers. Eventually matters became so serious that in July 1920 General Gouraud had to issue an ultimatum. Feisal delayed his reply and questioned the terms, while an Arab detachment attacked one of the advanced French posts, with the result that a French force took up its position at 'Ain el Jedcida, on the road from Beirūt to Damascus, two days before the delivery of Feisal's reply. As Feisal still refused to accept certain conditions, the French force advanced and, after a fierce combat at Khan Meizalun with some 20,000 Arabs, entered Damascus. Feisal with his chief councillors took to flight.

On June 20 1921, the Syrian Confederation, consisting of the states of Aleppo, Damascus and the Alaoulites, was proclaimed at Damascus and, in order to preserve an equal balance between the north and the south, the city had to share the capital honours with Aleppo. This was superseded later by the establishment of one capital at Damascus, and in 1925, at the wish of the inhabitants, Damascus became the capital of the Syrian State, comprising the two districts of Damascus and Aleppo under a president with a French adviser as High Commissioner's delegate. On April 8 and 9 1925, the visit of Lord Balfour to Damascus was the occasion of considerable rioting, nominally as a protest against the Zionist declaration bearing his name, but more generally recognised as a demonstration of anti-French feeling.

The Druses.—When the Druse rebellion (*see* DRUSES) broke out in July 1925, Damascus played an important part as the French advanced base and as the key to the general situation in Syria. The Damascenes were sympathetic to the Druses and, their discontent being aggravated by an exceptionally bad harvest, a general rising was feared with serious consequences in other Syrian towns. Two attempts were made by the Druses to effect a Damascene rising by attacks on the city. The first was a complete failure, but the second attack of Oct. 18 was a great deal more serious. Bands of Druses entered Damascus from the south and, receiving the support of the lower elements of the population, overran certain quarters, looting and pillaging as they went. Most of the inhabitants, however, disappointed at the small numbers of the Druses, failed to take any decisive action. French troops were sent into the streets to repel the insurgents, but, as the situation became more serious, the French troops were withdrawn and the order was given to bombard the affected areas. The bombardment lasted until Oct. 20, and great damage was done, including partial destruction of the Palais Azm, recognised as the most beautiful building in the city.

This action of General Sarrail, the French High Commissioner, was severely criticised, and he incurred well-merited censure for permitting the situation in Damascus to become such that a bombardment was a military necessity, and for carrying out such a drastic measure without issuing either an ultimatum to the inhabitants or notices to the foreign consuls. General Sarrail was recalled to France in Nov. of the same year. His dismissal, however, brought no peace to Damascus. Fighting continued around the city, a section of which suffered further bombardment on May 7 1926. *See* SYRIA. (E. W. P. N.)

DAMROSCH, WALTER JOHANNES (1862–), American musician and conductor, was born at Breslau, Germany, Jan. 30 1862. He went to America in 1871 and ten years later began his career as conductor in Newark, New Jersey. On the death of his father in 1885, he was appointed conductor of the Metropolitan Opera House, the New York Symphony Society and the Oratorio Society. In 1894 he founded the Damrosch Opera Company for producing Wagner and in 1896 produced Wagner's *Parsifal* in concert form for the first time in the United States. In 1903 he was appointed director of the New York Symphony Orchestra. He is the composer of *The Scarlet Letter* (1894); *Cyrano* (1913); and music for Euripides' *Medea*, *Iphigenia in Aulis* (Berkeley, 1915) and Sophocles' *Electra* (1917). In 1918, at the request of Gen. Pershing, he reorganised the bands of the American Expeditionary Force. He wrote an autobiography, *My Musical Life* (1923).

His brother, FRANK HEINO DAMROSCH, was born at Breslau, June 22 1859. He was conductor in Denver, Newark, Bridgeport and New York (the Oratorio Society, 1898–1912). From 1905 he was director of the Institute of Musical Art, New York City.

DAMS (*see* 14.801).—Until quite recent times the great majority of dams were constructed for the purpose of storing water to ensure regular supplies to communities for domestic purposes. The storage required to give a regulated supply and to utilise the water resources of large areas for hydroelectric power supply and irrigation on a large scale, in countries having the requisite conditions and resources, is in many cases enormously greater than that required for water supply to the largest towns. Hence, the developments of large dam structures in recent years have been extensive.

Earth Dams.—Earth dams are largely used on account of their permanence and cheapness and convenience of construction where suitable material is available at the site. Recent developments relate to the method of forming the watertight core. The puddle core has been largely abandoned, even where suitable material is procurable, on account of the long time required for its proper construction. A thin watertight core wall of reinforced concrete finds more common use now as being practicable for most sites and quicker to construct than a puddle wall.

The trend of development in America for the construction of large earth dams is towards the attainment of watertightness by the formation of a wide hearting of fine material bound with fine clay and silt separated and washed into the centre by hydraulic sluicing from the earth as dumped in banks along the upper and lower sides of the dam. Fig. 1 shows a cross section of the David Bridge dam in Vermont,[1] 200 ft. high, with an earthworks volume of 1,900,000 cu. yd., which was constructed in less than two years by this method. The upstream and downstream banks were formed by side-tipping from standard tracks working towards the centre. Between the banks there was formed, to the width of the hearting, a central pool of water, in which floating craft with high pressure pumps and monitor nozzles operated to sluice material from the inner faces of the banks down into the pond. The outer and inner banks were raised in stages as required, partly by the use of trestles and partly by the use of a dragline, which formed, from the material already tipped, a raised bank to carry the track for the tipping of the next stage.

Rock-fill Dams.—A rock-fill dam depends for its stability on an embankment of tipped rock material and for its watertightness on a skin of concrete or reinforced concrete laid on the hand-built waterface and carried down in the form of a vertical cut-off wall to an impervious stratum. Lack of suitable earth material and excessive cost of concrete necessitate consideration of the rock-fill type of dam. The embankment is usually formed with rock of all sizes as blasted from the quarry, the outer face being roughly built to a plain surface with large blocks and the inner face more carefully and solidly built to a uniform surface and formed with grooves or keyways to furnish a grip for the concrete. For important dams, special drainage arrangements are made for catching up at the back of the skin any water which

[1] *Engineering News Record* (Feb. 27 1924).

may percolate through it, and leading it by special drains through to the downstream side so as to obviate risk of scour under the dam. The water face is made steep (1:1 or steeper) to minimise the quantity of skin concrete, the outer face being generally somewhat flatter, about 4:3.

The largest dam of this type yet constructed is the Dix River dam in Kentucky, U.S.A., built 1923–5.[1] This has a height of 275 ft. and a volume of rock-fill of 1,747,000 cu. yards. The upstream slope varies from 1:1 at the top to 1·2:1 at the bottom. Downstream, the slopes are 1:1 at top and 1·4:1 at the bottom. A thick layer on the upstream face was hand-built with large stones, while the rest of the material was side-tipped from wagons. The watertight skin of reinforced concrete varies in thickness from 8 in. at the top to 18 in. at the bottom.

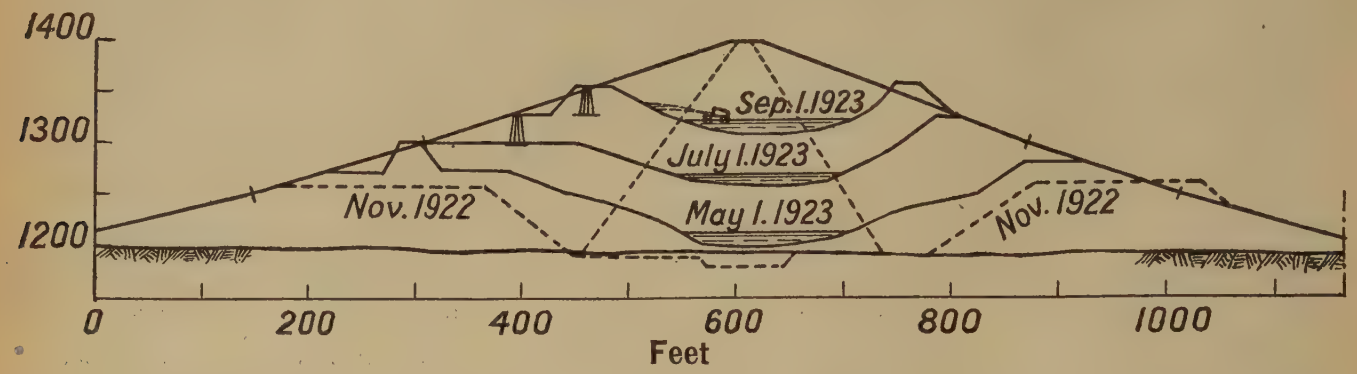

FIG. 1.—Cross section of the Davis Bridge Dam.

Gravity Concrete Dams.—The tendency in gravity dams is to use the simple triangular form for even the highest dam and to use concrete to the exclusion of masonry. The triangular form gives a uniform stability condition at any horizontal section, and the maximum stresses in the material are directly proportional to the depth below T.W.L. Assuming a usual inclination of the waterface, say 1:20, and concrete of normal density, the necessary inclination of the outer face will depend on the amount of upward water pressure on the base. If by means of effective drainage arrangements upward pressure is eliminated, an outer slope of about 0·65:1 will suffice. If the conditions require an allowance of upward water pressure on the base varying from the full head at the inner face to zero at the outer face, the outer slope will require to be about 0·80:1. If, in addition, it is necessary to allow for heavy ice pressure at the top of the wall, still greater slope, up to 0·85:1, will be required. These dimensions ensure that the resultant will pass within the middle third, so that there will be no tension on the concrete, and the maximum pressures at inner and outer toes when the slope is 0·80:1 will be slightly less than that produced by a column of concrete the same height as the wall. If, therefore, the compressive stress limit is put at the moderate value of 400 lb. per sq. in. the practicable height of the triangular gravity dam will be over 400 ft. (since 1 ft. depth of concrete produces a stress of about 1 lb. per square inch).

Sound construction requires a rich concrete mixture next the waterface and on the bottom to ensure watertightness and also in the regions of maximum stress at the inner and outer edges near the base in the case of high dams. The proportion of cement to mixed aggregate may vary from 4 cwt. per cu. yd. for the body of the dam to 5 cwt. or more for the places of maximum water pressure and stress.

The Barberine dam in Switzerland, completed 1925, and shown in cross section in fig. 2, illustrates the application of the triangular form, together with excellent arrangements for sealing the base by cementation through drill holes, and for providing for expansion and shrinkage in the upper part. The dam is of concrete with mixtures varying from 250 to 300 kgm. of cement per cu. metre, is without drainage arrangements and is designed for water uplift on the base varying from full-head at the inside to zero at the outside. The slope of the waterface is 1:20 and of the outer face 0·80:1. The cross section also indicates the masonry facing of gneiss applied on the outer slope, which has a southern exposure and is subject to severe temperature variations.

Horizontal Arch Dam.—The horizontal arch dam is suitable only for narrow gorges with sound rock at the sides to resist the great thrust from the abutments. The water pressure at any horizontal plane being constant, the appropriate arch form at that plane will be a segment of a cylinder of uniform thickness. If the radius of the extrados is constant at all depths the arch thickness required will be directly proportional to the depth of water. The vertical section will then be of triangular form, and if the waterface is vertical the angle of the outer slope will vary with the radius and the working compressive stress in accordance with the formula:—

$$\tan \alpha = \frac{0{\cdot}43r}{c}$$

where r = radius of extrados in feet.
c = average compressive stress in lb. per square inch.

The value of c for actual dams is usually between 200 and 400 lb. per sq. in., and should depend on the quality of concrete used. It should be noted that with c = 300 and r = 450, tan α will be = 0·65, which is the slope for the minimum gravity wall. As an arch dam is necessarily longer than a gravity dam for the same site, it follows that a radius of 400 ft. is near the upper limit of the field for installation of arch dams. The greatest economy of material can be shown to occur in a horizontal arch of given span when it subtends an angle of 133° at its centre. If the radius is constant and the gorge has flaring sides the arch angle will be variable and maximum economy of material will not be attained. Jorgensen's so-called constant angle

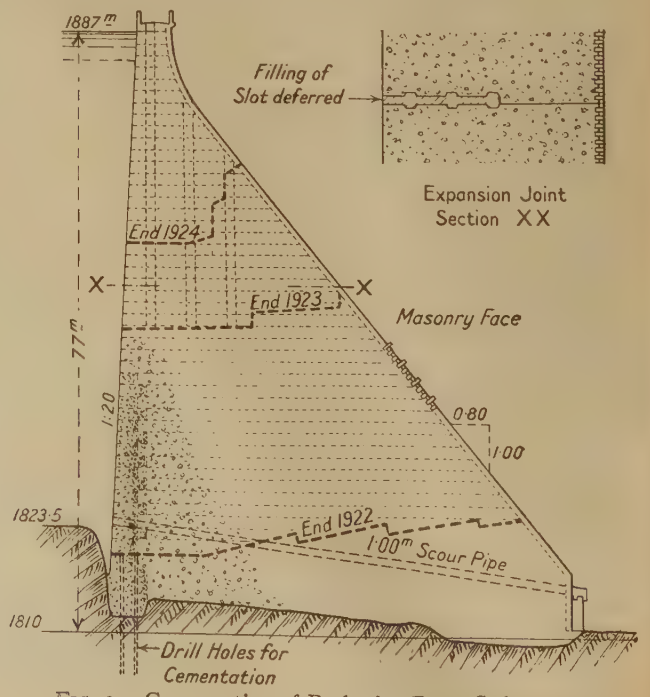

FIG. 2.—Cross section of Barberine Dam, Switzerland.

[1] *Engineering News Record* (April 2 1925).

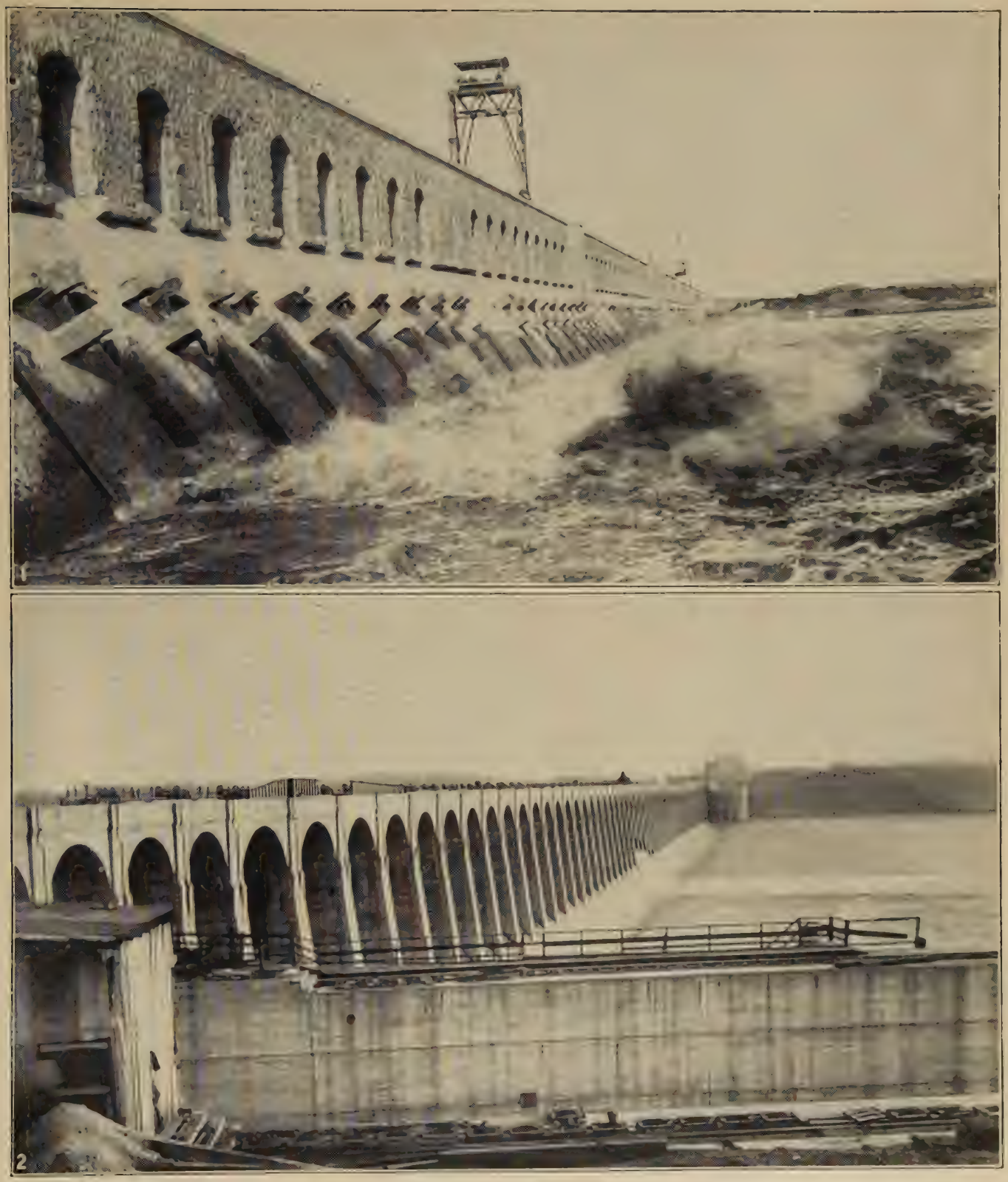

FIG. 1. SENNAR (OR MAKWAR) DAM ON THE BLUE NILE, SUDAN

The photograph presents a view of the dam from the east. The dam, designed as the principal unit of the Gezira Irrigation scheme, is composed of rubble masonry in mortar, continued on each side by earth embankments with heavy concrete facing walls, the total length of the entire structure being 9,925 feet. The height from the lowest point in the foundation to the top of the parapet is 130 ft., and it contains about 556,000 cu. yd. of masonry.

(*Photo by Central Press.*)

FIG. 2. WILSON DAM ON THE TENNESSEE RIVER, U.S.A.

The photograph presents a view of the dam from the north bank. The dam is a monolithic concrete structure, 4,500 ft. in length, 95 ft. high from river bed to crest, 140 ft. high from foundation to the level of the operating bridge, and 105 ft. thick at the base. It is the largest masonry dam in the world, containing about 1,353,000 cu. yd. of masonry.

type of arch dam has been introduced in recent years to economise in concrete, and results in variable radius of arch and warped curved surfaces of less satisfactory appearance than the cylindrical and conical surfaces of the constant radius dam.

The Salmon Creek dam in Alaska is an example of the constant angle arch type. It has a height of 168 ft., a maximum radius at the top of 332 ft. and a thickness varying irregularly from 6 ft. at the top, to 48 ft. at the bottom. An arch dam with a height of 444 ft. and a bottom thickness of 57 ft. is projected for the narrow gorge of the Drac at Sautet, France, by the Société des Forces Motrices Bonne et Drac.

Multiple Buttress Dams.—In multiple buttress dams the water load may be supported and transferred to the buttresses either by reinforced flat slabs or by arches. With flat slab construction

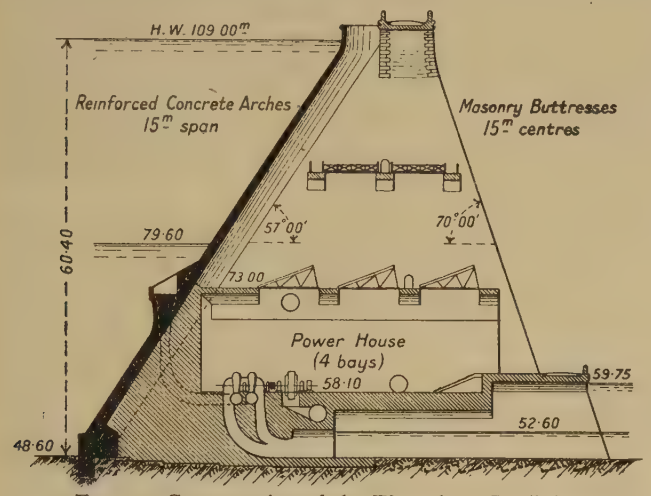

FIG. 3.—Cross section of the Tirso dam, Sardinia.

a spillway section can readily be formed by providing flat slabs also on the outer face, formed to a suitable spillway curve. The Junction Brook main dam of the Newfoundland Power and Paper Company is of this type and carries a single line railway. The buttresses, spaced at 18 ft. centres, are of plain concrete from 16 in. to 44 in. thick. The slabs vary from 16 in. to 47 in. in thickness and are heavily reinforced as simple beams to support the water pressure. Flat slabs form an uneconomical type of construction for support of heavy water pressures as compared with arches and entail a multiplicity of buttresses with close spacing, the practicable maximum being about 20 feet.

In multiple arch dams the buttress spacing may be from 15 to 60 ft., depending on the general height of the dam. The highest multiple arch dam yet constructed is the Tirso dam in Sardinia,[1] a cross section of which is shown in fig. 3. The buttresses, spaced at 50 ft., centres, are of masonry with courses sloped at the outer face to suit the direction of maximum pressure, and are designed to be independently stable and safe under the maximum loadings transmitted to them by the arches. The arches are of concrete, nearly semi-circular, lightly reinforced for temperature and shortening stresses, and have a thickness varying from 20 in. at top to 5½ ft. at bottom.

The dam provides storage for the triple purposes of power production, irrigation and river regulation, the power house being worked into the spaces between the buttresses.

Except in Italy, where masons are plentiful, the buttresses are generally formed in concrete or reinforced concrete, and the arches are made monolithic with the buttresses, so that the whole structure may be reckoned on for stability. The slope line of the arches usually makes an angle with the horizontal of between 45° and 60°, the outer face of the buttresses being considerably steeper. Proportions are generally so arranged that the maximum resultant pressure cuts the base of the buttresses nearer the middle than the one-third point, so that increased stability is obtained as compared with a gravity dam. Another satisfactory feature is the entire avoidance of water uplift on the bases. When properly designed, this type shows marked economy of material, the volume being only about one-fourth of that of a gravity dam and the possible saving in cost from 30 to 50%.

[1] *Engineering* (Nov. 7 1924).

River Dams.—Special circumstances arise in regard to dams on large rivers, where it becomes necessary to control the flood and backing-up height above the dam, and especially where the wet season flow of a river carrying much silt has to be stored to give regulated supply during the dry season. For such cases, movable openings are necessary on a scale commensurate with the flood conditions, a series of large rectangular steel gates of Stoney roller type operated by machinery being most commonly used. Automatic gates operated by the rise of the water are also used to some extent, but for the extreme case where the barrage must not be allowed to become a trap for large volumes of silt brought down during high floods, a continuous series of gates is used, extending from bank to bank and having their sills at the level of the river bed. The gates are separated by piers, usually of concrete, which must be designed to support the maximum water load from a panel of the barrage, as well as the erections and machinery for handling the gates. The Vaal River barrage[2] is an interesting example of this type of dam. (*See* HYDROELECTRIC ENGINEERING.)

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(J. WI.)

DANCING (*see* 7.794).—The years 1910–26 saw a remarkable revival of the love of all kinds of dancing in England and America. On the one hand the organisation popularly known as the Russian Ballet has put new life into stage dancing, while on the other the Americans are responsible for a reawakening of the love of dancing in the ballroom. The present article treats only of the latter. For the revolution in stage dancing. (*See* BALLET.)

The American Dances.—The only dance that has survived the American invasion is the valse, but even this has altered so much in style that it now bears very little resemblance to the dance immortalised by Edward and Johann Strauss. The original tempo of the valse was a slow three-four (very much the same as in 1926), but the tendency of ballroom orchestras to quicken the tempo came into play as the 19th century drew to a finish, until by the year 1904 it had become so rapid that dancing a valse proved altogether too fatiguing an affair. Various expedients were devised to overcome this difficulty—the most important of which was the "Boston," danced in a slower cross-rhythm and less tiring in consequence. The valse continued to dominate the English ballroom until the arrival of the American dances in 1912. The new dances, which were of negro origin, were of a "two-four" rhythm, and this change of time from the valse and the attractive lilt of the American dance bands immediately captivated the upper-class ballrooms. Their popularity increased year by year until every class in England had its own rendezvous for dancing. Hotels which owned ballrooms, disused for many years save for public dinners, opened them again for dancing; large dancing halls sprang up all over England, and the success of the new dances was intensified by the sale of gramophone records and by broadcasting. They have undergone various changes since their introduction into Europe—there were successively the two-step, one-step and fox-trot—the first two of these were more lively in rhythm than the last. The valse has continued through the enthusiasm for the American dances and has reverted to its original slow tempo.

The music used in the American dances is not the traditional dance band of strings and piano, but a "jazz" band. This consists of various combinations, the most common of which perhaps is—piano, violin, alto or tenor saxophone, banjo and trap drum. This last-named needs some explanation. The drummer uses a side drum, a big drum and cymbals played with the feet, and various other instruments on which he beats a tattoo with his drum-sticks in alternation with the side drum. He is in fact a sort of one-man band in himself and adds considerably to the rhythm of the ensemble. There is as much variety in the method of playing dance music to-day as in the dances themselves.

[2] *Engineer* (Dec. 1 1922).

Dance bands therefore vary considerably in skill, as might be expected, and the best known command very high salaries. The skill of a modern dance band lies in two essentials: first, good rhythm; and secondly, cleverness in extemporising variations on the tune by the different executors.

Future of Ballroom Dancing.—With regard to the future of ballroom dancing one may perceive signs of the time becoming ripe for change. The tendency of dance orchestras to quicken the tempo is being felt to a small degree, and it is significant that there is an attempt to popularise a slower dance as a relief from what are now the very quick American fox-trots. This dance is the Argentine tango, and is not to be confused with the Spanish tango, which is a solo dance for a woman.

The present-day standard of dancing in Great Britain is, in all probability, higher than it has ever been, and dancing is as popular and widespread as it was in the days of Elizabeth, when the English were known abroad as the "dancing English." In 1925 there arose an entirely new type of ballroom dancing, known as the Charleston. Negroid in origin, its peculiar and strenuous steps aroused some misgivings on the part of the medical profession as to the danger to the body caused by the excessive strain on the muscles subjected to constant distortion. Public endurance contests were often the scene of complete breakdown on the part of the participants, sometimes with permanent injury. The Charleston was taken up to some extent in England, but the dance was too ungracefully violent to remain popular either there or in the U.S. for very long, and in 1926 was already dying out. (G. T.*)

D'ANCONA, ALESSANDRO (1835–1914), Italian man of letters (*see* 1.951), died at Florence Nov. 6 1914.

DANIELS, JOSEPHUS (1862–), American editor and politician, was born at Washington, N.C., May 18 1862. He studied at the Wilson (N.C.) Institute and University of North Carolina, and at the age of 18 became editor of *The Wilson Advance*. He was admitted to the bar in 1885, but preferred newspaper work, becoming in that year editor of the Raleigh *State Chronicle*. He was printer for the state of North Carolina from 1887 to 1893; and then, for two years, was chief clerk of the Department of the Interior. From 1904 he was editor of the Raleigh *News and Observer*, with which his former paper was consolidated. He was on two occasions a delegate to the National Democratic Convention, and from 1896 to 1916 was a member of the Democratic National Executive Committee. In 1913 he was appointed Secretary of the Navy by President Wilson. His personal interest in the enlisted men was shown by his provision of opportunities for training in various trades. On retiring from this office in 1921 he resumed the editorship of his newspaper. He was the author of *The Navy and the Nation* (1919) and *Our Navy at War* (1922).

DANISH LITERATURE (*see* 8.39).—Denmark, though fortunately not directly involved in the World War, inevitably felt, as did other countries, the effects of the War and all it meant. There was first a period of excitement and enhanced vitality, degenerating at times into coarse indulgence; then a collapse of old and established ideas under the pressure of military, political and social disasters; and finally an attempt at re-orientation towards the problems of existence. This last was apparent, partly in ardent devotion to spiritual and religious questions, and again in a cold and clear appreciation of human and material possibilities. Intellectual life (which in Denmark is by no means confined to the social "upper" classes) exhibits a forceful upward tendency in almost every sphere.

The Novel.—It is in this branch of literature that the movement is most clearly apparent. Jakob Knudsen (d.1917: coll. works 1917) in a series of novels, of which *Rodfaestet* (1911) and *Angst og Mod* (1912–4) belong to this period, writes with deep feeling of human lives upborne by religious and ethical values. His characters are chiefly taken from the Grundtvigian homesteads of the agricultural districts. Johan Skjoldborg (coll. works 1911 and 1921) and Jeppe Aakjaer (coll. works 1918–9) choose for their heroes a somewhat more modern type of peasant and smallholder. Thorkild Gravlund, again, takes up the conservative tendency found in Jakob Knudsen, but with more stress on the social-psychological aspect of the locality (*Nilavs*, 1915–8; *Herredet*, 1919). . . has also written purely scientific studies of folk psychology such as *Dansk-Folkekarakter*, 1–3 (1920). Among books dealing with peasant life, the works of Marie Bregendahl must also be mentioned. The monumental work of Martin Anderson Nexö introduces a new class, that of the proletariat (*Pelle Erobreren*, 1906–10; *Dette Menneskebarn*, 1917, *et seq.*).

The social novel on a large scale is represented by Henrik Pontoppidan (Nobel Prize, 1917), who adds to his previous novel sequences a new one, *De Dödes Rige* (1912–6), giving a general view of Denmark as it was before the War. Middle-class society in Copenhagen is dealt with by Poul Levin and Otto Rung (*Den lange Nat*, 1913; *Paradisfuglen*, 1918; *Da Vandene sank*, 1922). The action of the two last named stories takes place during the War, as also that of *Livets Arabesk*, 1921, by Tom Kristensen, a pronounced artist type. Quaint sketches of provincial life are given by Johannes Buchholtz (*Egholms Gud*, 1915) and Anders Thuborg (*En Afkrog af Verden*, 1918). A talented writer of seafaring stories appears in Knud Anderson (*Havet*, 1924). Mention must also be made of Thit Jensen, with Sven Lange and Karl Larsen, who commenced semi-biographical novel sequences dealing with the years following 1870.

The psychological problem novel, to which category most of the above-mentioned works belong in some degree, is represented more especially by Harald Kidde (d.1918: *Helten*, 1912), Knud Hjortö (*Tvelys*, 1917), Karin Michaelis (*Den farlige Alder*, 1910; *Pigen med Glasskaarene*, 1924), Johs. Anker-Larsen (*De Vises Sten*, 1923, awarded the Gyldendal Literature Prize) and Tom Kristensen (*En Anden*, 1923). Apart from all these is Johs. V. Jensen, one of the most important renewers of the Danish language since Oehlenschläger (coll. works 1916). Particularly noteworthy are his short stories, the novel sequence *The Long Journey*, translated into English 1924, and his collections of poems. Novels of a partly historical nature were written by Gyrithe Lemche (*Edvardsgave*, 1900–24) and Svend Leopold (*Holberg*, 1922–4).

Lyrical Poetry.—This has always been the favourite form with Danish writers, and the art of verse was represented during 1910–25 by a number of highly talented poets. Among the older writers, who made their *début* in the 'eighties and 'nineties, are Sophus Claussen, who at the age of 60 published his most beautiful collection of poems (*Heroica*, 1924; coll. works, 1918), Johannes Jörgensen (selected works, 1915: *Der er en Brönd, som rinder*, 1920). This generation also included Helge Rode, Ludvig Holstein, Olaf Hansen, L. C. Nielsen, Kai Hoffmann, Thor Lange (d.1915), Christian Rimestad and Thöger Larsen. Jeppe Aakjær, who is not uninfluenced by Robert Burns, excels in the writing of lyrics. Valdemar Rördam, the translator of Kipling (selected poems, 1–2, 1923) is unique in splendour of rhythm and imagery, and in his spiritual outlook contrasts with Johs. V. Jensen, whose tendency is scientific and materialistic. Among the younger writers, Harald Bergstedt (*Sange fra Provinsen*, 1–4, 1913–24), Tom Kristensen (*Paafuglefjeren*, 1922), Hans H. Seedorff (*Vinlöv og Vedbend*, 1916: *Mod fremmede Stjerner*, 1919) and Emil Bönnelycke (*Selected Poems*, 1922) attracted most attention. Kai Friis-Möller, and a new writer of talent, William Waagner, should also be noted.

The Drama.—There is little to show during that period. A few writers may be mentioned: Sven Lange (*Samsom og Dalila*, 1909; *Kaerligheden og Döden*, 1914), Otto Benzon (*Foraeldre*, 1923), Carl Gandrup (*Faldne Engle*, 1923; *Fru Beates' Regnskab*, 1925) and Svend Borberg (*Ingen*, 1920).

Books of Travel.—More or less in the form of stories and sketches, these include subjects from all parts of the globe. Knud Rasmussen deals ethnographically with the arctic regions which he has recently studied on his numerous journeys in the Danish colony of Greenland. Aage Krarup Nielsen has written of life in the Antarctic (*En Hvalfangerfærd*, 1921) and, like Ebbe Kornerup, of the Far East; Jürgen Jürgensen of the Congo; Henning Kehler of Bolshevik Russia (*Russiske Kroniker*, 1920). Mention must also be made of Johannes Jörgensen's beautiful sketches of the south.

A remarkable and valuable contribution to modern Danish literature is made by Icelandic authors writing in Danish (*see* ICELANDIC LITERATURE).

Criticism and Literary History.—Georg Brandes, whose view of literature was rather that of the agitator than of the aesthetic critic, and who, despite his great age, produced notable works (*Goethe*, 1915; *Voltaire*, 1916; *Caesar*, 1918; *Michelangelo*, 1921), was followed by a series of highly dissimilar critics. Harald Nielsen (*Moderne Litteratur*, 1904, and a further collection 1923; *Holberg i Nutidsbelysning*, 1923) was the first to appear in opposition to Brandes, though as a critic he does not differ essentially from the older leader. The critical work of Hans Brix (*Gudernes Tungemaal*, 1911) has a marked aesthetic element, which has been further developed by Henning Kehler (*Om Ibsens Dramaer*, in "*Edda*," 1916). A decisive factor in the change of aesthetic views is the work of Wilhelm Wanscher (*Om den aestetiske Opfattelse af Kunst*, 1906; *Italien og den store Stil*, 1921).

The leading name among the older writers of literature history is unquestionably that of Vilhelm Andersen, whose great work on *Lines of Development in Danish Literature* (*Tider og Typer*, 1–4, 1907–16) was still in process of completion in 1925. In collaboration with Carl S. Petersen, he was also issuing at that period a *History of Danish Literature* (1922, etc.) to appear in three volumes. Valdemar Vedel described the development of European culture from the Middle Ages to the baroque, based on a comprehensive study of the literature. Among the younger writers may be mentioned Paul V. Rubow (*Dansk Literær Kritik i. XIX., Aarh.*, 1921). A factor of importance in the study of Danish literature is the Danish Literature Society, founded in 1911, which, in addition to critical editions of earlier Danish writers (Johs. Ewald, Sören Kierkegaard, Blicher, etc.), had undertaken to produce a *Dictionary of the Danish Language*, estimated to comprise 20 volumes, of which seven had already appeared in 1925. The study of Holberg was advanced by the publication of a Holberg Year Book, of which six volumes also appeared, and by several new editions of his works.

History, Philosophy, etc.—The abundant activity in various directions, inaugurated and, to some extent, maintained by older historians such as Kr. Erslev, Johs. Steenstrup, Troels-Lund (d.1921), was carried on by a younger generation. Erik Arup issued the first volume of a history of Denmark, based on materialistic principles. Individual periods and personalities have been dealt with by Aage Friis and Knud Fabricius. A work of remarkable intuition is Vilh. Grönbech's *Vor Folkeæt i Oldtiden* (1909–12). A fourth edition of the well-known topographical work *Traps Danmark* was about to be published at the close of 1925. The publications of the *Danish Folkemindesamling* should be noted, as also the *Memoirer og Breve* series (1–46), edited by Jul. Clausen and Rist (1905–25). Of the older philosophical writers, Kromann died in 1925. H. Höffding at an advanced age, published new works (*Den store Humor*, 1916). Among the younger generation Herbert Iversen (d.1920) attracted particular attention with his work *To Essays om vor Erkendelse* (1918). Theology had nothing of very great importance to offer after P. O. Ryberg Hansen's *Evangelierne som Kilder til Jesu Liv* (1904) and the various works of F. C. Krarup and J. C. Jacobsen. Religious history, on the other hand, attracted several writers, *e.g.*, I. P. Jacobsen (d.1918) (*Manes*, 1914–6), Johs. Pedersen (*Israel*, 1920) and Vilh. Grönbech (*Religiöse Strömninger i. det XIX., Aarh.*, 1922). An illustrated History of Religion, edited by E. Lehmann (1924), and a collection of the principal texts in the religions of the world (translated into Danish), edited by Poul Tuxen, appeared in 1919–24.

BIBLIOGRAPHY.—Interesting documents illustrating the intellectual movements of the period appear in the autobiography of Johs. Jörgensen, *Mit Livs Legende*, 1–6, 1916–9 and V. Vedel's collections of essays, *Menneskelighed*, 1920, and *Firsernes Förere*, 1923; also Helge Rode's *Pladsen med de grönne Traeer*, in which a neo-Christian awakening finds expression.

The following works by the above authors have been translated into English: Karin Michaelis, *The Dangerous Age* (1912); Martin Andersen Nexö, *Pelle the Conqueror* (1920) and *Ditte Girl Aline* (1921–3); Johannes V. Jensen, *The Long Journey* (1922–4); and J. Anker-Larsen, *The Philosopher's Stone* (1924). (C. Ro.*)

D'ANNUNZIO, GABRIELE (1863–), Italian poet, man of letters and soldier (*see* 2.78). The years 1908–21 were of great importance in D'Annunzio's career, not only in the field of literature, but also in that of war and politics. In 1908 he produced *La Nave*, a vivid presentation of the early history of Venice, setting forth his aspirations for Italy's destiny as a great sea power and as the mistress of the Adriatic—a curious forecast of his future political action. The following year *Fedra*, a classical drama, appeared; and in 1911 *Le martyre de St. Sébastien*, a dramatic mystery play in French verse with musical interludes by Debussy, was first performed in Paris. Though a remarkable *tour de force* and appreciated as such by French critics, this play was hardly one of his greatest achievements. *La Pisanella ou la mort parfumée* (1914), also written in French and produced in Paris, was a picturesque reconstruction of the medieval Levant depicted by the author in gorgeous colours.

The same year he produced *Il Ferro*, an Italian version of *Chèvrefeuille* (Paris, 1913), a drama of modern life, with a plot adapted from Hamlet and containing some powerful scenes. *Parisina*, a lyric tragedy in a Renaissance setting, with music by Mascagni, was first performed at Milan, also in 1914. D'Annunzio, though greatly attracted by the stage, did not abandon the field of fiction, and in 1910 he published *Forse che sì, forse che no*, a powerful, but somewhat long-winded novel, in which aviation played a considerable part. *La Leda senza cigno* (1913), consisting partly of essays and partly of fiction, originally appeared in the *Corriere della Sera*, and was afterwards issued in three volumes with a *licenza* in 1917. His purely poetic output was limited to the *Canzoni della gesta d'Oltremara* (1912), which dealt with the Libyan war and contained some admirable verse, as well as violent invectives against the Powers which were, in his opinion, hampering Italy in her Mediterranean policy.

On the outbreak of the World War D'Annunzio was living in France, having had to leave Italy on account of financial difficulties; but the moment the conflict began he became convinced of the necessity for Italy's intervention, in order to attain complete unity and to establish her sovereignty in the Adriatic. His addresses to the Italian people, full of eloquent and inspiring patriotism, were afterwards published in a volume *Per la più grande Italia* (1915). In the spring of 1915 he returned to Italy; his speeches at Quarto (near Genoa), during the Garibaldi celebrations and also those which he made in Rome aroused widespread enthusiasm, and undoubtedly contributed largely to Italy's intervention. From the moment Italy declared war D'Annunzio's career became one of the most romantic of modern times; for the man who had hitherto been regarded merely as a sensuous aesthete and a decadent, and whose only claim to distinction had been his exquisite sense of beauty and his mastery of the language, now proved himself to be not only a man of action and a soldier of almost incredible bravery, but also a politician who for many months defied powerful governments and received the attention of the world.

On Active Service.—Although 52 years old, he at once volunteered for active service. Having been a reserve cavalry officer in the Novara Lancers, he first joined the cavalry; but as at the time there seemed little chance of active service in that arm, he attached himself to the 77th Infantry and spent many months in the Carso trenches, always in the most exposed positions. Impatient for still greater sacrifices, he next joined the headquarters of the navy in Venice, and took part in many torpedo and submarine raids. Finally he joined the air service in the hope of achieving immortality even at the cost of his life. His exploits in the air were of the most fantastic nature, and he became an airman of the first rank. In one of his flights he lost an eye, in another was wounded in the wrist and on several occasions his aeroplane was riddled with bullets.

In Aug. 1918 he led a flight over Vienna, dropping propaganda pamphlets over the city. This exploit was particularly audacious, owing to the great distance over enemy country which had to be covered. His gallantry caused him to be promoted lieutenant-colonel, and he was decorated with the gold medal for valour (a distinction corresponding to the British V.C.), as well as with

four silver and two bronze medals; he was also created Officer of the Military Order of Savoy. On being demobilised in June 1919, he received an exceptionally flattering letter from the Chief of the General Staff, who regretted the loss of his valuable assistance, and expressed the hope that he would continue to remain " spiritually " in the army as an example of " faith, heroism and self-sacrifice." During the first period of the War he published 10 war poems, some of them of great beauty; and after Caporetto he delivered several eloquent addresses, which were afterwards collected in *La Riscossa*. On the Buccari enterprise he wrote *La Beffa di Buccari* (1918).

Seizure of Fiume.—After the Armistice the attitude of the Allied Powers, and especially that of President Wilson, towards Italy, aroused D'Annunzio's bitter indignation, and his letters and articles in this connection, collected in the volume *Contro uno è contro tutti* (1919), occupy a place in the literature of invective. The extreme violence of his language helped to embitter the relations between Italy and President Wilson. During the Nitti régime D'Annunzio personified the patriotic reaction against the government's policy; he not only became the idol of a small body of enthusiasts, but continued to attract the sympathies of the imperialists in Italy. The Fiume dispute symbolised in his mind the conflict between Italy's aspirations and the counter claims of her neighbours. When, as a result of the commission of inquiry into the anti-French riots at Fiume, it was decided considerably to reduce the Italian garrison and to police the town with Maltese or U.S. gendarmes, a movement was planned by Major Reina of the Granatieri brigade to re-occupy the town with regular troops and volunteers. D'Annunzio accepted the leadership of the expedition, and on the night of Sept. 11–12 he marched from Ronchi at the head of detachments of grenadiers and other troops and re-entered Fiume.

This action was vehemently discountenanced by the Italian Govt., and D'Annunzio was severely criticised by many of his admirers for having tampered with the discipline of the army and navy at such a critical moment, even for patriotic motives. On the other hand, the unpopular policy of Signor Nitti and the attitude of the Allies gained for D'Annunzio the sympathy of numbers of Italians. For 15 months he defied the Italian Govt. and indeed the whole of Europe with success. He assumed the style of ruler or commandant of Fiume and made of the town a new State. His " reign " was characterised by a picturesque mysticism, with Italian patriotism as the first article of his creed; and numbers of enthusiasts flocked to his standard from all parts of Italy. Men like General Ceccherini, one of the bravest soldiers in the Italian army, joined the commandant; as well as Maffeo Pantaleoni, the economist, De Ambris, the syndicalist leader and many officers of the army and navy. Others openly expressed their approval of D'Annunzio's action, among them the archaeologist Giacomo Boni, the poets Siciliani, Fucini and Orvieto, the aged Risorgimento patriot Senator Di Prampero, the scientist Professor Cian and Senator Del Lungo, the distinguished man of letters.

But D'Annunzio's newly acquired power finally went to his head. Both his language and action became more and more exaggerated and verged at times on the ridiculous; while the adventurous nature of his undertaking attracted many unworthy characters, not all of them Italians, who exercised an undesirable influence over him. He gradually came to regard not only the government and the army, but even the Italian people outside Fiume as his enemies, and on them he poured the vials of his wrath and eloquence, hitherto reserved for foreign Powers. When the Rapallo Treaty was concluded in 1920 he refused to recognise it, as he disapproved of its provisions regarding Fiume and Dalmatia; but his refusal not only caused the government serious inconvenience, but alienated the sympathies of many who had at first approved his action. The government was finally obliged to resort to force in order to carry out the Rapallo Treaty, and D'Annunzio, after vowing to hold Fiume to the bitter end, finally submitted in Jan. 1921, and left the city. He then went to live at Gardone on the lake of Garda. During his stay at Fiume he delivered innumerable speeches, all in a high-flown and exaggerated style, although passionately eloquent. Some of these appeared in newspapers, or were printed separately; while others were published collectively in two pamphlets: *Italia o morte* (1919) and *Italia e vita* (1920). His constitution of the *Reggenza del Carnaro* is a strange mixture of poetic concepts and mediaeval lore. His diplomatic correspondence with the Italian Govt., published by him in a " Green Book," also belongs to the domain of literature.

In 1921 he published *Notturno*, an analysis of his sensations during the blindness which resulted from an aeroplane accident; and in 1924 the first volume of *Le faville del Maglio* appeared. While at Gardone he was seriously injured in the head by a fall. He was from the first a strong supporter of the Fascist movement, and helped to organise the Fascist seamen's federation. In the spring of 1925 the premier, Signor Mussolini, spent three days with him at Gardone, a visit which aroused a good deal of curiosity. In 1924 the King conferred on him the title of Prince of Monte Nevoso, in recognition of his successful efforts to secure Italy's new eastern frontier, of which that mountain is the highest point. (L. V.*)

DANUBE (*see* 7.819).—In the new map of Europe the Danube passes through a considerable number of countries which are chiefly dependent upon it for their subsistence. It rises in Germany; flows through Austria, passing Vienna; past the Czechoslovak port of Bratislava; through Hungary, passing Budapest; through Yugoslavia, passing Belgrade; follows the Bulgar-Rumanian frontier for some distance, and runs out through Rumania into the Black Sea, passing the seaports of Brăila and Galatz. A boat going from Regensburg to the Black Sea crosses five frontiers, passes through the waters of seven countries and is obliged to stop at eight places for customs formalities before it reaches its port of destination. The traffic is as international as the river; before the War it was carried principally by Austrian and Hungarian companies, though Rumanian and Greek enterprises carried on a considerable traffic below the Iron Gate. Under post-War conditions the shipping shows the German, Austrian, Czechoslovak, Hungarian, Yugoslav, Bulgarian, Rumanian, Greek, French and Dutch flags, and in the Austrian and Hungarian companies important British interests are involved.

The Two Sections.—The Danube may be divided for traffic purposes into two quite distinct sections, the maritime Danube from the sea to above Brăila, and the fluvial Danube from this point up to Regensburg, where the river at present ceases to be navigable for large craft. Brăila and Galatz, situated respectively 171 and 150 kilometres from Sulina (at the mouth of the river), are the usual points for transhipment between seagoing vessels and barges. The export traffic on the maritime Danube consists principally of grain and other agricultural produce from Rumania, Bulgaria and Yugoslavia; timber from Rumania and Poland; and petroleum and its derivatives from Rumania. The import traffic is principally in manufactured and miscellaneous goods from western Europe. Besides transhipping goods on to barges, the seagoing vessels also tranship a considerable quantity on to the railways at the ports of Brăila and Galatz. A great part of the surplus agricultural produce of Hungary and Yugoslavia is carried up the Danube to Germany, Austria and Czechoslovakia. The normal traffic downstream consists of goods manufactured in the three last-mentioned countries, with some from Hungary. The volume of traffic has never approached that on the Rhine, where the countries are much more highly developed industrially and vast quantities of coal and ore are consigned from and to the Ruhr.

The European Commission.—The administration of the Danube was formerly controlled by the single European commission of the Danube, an institution set up with a provisional character by the Treaty of Paris in 1896. Its headquarters were at Galatz, and it administered the Danubian delta only, eight interested nations being represented on it. The conservancy of the other Danubian reach of international importance—the Iron Gate—was entrusted to Austria-Hungary, and assigned by her to Hungary.

In the Treaty of Bucharest (May 1918) the Central Powers

reduced the membership of the European commission to "states situated on the Danube or the European coasts of the Black Sea." The Treaty of Versailles (June 1919) reinstated the commission in "the powers it possessed before the War." It went on that "as a provisional measure, only representatives of Great Britain, France, Italy and Rumania shall constitute this commission." The commission acquired definite character when the Danube statute was signed in Paris July 23 1921. In future, subject to the unanimous consent of the states represented on the commission, any European state which is able to prove its possession of sufficient maritime commercial and European interests at the mouths of the Danube may be represented on it. Up to 1926, however, the representation had not been increased.

The International Commission.—The Treaty of Versailles, Art. 347, provided that "from the point where the competence of the European commission ceases," *i.e.*, from above Brăila, "the Danube system referred to in Art. 331," *i.e.*, as far as the highest navigable point at Ulm, "shall be placed under the administration of an International Commission composed as follows:—

Two representatives of German riparian states,
One representative of each other riparian state,
One representative of each non-riparian state represented in the future as the European commission of the Danube."

This Commission was to carry on the administration provisionally until the conclusion of a definitive statute concerning the Danube.

On July 23 1921 this statute was signed. Many of its provisos simply followed the lines of the "convention on the régime of navigable waterways of international concern" concluded at Barcelona April 20 1921. Article I. declared navigation on the Danube system to be unrestricted and open to all flags, on a footing of complete equality, from Ulm to the Black Sea, and the internationalised portions of the Danube tributaries were defined. The provisional composition of the International Commission was confirmed. It had to see that the declaration in Art. 1 was not infringed by any riparian state or states, to draw up a programme of public works for the improvement of the waterway on the basis of proposals submitted by the riparians, controlling and if necessary modifying the annual programmes of the riparian states for current works of maintenance. The cost of such works was borne by the riparian state concerned, assisted, if the commission so decided, by other states interested.

The cost of works of improvement (not maintenance) might be covered by navigation dues, to be imposed (with the Commission's authorisation) by the riparian state which had executed the works, or by the Commission itself, if it had executed them at its own charges. Dues were to be assessed on the ship's tonnage and not based on the goods transported, revenue from them was to be applied exclusively to the works for which they were imposed, there was to be no differential treatment of flags. Customs duties levied by a riparian on goods loaded or discharged at the Danubian ports in its territory were also to be levied without distinction of flag or hindrance to navigation, and were not to be higher than duties levied at other frontiers of the same state. The transport of goods and passengers, even between ports of the same riparian state, was to be unrestricted and open to all flags on a footing of perfect equality, with the exception of regular local services which may only be carried out by foreign craft subject to the observance of the national law of the local sovereign, and in agreement with the authorities of the riparian state concerned (Art. 22). Passage of goods and passengers in transit was to be free. Uniform police regulations were to be drawn up and applied by each riparian on its own territory. A special joint service of Rumania and Yugoslavia, organised with the approval of the commission, will have to take over the maintenance and improvement of the Iron Gate section, with headquarters at Orsova. The Commission was to decide on special works to be undertaken (and dues to be levied for the purpose) and to have power to abolish the service when its work was done; it could inaugurate like services elsewhere if necessary.

The commission was to determine its own procedure and administer its own budget, the presidency being held for six months by each delegation in turn. Its seat was to be at Bratislava the first five years, and thereafter it might be established at other towns on the Danube, selected at its discretion, for five-year periods in rotation. Its property and members were to enjoy diplomatic privileges and it was to fly its own flag. It was to deal in the first instance with questions regarding the interpretation and application of the convention; but the special jurisdiction set up by the League of Nations would ultimately have to deal with complaints from a state that the commission was acting *ultra vires*, or from the commission against a state for neglecting to carry out its decisions. Every effort was made to insure uniformity between the workings of the International and the European commissions, and between different signatory states.

The convention came into force June 30 1922. One of the most important questions that have been raised since that date was connected with the interpretation of Art. 22 (above), as certain states in eastern Europe were anxious to reserve to their own flag the passenger and goods traffic between ports in their own territory. In the discussion on Art. 22, the Rumanian delegate stated that the carriage of goods on river craft between two ports in the same country did not constitute cabotage if the goods were subsequently transhipped to a seagoing vessel to export, and that Art. 22 imposed no restriction on the traffic carried on up to that time by Greece. It would seem to be established by the decisions of the Powers' conference that casual transport by foreign vessels between two ports in the same state is to be unrestricted even if it takes place repeatedly. (*See* INLAND WATER TRANSPORT.)

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DANZIG, FREE CITY OF (*see* 7.824), a territory under the protection of the League of Nations, has an area of 791 sq. m.; the territory is divided into municipalities and rural districts. Population of the whole state (1924) 385,000 (96% of which were Germans), that of the Danzig municipality being 206,500. Besides the municipality of Danzig, there are the municipality of

Zoppot (27,500 inhabitants), the two towns Tiegenhof (3,100) and Neuteich (2,900) and some greater communities as Oliva (14,000) and Ohra (12,500). Two-thirds of the population are Evangelical and one-third Roman Catholic, but the Mennonites

are represented in districts in the delta of the Vistula. A Roman Catholic bishopric of Danzig was created in Jan. 1926.

History.—Danzig, which until the close of the World War had been the capital of West Prussia, was separated with a considerable part of the surrounding country from the German Empire by the Treaty of Versailles, and received the status of a free city. The decision registered in Articles 100–8 of the treaty represented a compromise between the Polish demand for the cession to the new Polish state of the most convenient outlet and inlet for Polish commerce, and the reluctance felt by the Peace Conference to place a city, 96% of whose population was German, under another sovereignty. The separation became effective on Jan. 10 1920, and the administration of the city and the territory was placed temporarily under Allied administration. Sir Reginald Tower acted both as Allied administrator and as High Commissioner for the League of Nations, and two battalions of Allied troops under the command of Sir Richard Haking were stationed in the city. This interim régime lasted until Nov. 15 1920, when the formal proclamation of the free city of Danzig as an independent political state was made by the representative of the League of Nations. The troops were withdrawn, and Gen. Haking acted as high commissioner for the League until Feb. 1923, when he was succeeded by Mr. M. S. Macdonnell. In Feb. 1926, Mr. Macdonnell was succeeded by Dr. van Hamel, a Dutch jurist. Internal administration was under the burgomaster, Herr Sahm, who, as soon as the constitution came into force, was elected president of the Senate.

Constitution.—The constitution, drafted by a Constituent Assembly elected in May 1920, was ratified, with some small amendments, by the League of Nations, and finally authorised by the high commissioner in May 1922.

The international and public status of the free city as an entirely separate state and independent member of the community of nations under the protection of the League of Nations, represented in Danzig by a special high commissioner, is based on Articles 100–8 of the Treaty of Versailles and the subsequent treaties between Danzig and Poland as provided for in the Treaty of Versailles. Of these, the most important are the Danzig-Polish Treaty drafted by the Conference of Ambassadors with the assistance of delegations from the Polish and the Danzig states, and signed in Paris on Oct. 27 1920, and the Warsaw Convention of Oct. 24 1921 (a supplement to the first-named treaty). The high commissioner of the League of Nations decided in the first instance all differences arising between Danzig and Poland. The two parties retain the right of appeal to the Council of the League of Nations. Poland's rights in Danzig are exclusively economic and ensure her free access to the sea.

The administration of the harbour and waterways is carried out by a harbour commission consisting of five nominees each from Danzig and Poland under the chairmanship of a president of Swiss nationality appointed by the League of Nations. The settlement of this question led to much friction, and the document transferring the ownership of the state property in the port and waterways to Poland, Danzig and the harbour commission was only signed on May 3 1923.

The administration of the railways in the free city, with the exception of narrow gauge railways and street tramways, is under the directorate of the Polish State Railways, Danzig's special interests being protected by a representative of the free city.

The conduct of the free city's foreign relations is committed to the Polish Govt., which is also entrusted with the protection of Danzig nationals abroad. In foreign towns, where Poland is represented by a consulate and where Danzig has important commercial interests, Danzig officials are to be attached to the consulate. Danzig takes part in international conferences as an independent state. The official language is German.

The legislative body, the Volkstag, consists of 120 members. The Senate consists of a president and seven Senators holding chief office (elected for a term of four years) and a vice-president and 13 Senators in adjunct office (elected for an indefinite period, depending on the confidence of the Volkstag).

In accordance with the provision of the Treaty of Versailles the free city is in customs union with Poland. The organisation of the customs is under the government of the free city.

Posts, telegraphs and telephones are under the postal and telegraphic administration of the free city, which is a member of the international postal union. Poland is only entitled to have a postal service office in the harbour for the purpose of maintaining direct communication between Danzig and Poland, as well as between Poland and overseas countries. The area of the harbour has recently been defined to include most of the town of Danzig.

Education.—Besides numerous elementary schools, technical and advanced schools, as well as secondary schools, there is a technical university with an instructional staff of 58 professors. In the summer term, 1925, there were 1,526 students.

Trade and Shipping.—The situation of Danzig on the mouth of the river Vistula is most favourable. The Vistula connects Danzig with Poland and, by means of its tributaries and canals, with Germany, the Ukraine and Lithuania. The so-called "Dead Vistula" is navigable from the mouth at Neufahrwasser to a distance of four miles for ships drawing 30 ft. and for a further two miles up the river Mottlau for vessels of about 15 ft. draught. Facilities are available for the repair and maintenance of ships. Up to 6,000 tons these can be accommodated in floating docks, of which there are several. There are four dockyards: F. Schichau, International Shipbuilding and Engineering Co., Ltd. (comprising the former Imperial dockyard and the railway-workshops), Klawitter, and Wogan. The International Shipbuilding and Engineering Co., Ltd., has an original capital of £10,000, English and French capital participating each with 40% and Danzig and Polish capital each with 10%. Schichau has built vessels of 35,000 tons. The present annual building output of 20,000 tons could be largely increased. The free basin has a wharfage of about 3,600 ft., and vessels drawing to 25 ft. can lie alongside. Electric cranes and warehouse accommodation are provided and railway connection exists with the main system. An important adjunct to the port is the island of Holm, having a basin of great potential value as a commercial harbour.

The chief imports are foodstuffs, fertilizers, chemicals, building materials, ceramics, raw cotton and textiles; the principal exports are timber, sugar, grain, naphtha and coal. Large granaries and warehouses for sugar and grain stand near the wharves of the port, which also afford storage capacity for over 20,000 tons of naphtha, of which some 100,000 tons may be expedited in one year. As for timber, 1,500,000 tons can be loaded during one year. Large timber ponds are at Holm I. and extend for several miles along the bank of the "Dead Vistula" between Danzig and Plehnendorf. The port is practically ice-free, and has great commercial possibilities, the natural features of the waterways and surrounding country rendering expansion easy. Thanks largely to the protection afforded by the peninsula of Hela, it has special advantages of security. There is scarcely any current, the main river having received another outlet to the sea several miles further east, near to Schiewenhorst.

Danzig's mercantile fleet consists of 67 vessels with 117,000 gross registered tons. There are regular passenger-and-cargo sailings from the port of Danzig to nearly all the ports of the Baltic and the German Ocean, even to New York, Philadelphia and the Atlantic ports of Canada, and to London and Hull. As to the railway traffic, there are direct express passenger trains from Danzig to all the chief centres of Germany and the Baltic states. Danzig is an important junction of aeroplane communications. Aeroplanes leave Danzig regularly for Berlin, Marienburg, Königsberg, Stockholm and Warsaw.

Banking and Finance.—The free city has a currency of its own, the unit of which is the gulden (fixed at 1/25th of the £ sterling and divided into 100 pfennigs). This new currency was introduced by the Bank of Danzig, as an emission bank, in the beginning of the year 1924. The fully paid-up capital of the bank is 7,500,000 gulden. Besides the Bank of Danzig there are five big Danzig banks, as well as branches of most of the important German and Polish banks. There is also a produce and a stock exchange, and twice a year (springtime and autumn) international sample fairs are held.

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DARDANELLES (*see* 7.829), the strait uniting the Sea of Marmora with the Aegean. The question of the military, naval and political status of the Dardanelles and the Bosporus was raised by the defeat of Turkey in the War of 1914–8. In the armistice signed at Mudros (Oct. 30 1918), one of the principal conditions was that the straits should be opened to the Allied fleets, and the future régime of the straits figured prominently in the abortive Treaty of Sèvres (Aug. 10 1920), and in the definitive Straits Convention (July 24 1923), which was negotiated during the Lausanne Conference.

On the side of the Allies the initiative in this matter was taken by Great Britain, and British statesmen, under the influence of the failure to force the Dardanelles during the World War, were

eager to introduce a régime which would keep the straits open, not only to merchant ships, which had enjoyed freedom of passage for more than a century, but to warships both in peace time and in war time. This marked a complete reversal of British policy which, for a century past, had aimed at closing the straits to the ingress or egress of all except Turkish warships, with the object of preventing the Russian Black Sea fleet from issuing into the Mediterranean and threatening the flank of the British line of communications with India. As a result of the World War, Russia had ceased for the time being to be a naval power, while the right to enter the straits, which had been secured to the British Navy under the Armistice with Turkey, had enabled Great Britain to intervene with considerable effect in the Russian civil war between Whites and Reds. For these reasons, partly practical and partly sentimental, but all based on an abnormal and probably temporary state of affairs, the permanent opening

of the straits became one of the principal aims of British Levant policy during the long-drawn-out settlement after the War. For corresponding reasons, Russia, in her metamorphosis as the Union of Socialist Soviet Republics, likewise reversed her traditional policy and set herself to close the straits again to warships, in order to keep the British fleet out of the Black Sea.

Treaty of Sèvres.—In the Treaty of Sèvres the freedom of the straits for warships was provided for by three separate guarantees. First, the sovereignty over the two shores of the Dardanelles, which hitherto had both been under Turkish rule, was now divided, the Gallipoli peninsula and all eastern Thrace up to the Chatalja line being transferred from Turkey to Greece, while only the Asiatic shore of the Dardanelles was left to Turkey. Since Greece and Turkey were unlikely to find themselves on the same side in any war, either local or general, this division of sovereignty would have constituted a guarantee of a crude but effective kind, on the presumption that, if either party attempted to use its shore in order to obstruct the passage in violation of the treaty, the other party would place its shore at the disposal of the Powers who had been made guarantors of the treaty under other articles.

The remaining articles placed a military sanction in the hands of Great Britain, France and Italy. A zone of territory was laid down, including the whole of the Asiatic and the European shores of the Dardanelles, Marmora and Bosporus, with the adjoining territorial waters and a number of islands in the Sea of Marmora and off the mouth of the Dardanelles. Within this zone all the fortifications were to be dismantled permanently, and the territorial sovereigns, Turkey and Greece, were prohibited (with two unimportant exceptions) from maintaining armed forces, whereas the three principal Allied Powers, as guarantors, were permitted to do so.

It was further laid down that the waters of the straits should not be subject to blockade and that no belligerent right or act of hostility be committed within them unless in pursuance of a decision of the Council of the League of Nations. The commission (on which the eventual representation of both Russia and the United States was provided for) was to have two distinct though related functions. It was to organise and administer the freedom of the straits, and also to report upon any interference with that freedom. In addition to extensive conservancy duties, similar to those entrusted to the European Commission of the Danube, the Straits Commission was empowered to raise its own police force under foreign officers, to claim diplomatic privileges and immunities, and to exercise its powers in complete independence of the local sovereign.

Turkish Conditions Imposed.—These arrangements never came into force, for though the Treaty of Sèvres was signed by representatives of the expiring Ottoman Govt. at Constantinople, it was never acceped by the new Nationalist Govt. at Angora. The question of the straits was dealt with in Article 4 of the Turkish National Pact of Jan. 28 1920, which accepted the opening of the straits to commerce, but made this subject to the provision of security for Constantinople and tacitly repudiated, by passing it over in silence, the new claim that the straits should be opened to foreign warships. The debâcle of the Greek Army in Anatolia in the summer of 1922 enabled the Turks to impose their point of view upon the Allies.

In the armistice of Mudania (Oct. 11 1922), the retrocession of Eastern Thrace to Turkey was conceded, and this removed the first of the three Sèvres guarantees before the conference of Lausanne (*q.v.*) opened. At Lausanne, Lord Curzon concentrated his efforts upon saving what he could of his policy regarding the straits, and on this point the Turkish negotiators came some distance towards meeting him, though not till they had cut out so many of the Sèvres guarantees that the régime of the straits, as finally established, became a paper constitution rather than an arrangement on which reliance could be placed in time of stress.

The demilitarised zones of the Sèvres scheme were reduced in area; they were to be closed to Allied as well as to Turkish forces (which extinguished the positive military sanction of the Sèvres Treaty); any right of the Allies to occupy or even inspect the zones in case of actual or prospective violation on Turkey's part was passed over in silence; while, on the other hand, it was expressly stipulated that Turkey might maintain a garrison in Constantinople, including its insular and Asiatic suburbs, up to a maximum strength of 12,000 men; that she might utilise the demilitarised zones for lines of communication between her military forces in Asia and Europe; and that she might anchor her fleet (an arm which the Sèvres Treaty had forbidden her to possess) in the demilitarised waters.

The commission of the straits was maintained for conservancy purposes alone, but even then with diminished functions and under Turkish presidency. In return for the few points which they saved from the wreck of their policy, the three principal European Allied Powers and Japan pledged themselves to resist by force any violation of the freedom of navigation and also of the security of the demilitarised zones (a clause which virtually gave Turkey a territorial guarantee of her most exposed and most valuable territories). Under these conditions, the Turks conceded to warships a restricted right of passage.

It was noteworthy that the Russian delegation at the Lausanne Conference did its utmost to prevent agreement on these lines between Turkey and the Allies and made a formal protest in energetic terms against the text of the Straits Convention. Although the Soviet Govt. acceded to the convention on Aug. 4 1923, it had become evident at Lausanne that, as between Russia and Turkey, the problem of the straits was still unsolved.

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DARDANELLES CAMPAIGN.—This campaign, brought about by a desire on the part of the Allies that communications should be opened up from the Mediterranean into the Black Sea with a view to assisting Russia, was begun in Feb. 1915 as a purely naval undertaking (*see* WORLD WAR, *Naval*).

But it had been realised from the outset that, even should the warships succeed in attaining their object, land forces would sooner or later be required to aid in the campaign, if only to secure the communications of the fleet after it had passed into the Sea of Marmora. Before the failure of the naval attack of March 18, Entente troops had been set in motion for the Aegean. Some were already in Lemnos, and Sir Ian Hamilton, chosen as commander-in-chief of the military contingents, had arrived in time to witness the fight of the 18th. In view of its result, the Allied Governments decided that from this time onwards the gathering army must assume the principal rôle in the effort to secure possession of the Straits. Hamilton was unable to initiate land operations at once. The Turks were making preparations to repel landings on both sides of the Straits, while the troops at his disposal were partly in Egypt, partly at Lemnos, and partly on the high seas, en route from England and France.

Organisation in Egypt.—He decided therefore that his army must in the first place be concentrated in Egypt, to be organised for the hazardous undertaking to which it was about to be committed, and that it must then be disposed in transports in accordance with tactical requirements in anticipation of a landing in face of the enemy. A month was lost in consequence. During that month the Turkish Army was formed (March 24) to guard the Straits. Marshal Liman von Sanders, head of the German military mission in Turkey, was appointed its commander-in-chief, and under his instructions the defence system, organised in consequence of the warning offered by the naval operations, was overhauled and developed.

Constitution of Attacking Army.—The Franco-British expeditionary force was composed of five divisions—two (the 29th and the Royal Naval) furnished by the United Kingdom, two formed of Australian and New Zealand troops, and one composed of French colonial troops. Against this force Liman von Sanders could pit six divisions, but these were perforce dispersed; two (3rd and 11th) were watching the coast on the Asiatic side, two (5th and 7th) were near Bulair to guard against a landing at the neck of the Gallipoli Peninsula, while the remainder (9th and 19th) were disposed towards its southern end.

I. THE FIRST LANDINGS

The expeditionary force concentrated in Mudros Bay, Lemnos, in the third week of April. Hamilton contemplated two distinct major operations to secure a footing on the Gallipoli Peninsula. The 29th Div., supported by the Royal Naval Div., was to be put ashore at its extremity, an area which it is convenient to designate as Helles; the Australian and New Zealand Divs. under Sir W. Birdwood were to land just north of Gaba Tepe, where there are extensive beaches. But part of the one available French division was furthermore to effect a descent at Kum Kale, opposite Helles, as a subsidiary operation, subsequently being transferred to Helles. After a short delay, enforced by bad weather, the armada put to sea during the nights of April 23–4 and 24–5, so that the transports and the covering warships should arrive at their various rendezvous at or before dawn on the 25th, and the day broke calm after a placid night.

Landing at Cape Helles.—Five points had been selected in the Helles area for attack. Enumerating from right to left the beaches were " S " in Morto Bay, " V " and " W " on either side of Cape Helles, and " X " and " Y " on the outer shore. The attacks at " S " and " Y " were intended to be subsidiary; but great importance was attached to " W " and " V, " as those two beaches offered the most suitable landing places from the point of view of subsequent operations. Owing to its vicinity to " W," " X " was calculated to play a very prominent part in the affair as a whole. Covered by the fire of battleships and cruisers, the troops started in flotillas of boats soon after dawn for all points, and, as it turned out, the actual disembarkations at " S," " X " and " Y " were carried out without any great difficulty. But at " W " the troops only gained a footing after incurring heavy loss, while at " V," where a large part of the landing force was carried in the steamer " River Clyde " which was run ashore, the effort nearly failed altogether. After hard fighting all day the position at nightfall was that the troops landed at " W " and " X " beaches had joined hands and that a battalion was established at " S, " while the situation at " V " was critical, as also at " Y"; but during the night more troops were got ashore at " V," and those at " Y " were safely withdrawn and re-embarked next morning. Losses had been severe.

Landing at Kum Kale.—In the meantime a French brigade had, after a tough struggle, effected a lodgement at Kum Kale (Qum Qal'e). The Turks were in strong force here, so that any advance by the French was out of the question, but their presence on the Asiatic side was being indirectly helpful to secure a footing on the further shore. Some little progress was made on the morrow in spite of determined resistance by the enemy, additional troops were landed, and during the night the French were withdrawn from Kum Kale and they were landed at " V " beach on the 27th. On that day the Allies' line was again advanced by a few hundreds of yards; but the Turks had received substantial reinforcements in this quarter, and but little ground was gained when Hamilton ordered a fresh attack on the 28th. The invaders had suffered very heavy losses during the initial landing and the subsequent strenuous encounters, and there were no reserves on the spot to fill the gaps that had been created in the ranks.

Landing at Anzac.—Birdwood's divisions had in the meantime effected a lodgement to the north of Gaba Tepe. The actual disembarkation had in this case been started before dawn on the 25th at a point about a mile and a half north of the Gaba Tepe promontory, and at a spot where the hills rose abruptly from the actual beach which came to be known as Anzac. A haphazard line on the heights immediately above the beach had been secured at once, the Turks being in weak force at the moment when the advanced parties of invaders reached the shore; but the defenders were able to hurry reinforcements to the point of danger and the actual area secured was of limited extent. Won practically at the first blow, it provided but a scanty water supply, it presented great inconveniences and its beach was much exposed in the event of bad weather setting in; it was but slightly extended during the following three months, for Liman von Sanders realised that owing to its proximity to the Narrows of the Dardanelles, it represented a very serious danger to the Turks, and he took steps accordingly. Although the Ottoman troops delivered vigorous counter-attacks on the 26th, these were beaten off with loss to the assailants, and by the night of April 27–28 the position of which Birdwood had contrived to gain possession had come to be, tactically, fairly secure.

Hamilton thus gained a somewhat precarious footing at two points of the peninsula. But his two forces were some 15 m. apart, and what amounted to little more than a patch of ground had been won in either case. His intentions were now completely exposed to the enemy, and the great advantage of surprise had passed away without his force having established itself in a dominating position capable of being turned to satisfactory account in subsequent operations. In both areas the Turks enjoyed the tactical command, they were at least equal in force to the Allies, their guns were able to bear with effect upon the beaches used as landing places and advanced bases, and, although at this time of the year the weather was generally calm, these beaches provided but inadequate facilities for the landing of ammunition, armament or stores.

Reinforcements.—Early in May the Allies' contingents planted in the Helles area were strengthened by the arrival of the British 42nd Div., an Indian brigade, and the French 2nd Division. Some ground was gained on May 6, and during the next day or two determined counter-attacks on the part of the enemy

were effectually repulsed. The two French divisions were occupying the right of the line, next to the Straits; and that arrangement held good up to the time when the Gallipoli Peninsula was finally evacuated early in Jan. in the following year. Both here and facing the Australasian troops at Anzac the Turks had dug themselves in, establishing elaborate defences, and trench warfare was becoming the order of the day.

During the month a state of stalemate set in, and although ground was gained by the Allies in attacks delivered in the Helles area on June 4, 21 and 28 and during the month of July the line was gradually pushed forward near Krithia, the situation was so unpromising that the British Govt. decided to send five more divisions (10th, 11th, 13th, 53rd and 54th) to the Aegean. These arrived at the islands of Mytilene and Imbros during the closing days of July and the first days of August. Hamilton's artillery was at the same time strengthened, and his very inadequate ammunition supply somewhat improved. But Liman von Sanders was likewise receiving reinforcements, and, although the Ottoman maritime communications with the Gallipoli Peninsula were from time to time imperilled by the submarines of the Allies, the relative strength of the two opposing armies facing each other in the theatre of war was not, as it turned out, greatly affected by the appearance of the fresh troops sent out from England to these waters. The Allies, in view of the coming of reinforcements, treated July as a month of preparation, although a general attack was delivered by them in the Helles area by which a little ground was gained. A few days later the first of the reinforcing divisions, the 13th, arrived and was landed at Helles as a temporary measure.

II. SARI BAIR AND SUVLA BAY

How to employ the fresh divisions coming out from home had to be decided by Hamilton. The French had from the outset favoured operations on the further side of the Straits, and there was something to be said for such a plan of campaign. But a descent in that quarter must involve a disembarkation in face of opposition, the perils of which had been made apparent on April 25; moreover, granting the landing to be successful, the forces would start work much further from the Narrows of the Dardanelles, the true objective, than were either Helles or Anzac. There were also not wanting inducements for the Allies to attempt a landing at Bulair, seeing that their presence at that point would carry with it the severance of the Turkish land communications with the peninsula. But this would likewise mean a landing in face of opposition; and the distance of Bulair from the Island of Imbros, the nearest base of operations for the peninsula, provided a strong argument, from the point of view of ship transport, against such an undertaking. Moreover, a landing either on the Asiatic side or at Bulair meant a dispersion of the Allies' forces as a whole, unless Helles or Anzac, or both of them, were to be abandoned; and the fact that the Ottoman commander-in-chief had to be prepared for his opponent adopting one of these two plans, offered a strong argument against selecting either of them.

British Plans.—Hamilton decided that his great effort should be made at, and immediately north of, Anzac. The rugged bluffs on which Birdwood's men had taken root since April were spurs of a tangled mountain mass known as Sari Bair, from the topmost ridges of which the Narrows were visible four or five miles off; Anzac was moreover situated almost at the narrowest point of the peninsula. The plan was to reinforce Birdwood secretly by a division and a half (the 13th and part of the 10th) and that, thus strengthened, he should secure possession of Sari Bair by a night attack. A further force (the 11th Div. and the rest of the 10th) was on that same night to effect a landing at an entirely new point—Suvla Bay—a few miles north of Anzac, where the Turks were known to be few. This force was to assist the troops attacking Sari Bair in due course; and the possession of Suvla Bay would furnish troops ashore in and about this area with a much more sheltered landing place than the beaches about Anzac offered. The last divisions to arrive, the 53rd and 54th, were to be employed wherever should seem best after the offensive had begun; to land the whole of the reinforcements simultaneously would not have been practicable with the amount of water transport available.

The utmost secrecy was observed by the Allies' staff. Steps were taken to mislead the Ottoman authorities by means of feints and of reconnaissances executed at localities other than those selected for operations. False reports were circulated assiduously by the intelligence department. Liman van Sanders was well aware of the arrival of large bodies of British troops in the Islands; but he remained in complete ignorance of his rival's real design until this was actually in course of execution. He had organised his forces as a southern group watching Anzac, while two divisions were retained near Bulair, where he was disposed to anticipate that the blow would fall. There were also large bodies of Turkish troops in reserve about Chanaq, and others about Kum Kale and Besika Bay. Numerically the contending armies at this critical juncture were about equal, but the Turks were necessarily much dispersed, so that the result of the impending clash of arms really hinged upon the speed with which the attacking side should gain ground before the defenders had time to concentrate.

The Allies' offensive started on Aug. 6 with two preliminary enterprises. An onset was made upon part of the Turkish lines in the Helles area. Portions of Birdwood's force broke out of the southern end of the Anzac position and gained ground. But the real purpose of the two operations was to occupy the enemy's attention and to conceal a design of much greater moment.

Attack on Sari Bair.—So dexterously had the assembling of the reinforcements in the Anzac area been effected that the Turks were entirely unaware that Birdwood's army had been nearly doubled. The plan for gaining possession of the Sari Bair mountain was that several columns were to move out from the northern end of the Anzac position at nightfall on Aug. 6 and, on reaching their appointed stations, were to wheel to the right and to work their way in the dark up certain steep but well-defined gullies that led up to the summit. But, although the Turks were to some extent surprised, and although the outlets of the gullies were in consequence in the assailants' hands by midnight, so stubborn a resistance was offered by the defenders that by daybreak the columns were not much more than half way up, and all attempts to win the upper ridges failed on the 7th in the face of the Turkish reinforcements.

After a rearrangement of the troops during the night, the offensive was resumed on Aug. 8; but except at one point very little progress was made. After a fresh reorganisation during the dark hours another effort was made on the 9th, and on this occasion a small body of British and Indian troops actually fought their way to a commanding summit from which the Narrows were seen, but they were driven off again. Next day the Turks, now in great force, counter-attacked and thrust those opposed to them back down the slopes all along the line, whereupon strenuous fighting ceased. Both sides had lost heavily, but victory for all practical purposes rested with the Osmanlis, even if the Anzac position had been extended considerably in a northerly direction as a result of the operations.

Landing at Suvla Bay.—Stirring events had in the meantime been taking place around Suvla Bay. The troops detailed for the landing in this quarter belonged to the British "New Army"; they were not conversant with active service conditions, and they were being highly tried in being called upon to execute a landing in force at night in face of opposition. There was indeed no precedent for an undertaking of this kind under modern tactical conditions, but the Turks were known not to be in sufficient strength to offer serious resistance. As it was, the whole of the 11th Div. was ashore before dawn; but the urgent need of pressing forward at once was not realised by the attacking side, and some confusion arose when the 10th Div. arrived and began to disembark. No vertebrate advance in force took place until late in the afternoon, and at nightfall the attacking force had only reached the foot of the hills lying to the east of the landing places and captured one advanced spur. The troops had suffered greatly from thirst, the arrangements with

regard to water having practically broken down, mainly owing to the inexperience of the troops themselves.

Attack in the Hills.—When Liman von Sanders learned during the night of Aug. 6–7 that the Allies were landing in force at Suvla and were attacking Sari Bair from Anzac, he ordered the two divisions at Bulair to proceed to Suvla with all speed. But this meant a two days' march along indifferent roads. Consequently there was still on Aug. 8 a great opening left for the attacking side to complete the first part of its programme, *i.e.*, to gain possession of the heights to the east of Suvla which dominated the landing places and a considerable area of level ground around Suvla Bay. But no organised move took place. The opportunity was allowed to slip by, and that night Turkish reinforcements began to arrive from Bulair and to occupy the all-important high ground. Next morning the 10th and 11th Divs., supported in a measure by the 53rd Div., which had arrived during the night, advanced to the attack. But the effort failed, and when it was renewed on the following day the Turks had been so effectually reinforced that the offensive enjoyed little chance of achieving success. That day, Aug. 9, was the last on which there remained any hope either of the Sari Bair offensive achieving success or of the Suvla force establishing itself in a satisfactory position. This force, however, made a fresh attempt on the 10th to wrest the heights in front of it out of Osmanli keeping; but this failed completely, and further offensives in this quarter were abandoned for the time being.

Hamilton's carefully devised scheme of offensive operations had in fact come to nought in its most important features. The determined effort to secure possession of Sari Bair had miscarried. A footing had, it is true, been gained at Suvla, giving the Allies control of a fairly well sheltered inlet on the outer coast of the peninsula; but as the high ground within easy artillery range of the landing places, which overlooked the whole occupied area, remained in the hands of the Turks, much of the benefit hoped for from its acquisition was neutralised. Only a restricted patch of Ottoman territory had in fact been occupied thanks to the new undertaking, and although the position at Anzac had been extended and improved it remained a very bad one. The Allies now occupied many miles of front in the peninsula, but there was scarcely a spot where the enemy did not enjoy the advantage in respect to ground; what the attacking forces needed from the outset was depth rather than breadth, and depth they had failed to secure. They had moreover incurred very heavy losses during the succession of combats lasting from Aug. 6 to 10, and, except for a mounted division coming from Egypt to fight on foot, no reinforcements were on the way; the 54th Div. had already been swallowed up at Suvla. The defending side had also, no doubt, suffered heavily in casualties, notably on Sari Bair; but Liman von Sanders could fairly claim that, even if some valuable ground had been lost by the Turks, he had held his own in a contest in which his adversary had enjoyed the initiative and had been in a position to effect a surprise.

An effort was made by the troops on the extreme left of the Allies' position at Suvla to gain ground along the ridge north of the Suvla plain on Aug. 15, but nothing came of it. Hamilton, however, did not despair of improving the situation in this area, so the mounted division from Egypt and another division from Helles were quietly concentrated there in support of the troops already on the spot, and on the 21st, a determined attempt was made to capture some of the high ground which had baffled the attempts of the invaders on the 9th and 10th. Large forces were engaged on either side in this battle, and the attack was prepared by a heavy bombardment of the Ottoman trenches, in which warships moored in Suvla Bay, where they were secure from submarines, participated. But after a sanguinary encounter the assailants met with a decisive rebuff, and from that date onwards no serious offensive operation was attempted by the Allies in the Dardanelles campaign. The conditions of stalemate which had prevailed before the arrival of the five new divisions from England set in afresh and continued to the end.

As a consequence of the failure at Suvla during the early days of its occupation certain changes in command were carried out, Gen. Byng, especially sent out from home for the purpose, taking over command in this area. Gen. Davies was in command at Helles, and, as the right of the Suvla force was in touch with the left of the Anzac force in the low ground near the shore, Byng and Birdwood now held a continuous front extending from a point on the coast about 3 m. northeast of Suvla Bay near to Gaba Tepe, overlooked for practically the whole of its length by high ground in occupation of the Turks. Owing to the losses that had been suffered during the August combat and even before the final reverse of Aug. 21, Hamilton had cabled home asking for reinforcements and for the very large drafts needed to bring his depleted units up to their war establishment, amounting to a total of 95,000 men. He had, however, been informed that no large bodies of fresh troops could be spared for the Dardanelles theatre. A temporary change of plan did occur a few days later owing to a French proposal to despatch four divisions to the scene to operate on the Asiatic side of the Straits, whereupon the British Govt. became disposed also to send fresh divisions.

III. EVENTS IN THE BALKANS AND EVACUATION

These projects were dropped early in September, owing very largely to the threatening aspect of affairs in the Balkans. (*See* SALONIKA CAMPAIGNS; SERBIAN CAMPAIGNS.)

Serbian Defeat.—The campaign by which the Central Powers and Bulgaria crushed Serbia for the time being, and by which communications were opened through Bulgaria between Austria-Hungary and the Ottoman Empire, profoundly influenced the situation in the Gallipoli Peninsula to the disadvantage of the Entente. Not only was all idea of reinforcing the Allied army that was planted in this region abandoned, but some of Hamilton's troops had before long been transferred to Salonika. The linking up of Turkey with the Central Powers by railway, moreover, connoted that Liman von Sanders would speedily be furnished with ample munitions of all kinds, which would make the prospect of Anglo-French forces gaining possession of the Straits remoter than ever.

Withdrawal Discussed.—By the middle of September the Paris Government had come to the conclusion that there was now no hope of victory in the Dardanelles theatre; but the British Cabinet, influenced by anxiety as regards prestige in the East and by disinclination to abandon an enterprise in which great sacrifices had been incurred and from which much had at one time been expected, could not make up its mind to cut losses and to withdraw. On Hamilton being asked to give his views concerning the question of evacuation, he pronounced himself as emphatically opposed to such a step, so Sir C. Monro was sent out from England to take his place. The new commander-in-chief, impressed by the very unsatisfactory positions occupied by the Allied troops, by the impossibility of their making any progress at their existing strength, and by the risks that the army ran by clinging to such a shore without any safe harbour to depend upon for base in stormy weather, declared unhesitatingly in the closing days of October for a complete withdrawal after examining the situation on the spot and consulting with Birdwood, Byng and Davies.

Lord Kitchener's Visit.—The British cabinet would not, however, accept the recommendation, and they despatched Lord Kitchener to the Aegean to investigate and report. He had viewed proposals to abandon the campaign with alarm; but after visiting the peninsula he realised that evacuation was the only justifiable course, and reported to that effect. All this time winter was drawing nearer and the need for a prompt decision was becoming more and more urgent, but the authorities in London lost another fortnight before, on Dec. 8, they at last sent instructions to Monro to withdraw from Suvla and Anzac, while retaining Helles.

Evacuation of Suvla Bay and Anzac.—Anticipating orders to this effect, Monro had already made certain preparations for evacuation, and, as he was also responsible for the British forces at Salonika, had placed Birdwood in command, Gen. Godley

relieving Birdwood at Anzac. It was recognised that the withdrawal of the vast accumulation of stores about the beaches, and also of the bulk of the actual troops, must be carried out gradually on successive nights, and this process was at once set on foot both at Suvla and at Anzac. The decision come to as to the final stage of the operation was that the front trenches should be held up to the last on the night of definite evacuation, and that the troops manning them should hasten straight to the beaches, everything removable having already been embarked; at a given moment the trenches (which at many points were but a few yards from those occupied by the Turks) would be vacated by detachments which by that hour would have shrunk to mere handfuls of men. The final night was provisionally fixed as that of Dec. 18–19, and, thanks to favourable weather and to the efficiency of the arrangements, the very critical undertaking was carried out with triumphant success just as had been laid down by programme 10 days before. Night after night the landing places were scenes of unceasing activity as war material, food supplies, animals and finally large bodies of troops, were got away. During the daytime reliefs took place as usual, pretences were made of landing stores and animals, and the result was that the Turks remained in complete ignorance of what was passing close to their lines. On Dec. 18 only a meagre force, composed almost entirely of infantry and disposed almost entirely in the front trenches, was holding a front of 10 m. face to face with an enemy incomparably stronger in numbers.

At nightfall the very few guns not yet withdrawn were hurried off to the jetties; then the troops along the front were quietly withdrawn by successive detachments; finally the parties still in the trenches slipped away; and when dawn broke the Turks discovered that the invaders were gone. Practically nothing worth mentioning had been left behind at Suvla, and at Anzac, where conditions were more difficult, only a very few worn-out guns had to be abandoned and some valuable war material destroyed. The relaxing by the Allies of their frail hold upon a strip of the outer coast-line of the Gallipoli Peninsula had been effected more successfully than the most sanguine amongst them had permitted themselves to hope.

Yet, for a week subsequent to the good news reaching them, the British Government remained irresolute with regard to the policy to be pursued at Helles. Then, however, Monro received the expected sanction for evacuating that area likewise, and Birdwood promptly grappled with this fresh problem, a problem rendered more difficult than the last owing to Liman von Sanders having full warning of what might be expected and, moreover, now enjoying an enormous preponderance in force. He had 21 divisions available, while there were only four left to oppose him.

Evacuation of Cape Helles.—The same principles as had been adopted by Byng and Godley at Suvla and Anzac were put in practice at Helles, the withdrawal of stores, war material, animals and personnel being carried out on successive nights. While the front trenches were to be held up to the last, the fighting force ashore was to be gradually reduced, and the detachments holding the front trenches were at the given hour on the last night, fixed provisionally for that of Jan. 8–9, to vacate them and hurry straight off to the beaches. But the weather was none too favourable on several of the preliminary nights, and the enemy's guns gave a good deal of trouble on the beaches, causing many casualties. The Turks were aware that a withdrawal was gradually being carried out; but they could not tell which would be the final night, nor could they make sure how far the number of combatants within the British lines had been reduced. So, with the intention of ascertaining the strength of their opponents, on Jan 7 they delivered a half-hearted attack upon the left of the British position. This was beaten off, and they came to the mistaken conclusion that the final evacuation was not imminent.

Shortly after dark set in on the night of Jan. 8–9 the wind rose ominously. Nevertheless the guns remaining to be embarked were got off, the infantry followed, and the last detachments quitted the front trenches at 11:45 P. M., without the Turks noting their departure. But when they reached the shore it was found, in the case of those detailed for Gully Beach, that embarkation there was impracticable; so these had to march to "W" Beach and they were not afloat till after 4 A. M., only being got off with great difficulty owing to the surf. Several worn-out guns had been intentionally left behind, besides much ordnance material and foodstuff; but practically all of this was rendered unserviceable, for, just as the last boats were lowered off, the masses of stores were set on fire, and only then did the Turks discover that their opponents had evaded them a second time. The withdrawal from Helles had been a masterly military and naval achievement.

IV. CONCLUSIONS

Most authorities on war agree that the failure of the Entente in this memorable campaign was primarily due to the abortive naval effort to force the Dardanelles. This gave the Turk such warning of what was in store that, when Hamilton's army was ready to land, the defenders were in a position to bring it at once to a standstill. The only chance of success after that lay in very substantial reinforcements reaching the scene promptly. But neither the British nor the French could divert the requisite military resources from the main theatre of war at the moment, and when some additional troops were sent later, their numbers were insufficient and it was too late.

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(C. E. C.)

DARLING, CHARLES JOHN, 1ST BARON (1849–), British judge, was born Dec. 6 1849. At the age of 24 he was called to the bar; in 1885 he took silk, and shortly afterwards entered Parliament as Conservative member for Deptford. He sat in the House of Commons from 1888 until 1897 when he was knighted. His appointment in 1897 to a judgeship was not received with universal approval; but he later justified the choice by proving himself to be a man of acute understanding, with an unusual insight into human nature. He achieved success rather by his mother wit than by his knowledge of the law; and his shrewd and entertaining dicta made him a favourite with the public. In 1923 he retired, and in 1924 was granted a peerage. Among his published works are *Scintillae Juris* (1877); *Meditations in the Tea Room* (1879); *Seria Ludo* (1903); *On the Oxford Circuit* (1909).

DARROW, CLARENCE SEWARD (1857–), American lawyer, was born at Kinsman, O., April 15 1857. He received a public school education and was called to the bar in 1875, afterwards practising in Chicago. He appeared as counsel in a large number of important cases, many of which attracted wide attention and became recognised as one of the leading criminal lawyers in the United States. He was retained by the labour organisations in nearly all their litigation of recent years. Among the celebrated cases in which he appeared were the Debs strike case (1895), anthracite coal strike arbitration (1902), Steunenburg murder (1907), *The Los Angeles Times* dynamite case (1911) and the Loeb-Leopold case (1924). In July 1925 he defended J. T. Scopes at the Tennessee evolution trial. He wrote *Crime, Its Cause and Treatment* (1922), and many other books and pamphlets on social and economic questions.

DARTMOUTH COLLEGE (*see* 7.838) in the period between 1908 and 1926 experienced a great expansion in its equipment, endowment and enrolment. It has 22 buildings devoted to lecture-rooms, laboratories, administration and similar purposes. The extensive gymnasium was erected in 1910; Robinson Hall, the home of all undergraduate organisations except athletic, in 1914; and the Steele Chemistry Laboratory in 1920–1. The construction of a new library costing $1,000,000 will begin in 1926. Six of the 18 dormitories, which together house 1,350 students, were added between 1908 and 1923. The value of the equipment is over $3,000,000. The college also has single or apartment houses for housing 50 faculty families. Its productive investment assets more than doubled in this period, approximating $7,500,000. In

1925–6 it had over 200 officers, administrative and professional, with 2,100 enrolled students. The tuition cost is $400 a year. Provision is made through scholarships for assisting students unable to pay this sum.

In 1910, 62% of the students came from New England. The constituency of the college gradually changed until, in 1924–5, the majority came from outside New England, only 44% of the men coming from homes within those states. The trustees set a limit on the number to be accepted—at about 2,000. Candidates were selected on a basis of character, scholarship and general accomplishments. In June 1925 certain major changes were made in the curriculum, providing *inter alia* for special treatment for students of higher grade, and for the granting of but one degree, Bachelor of Arts. One of the most interesting influences of the college is promoted by the Dartmouth Outing Club, for the stimulation of healthful outdoor activities. The total number of Dartmouth men, graduates, undergraduates and faculty, who served in the army, navy or marine corps during the World War was 3,319. Those dying in active service numbered 112.

(R. R. L.)

DARWIN, SIR GEORGE HOWARD (1845–1912), British astronomer, was born at Down, Kent, July 9 1845 and was the second son of Charles Darwin (*see* 7.840). He was educated at Cambridge University (second wrangler and Smith's prizeman) where he became Plumian professor of astronomy and experimental philosophy in 1883. His work on the application of harmonic analysis and prediction to oceanic tides is monumental, as is his discussion of the influence of tidal friction in determining the evolution of binary systems, with special reference to the earth and moon. In an early paper he discussed the possibility of geological changes having altered considerably the inclination of the earth's axis to the plane of its orbit, and came to a negative conclusion. These works constituted the first attempt to apply thorough dynamical analysis to cosmogony and the major problems of geological evolution. He also carried out important work on periodic orbits in the problem of three bodies, figures of equilibrium of rotating masses of fluid and the stresses in the earth's crust produced by continents and mountains. He was awarded the gold medal of the Royal Astronomical Society in 1892 and the Copley Medal of the Royal Society in 1911. He was made K.C.B. in 1905, and he died in Cambridge on Dec. 7 1912.

Among his works are *The Tides and Kindred Phenomena in the Solar System* (1898), 3rd ed. (1911); *Scientific Papers* (1909–16).

DAS, CHITTA RANJAN (1870–1925), Indian politician and leader of the Swaraj party in Bengal, was born at Calcutta on Nov. 5 1870. His father, Bhuban Mohan Das, an attorney of the Calcutta High Court, joined the Brahmo Samaj, and edited the *Brahmo* (afterwards the *Bengal*) *Public Opinion*. Chitta Ranjan was educated at the London Missionary College, Bhowanipore, and at the Presidency College, Calcutta, obtaining the B.A. Degree. He came to London to compete for the Indian Civil Service, but, just failing to secure a place in the examination, pursued legal studies instead and was called to the bar by the Middle Temple on June 26 1894. Joining the Calcutta bar, he first came into prominence as counsel for Arabinda Ghosh in the Manicktollah bomb conspiracy case. The acquittal of Arabinda after prolonged trial, and the small remuneration accepted by Das, brought him popularity and a large practice. His prosperity enabled him to meet all debts in connection with his father's bankruptcy, though he was under no legal obligation to do so. He defended relays of young political desperadoes, and assisted in keeping extremist papers, such as *Bande Mataram*, going, until they were checked by the Press Act, 1910.

More and more the young lawyer threw himself into Nationalist and literary activities. In 1895 he had published a volume of Bengali lyrics *Malancha* which "introduced a new element of freedom and realism into our modern lyrical literature" (Motilal Ghose in foreword of Speeches by Das, 1918), and two further volumes were issued during the War. In 1915 Das started the Bengali monthly *Narayana*, but his chief journalistic work was the founding and conduct of the aggressive Swarajist daily, *Forward*. "His dominating note was hatred—and dread—of everything that savoured of the West. . . . It was the pursuit of these false gods that had converted Bengal from a smiling land of happiness and plenty into a salt waste over which brooded stagnation and death" (Lord Ronaldshay's *Heart of Âryâvarta* (1925). Yet he was sufficiently interested in the shaping of political reforms on western lines to participate in discussions leading to a joint address of Europeans and Indians to the Secretary of State and the Viceroy in Nov. 1917 (see Lionel Curtis, *Diarchy*, 1920).

Das became an influential though not always tractable supporter of M. K. Gandhi in the non-coöperating movement launched in the autumn of 1918. Apart from defending in political cases, he abandoned almost entirely his large practice, took to the wearing of *khadar* (homespun cloth) and lived in the utmost simplicity in order to devote his means to the Swarajist cause. Late in 1921 it was found necessary to proscribe the "volunteer" movement in Bengal, as in other provinces. On Dec. 10, some days before Das was due to preside at the Indian National Congress at Ahmadābād he was arrested for issuing a public appeal for the proscribed organisation, and was sentenced to six months' imprisonment. The daily conflicts of his followers with the police in Calcutta were complicated by processions of Bengali ladies, headed by Mrs. Das, who was in thorough sympathy with her husband's views. She was arrested, but by order of the governor, Lord Ronaldshay, was speedily released. Das presided at the National Congress at Gaya in Dec. 1922, and endeavoured to secure revocation of previous resolutions against entering the Legislatures, suggesting obstructive tactics in place of boycott. The controversy sharply divided the non-coöperationists, but with the decline of Gandhi's influence the Das policy gained ground, and was largely followed at the end of 1923 in the second general election under the Reforms; Das was elected to the Bengal Council by more than one constituency. In the following April his party captured the majority of seats in the Calcutta Corporation elected under a new Act, and Das was elected the first mayor of Calcutta.

In the Bengal Legislature Das did not command a clear majority, but he knew how to bring pressure to bear on the Independents and also upon the Mahommedans, to whom he suggested a pact under which, when Swaraj came, a substantial proportion of elective seats and public appointments would be reserved for them. He secured a bare majority on March 24 1924 for refusal of the salaries of Ministers whom Lord Lytton, the governor, had provisionally appointed. Lord Lytton's offer of a ministership to Das, as commanding a larger body of votes in the Legislature than any other member, was refused after considerable hesitation. Das laid down unacceptable conditions, and offered vehement opposition to the Bengal Criminal Law Amendment Ordinance (Oct. 25 1924) subsequently embodied in a certified Act under which 110 persons were kept in imprisonment for terrorist conspiracy, some of them having close association with Das. His refusal of office and command of votes in the Legislature led to the suspension of the diarchical system in Bengal, all transferred subjects being taken over by the executive government.

At the Bengal Provincial Conference at Faridpur, early in May 1925, Das modified his position and a resolution was passed condemning revolutionary tactics, though a year earlier at Serajganj the conference had praised the patriotism of the murderer of Mr. Day, a European merchant who was assassinated in the streets of Calcutta in mistake for a high police official, the resolution receiving the approbation of Das' paper *Forward*. There can be no doubt that the connection between the Terrorists and the Swarajists under Das was more than mere sympathy of the latter for the former. While each party had its own separate aims, each was working to use and assist the other in so far as it was useful for the attainment of its own ends.

There was public surprise, not unmingled with amusement, when the Secretary for India in the first Labour government, Lord Olivier, stated in debate (July 21 1924) that he was informed

by a high authority in Indian politics that Das had "the reputation of being a particularly upright and scrupulous politician second only to Gandhi himself in saintliness of character." Undoubtedly, the Indian mind was impressed by the great personal sacrifices of Das for the Swaraj cause, and by his courage in act and utterance. In resource and driving power he stood high above his associates. He was skilful in swaying Bengali audiences and individuals, being capable both of playing upon their weaknesses and appealing to what was best in them. He was eloquent, emotional and clever, generous, warm-hearted and a lover of popularity. His vision of India under Swaraj as a conglomeration of semi-autonomous villages had no relation to the hard facts that make centralisation inevitable.

Competent judges believe that Das was gaining a fresh outlook, more tolerant of Western ideas, in the closing months of his life. He was at Darjeeling in search of health when he died from heart failure following diabetes, on June 16 1925. The body was taken to Calcutta for cremation, and the funeral concourse was one of the very largest in living Indian memory. A national memorial was promoted and received support from Indians of all political views.

Das' book, *India for Indians* (1918), gives extracts from speeches. A substantial volume of *Speeches* (some translated from Bengali) was published in Calcutta 1918. *The Way to Swaraj* (1923) gives the speeches made during a tour in southern India, and expounding, according to the prefatory note, "the whole of Desabandhu's philosophy of Indian Nationalism." This philosophy is discussed with penetrating insight in Lord Ronaldshay's books: *India: A Bird's-eye View* (1924) and *The Heart of Âryâvarta* (1925). (F. H. B.*)

DATO, EDUARDO (1856–1921), Spanish politician, was born at Corunna Aug. 12 1856. He graduated in law at the University of Madrid and was elected a deputy in 1884. An Under-Secretary for the Home Dept. in 1892, he became Minister for the department in 1899, and was largely responsible for bills regarding accidents, insurance and women's labour. In Dec. 1902 he became Minister of Justice, in 1907 mayor of Madrid and then president of the Chamber. He was elected a member of the Royal Academy of Social and Moral Sciences June 20 1905. He belonged to the "Liberal-Conservative" variety of the Conservative party, which his friend and political chief Silvela had represented, and, after Silvela's death continued to maintain this attitude. When in 1913 Señor Maura refused to take power, Señor Dato dissented from his chief, carrying with him the majority of his party, which elected him as its leader. When the World War broke out, he was responsible for Spain's declaration of neutrality. Becoming Prime Minister again in June 1917, he faced with determination the revolutionary outbreaks and disturbances of that summer. He resigned in October, but in 1920 resumed office, and while Prime Minister was murdered in Madrid March 8 1921.

DAUDET, LÉON (1867–), French man of letters and politician, was born in Paris Nov. 16 1867, the son of Alphonse Daudet (*see* 7.848). He married a granddaughter of Victor Hugo. Like his father he began by writing numerous novels, but failed to gain distinction as a novelist. His true vocation was that of a pamphleteer, and his violent opposition to the Government gave him the opportunity for displaying his talents as a controversialist. He wrote for *Le Gaulois* and *Le Figaro*, and also for *La Libre Parole*, a violently anti-semitic paper, in the columns of which he was able to give full vent to his fiery temperament. Influenced by the writer, Charles Maurras, he adopted the doctrines of neo-royalism. At the time of the Dreyfus case, through the generosity of Madame de Loynes, the royalist paper, *Action Française*, was founded in 1899, afterwards appearing as a daily paper in 1908. Through its columns Daudet soon became a power in the political world. His inflexible will, the lucidity and force of his literary style, the wealth of his invective, often highly-coloured, combined to make him read and feared for 20 years. During the elections of 1919 he was elected to the Chamber as a deputy for Paris. But by this time his influence as a controversialist was no longer as strong as it had been. With the establishment of peace, he suffered a decline recalling the cases of Rochefort and Drumont. The suicide of his anarchist son caused a great sensation.

Daudet wrote about 20 novels, of which the best are those which reflect his own dominating personality, such as *L'astre noir* (1893); *Les Morticoles* (1894); *Le voyage de Shakespeare* and *Sylla et son destin* (1922). Among his philosophical and controversial works may be mentioned *L'Hérédo* (1916); *Le monde des images* (1919); *L'avant-guerre* (1913); *Le stupide XIXe. siècle* (1922); and *Souvenirs* (1914). It is by this last work, still incomplete, that Daudet will probably be best remembered; for with its series of pen-portraits and caricatures it suggest a whimsical Saint-Simon, and vividly depicts modern political and literary life.

See Robert Guillou, *Léon Daudet: son caractère, ses romans, sa politique* (1918); André Goucher, *L'honorable Léon Daudet* (1921).

DAUMET, PIERRE JEROME HONORÉ (1826–1911), French architect, was born on Oct. 23 1826 in Paris. He entered the École des Beaux-Arts in 1846, and in 1855 he was awarded the Prix de Rome. In 1861, he was sent on an archaeological expedition to Macedonia, and published, in collaboration with Léon Henzey, an important work on the researches in Thessaly, Thrace and Illyria. But he is principally known for his achievements in restoring monuments of French architecture, in particular the Castle of Chantilly, and the Palais de Justice, Paris, and the Theatre at Orange. In Nov. 1884 Daumet was entrusted with the construction of the Église du Sacré-Cœur on Montmartre, which had already been begun by the architect Abbadie; but the following year he abandoned the task, after a dispute with the ecclesiastical authorities. In 1885 he was chosen a member of the Académie des Beaux-Arts, and in 1889, was awarded a gold medal for his designs exhibited at the Paris Exhibition. He died in Paris on Dec. 15 1911.

DAVIDOVIC, LJUBOMIR (1863–), Yugoslav politician, was born at Vlaška in Serbia. In 1901 he entered Parliament and, the next year, with Ljubomir Stojanović, founded the Independent Radical party. In 1904 he became Minister of Education, in 1905 President of the Skupština and in 1909 mayor of Belgrade. In that year he was one of the Serbian witnesses at the Friedjung trial in Vienna, and soon afterwards Professor Masaryk laid before the Austrian delegation the papers on which the forgers had practised Davidovic's signature. In the Serbian Coalition Cabinet, formed during the Austrian invasion in Nov. 1914, Davidovic again became Minister of Education, but in 1917 he resigned office and remained in active opposition to Pašić throughout the remainder of the World War. In 1919 he was elected chief of the newly formed Democratic party and was Yugoslav Premier from Aug. of that year until Feb. 1920. In later years he adopted a conciliatory attitude towards the Croats, and condemned the policy of extreme centralisation. In July 1924 he again became Prime Minister at the head of a coalition of Democrats, Slovene Clericals and Bosnian Moslems, supported by the Croat peasants. He was, however, unable to maintain himself in office, and was replaced, in Oct. 1924, by a purely Radical Government under Pašić.

DAVIDSON, RANDALL THOMAS (1848–), English divine (*see* 7.863), appointed Archbishop of Canterbury in 1903, was with King Edward VII. at his death in 1910, as he had been with Queen Victoria in 1901, and he crowned King George V. in 1911. He was one of the four counsellors of state who acted as His Majesty's Commission when the King went to India in 1911, and again in 1925 when the King went to the Mediterranean after illness. During the whole of this period he took a leading part as spokesman of the national Church in the House of Lords. Lord Morley bore public witness to the effectiveness of his intervention in the critical debate on the Parliament Act in 1914. He made important contributions in debates on temperance, divorce and various social and moral questions. His influence was also constantly and successfully exerted in matters affecting the welfare of native races, *e.g.*, in Kenya, and he made notable appeals on behalf of Christian minorities in the East. In general national and ecclesiastical affairs his attitude is admirably

expressed in his Charge, *The Character and Call of the Church of England* (1912).

Trusted by Englishmen of all classes for his wisdom and goodness, the Archbishop commanded the confidence of Free Churchmen to a greater degree than any of his predecessors. He had a peculiarly anxious task during the World War, and his utterances from 1914–9 published in *The Testing of a Nation* (1919) show the combination of just patriotism with an international spirit by which his leadership was distinguished. On more than one occasion he lifted up his voice both in Convocation and the House of Lords against reprisals which had "as a deliberate object the killing and wounding of non-combatants." Twice he visited the troops in France. In 1916 he placed himself at the head of a national mission, which aimed at the deepening of religious life at home. At an early date he gave public support to the proposals for a League of Nations, and it was recognised as specially fitting that he should preach the sermon at the opening of the third Assembly in Geneva, 1922, since published with other post-War addresses in *Occasions* (1925). In 1922 Dr. Davidson took the lead in issuing a vigorous protest, signed by the leaders of the Anglican, Roman, Free Church and Jewish Communions, against religious persecution in Russia—one result of which was the saving of the Patriarch Tikhon's life. In 1923 he also made a successful public appeal for the retention of the Oecumenical Patriarchate at Constantinople.

The Archbishop also took a deep interest in the work of the Church overseas. He presided over the sixth Lambeth Conference in 1920, attended by 252 out of the 368 bishops of the Anglican Communion, and throughout the deliberations adopted a strong forward-looking attitude. After the issue of the Appeal to all Christian People by that conference he took a prominent part in securing widespread consideration of the proposals for the reunion of Christendom which it contained. He actively forwarded conferences with the Free Church representatives in England, a series of important meetings being held at Lambeth Palace. He further expounded the Appeal to the General Assemblies of the Church of Scotland, and the United Free Church of Scotland in 1921. In addition, the Archbishop markedly developed friendly relations between the Anglican and Orthodox churches, and it was to him that the Patriarch (Meletios IV.) of Constantinople communicated his Synod's acceptance of the validity of Anglican Ordinations in 1922. He also took "cognisance" of the conversations between Anglican and Roman Catholic theologians held at Malines (1921–4) under the presidency of Cardinal Mercier, and which took place with the cognisance of Pope Pius XI.

In 1920 two other events occurred with which he was closely identified in different ways. The first Archbishop of Wales was enthroned by him at St. Asaph, following upon the disestablishment of the Welsh Church. The National Assembly of the Church of England, with the powers conferred upon it by the Enabling Act of 1919, met for the first time. Dr. Davidson's chairmanship of the National Assembly gave it a vitality and coherence which would otherwise have been difficult to attain. The two chief church problems which confronted his primacy were those connected with modern criticism, and with ecclesiastical discipline in ritual and doctrine, including Prayer-Book revision. His own policy was to try to secure the fidelity to primitive Christianity, historical continuity, due regard to the needs of the present day and loyalty to truth, for which the Church of England stands. (G. K. A. B.)

DAVIES, ARTHUR B. (1862–), American painter, was born at Utica, N.Y., Sept. 26 1862. He was a pupil of Dwight Williams at Utica, afterwards studying in New York and Chicago. He became an adherent of the Romantic school of painting and made notable contributions in the fields of etching and colour-lithography. Among his more important works are "Dream" and "The Girdle of Aries," in the Metropolitan Museum, New York City; "Maya, Mirror of Illusions," in the Art Institute, Chicago; "Spring in a Valley" and "Night Overture," in the Minneapolis Institute of Art; and "The Place of the Mother" and "Children of Yesterday," in the Brooklyn Museum. In 1923 his picture, "After-Thoughts of Earth," procured for him from the Carnegie Trust a medal of the first class and $1,500. He had previously been the recipient of the Corcoran Gold Medal (1916).

DAVIES, SIR LOUIS HENRY (1845–1924), Canadian politician and jurist (*see* 7.865), was in 1901 appointed a judge of the Canadian Supreme Court. In 1918 he became chief justice and in the following year was sworn of the Privy Council. He died at Ottawa May 1 1924.

DAVIS, HENRY WILLIAM BANKS (1833–1914), British painter (*see* 7.866), died at Glaslyn, Radnorshire, Dec. 1 1914.

DAVIS, HENRY WILLIAM CARLESS (1874–), British historian, a son of H. F. A. Davis of Stroud, Gloucestershire, was born Jan. 13 1874 and educated at Weymouth College and Balliol College, Oxford. He was made a fellow of All Souls College and from 1902 to 1921 was a fellow of Balliol, where he was responsible for much of the history teaching. During the World War he served in the War Trade Intelligence Department. In 1921 Davis was appointed professor of modern history at Manchester and in 1925 he returned to Oxford as regius professor of modern history. He became director of the *Dictionary of National Biography*, when, in 1902, the copyright of that work passed to the Clarendon Press. Davis's early historical work was chiefly done in the medieval field and found expression in his *England under the Normans and Angevins*, 1905; *Mediaeval Europe*, 1911, and a revised edition of the *Select Charters* of William Stubbs, 1913. During the War period he turned to subjects bearing on the struggle, wrote *The Political Thought of Treitschke*, 1914; edited *The Oxford Pamphlets* and worked on a history of the Peace Conference.

DAVIS, JOHN WILLIAM (1873–), American lawyer, was born at Clarksburg, W.Va., April 13 1873, where he received his early education. He graduated from Washington and Lee University in 1892, and from the Law School there in 1895, being admitted to the bar in the same year. After a year as assistant professor of law at his alma mater, he returned in 1897 to Clarksburg, where he entered into an informal partnership with his father, also a lawyer, which continued until 1913. In 1899 he was elected a member of the West Virginia House of Delegates, and in 1904 was a delegate to the Democratic National Convention at St. Louis. He was elected to the 62nd (1911) and 63rd (1913) Congresses for the first West Virginia district. During his period of service he was one of the managers on the part of the House in the successful impeachment of Judge Archbald.

In Aug. 1913, he was appointed solicitor-general of the United States, an office which he held until 1918. In this position he conducted many important cases, among them the Midwest Oil case, involving the right of the President to withdraw from entry public lands thought to contain mineral deposits. From 1913 to 1918 he was counsel for the American Red Cross. In 1918 he was appointed American delegate to a conference with Germany at Bern on the treatment and exchange of prisoners of war, and in the same year succeeded Walter Hines Page as American Ambassador to Great Britain, retaining this post until 1921. Among the honours conferred upon him was that of election as a bencher of the Middle Temple.

During the Peace Conference John W. Davis was one of President Wilson's chief advisers, and was the American representative on the joint committee which drafted the form of Allied control and government in the occupied Rhineland territory. In 1921 he returned from England and accepted a partnership in the New York law firm of Stetson, Jennings and Russell, which had many distinguished clients, among them J. P. Morgan & Co. and the Guaranty Trust Company. Mr. Davis was nominated on the 103rd ballot as Democratic candidate for the presidency at the Democratic National Convention held in New York City July 1924. The ensuing election resulted in an overwhelming victory for Calvin Coolidge, the Republican candidate, the electoral vote being 382 for the latter, 136 for Davis and 13 for La Follette, the Progressive candidate, while the popular vote was 15,748,356 for Coolidge, 8,617,454 for Davis and 4,686,681 for La Follette.

DAVIS, RICHARD HARDING (1864–1916), American writer, was born in Philadelphia April 18 1864. He studied at Lehigh and Johns Hopkins universities and in 1886 became a reporter on the Philadelphia *Record*. After working on several newspapers he acted as managing editor of *Harper's Weekly*. He became widely known as a war correspondent, reporting every war from the Greco-Turkish War (1897) to the World War. Of his numerous works of fiction, the earliest are the best, especially *Gallegher and Others* (1891); *Van Bibber and Other Stories* (1892); and *Episodes from Van Bibber's Life* (1899). His other books include: *Soldiers of Fortune* (1897); *Captain Macklin* (1902); *The Bar Sinister* (1904); *Vera the Medium* (1908); and *With the French in France and at Salonika* (1916). His plays include: *Miss Civilization; The Dictator; The Galloper; The Orator of Zapata City;* and *The Zone Police* (1914). He died near Mt. Kisco, N.Y., April 11 1916.

DAWES, CHARLES GATES (1865–), American statesman and financier, was born in Marietta, O., Aug. 27 1865, the son of Gen. Rufus R. Dawes. He was educated in his home town, graduating from Marietta College in 1884 at the early age of 19. He then attended the Cincinnati Law School and in order to defray his expenses obtained employment during his vacation on the Marietta, Columbus and Northern Ohio Railway. Before finishing his two-year law course he was made chief engineer in charge of construction on this railway—a fact eloquent of the energy and versatility which were to distinguish his whole career. He received his LL.B. degree in 1886, before he was old enough to practise. Admitted to the bar several months later, he commenced practice at Lincoln, Neb., in 1887. Two years later he married Caro D. Blymer of Cincinnati.

Dawes' reputation as a lawyer was established by his part in the Nebraska rate case, in which he appeared successfully as counsel for the Lincoln Board of Trade in an effort to obtain a reduction in railway rates in Nebraska. In 1894 he became extensively interested in the gas business at Evanston, Ill., and at other western points, and removed to Evanston in that year. In 1896 he organised the movement in Illinois to nominate William McKinley as Republican candidate for the presidency. He was chosen a member of the executive committee of the Republican national committee, and was active in securing McKinley's nomination and election. He was appointed comptroller of the currency by President McKinley Jan. 1 1898. His tenure of office was conspicuous for efficiency of administration and disregard of "red-tape" methods, especially in the conduct of the many receiverships and trusts created by the financial disorders following 1893. Retiring from this office in 1902, he organised the Central Trust Co. of Illinois, which, under his presidency, became one of the strongest financial institutions in Chicago.

On the declaration of war against Germany by the United States April 6 1917, Mr. Dawes volunteered for service and was given a commission as major and later as lieut.-col. of the 17th Engineers (Railway), his well-known ability and early experience in railway construction outweighing the fact that he was over age. He landed in France July 17 and was placed on the headquarters staff of the American Expeditionary Force by Gen. Pershing as chairman of the General Purchasing Board and chief of supply procurement charged with the duty of collecting supplies in Europe and of co-ordinating their purchase in such a way as to guard against inflated prices and duplication of orders. His conspicuous success in directing these transactions, which secured for the American Army over 10,000,000 ship tons of supplies in Europe as against 7,000,000 shipped to it from the United States, led to his promotion to the rank of brigadier-general in 1918 and, on the unification of command of the Allied forces under Foch, Gen. Dawes was appointed as U.S. member of the Military Board of Allied Supply, the organisation of which had been largely due to his efforts. This board for the last four months of the War co-ordinated the movement of supplies for the Allied Armies in the zone of the advance.

After the conclusion of the Armistice, Dawes became a member of the liquidation committee of the A.E.F., charged with the task of disposing of the huge accumulations of American property in France and of settling outstanding claims against the army, which engaged his efforts until Aug. 1919, when he resigned his commission and returned to the United States. Upon the creation of a Budget Bureau by Congress, April 1921, the directorship of it was offered to Gen. Dawes by President Harding and was accepted on condition that the bureau should be non-political, that in gathering information the director should be assumed to be acting for the President and his calls for consultation or information should take precedence of all others. His work in organising this bureau and creating under executive order the existing system of co-ordinating boards now operating in government business was carried through with characteristic vigour and directness and resulted in savings estimated officially at $250,000,000 in the first year. Having completed the task of placing the budget on a satisfactory and permanent basis, he resigned his position June 30 1922.

In the meantime the collapse of the German financial structure and international reactions resulting therefrom had precipitated a crisis in European affairs, the outcome of which appeared ominous. At this juncture, the Allied Reparations Commission, in 1923, appointed Gen. Dawes and Owen D. Young as U.S. members of the committee of experts to report upon means of balancing Germany's budget and stabilising its currency. Dawes was selected as chairman, and the committee's report, known as the "Dawes Plan," was subsequently ratified and accepted by all the Powers concerned. By making the actual transfer of reparation payments conditional on the stability of German exchange, this plan provided a non-political and automatic means for determining Germany's ability to pay and so withdrew this vexed question from international controversy and paved the way for the later agreements entered into at Locarno (*see* REPARATIONS).

At the Republican National Convention held at Cleveland, O., June 10–12 1924, following the nomination of President Coolidge for re-election, Gen. Dawes was nominated for vice-president on the third ballot by a vote of 682½ against 334½ for Herbert Hoover and 75 for Judge Kenyon. Following the overwhelming triumph of the Republican ticket at the ensuing election, Gen. Dawes assumed office on March 4 1925. In his inaugural speech he called for a revision of the rules of procedure in the Senate so that a majority vote could apply the closure to debate. He later carried his proposals for senatorial reform before the people in a series of public meetings in various parts of the country.

Another aspect of Gen. Dawes' character is revealed by two acts of philanthropy. In memory of his son, Rufus Fearing, who was accidentally drowned Sept. 5 1912, he established the Rufus F. Dawes hotels in Chicago and Boston, at which impoverished men could obtain food and accommodation at nominal rates. As a memorial to his mother he established the Mary Dawes Memorial hotel, where women might live at small cost and retain the physical comforts and social opportunities compatible with self-respect. In the course of his varied and successful career as engineer, lawyer, politician, comptroller of the currency, public utility operator, banker, philanthropist, soldier, organiser of the Government budget, leading spirit in the settlement of German reparations, and Vice-President of the United States, Gen. Dawes found time also to become an accomplished musician on the piano and flute, and is the composer of the well-known "Melody in A Major." His outstanding achievements were rewarded with a number of decorations, including the D.S.M. of the United States, Croix de Guerre and Commander of the Legion d'Honneur of France, Companion of the Order of the Bath of England and Commander of the Order of Leopold, Belgium. His forceful expression "Hell and Maria," used in giving evidence contributed not a little to his popularity.

Dawes wrote *The Banking System of the United States and its Relation to the Money and Business of the Country* (1894); *Essays and Speeches* (1915); *A Journal of the Great War* (1921); and *The First Year of the Budget of the United States of America* (1923). (O. D. Y.)

DAWES PLAN: *see* REPARATIONS.

DAWSON OF PENN, BERTRAND EDWARD DAWSON, 1ST BARON, British physician. He studied medicine at University College and the London Hospital, where in 1896 he became an

assistant physician, and in 1906 physician. He carried out extensive researches on gastric affections, and became one of the leading authorities on this subject. He was appointed physician extraordinary to King Edward VII. in 1907, and later physician in ordinary to King George V. and in 1923 to the Prince of Wales. During the World War he did very valuable work on war diseases, publishing various papers on paratyphoid and infective jaundice. He was made G.C.V.O. in 1917, K.C.M.G. in 1919 and in 1920 was raised to the peerage. Dawson has published *The Diagnosis and Operative Treatment of Diseases of the Stomach* (1908), various contributions to Allchin's *Manual of Medicine*, and many papers in medical journals on gastric disorders.

DAWSON, GEORGE GEOFFREY (1874–), British journalist, was educated at Eton and Magdalen College, Oxford, and was elected a fellow of All Souls College in 1900. Passing into the civil service, he was appointed to the Colonial Office, and in 1901 he went to South Africa as private secretary to Lord Milner, then high commissioner. On Lord Milner's retirement from the high commissionership in 1905 he accepted the editorship of the Johannesburg *Star*, which he held for the next four years. Returning to London in 1910, he was appointed a director of *The Times*, which was then in the early days of Lord Northcliffe's direction, and in 1912 succeeded Mr. G. E. Buckle as editor. The conspicuous success which *The Times* attained during the difficult years of the World War was largely due to Mr. Dawson's sound judgment and knowledge of affairs, which formed an admirable and often very necessary complement to Lord Northcliffe's imagination and genius. In 1919, however, Mr. Dawson found himself unable to carry out Lord Northcliffe's policy for *The Times* and resigned. He was succeeded by Mr. Henry Wickham Steed (*q.v.*). When in consequence of Lord Northcliffe's death in 1923 *The Times* was reconstructed, Mr. Steed retired and Mr. Dawson was recalled to the editorship. During his absence from journalism he was estates bursar of All Souls College (1919–23) and secretary to the Rhodes Trust (1921–2). In 1917, under the terms of a relative's will, he took the name of Dawson instead of Robinson.

DAYLIGHT SAVING.—In the second year of the World War nearly every country in Europe adopted the device of putting the clock forward an hour during the spring, summer and autumn months. The motive was quite simply to get people to bed an hour earlier and out of bed and at work an hour earlier, to save fuel for lighting and heating.

Great Britain.—In Great Britain, the idea itself did not arise out of the War at all. About 1907 it occurred to Mr. William Willett, a Chelsea builder, that civilisation got up an hour or two too late in the summer months, and had a short evening for outdoor recreation, when it might have a long one. He devoted himself to a campaign for putting the clock on by 80 min. in the spring and summer months. He made no attempt to found a league or society, but ran the campaign himself at his own expense and succeeded so far that in 1908 Mr. (afterwards Sir Robert) Pearce introduced a bill in the House of Commons to put the clock on by law. The bill was sent to a Select Committee the following year. In 1916, the expert committee set up by the British Government to study the question of fuel economy advised that the measure should be adopted. The scheme was simplified. Mr. Willett had proposed that the clock should be put on 80 min. in four moves of 20 min. each. The first Select Committee in 1908 had advocated one movement of the clock of one hour in the spring. This was the method adopted by the Act which was passed on May 17 1916 and put into operation the following Sunday, May 21. There was a good deal of opposition. Farmers objected to it because milkers would have to get up an hour earlier to do their work, which meant getting up in the dark during the greater part of the year. Hay and corn harvests could not be carried until the dew was dried off, which meant an hour during which labourers could do nothing. When put to the test of practice these difficulties proved to have been much exaggerated.

In the House of Commons Sir Frederick Banbury and Lord Hugh Cecil were the tellers against the bill in the division upon the second reading. In the House of Lords Lord Balfour of Burleigh opposed it as "the most absurd and ridiculous bill that had ever been presented to the House." He said further that

> He did not propose to give it strenuous opposition as it was but a temporary measure for the duration of the War. But if any attempt were made after the War to make it a permanent institution it would have to receive the most critical attention. He asked their lordships to carry their minds to the night in October when the clock was set back. At 1 o'clock the clock would be put back to midnight. Supposing some unfortunate lady was confined with twins and one child was born 10 minutes before 1 o'clock. If the clock was put back the registration of the time of birth of the two children would be reversed. The second child would be born 50 minutes before the other. Such an alteration might conceivably affect the property and titles in that House.

The actual introduction of summer time on Sunday, May 21 1916, was fortunate in the matter of weather. May 21 was a day of summer warmth and sunshine, and the fine evening was a strong popular argument for the advancing of the clock. Some few adjustments had to be made and warnings issued. The president of the Royal Meteorological Society sent out a letter stating that Greenwich mean time would continue to be used for all meteorological observations and publications, but asked that regular observers for this Society should state in their reports whether they were recording Greenwich or summer time. The Port of London Authority announced that the tide tables in the almanacs would remain Greenwich time. The Royal and L.C.C. parks decided to close at dusk by the sun, but Kew Gardens decided to follow the clock and closed an hour earlier by the sun. At Edinburgh the Castle gun continued to be fired at 1 P.M. summer time, but the ball on the top of the Nelson Monument on Calton Hill was dropped at 1 o'clock, Greenwich mean time, for the benefit of mariners who watched it from the Firth of Forth. The legal change of the clock was fixed for 2 A.M. in the morning, so that only travellers by long-distance trains running through the night actually saw the jump of an hour.

In Great Britain summer time was renewed after the War by a series of Acts of Parliament. The final and permanent Act of 1925 provided that summer time should begin on the day next following the third Saturday in April, or if that day is Easter day the day next following the second Saturday in April. Summer time closes in Great Britain on the first Saturday in October. The official time for altering the clock is 2 A.M. on Sunday morning. (H. D.*)

United States.—The course of the daylight saving movement in the United States has been different. No public interest was developed in the project till after the outbreak of the World War, and it was not until 1916 that a nation-wide campaign was initiated in its support. Opinion was divided, but in 1917 Congress passed an Act, to take effect in 1918, whereby the standard time of the United States would be advanced one hour on the last Sunday in March and set back one hour on the last Sunday in October. The Act was effective from March 31 till Oct. 27 1918, and again on March 30 1919. Strenuous opposition developed, however, from the farmers and the law was repealed Aug. 20 1919 over the President's veto. Since then the question has been left to the various state and local authorities, with the result that daylight legislation has been sporadic and intermittent. Daylight saving was observed in 1925 in the states of Massachusetts and Rhode Island by virtue of state laws, and by municipal ordinance in the New York Metropolitan district, Philadelphia, Chicago and a number of other cities and towns, but the movement as a whole has lost ground.

DAYTON, O., U.S.A. (*see* 7.877), made a remarkable recovery from its losses in the floods of March 1913, which covered 7 sq. m. of its area, including the business district and large residential sections, the water standing 12 ft. deep on Main street. A pestilence was only averted by prompt and energetic measures. A relief fund of $750,000 was disbursed by the American Red Cross and the Citizens' Relief Committee. To prevent a recurrence of the catastrophe, the Miami Conservancy District, formed in 1915 under the provisions of a state law of 1914, constructed a series of dry reservoirs at a cost of $35,000,000,

which met successfully the test of severe spring storms in 1922. The total value of the output of the factories rose from $60,378,000 in 1909 to $174,991,000 in 1919 and $187,933,516 in 1923. The population increased from 116,577 in 1910 to 152,559 in 1920, of whom 9,025 were negroes (an increase of 86·4% in 10 years) and 13,165 foreign-born (a decrease of 5·3%); in 1925 the official estimate was 172,942. (*See* Cox, J. M.)

Dayton was the first large city to adopt the commission-manager form of government which came into effect Jan. 1 1914. Between 1910 and 1925, nearly $7,500,000 was spent on public-school buildings. The University of Dayton, until 1920 St. Mary's College, had an enrolment of 1,150 in 1925. The Civic Music League was organised in 1912, and an art institute was established in 1919 in a reconstructed factory building. The importance of Dayton as an aviation centre, the home of Wilbur and Orville Wright, was increased during the War, when the U.S. Govt. located its aviation experiment laboratories at McCook Field. When this became too small, the Wilbur Wright Field was expanded to 5,000 ac. by the gift of the people of Dayton (1924). This was accepted by the War Dept. as the permanent location for the engineering division of the air service.

DEAF AND DUMB.—The effects of deafness upon the physiology and the psychology of the individual necessarily vary according to its history, its degree and its possible physical and mental complications. It is practically impossible to obtain complete or reliable statistics of the incidence of deafness in the general population; or of the history and nature of the affliction.

I. GREAT BRITAIN

The census authorities of Great Britain and Ireland still use headings which, under the circumstances in which these are answered, render the published results both incomplete and unsatisfactory. The Board of Education is the only other official department which issues any statistics on the deaf, and these necessarily relate to children. In his report for 1924, the chief medical officer states that there were, in that year, 3,584 deaf children and 423 partially deaf children in attendance at certified special schools: 288 deaf children and 1,279 partially deaf children were attending public elementary schools or other institutions and 301 deaf children and 79 partially deaf children were at no school or institution, while there were 586 vacancies for such children in the special schools. The incidence of total deafness in children, as shown in the returns of the local education authorities for 1924, was ·81 per 1,000 children; that of partial deafness in the same year was ·35 per 1,000 children. The incidence of deafness in school children varies very widely in different districts and is shown in the chief medical officer's report to be 5·18 per 1,000 children in the Is. of Scilly and ·33 in Southport.

Classification.—The National College of Teachers of the Deaf has for many years past advocated the scientific classification of deaf children for the purposes of instruction according to the history and degree of their deafness and their mental condition. Clearly, the partially deaf, and those who lose their hearing after the habit of speech has been naturally acquired, stand in a different relation to education from the deaf born, whose minds have never been stimulated by heard speech. Up to comparatively recent times, both types were grouped together for instructional purposes, an entirely wrong procedure. The movement to give these children the advantages of a hearing environment and to train them by methods adapted to children who hear is steadily growing, and schools for partially deaf children are increasing in number. This is only part of the classification necessary to ensure that each type and condition of deafness shall receive the special educational care it needs. The London County Council institution for the defective deaf at Rayners is another step in this direction.

International Action.—At the International Conference of Teachers of the Deaf held in London in 1925, which was attended by leading experts from some 15 nations, recommendations were adopted, urging the need for opportunities for the higher education and technical training of the deaf after school age; the establishment of classes for the partially deaf in connection with schools for hearing children, such classes to be taught by specialist teachers of the deaf; the enforcement of a compulsory hearing test in elementary schools, in order to ensure the detection and treatment of deafness in its early stages; the appointment of national committees to enquire into, and report upon, all matters affecting the education, training, industrial and social conditions of the deaf in the various countries represented; and the establishment in every country of a national organisation to promote the general interests of the deaf throughout life. The Conference also decided to organise an international organisation of teachers of the deaf.

The British Association.—The British Deaf and Dumb Association is a national body consisting of deaf adults together with the leaders, hearing and deaf, of the local welfare societies, of which there are some 60 in existence, and is complementary to that of the teachers. The main consideration of its congress at Southampton was devoted to the industrial and social position of the deaf.

The great advance in the education of the deaf during the 20th century has established their fitness for higher educational and technical training. With this conviction the leaders of the schools and welfare societies for the deaf initiated, in 1923, a movement for the reconstitution of the then national bureau for promoting the general welfare of the deaf, established in 1911, which was reorganised as the National Institute for the Deaf and came into being in April 1925.

The National Institute.—The main attention of the institute has been devoted to the industrial conditions of the deaf, the conditions of the deaf in poor law institutions and mental hospitals and the care of the blind-deaf. One of the greatest needs at the present time is the establishment of provision for the training of the deaf who leave school, in skilled trades in order to prevent the wastage of intelligence and ability now too common.

In Great Britain the compulsory education of deaf children has been operative since 1894. No official enquiry has yet been made into the conditions and needs of the deaf after school age; and the committee of the National Institute are of opinion that the appointment of a departmental committee for this purpose is long overdue.

The general objects of the Institute are:—

The prevention of deafness; the education of the deaf, including the proper administration of the law affecting the attendance of deaf children at suitable schools, and the furtherance of their early training; the re-education of the partially deaf through speech-reading; the provision of efficient training in trades for children leaving school, and of opportunities for continued academic study; the adjustment of official and trade regulations, where they operate harshly against the deaf worker; the provision of opportunities for the higher education of the deaf; the adequate care of the blind-deaf and the mentally defective deaf; the social elevation and fuller citizenship of the deaf; supplying information to, and advising public departments, private bodies and individuals needing this assistance; and generally by propaganda, whether in the way of local or national action, to influence the public in favour of the deaf, with a view to bringing about necessary reforms. (F. G. B.)

II. THE UNITED STATES

During the years 1910–25 the number of schools for the deaf in the United States increased from 145 to 167. The school attendance during the same period has grown from 13,540 to 15,473. It is not likely that this increase in number of pupils means an increase in the actual percentage of deaf children in the United States, but that it is due to the passage of more compulsory school laws and to the more careful execution of such laws. Probably the increase is partly due also to the increasing tendency to transfer hard-of-hearing children, who are dropping behind in the ordinary public schools, to special schools for the deaf. The increase in the number of schools is largely confined to the establishment of small day schools, particularly in the middle western states.

Entirely new school plants have been built in Connecticut at Hartford, in Tennessee at Knoxville and in New Jersey at Trenton. These new plants are of three distinct types: the first, single building to include all the activities of the school; the second, a group of buildings separating the activities to some

extent; and the plant at Trenton, a highly divided plant with many cottages accommodating small groups of children only. It is worthy of note that the plant in construction at the Tennessee School was designed and built under the direction of a deaf architect, a graduate of Gallaudet College. Many other schools have added to their physical equipment, particularly to their primary departments and their trades schools.

Labour bureaus for the deaf have been established as part of the state government in North Carolina and Minnesota, for the purpose of aiding deaf workers to obtain employment. Social workers to keep in touch with both the young and the adult deaf have been appointed in the states of Illinois, Pennsylvania and Minnesota. Considerable attention has recently been given in educational work for the deaf to the training of residual hearing and the improvement of speech and accent by the use of musical instruments, such as the piano. Various electrical inventions have been placed upon the market for use with hard-of-hearing pupils, some of which can be operated by one teacher for a whole class. Such instruments, however, are yet in their experimental stage, as far as value in educational work goes.

The course of instruction at Gallaudet College, which receives graduates from various state, city and private schools of the country, has been extended to include practical work for the men, such as printing, mechanical drawing, agriculture and chemistry. Courses in library cataloguing, domestic art and domestic science have been added for the benefit of the women students.

A survey of over 40 schools in the United States was undertaken in 1925 by the National Research Council. It covered, among other questions, that of hearing, speech and speech-reading powers of pupils, causes of deafness, courses of study given in schools, trades taught, laws under which the schools operate and the general equipment for instruction of pupils. Schools visited were both of the institutional and the day-school type. The results of this survey are being published in the *American Annals for the Deaf*. They already seem to show the need of more attention to auricular work and of better speech teaching in the American schools.

DEAKIN, ALFRED (1856–1919), Australian statesman, was born at Melbourne Aug. 3 1856. Educated at the University of Melbourne, for a time he worked as a journalist, being called to the Victorian bar in 1877. He entered the Victorian Legislature in 1878 and held several important ministerial posts. He played a prominent part in the Federation movement and, in 1901, as attorney-general, was included in the first Federal Cabinet of Sir Edmund Barton, whom he succeeded as Prime Minister in 1903. During his legislative career in Victoria he was active in promoting social legislation and an ardent advocate of preference in favour of Great Britain. This fiscal policy he pursued during his three Federal premierships (1903–4, 1905–8, 1909–10), and supported Australia's co-operation in Imperial defence, being responsible for the reception of the measure authorising Australian naval construction in 1909, and for the invitation to Lord Kitchener to visit Australia and report on the question of defence. After 1910 he led the Opposition in the Australian Parliament until compelled to retire owing to ill-health in 1913. He died Oct. 7 1919.

DEATH: WHY AND WHEREFORE (*see* 7.898).—The life cycle of individual multicellular organisms, standing relatively high in the scale of organic specialisation, as for example, a fly, a bird or a man, is typically divisible into five biologically differentiated, and usually distinct, phases as follows: (*a*) The formation of the *zygote*, which is the individual, by the union of ovum and spermatozoon in the process called fertilisation. The life-history of the individual, as a distinct and biological entity, begins with this event. (*b*) The period of *development and growth*, which has two sub-phases, commonly designated respectively as embryonic or foetal, and post-embryonic or post-natal. The duration of this growth phase of the life-cycle in time varies widely in different organisms, as from 8 to 10 days in the fruit fly, *Drosophila*, to more than 20 years in man.

This developmental and growth phase finally comes normally to an end in most forms of higher animal life, and is succeeded by (*c*) the phase of *adult stability*, in which no marked changes are observable either in the direction of growth or degeneration. This phase is the " prime of life " in common parlance. Its duration in time is again widely variable. Sooner or later the individual can be observed to have passed definitely into the next phase of the life-cycle, which may be designated (*d*) the period of *senescence*. This phase is characterised by a progressive waning in the intensity of the vital processes generally, accompanied by regressive and degenerative changes in the structures of the body. The duration in time of this portion of the life-cycle again varies greatly, but ultimately, in all the more highly specialised organisms, the life of the individual, as such, comes to an end with the terminal event of the cycle (*e*) *death*. By this term is designated the cessation of all vital capacity.

The Cycle of Life.—In the cycle of individual life as outlined, the most significant phases biologically are obviously (*b*) growth and (*d*) senescence. Phases (*a*) and (*e*) (fertilisation and death) are the terminal events of the important periods (*b*) and (*d*). Phase (*c*) is transitional between (*b*) and (*d*), and may be wholly absent, as when obvious senescent changes follow immediately upon the cessation of obvious growth. Indeed it is doubtful if phase (*c*) has theoretically any place in the life-cycle at all. Perhaps in cases where a stable adult plateau in the middle of the cycle seems to exist, it merely means that the changes of growth or of senescence are proceeding at too slow a rate to be observable by the relatively crude methods available.

Senescence and Death.—The special problem of the biology of death is the analysis and elucidation of phases (*d*) and (*e*) of the life-cycle, senescence and death. As a result of investigations in this special field of general biology certain broad generalisations are now possible. The more important of these will now be discussed.

Time Duration.—The time duration of the entire individual life-cycle varies enormously, both as between different forms of life, species, genera, families, etc., and also as between different individuals belonging to the same species. Thus the maximum duration of life of the rotifer, *Proales decipiens*, is 8 days (Noyes). At the other extreme there are other authentic records of individual reptiles living to as much as 175 years, and of individual birds and mammals living to well over 100 years.

Zoological Groups.—The differences between distinct groups of animals (species, genera, families, etc.) in respect to the length of the life-span stand in no generally valid, orderly relationship to any other broad fact now known in their structure or life-history. In spite of many attempts to establish such relationships every one so far suggested has been upset by well-known facts of natural history. Thus it has been contended that the duration of an animal's life is correlated with its size, in the sense that the larger the animal the longer its life. But plainly this has no general validity. Men and parrots are smaller than horses, but have life-spans of much greater length.

Individual Differences.—The differences between individuals of the same species in the duration of their lives are distributed in a lawful and orderly manner, in marked contrast to the apparently haphazard character of the inter-group variation in length of life-span just discussed. The individual variation in the duration of life is capable of exact mathematical description, and, indeed, its treatment constitutes a special branch of mathematics, known as actuarial science. It has been shown by Pearl and his students that if the life of different animals, such as the rotifer, *Proales*, the fly, *Drosophila*, various other insects and man, be measured not in absolute time-units of years or days, but in terms of a relative unit, namely a hundredth part of the biologically equivalent portions of the life-span in the several cases, then the distribution of individual variation in duration of life, or the distribution of mortality in respect to age, or, in short, the life-curve, is quantitatively similar in these widely different forms of life almost to the point of identity. This is illustrated in fig. 1.

These facts suggest that the observed differences between individuals in duration of life are primarily the result of inborn differences in their biological constitutions (their structural and functional organisations) and only secondarily to a much smaller

degree the result of the environmental circumstances in which their lives are passed. This inference is supported by the further fact that:—

Inheritance.—The differences between individuals which find expression in varying degrees of longevity, or duration of life, are definitely inherited. This has been demonstrated statistically

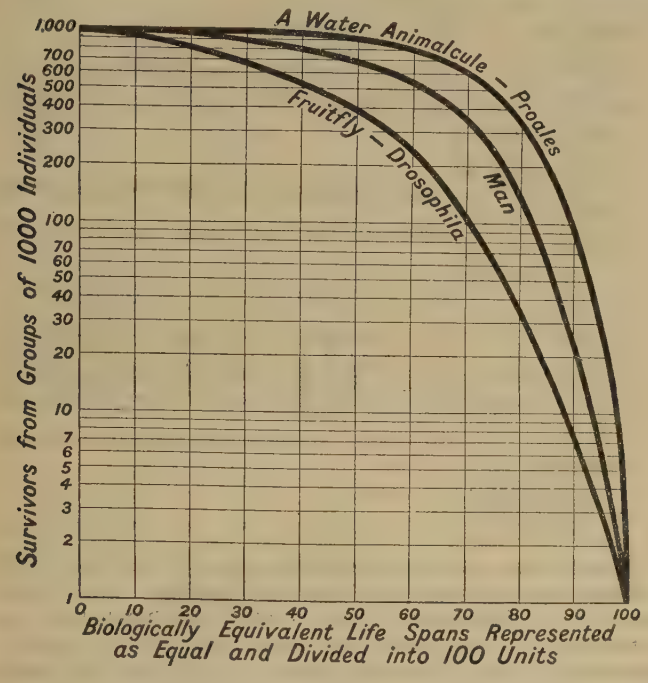

FIG. 1.—These curves show the survival rates for man, a fruit fly (Drosophila) and a water animalcule (Proales) at corresponding ages. The remarkable similarity of these curves shows that actuarial tables constructed for man would apply with little change to these other animals, although the fruit fly lives, on the average, about 50 days and the water animalcule less than 8 days.

for man by Karl Pearson, Alexander Graham Bell, Pearl and others. It has been proved experimentally by cross-breeding long-lived and short-lived strains of the fruit fly, *Drosophila melanogaster* (Hyde, Pearl and his students, Parker and González). The results of such an experiment are shown in fig. 2.

In the first generation (F_1) from such a cross the progeny exhibit a life-curve essentially like that of the long-lived parent stock, but with a slightly greater average duration. If now these F_1 individuals are bred together *inter se* there are produced in the second cross-bred generation (F_2) two kinds of individuals, one of which (long-winged) has a life-curve like the original long-lived parent stock, while the other (short-winged) resembles in duration of life the original short-lived parent stock. In addition to these experiments along Mendelian lines, it has been shown that there can be isolated from a general population of wild *Drosophila* inbred strains showing definite and permanent innate differences in average longevity. The conclusion that individual differences in life duration are fundamentally an expression of hereditary differences between individuals is firmly established.

Natural Death a Novelty.—Neither senescence nor natural death are necessary, inevitable consequences or attributes of life. Natural death is biologically a relatively new thing, which made its appearance only after living things had advanced a long way on the path of evolution. The evidence supporting this conclusion is manifold, and may be considered under several heads. (*a*) Various single-celled organisms (*Protozoa*) have proved, under critical experimental observation, to be immortal. They reproduce by simple fission of the body, one individual becoming two, and leaving behind in the process nothing corresponding to a corpse. The brilliant work of Woodruff and his students, in particular, has demonstrated that this process may go on indefinitely, without any permanent slacking of the rate of cell division corresponding to senescence, and without the intervention of a rejuvenating process such as conjugation or endomixis, providing the environment of the cells is kept favourable. (*b*) The germ cells (ova and spermatozoa) of all sexually differentiated organisms are, in a similar sense, immortal. Reduced to a formula we may say that the fertilised ovum (united germ cells) produces a soma and more germ cells. The soma eventually dies. Some of the germ cells prior to that event produce somata and germ cells, and so on in a continuous cycle which has never yet ended since the appearance of multicellular organisms on the earth. (*c*) In some of the most lowly organised groups of many-celled animals or *Metazoa*, the power of multiplication by simple fission, or budding off of a portion of the body which reproduces the whole, is retained. This asexual, or agamic, mode of reproduction occurs as the usual, but not exclusive, method in the three lowest groups of multicellular animals, the sponges, flatworms and coelenterates. More rarely it may occur in other of the lower invertebrates.

So long as reproduction goes on in this way in these multicellular forms there is no place for death. In the passage from one generation to the next no residue is left behind. Agamic reproduction and its associated absence of death also occurs commonly in plants. Budding and propagation by cuttings are the usual forms in which it is seen. The somatic cells have the capacity of continuing multiplication and life for an indefinite duration of time, so long as they are not accidentally caught in the breakdown and death of the whole individual in which they are at the moment located. (*d*) There is some evidence that in certain fish there is no occurrence of senility or natural death, but that instead the animal keeps on growing indefinitely, and would be immortal except for accidental death. The animal soma in such

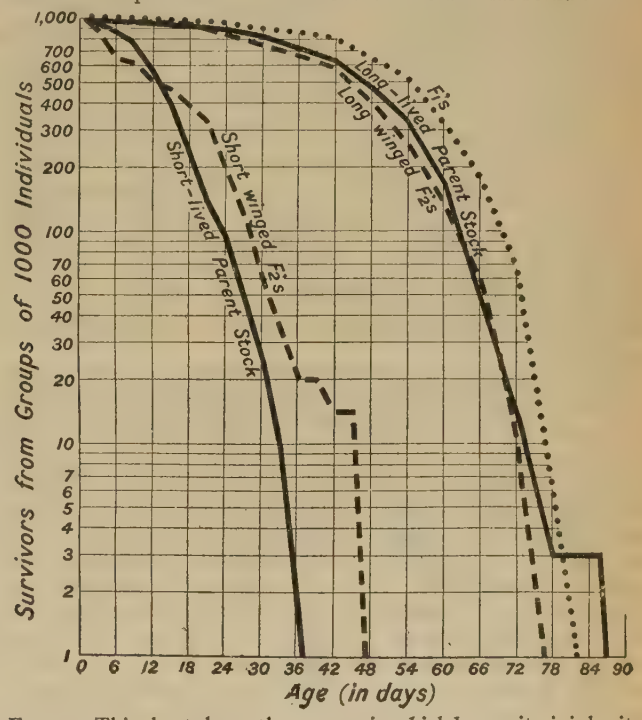

FIG. 2.—This chart shows the manner in which longevity is inherited among fruit flies (Drosophila) when a long-lived stock is crossed with a short-lived one (both represented by an unbroken line). The first generation of progeny (dotted line, F_1's) is longer-lived than either parent stock. The first generation, when inbred, produces progeny of two kinds (broken lines, F_2's): a short-winged, which approximates in length of life the short-lived ancestral stock, and the long-winged, which approximates the long-lived one. The Mendelian laws of heredity are thus seen to hold, in the case of these fruit flies, for longevity, which is thereby shown to behave like a definitely inheritable quality.

cases behaves like the root stock of a perennial plant. (For further discussion of this line of evidence see interesting correspondence by Geo. P. Bidder, in *Nature*, vol. 115, Jan. to June 1925, *passim*.)

(*e*) The successful cultivation *in vitro* of the tissues of higher vertebrates, even including man himself, over an indefinitely long period of time, demonstrates that senescence and natural death are in no sense necessary concomitants of cellular life. Carrel and Ebeling, by transferring the culture at frequent intervals into fresh nutrient medium, have kept alive for more than 14 years, and in perfectly normal and healthy condition, a culture of tissue (*see* TISSUE CULTURE) from the heart of a chick embryo. There is every reason to suppose that, by the continuation of the same technique, the culture can be kept alive indefinitely. The experimental culture of cells and tissues *in vitro* has now covered practically all of the essential tissue elements of the metazoan body, even including some of the most highly differentiated of those tissues. Nerve cells, muscle cells, heart muscle cells, spleen cells, connective tissue cells, epithelial cells from various locations in the body, kidney cells and others have all been successfully cultivated *in vitro*.

Potential Immortality.—It may fairly be said that the potential immortality of all essential cellular elements of the body either has been fully demonstrated, or has been carried far enough to make the probability very great, that properly conducted experiments would demonstrate the continuance of the life of these cells in culture to any indefinite extent. It is not to be expected, of course, that such tissues as hair or nails would be capable of independent life, but these are essentially unimportant tissues in the animal economy, as compared with those of the heart, the nervous system, the kidneys, etc. Generalising the results of the tissue culture work of the last two decades it is highly probable that the cells of all the essential tissues of the metazoan body are potentially immortal, when placed separately under such conditions as to supply appropriate food in the right amount, and to remove promptly the deleterious products of metabolism.

Death among Multicellular Animals.—A fundamental reason why the higher multicellular animals do not live forever appears to be that in the differentiation and specialisation of function of cells and tissues in the body as a whole, any individual part does not find the conditions necessary for its continued existence. In the body any part is dependent for the necessities of its existence, as for example nutritive material, upon other parts, or put in another way, upon the organisation of the body as a whole. It is the differentiation and specialisation of function of the mutually dependent aggregate of cells and tissues which constitute the metazoan body that brings about death, and not any inherent or inevitable mortal process in the individual cells themselves.

When cells show characteristic senescent changes it is probably because they are reflecting, in their morphology and physiology, a consequence of their mutually dependent association in the body as a whole, and not any necessary progressive process inherent in themselves. In other words, in the light of present knowledge, it seems necessary to regard senescence as a phenomenon of the multicellular body as a whole resulting from the fact that it is a differentiated and integrated morphologic and dynamic organisation. This phenomenon is reflected morphologically in the component cells. But it does not primarily originate in any particular cell because of the fact that the cell is old in time, or because that cell in and of itself has been alive; nor does it occur in the cells when they are removed from the mutually dependent relationship of the organised body as a whole and given appropriate physico-chemical conditions. In short, senescence appears not to be a primary attribute to the physiological economy of individual cells as such, but rather of the body as a whole. The suggestion of Bidder that in air-breathing animals senescence and death are the alternative to physically impossible gigantism is essentially another way of expressing this idea.

Times of Death.—The different organ systems of the body have characteristic times of breaking down and leading to death. These differences probably represent in considerable part different innate degrees of organic fitness of the different tissues and organs, and also in part the degree of exposure of the different organ systems to environmental stresses and strains. The following table, based upon mortality returns of the U.S. Registration Area in 1910, illustrates these differences. The figures tabulated are (*a*) the mean or average age at death, and (*b*) the median age at death (that is, the age so chosen that the same number of deaths occur below this age as the number occurring above it).

Deaths due primarily to organic breakdown or failure of	Mean age at death (years)		Median age at death (years)	
	Male	Female	Male	Female
1. Alimentary tract and associated organs of digestion	25·54 ± ·06	28·24 ± ·07	4·98 ± ·08	14·93 ± ·09
2. Respiratory system	32·24 ± ·05	32·57 ± ·06	31·86 ± ·07	28·24 ± ·08
3. Skeletal and muscular system	35·09 ± ·29	37·96 ± ·32	33·02 ± ·36	35·96 ± ·41
4. Endocrinal system	44·17 ± ·82	44·15 ± ·36	45·45 ± 1·03	43·42 ± ·46
5. Skin	46·73 ± ·34	42·45 ± ·46	53·47 ± ·43	48·96 ± ·58
6. Sexual system	47·37 ± ·32	42·47 ± ·08	57·96 ± ·40	40·88 ± ·11
7. Nervous system	49·11 ± ·08	51·56 ± ·09	54·64 ± ·10	60·29 ± ·12
8. Circulatory system and blood	54·50 ± ·07	54·25 ± ·08	62·04 ± ·09	62·14 ± ·09
9. Excretory system (kidneys and associated organs)	57·94 ± ·07	54·24 ± ·09	61·37 ± ·09	57·50 ± ·11

There are thus wide differences in the time of breakdown of the different organ systems, as reflected in mortality. The alimentary tract, on the average, " wears " rather less than half as long as the excretory system. The two organ systems which stand at the head of the list as leading earliest to death by their breakdown are the two (alimentary tract and respiratory system) which are in direct contact with external environmental agents (food and air) throughout life. The two which stand at the bottom of the list (the circulatory and excretory systems) practically never come into direct contact with the external environment.

Rejuvenation.—In recent years numerous attempts have been made to bring about " rejuvenation " of the ageing body, and to lengthen the span of life by various surgical alterations of certain endocrinal organs, particularly the essential organs of sex (*see* REJUVENATION). Whatever may be the immediate physical and psychological effects of such procedures, there is as yet no convincing evidence that they alter the expectation of life of the individual.

Senescence.—Many theories of senescence have been advanced. No one of them can be regarded as entirely satisfactory, or as generally established by the evidence. Most of them suffer from the logical defect of setting up some particular observed attribute or element of the phenomenon of senescence itself, such as protoplasmic hysteresis, slowing rate of metabolism (meaning essentially only reduced activity), etc., as the cause of the whole. More experimental work on the problem is essential; in particular in the direction of producing at will, and under control, the objective phenomenon of senility irrespective of the age of the organism, and conversely preventing the appearance of these phenomena in old animals.

LITERATURE.—The literature on the subjects treated in this article is widely scattered in biological, medical and statistical journals and separate treatises. The following books summarise the field, and will serve to introduce the reader to the detailed literature: C. M. Child, *Senescence and Rejuvenescence* (1915); E. Korschelt, *Lebensdauer, Altern und Tod* (1922); R. Pearl, *The Biology of Death* (1922); T. Brailsford Robertson, *The Chemical Basis of Growth and Senescence* (1923); *Studies in Human Biology* (1924). (R. PE.)

DEATH-RATE: *see* POPULATION.

DE BOSIS, ADOLFO (1863–1924), Italian poet and man of letters, was born at Ancona. He studied at the University of Rome, where he graduated in law and practised for a few years, but was always more interested in literature. In 1895 he became editor of *Il Convito*, a literary review to which D'Annunzio and

other distinguished writers contributed. Although he was afterwards largely absorbed by business affairs, as manager of the Italian Carbide Company, he continued his literary activities and made his reputation as the translator of Shelley (*Il Prometeo liberato*, 1922) and Homer into Italian verse. He was also an original poet of considerable distinction, and in 1900 he collected his own poems in a volume entitled *Amori ac silentio sacrum*, which was republished in 1914, together with *Le rime sparse*, and again in 1923. He was not a prolific writer, but he exercised considerable influence on the younger authors of his time, many of whom were inspired by his deep love of the classics and keen sense of beauty. He died near Ancona Aug. 29 1924.

DEBS, EUGENE VICTOR (1855–), American politician, was born at Terre Haute, Ind., Nov. 5 1855. On leaving the public schools he became in 1871 a locomotive fireman. In 1879 he was elected city clerk of Terre Haute and in 1881 was re-elected. During 1885 he was a member of the Indiana Legislature. Previous to this, in 1880, he was elected secretary and treasurer of the Brotherhood of Locomotive Firemen and was appointed editor of *The Locomotive Firemen's Magazine*. In 1893 he organised the American Railway Union and was elected president of the Union, serving four years. In 1894 he led the strike which, beginning in the Pullman-car plants, soon involved the railways leading into Chicago (*see* 6.124).

Debs was arrested on a charge of conspiracy to kill, and acquitted, but was later convicted of contempt of court for violating an injunction, and sent to gaol for six months (May–Nov. 1895). In 1897 he allied himself with the socialist movement. He was Socialist candidate for the presidency of the United States in 1900, 1904, 1908, 1912, but declined the nomination in 1916. In 1907 he was on the editorial staff of the *Appeal to Reason* and in 1914 became editor-in-chief of the *National Rip-Saw*, a Socialist paper published at St. Louis. He was a pacifist and in Sept. 1918 was convicted of violating the Espionage Act and sentenced to 10 years in the penitentiary. In 1920, while in prison, he was again nominated presidential candidate by the Socialists and received 915,302 votes. His sentence was commuted by President Harding in Dec. 1921. He is the author of *Unionism and Socialism; a Plea for Both* (1904).

DEBTS, INTER-ALLIED.—An examination of the methods by which the Allies financed the cost of the War (that is to say, the difference between normal pre-War expenditure and actual expenditure for the period 1914–9 inclusive) can only give approximate results, but it is estimated that of the total War expenditure 6% was met by taxation, 77·2% by home borrowing, 14·5% by loans between the Allied Govts. themselves and 2.3% by borrowing in other foreign countries. In general the funds placed by the Allies at each other's disposal were utilised, not for internal expenditure by the borrowing country, but for purchase in the lending country of military stores and supplies and, in certain cases, for exchange stabilisation and interest payments on pre-War external loans. At one time or another during the War all the Allies employed this means of obtaining funds abroad, but only three of the Allied and Associated Powers acted to any appreciable extent as lenders, namely Great Britain, the United States of America and France, the advances made by Italy being comparatively unimportant. It is extremely difficult to arrive at any accurate estimate of the total sum of these transactions, the details of which are still the subject of dispute between the governments concerned. In the majority of cases, however, official statements have now been published by the various creditors showing the total amount claimed by them from each of their debtors (*see* CURRENCY).

I. STATEMENT OF LOANS AND FUNDING AGREEMENTS

Great Britain.—For Great Britain the figures in Table I. are taken from a statement made by the Chancellor of the Exchequer (Mr. Churchill) in the House of Commons on July 27 1925. They show the amount of the original advances and, after addition of interest due and deduction of principal and interest repaid in cash, the net amount due on June 30 1925. The Belgian pre-Armistice debt of £110,000,000 is not given, as, under the Treaty of Versailles, this is a charge on German Reparations. The figures do not include loans made to the Dominions for War purposes, but do include advances made to certain new and ex-enemy states as well as to Allies, in the period immediately following the War:—

TABLE I.

Loans Advanced by Great Britain to Certain Countries for War and Post-War Purposes as at June 30 1925

(In thousands of £)

	Original Advances	Debt at June 30 1925
Allied Govts.		
France	446,226	626,182
Russia	483,321	756,705
Italy	369,824	589,530
Serb-Croat-Slovene kingdom	22,383	29,905
Rumania	16,401	26,124
Portugal	15,611	22,678
Greece	16,391	21,237
Belgium (post-Armistice)	6,799	..
Total A	1,376,956	2,072,361
Loans for Relief		
Austria	11,578	11,341
Rumania	1,892	2,200
Serb-Croat-Slovene kingdom	1,884	2,388
Poland	3,682	4,770
Czechoslovakia	461	474
Estonia	241	251
Hungary	109	109
Armenia	88	111
Lithuania	17	..
Latvia	20	..
Loans for Reconstruction		
Belgium	9,000	9,000
Belgian Congo	3,550	3,550
Other Loans—Stores, etc.		
France	6,726	4,500
Greece	395	395
Armenia	747	908
Czechoslovakia (Wheat Loan)	1,901	..
Baltic States	2,435	2,435
Repatriation of Prisoners		
Czechoslovakia	827	827
Poland	168	168
Rumania	138	138
Serb-Croat-Slovene kingdom	187	187
Latvia	130	130
Total B	46,176	43,882
Total A and B	1,423,132	2,116,243

TABLE II.

Loans Advanced by the United States to Certain Countries for War and Post-War Purposes

(In thousands of dollars)

Country	Principal of Liberty Loan Acts Advances	Principal of Surplus Stores and Relief Credits	Total Principal
Armenia	..	11,960	11,960
Austria	..	24,056	24,056
Belgium	349,214	29,873	379,087
Cuba	10,000	..	10,000
Czechoslovakia	61,974	29,906	91,880
Estonia	..	13,999	13,999
Finland	..	8,282	8,282
France	2,997,478	407,341	3,404,819
Great Britain	4,277,000	..	4,277,000
Greece	15,000	..	15,000
Hungary	..	1,686	1,686
Italy	1,648,034	..	1,648,034
Latvia	..	5,132	5,132
Liberia	26	..	26
Lithuania	..	4,982	4,982
Nicaragua	..	167	167
Poland	..	159,667	159,667
Rumania	25,000	12,922	37,922
Russia	187,730	4,871	192,601
Yugoslavia	26,780	24,978	51,758
Total	9,598,236	739,822	10,338,058

Great Britain's only debt to another Allied Govt. was that of $4,277,000,000 to the United States. As will be seen from the above, her advances to Allies greatly exceeded the amount borrowed from the United States.

United States.—The United States was a creditor only; and after entry into the War in April 1917 incurred the main responsibility for financing the Allies. Great Britain was the principal debtor, but a considerable proportion of the funds which she obtained in this way were re-advanced by her to the other Allies. After the Armistice large sums were provided by the American Govt. for relief credits in Central Europe and for purchases of War stores. Table II. on p. 829 shows the total loans to the Allies and Hungary as given in the annual statement of the Secretary of the United States Treasury for 1925.

The majority of these loans have since been the subject of funding agreements, as the following official statement shows:—

TABLE III.

Funding Agreements of Certain Countries with the United States
(In thousands of dollars)

Country	Date of Agreement	Principal of Obligations Funded	Accrued Interest Funded	Funded Bonds Received or to be Received
Belgium	Aug. 18 1925	377,030	40,750	417,780
Czechoslovakia	Oct. 13 1925	91,880	23,120	115,000
Estonia	Oct. 28 1925	12,066	1,764	13,830
Finland	May 1 1923	8,282	718	9,000
Great Britain	June 19 1923	4,074,818	525,182	4,600,000
Hungary	April 25 1924	1,686	253	1,939
Italy	Nov. 14 1925	1,647,869	394,131	2,042,000
Latvia	Sept. 24 1925	5,132	643	5,775
Lithuania	Sept. 22 1924	4,982	1,048	6,030
Poland	Nov. 14 1924	159,667	18,893	178,560
Rumania	Dec. 1 1925	36,128	8,462	44,590
Total		6,419,540	1,014,964	7,434,504

N.B.—Cuba has repaid her debt in full.

France.—The position of France, which, like Great Britain, was both a borrower and a lender, is more obscure. In the first place, she has as yet (1926) made no final funding arrangements with either Great Britain, from whom she borrowed £446,226,000, or the United States, from whom she received $3,404,000,000. On the other hand, she advanced considerable sums to Russia and the smaller Allies; here, too, no refunding arrangements have been made, and in many cases the exact amount is in dispute. In the inventory of the French financial position laid before the Chamber in Dec. 1924 by M. Clémentel, the then Minister of Finance, the following list is given of advances made by France with the note that it must be taken as a general indication of the position as at June 30 1924 and not as a statement of exact figures. Foreign currencies are converted into francs at the rates ruling on June 30 1924, when the American exchange was 19 fr. to the dollar.

War and Post-War Loans Made by France Outstanding on June 30 1924

	Thousand francs
Russia (old régime)	6,023,300
Russia (various later governments)	490,000
Belgium	3,067,295
Yugoslavia	1,738,566
Rumania	1,132,000
Greece	537,514
Poland	895,400
Czechoslovakia	542,200
Italy	350,273[1]
Portugal	9,000
Estonia	3,500
Latvia	9,000
Lithuania	2,300
Hungary	800
Austria	331,926
	15,133,074

[1] This represents net debt due to France and is at variance with published Italian figures.

Italy.—Italy was in the main a borrower, although to some extent she made advances to other Allies. After her entry into the War in May 1915 she borrowed from Great Britain £369,824,000 and from the United States $1,648,000,000. According to official figures her loans to other Allies were as follows, but certain of the items in the French account are in dispute. Foreign currencies are converted at the rates ruling on April 23 1926.

	In thousand lire
Rumania	189,936
France	292,380
Russia	63,000
Yugoslavia	56,000
Greece	5,000
Austria	1,730,000
	2,336,316

Russia.—Russia, on the other hand, was entirely a borrower. Her loans from Allied Govts. up to the time of the revolution in 1917 were as follows:—

Great Britain	£483,321,000
United States	$187,729,750
France	fr. 6,023,300,000
Italy	lire 36,045,000

Other Allies.—Belgium was also a borrower, and received considerable sums from the United States, Great Britain and France. As a recognition, however, of the damage done consequent on the violation of the treaty of 1839, Germany undertook in Article 232 of the Treaty of Versailles "to make reimbursement of all sums which Belgium has borrowed from the Allied and Associated Govts. up to Nov. 11 1918, together with interest at the rate of 5% per annum on such sums." At the time of the Peace Conference the representatives of Great Britain, France and the United States agreed, subject to ratification by their Governments, to accept German bonds to the value of the Allied pre-Armistice loans to Belgium, thus freeing Belgium from the responsibility of these debts. This was eventually carried out by Great Britain and France. The United States Congress, however, refused to ratify the agreement, and the pre-Armistice debt was the subject of a special arrangement in the subsequent Belgian Debt Funding agreement. For the sake of convenience, the following table gives the advances made by each of the Allies during both periods:—

	Pre-Armistice	*Post-Armistice*
Great Britain	£110,000,000[1]	£18,500,000
United States of America	$171,780,000	$207,307,194
France	fr. 3,219,474,742[1]	fr. 241,472,300

[1] Including interest at 5%.

Of the other Allies, Rumania, Yugoslavia, Greece, Portugal, Armenia, Nicaragua and Liberia were all borrowers, while after the Armistice the new States of Poland, Czechoslovakia, Finland, Lithuania, Latvia and Estonia received advances for various purposes, and Austria and Hungary, of the ex-enemy states, received relief credits. The actual amounts loaned can be seen from the preceding tabulations.

II. HISTORY OF THE LOANS

Any attempt to trace in detail the development of Inter-Allied borrowings, of which the above official figures represent the present position, must be one of great difficulty. For the greater part no authoritative information has been made available as to the dates at which these various obligations were incurred, and the figures given in the following survey must be taken as mere estimates. For the sake of convenience the history of these loans may be divided into three periods:—

First Period: 1914-7.—Up to the end of 1914 the various Allies were able in the main to finance their own foreign purchases. Russia, however, soon found herself in difficulties. Unlike Great Britain and France, her Government was unable to command large funds abroad, while her incapacity to manufacture munitions on a sufficiently large scale necessitated heavy purchases from her Allies. In addition, considerable sums were required for the payment of interest on the existing external debt. As

early as Oct. 1914 she had been forced to apply to the British Govt. for assistance, and a credit of some £11,500,000 was opened on her account at the Bank of England against a shipment of gold to the value of £8,000,000. At the end of the year a further credit was granted, and in Feb. 1915 at a meeting in Paris the British, French and Russian Finance Ministers agreed to unite their financial resources, to share the advances made to Allied Govts., to issue a joint loan and to co-operate in the purchase of supplies abroad. Actually the second proposal was never carried out, but as a result of this and subsequent conferences large funds were raised for Russia in both France and England by the sale of Russian Treasury Bills on the open market and by the extension of governmental credits against a small proportion of gold from the Russian reserve. It is estimated that Russia, during the period 1914–Sept. 1917, borrowed £483,000,000 from the British Govt., against a deposit of gold in London of £60,000,000, and 6,000,000,000 fr. from the French Government. She also obtained credits from the United States Govt. between the months of April and Sept. 1917. In the United States and Japan, moreover, considerable sums were placed at her disposal by the British Government.

The next country to find difficulty in financing its War requirements abroad was France. In Oct. 1914 she had found it advisable to arrange for the issue of Treasury Bills on the London market. By May 1915 some £10,000,000 worth of these bills had been placed, and by the end of that year the figure of open market borrowings had risen to £33,000,000 and to £80,000,000 in 1917. In May 1915 it was agreed that the British Govt. should grant France substantial credits against shipments of gold in the proportion of three to one. This system lasted until the end of 1916, when the shipment of gold ceased. During the same period France raised considerable sums on the American market, of which the most important was the joint Anglo-French loan for $500,000,000 in Oct. 1915, repaid in 1920. France, during this period, borrowed altogether nearly £200,000,000 from the British Govt. and dispatched to London some £53,500,000 in gold. To the other Allies the French Govt. lent approximately 6,500,000,000 francs.

Great Britain during this period loaned to her Allies over £900,000,000. In addition to the above-mentioned advances to France and Russia, £60,000,000 were advanced to Belgium and £27,000,000 to Rumania, Serbia, Greece and Portugal. Up to Oct. 1915 Great Britain had not had occasion to borrow in the United States, but it was found impossible to maintain the American exchange unless funds were available to cover the greatly increased purchases there of war materials. The joint Anglo-French loan was raised on the market without other security than the credit of the two governments, but all moneys subsequently raised in America during this period took the form of credits or secured notes, collateral being deposited in each case. For this purpose the British and French Govts. encouraged their nationals either to sell or lend to the Government their holdings of American securities, which were either sold for dollars or employed as collateral.

Italy did not enter the War until May 1915, and from then until the end of this period confined her borrowing to the United Kingdom (with the exception of a small amount raised in Canada). Credits to the extent of some £153,000,000 were granted to her by the British Govt., gold to the value of £22,200,000 being deposited in London as security. On the other hand, she herself advanced about 63,000,000 lire to Russia. Her advances to France during this period are in dispute.

The Second Period.—This dates from April 1917, when the United States entered the War, till the Armistice in Nov. 1918. Towards the end of the previous period the Allies were beginning to grow anxious as to their ability to continue the purchase of supplies in America on the then existing scale for an indefinite period. Accordingly, one of the first acts of the United States Govt. after the declaration of War was to obtain the consent of Congress to a law (Liberty Loan Act) authorising the extension of credits to Allied Govts. up to a total of $3,000,000,000. This limit was subsequently raised three times up to a total of $10,000 million in July 1918. Such credits were granted without collateral and for an indefinite period, and were to bear the same rate of interest and be subject to the same conditions as the corresponding bonds to be issued on the United States market in order to raise the sums required. From that time the American Govt. assumed the responsibility for Allied purchases in the United States. Market borrowings by the Allies ceased with the exception of certain small amounts required for the purpose of refunding existing market loans, some of which, however, were also paid off with the funds obtained from the new credits.

The total advances by the United States Govt. to the governments of the Allies amounted during this period to some $8,200,000,000, of which Great Britain received approximately $4,000,000,000, France $2,800,000,000, Italy $1,030,000,000 and Belgium $171,780,000. Russia received $188,000,000 before the revolution, and certain smaller Allies account for the remainder. During the same period the British Govt. continued to finance the requirements of the Allies in the United Kingdom, and also assisted them by the employment, to a certain extent, of the credits extended to her in America. These credits were principally employed for the purchase there of raw materials required for the manufacture in the United Kingdom of war supplies for the Allies. For, as the needs of the United States Army increased, her ability to meet all the Allied requirements decreased to some extent, and Great Britain endeavoured to take her place. In Aug. 1918, however, it was arranged that each Ally should be debited by America with the cost of the necessary raw materials. In addition, during the early part of 1917 Great Britain advanced funds from her American credits to the Russian Govt. for interest payments due in America. Total loans by Great Britain to her Allies during these years amounted to over £550,000,000, of which France borrowed nearly £250,000,000, Italy £220,000,000 and Belgium £50,000,000. France, on the other hand, in addition to the advances made by Great Britain, borrowed nearly $3,000,000,000 from the United States, and loaned to her other Allies nearly 7,000,000,000 francs. Italy, Russia, Belgium, Serbia and Rumania were all borrowing nations.

Third Period: Nov. 1918–Sept. 1920.—Although the Armistice was signed on Nov. 11 1918, nearly two years elapsed before it was possible for the lending Governments to cease making advances to the other Allies for the payment of goods already supplied or ordered. They were also required to enable the Allies to purchase war stores left by the lending Governments in their territories. In addition, the impoverished condition of Europe made it essential, if complete economic chaos were to be avoided, for relief credits for the purchase of foodstuffs and for reconstruction to be granted not only to the poorer Allies but also to certain of the new states created by the peace treaties, and even to some of the enemy countries.

In the United States there was some doubt after the Armistice as to the legality of granting further credits under the Liberty Loan Acts. These Acts limited advances to the period of the War, and Congress had refused to approve any prolongation. On the other hand, the presidential proclamation announcing the official termination of the War was not published until July 2 1921, and the Administration felt themselves justified in continuing to make advances during the intervening period. The balance of $1,700,000,000 authorised under the Acts was, in this way, advanced to the Allies and utilised by them partly to meet existing contracts in America and partly for the purchase of supplies for the relief of Europe. Moreover, special credits were granted with the approval of Congress to the extent of $740,000,000, of which $600,000,000 were advanced for the sale of War stores to Allied Govts., and $140,000,000 for the sale of flour through the United States Grain Corporation. To this must be added a revolving credit of $100,000,000 opened in favour of the American Relief Administration.

Relief and reconstruction loans by the British Govt. amounted during this period to £32,522,000, loans for the purchase of war stores to £12,205,200 and for the repatriation of prisoners to £1,450,000. Similar advances by France amounted to some 1,500,000,000 fr. and by Italy to approximately 600,000,000 lire.

III. THE DEBT SETTLEMENTS

Before even the last inter-Ally loans had been made, it was clear that the problem of repayment would assume an importance in international politics second only to the question of reparations. Soon after the Armistice it became known that the British Govt. favoured a general cancellation of inter-Ally debts, but the United States was not prepared to agree to such a course. In May 1920 the inter-Ally Conference on Reparations at Hythe declared that it was "important to arrive at a settlement which will embrace the whole body of the international liabilities which have been left as a legacy of the War, and which will at the same time ensure a parallel liquidation of the inter-Ally war debts and of the reparation debts of the Central Empires." This was followed, however, a few days later by a statement by the Chancellor of the Exchequer in the House of Commons to the effect that the question of the United Kingdom debt to the United States of America was being dealt with independently of any question of the part of this country's share of indemnity from Germany. By 1922 the different points of view of the various Allied and Associated Powers on this subject became clearly defined. On Feb. 9 of that year the American Foreign Debt Funding Bill was signed, authorising the refunding of Allied debts to the extent of $11,000,000,000 into securities with a maximum currency of 25 years, carrying interest at a rate of not less than 4¼%, the negotiations to be carried out by a commission of five members (subsequently increased to eight) under the chairmanship of the Secretary to the Treasury. It was, at the same time, made clear that the United States Govt. would not consider the remission of debts due to them from the Allies but would look for repayment in full, though it was recognised that immediate payments would not be possible in every case. This action had a determining effect on the attitude of the Powers concerned towards the whole problem of inter-Ally debts.

The Balfour Note.—Great Britain, which had hitherto made no final pronouncement of policy, was now faced with the necessity of funding her debt to America, and consequently compelled to lay down a principle for dealing with her own debtors. Accordingly, on Aug. 1 1922, a Note was dispatched to the governments concerned which has since formed the basis of British policy. In this communication, commonly known as the "Balfour Note," it was stated that, while Great Britain would have been willing to forego all claims for reparations and the repayment of inter-Ally debts if this had formed part of an universal settlement, she must now ask for some measure of repayment. She would, however, be content with a total sum from her Allies and Germany sufficient to cover her own payments to the United States, though this was equivalent to only one quarter of the amount due to her. The French reply in Sept. was inconclusive and unsatisfactory, and the policy of that country was definitely revealed in Oct. at a meeting of the Reparations Commission.

At this meeting certain proposals were submitted by the British delegate for the settlement of the reparations problem, provided that the question of inter-Ally debts was settled at the same time. The French delegate rejected this scheme and put forward a counter-proposal which definitely made the payment of inter-Ally debts dependent on receipts from reparations. At the inter-Allied Conference in London in Dec. 1922 Signor Mussolini, on behalf of Italy, proposed the cancellation of part of Germany's reparation liability if Great Britain would agree to the cancellation of the debts due to her from her Allies. M. Poincaré elaborated this scheme and offered to hand over forthwith part of the French claim on Germany in payment of her debt to Great Britain and to accept similar terms from her own Allied debtors. Both these proposals were rejected by Mr. Bonar Law. The discussion was continued at the Paris Conference on Reparations in Jan. 1923. At this conference the French Govt. reiterated the principle of the dependence of inter-Ally repayments on German reparations.

The British proposal, which was contingent on the acceptance of their plan for the solution of the reparations question, rested on the basis of the remission of all European Allied debts to the United Kingdom except a small percentage which was to be paid in German obligations, while all German payments over a fixed minimum were to be available for the repayment of European debts to the United States. The failure of the Paris Conference, which was followed by the French occupation of the Ruhr, marked the last attempt to reach any common basis of agreement on this question, although the question was dealt with in the British Note of Aug. 11 1923 addressed to the French and Belgian Govts. regarding the occupation of the Ruhr. In this document the British Govt. offered as part of a general settlement of the Reparation question to accept in full payment of both reparation and Allied debts a sum equivalent to the amount necessary to cover the funded British debt to the United States, which was estimated on a 5% basis at 14·2 milliards of gold marks. The proposals contained in this Note were not accepted by the Allied Govts. concerned.

Anglo-American Funding Agreement.—Meanwhile, the constitution of the United States Funding Commission in Feb. 1922 was immediately followed by preliminary discussions between the British and American governments regarding the debt due from the United Kingdom. It was finally arranged that a British delegation, under Sir Robert Horne (the then Chancellor of the Exchequer), should leave for Washington in Oct. with the object of negotiating a settlement. Owing to the change of Government in Great Britain, its departure was postponed, but a payment of $100,000,000 was made on account—the first Allied payment in respect of interest on war debts. The mission finally sailed early in Jan. 1923 under Mr. Baldwin (the new Chancellor of the Exchequer), and returned to England at the end of the month with a proposed settlement which was accepted by the Cabinet on Jan. 31. Under the terms of this agreement the whole principal sum, which after allowing for interest due to Dec. 15 1922 at 4¼% per annum and for payments already made, was agreed upon at $4,600,000,000, is to be repaid over a period of 62 years in annual instalments increasing from $23,000,000 in the first year to $175,000,000 in the last. Interest is to be paid at the rate of 3% per annum on unpaid balances for the first 10 years and at 3½% for the remainder of the period. The total annual payments on account of interest vary between $161,000,000 and $187,000,000. Great Britain has the right to defer half the interest for the first five years, to anticipate payments and to make payments in U.S. Govt. bonds issued subsequent to April 1917. As these terms were not in accordance with those which the United States Debt Funding Commission was authorised to accept, it became necessary for Congress to approve the agreement, which was done on Feb. 28. On March 15 the first payment under the scheme was made by Great Britain.

Other Funding Agreements.—While the British negotiations were in progress, the United States administration had made their wish to be repaid known to the other countries concerned. The first country to respond was France, which in July 1923 dispatched a mission under M. Parmentier to Washington. No basis of settlement, however, was reached, and negotiations with the Czechoslovak Govt. led to the same negative result. In Oct. the Administration, hearing that the Rumanian Govt. contemplated raising a foreign loan, protested against such action before the American Relief Debt was funded. A Rumanian mission subsequently visited the United States, but failed to come to terms. In March 1923 an agreement was reached with Finland for the funding of its debt of $8,000,000 on the same terms as those accorded to Great Britain. No further settlements were reached until 1924, when an agreement was signed in April with Hungary for the refunding of the Relief credits to the extent of $1,939,000 on similar terms to those accorded to Great Britain and Finland. This was followed by settlements with Lithuania (Sept. 1924) and Poland (Nov. 1924).

In Dec. 1924 the authority of the Debt Funding Commission was extended for another two years and in the following May a *démarche* was made by the United States Govt. to induce the governments whose debts were still unfunded to negotiate for repayment on the basis of the capacity to pay of the debtor. Consequently, in the latter part of 1925 the majority of the remaining Allies either came to terms or initiated discussions. Thus

in Aug. a Belgian delegation arrived at Washington and an agreement was shortly reached by which the debt was divided into two parts. The pre-Armistice debt of $171,780,000 was treated specially, as by the Treaty of Versailles Germany must pay the Belgian war debt as part of her reparations. Belgium undertakes to repay this sum in full over a period of 62 years, but no interest is payable. The post-Armistice debt of $246,000,000 is also to be repaid in full over 62 years, and in addition interest is to be paid at the rate of 3% for the first 10 years and at 3½% thereafter.

In Oct. an agreement was reached with the Czechoslovak Govt. which fixed the debt due at June 1925 as $115,000,000, repayable on terms similar to those reached with Great Britain. Latvia had already signed an agreement in Sept., and was followed by Estonia in October. In Nov. an Italian delegation signed an agreement which fixed the principal sum due at $2,042 million to be repaid over a period of 62 years. Interest, however, will not be paid during the first 10 years, and thereafter only at a rate rising by 10-year periods from one-eighth of 1% to 2% per annum, or an average of just under 1% per annum for the whole time. This was followed in Dec. by a settlement with Rumania, on the British model.

The French Debt.—Meanwhile, the French Govt., which, since the failure of M. Parmentier's mission in 1923, had made no move with regard to the refunding of its debt to the United States Govt., dispatched in Sept. 1925 a mission under M. Caillaux (the then Minister of Finance), but the proposals put forward at that time were unacceptable. Better fortune attended the next attempt, and on April 29 1926, an agreement was signed. By this France undertook to pay a total of $6,847,674,102 over a period of 62 years, and to issue bonds, beginning at $30,000,000 for 1926 and rising to $125,000,000 for the seventeenth and subsequent years. No interest is payable until June 15 1930, after which one per cent will be paid to June 15 1940, 2% to June 15 1950, 2½% to June 15 1958 and 3% thereafter.

Of the remaining debtors, Yugoslavia sent a delegation to Washington, while the Greek negotiations have reached a deadlock. There is little hope of the Russian Govt. making any such move. If the settlements which have already been made are considered, it will be seen that the terms of the Debt Funding bill with regard to the repayment of capital in full have been carried out in each case, and that, where concessions have been made, they have taken the form of a reduction in the rate of interest. Thus, Great Britain is paying 76% of the 4¼% per annum laid down by the law, while Belgium pays 48% and Italy 25½%. These agreements were ratified by Congress early in 1926.

Debts to Great Britain.—Up to the end of 1924 little or no progress had been made with regard to the repayment of debts due to Great Britain from her Allies. In Dec. of that year the Chancellor of the Exchequer (Mr. Churchill) made an official statement to the effect that Great Britain would expect any country making a funding agreement with the United States to come to terms, *pari passu*, with his country. As a result, the French Govt. took advantage of Mr. Churchill's presence in Paris in Jan. 1925, at a financial conference on the Ruhr and the Dawes scheme, to state their intention of opening negotiations and to ask for a definition of the British position. An official reply in Feb. adhered to the principle of the Balfour Note, while no longer supporting the proposals contained in Lord Curzon's Note of Aug. 1923 on the ground that they were out of date. It further proposed that France should pay fixed annual amounts from her own resources, together with a further annuity based on the French share of the Dawes annuities. Direct negotiations were resumed in London in July, when Mr. Churchill proposed the payment by France for 62 years of an annuity of £20,000,000, subsequently reduced to £16,000,000 and only a small proportion of which was based on payments to France under the Dawes scheme. M. Caillaux's counter-proposal of £10,000,000 led eventually to a compromise on a basis of an annual payment for 62 years of £12,500,000, with a partial moratorium until 1930, and a vague proviso to suspend transfers if the French exchange was in danger. Further, these terms were to be revised if the final terms to be arranged with the United States Govt. should be more favourable to America. This proposal, which reduced the French debt to Great Britain by nearly two-thirds, was referred by M. Caillaux to the French Govt. and was in principle accepted, but the political situation in that country had up to 1926 prevented a formal agreement.

French opinion was subsequently moved towards the hope of obtaining better conditions by the terms of the Italian agreement with Great Britain signed on Jan. 27 1926. The total amount of the Italian debt at that date was calculated at £610,840,000, and it was agreed that Italy should pay 62 annual payments of £4,500,000 with a partial moratorium for the first seven years. In addition, the Italian gold to the extent of £22,200,000 which had been deposited in the Bank of England as part security for certain loans is to be returned to her by instalments over the same period. It will be seen that, while the total amount to be repaid is not so great in proportion as that which the United States will receive, the value is about the same. Of the remaining debtors Belgium has repaid her post-Armistice debts, and Rumania has reached an agreement on the same basis as that of the offer to France in Aug. 1925, while Yugoslavia, Greece and Portugal have either opened negotiations or are preparing to do so. Russia alone has made no move. As far as relief credits and credits for stores are concerned, Lithuania and Latvia repaid the amount due on Jan. 1 1925, while funding agreements for the full amount have been concluded with Poland, Czechoslovakia, Estonia, Hungary and Rumania, and early negotiations are anticipated with Yugoslavia and Greece.

Although it is the declared policy of both Great Britain and the United States to treat the problem of inter-Ally debts as entirely separate from that of reparations, the doctrine of repayment according to capacity, enunciated by the United States, has led to results which are not without interest. Great Britain has advanced to her Allies a total sum of £1,423,132,000, and, on the basis of arrangements already concluded or in course of negotiation, will receive a total sum on account of both principal and interest of £1,147,000,000 in the form of annual payments over a period of 62 years of £18,500,000. On the other hand, she borrowed from the United States approximately £960,000,000, on which she is now paying £30,000,000 and will later have to pay £38,000,000 per annum, so that, in effect, although she loaned over 50% more than she borrowed, she will receive from her Allies less than half the amount which she must in her turn pay. Even if she receives her full share of £20,000,000 per annum of German reparation payments under the Dawes scheme (which is a very optimistic estimate), her total receipts on account of inter-Ally debts and reparations combined would only just cover her payments to America. On the other hand, it is interesting to note that the United States should eventually receive on account of loans to her Allies an annual sum equivalent to 65% of that payable annually by Germany in a standard year under the Dawes scheme in respect of reparations. (R. J. S.)

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DEBUSSY, CLAUDE ACHILLE (1862–1918), French composer (*see* 7.906), died in Paris March 26 1918.

DE CAMP, JOSEPH RODEFER (1858–1923), American painter (*see* 7.909), died at Boca Grande, Fla., Feb. 11 1923.

DECORATIVE ART.—The hopes which came to birth at the end of the 19th century seemed, in the early years of the 20th, to have succumbed. The *art nouveau* of 1900, freed from imitation of the styles of the past, did not extend beyond a restricted circle of amateurs, and the mass of the greater public remained hostile, or at least indifferent, to its manifestations. In 1901 the *Société des Artistes Décorateurs* held, in Paris, the first of its series of expositions, which it continued without interruption for a quarter of a century, and from 1905 onwards the *Salon d'Automne* provided annual evidence of the efforts of the artists.

But between the great firms and the actual creators of models the divorce was an enduring one. The artists, thrown back on themselves and lacking the resources of capital, unknown moreover to the purchasing public, became isolated in researches whose originality was prejudicial to their realisation in practice. The heads of the industry, at the same time, content to repeat at small expense the currently accepted models, held firmly to routine. At the Turin Exhibition in 1911 the French section showed a general survey of modern art opposite the special pavilions erected as a homage to the styles of the 18th century and the empire. The splendours of the past still lay heavy on the efforts of the present. The art of the past remained, for the industrials, the true source of inspiration, the goal of artistic discipline, and the surest road to enduring prosperity.

But certain countries, less burdened by the extortionate demands of past glories, were striving to open the markets to contemporary creative efforts. In Germany the *Werkbund*, the league of crafts, had established a link between art and craft, and made into a reality the conceptions of Ruskin and Morris, though modified by the mechanical advances of modern days. The new society, founded under state auspices in 1907 and backed by powerful resources, selected, in all the arts and in all parts of the country, the men most qualified to collaborate. The result of this disciplined effort was made unmistakably clear at the Brussels Exhibition of 1910. Nor did it fail to make a lively impression on the French public on the occasion of the exhibition at the *Salon d'Automne* by the Munich group of artists.

A Great Exhibition Planned.—To reply to this effort, which had outstripped her own, France began, in 1911, to draft the plan of an international exhibition of decorative art. It was projected for 1915, but the War postponed it for 10 years. From its inception, its success was conceived as being dependent upon a previous understanding between factories and studios. More than ever did this seem indispensable. The decorative artists, for lack of any extensive market, found themselves faced by the gravest financial difficulties. The industrial side was threatened by dangers of another sort. On the one hand, they were forced to reckon with new tastes and aspirations among a section of their clients; on the other, foreign competitors were beginning to market for themselves works in reproduction of the old styles, having decided to cut themselves free from the useless tribute which they paid to French manufacture. Something else had perforce to be sought. Interests which previously had been in opposition were now tending to close their ranks, and the need for undertaking propaganda in common was to make them see eye to eye. In 1922 active negotiations ended in an agreement which was the veritable charter of modern decorative art. This agreement fixed the principles of future collaboration. It recognised the right of the signature of the artist and his sole authority in authorising any modification of the work, and allowed the contract between designer and factory to follow forms of extreme flexibility.

This collaboration gives modern decorative art its true character. No longer does it appear as a protest against the old formulae; no longer does it pursue novelty into the jungles of the bizarre. Our decorators are modern, just as, in their own day, were the contemporaries of Francis I., Louis XIV. or Louis XV. Far from denying the past, they continue it; for the claim to adapt the background of life to the aspirations of one's time is in itself a fidelity to the spirit of tradition. The art of the house, the street or the stage is now becoming, as it was in former times, the reflection of a society. The strange discordance, noticeable throughout 100 years, between scientific development and the stagnation of all the industrial arts, at last reached its term.

I. A GENERAL SURVEY

Decorative Art To-day.—Henceforth decorative art covers the whole field of social life. The exhibition of 1925 bore a close resemblance to a universal exhibition. With its 37 classes it surveyed the most diverse aspects of life—the house and its furnishings, clothing and its ornaments, the town with its thoroughfares and gardens. There were few problems touching public or domestic life which it was not called upon to deal with, if not to solve. Modern art stands no longer classified in show-cases, expressed in useless and costly playthings, in objects created for show rather than use. Art is no longer an accessory, a superfluous element, a pretty lace trimming stitched to the clothing of life. It is met with everywhere, without seeking it or thinking of it, in the shape of a hood, in the outline of a lock, in the curves of a plate or the lines of a steam radiator.

As in all the great epochs, every object is an object of art, so soon as its form accords with its function and its material. Whatever their variety, they reflect a common tendency. The maxim of Buffon that "the style is the man" applies, not only to the expression of thought in writing, but to plastic expression as well. The decoration of 1900 had sought its renaissance in a return to nature, in the analysis of the forms of flowers and animals, in the graceful and cunning spirals of metallic architecture. The theories of Gallé and the influence of Japanese art fostered this tendency; the ornamental experiments of sculptors had developed its themes. Henceforth it seems as if science, the creator of a new world order, has imposed its influence on artists.

How could they remain indifferent to this neo-mechanical world, with its latent, intimate omnipresence, the vehicle of mankind's interdependence—steamships, locomotives and aeroplanes assuring the mastery over continents, oceans and seas; the aerials and receivers which capture the human voice over all the surface of the globe; cables marking out the roadways awakened to a new life; visions of the whole world projected at high speed on to the cinematograph screen? Must not all this confused seething of universal activity leave its marks on the brain of the artist? Machinery has fashioned all the forms of labour anew.

Work of the Architect.—It was in architecture that this influence first made itself felt. This art owes its greatest advance to the researches of engineers. The exhibition of 1889 had been, as it were, the consecration of architecture in metal. This has given place to-day to that of reinforced concrete. This material has solved the problems of wide arches and spacious openings which the Gothic builders tried to realise with the aid of the ogive arch and the flying buttress.

The architect of the present day, with this mastery as his starting-point, is able to open up immense naves in which the walls are no more than partitions independent of the structure of the edifice. Concrete, run and dried in moulds, imprints on our edifices the characteristic form of a cubic box, in which variety emerges only from effects of light, from projections and indentations, where the right angle reigns supreme, to the exclusion of the curve, familiar to the architects of the end of the 19th century. The flat roof, attempting to supplant the sloping roof of tiles or slates, has led us far from traditional ideas. Just as stone construction calls for the carvings of sculpture, so concrete seems to call for that facing with mosaic or marble which in former times enhanced the splendour of Rome, Byzantium or Venice.

The beauty of the facings of the porticoes was one of the attractions of the galleries of the exhibition. From this sprang the expansion of the scope of ceramic decoration. In the hands of architects, mosaic no longer produces its effects only from the variety of colour, but also from that of forms. Geometrical patterns, and conventionalised animals, form panels, the joins of which, of variable thickness, compose a subsidiary tracery com-

"THE CHASE"

Wooden screen painted by Carlo Ciampaglia. (By permission of the artist.)

parable with the leaded joins of the stained-glass window. The attempts made by the Sèvres manufactory to fashion panels of stoneware, of earthenware and of porcelain take on, in this light, a significant value.

Furniture.—The same causes and the same effects appear even more strikingly in the art of furniture: unified surfaces, straight lines and ornament laid on. Our epoch makes its own inexorable demands: the current price of building land tends to diminish the cubic capacity of the domicile; low ceilings, furniture made horizontal rather than vertical, beds reduced to the divan with a wooden frame. The chest of drawers has replaced the mirrored wardrobe; the mirror is in the interior of a folding toilet table; chairs are low and deep; the sideboard has no pediment, any more than the cornice has mouldings. Marble and metal do not add their polished coldness to the wood. Their virtue is comprised entirely in the surface covering taken from the most precious tropical woods, from their most intricately veined boles, from their richest freaks, cut in thin veneer and applied in layers which follow the formulae supplied by the aviation industry. Thus do advances in mechanical process respond to new social demands.

The exigencies of modern life act not only on the form but on the distribution of furniture. Apartments of a former day were divided by thick partition walls, impossible to shift, and the rooms were again subdivided in order to provide nooks for the lamp and the fireside. The tendency to suppress the focus of distribution of light or heat derived from one single and external source has modified the conditions of the problem and at the same time facilitated the removal of all partitions whose existence is no more essential to the solidity of the rooms than the paper walls of the Japanese house. Rooms are no longer exclusive or restricted in function. The bed shuts up into a different form; screens, which form wall panels during the daytime, can be taken down at night to form enclosed rooms, in combinations at once ingenious, invisible and interchangeable. We are returning to the medieval conception of the common hall, renewed in our own epoch by the studio or living-room; and it is here that scope is found for the inventive gifts of the decorator in the creation of an *ensemble*, which is the aim of our modern furnisher. The artist who can carry out the *ensemble* has inherited powers which belonged to the upholsterer, but under very different conditions. He becomes a kind of chief engineer for the interior of the house. He will decide the shape of the piano, the distribution of the lighting apparatus, the binding of the books, the outlines of the card-table. He imposes his conception on his client, who henceforth becomes subordinate to its demands.

Other Forms of Decoration.—Analysis reveals a similar evolution at work in the numerous and varied elements of modern decoration. Workers in ceramics are subordinating ornament to material. Ornament is born from the material, and unites with its support as flesh with bone. It is from the composition of the glass, from the juxtaposition of the layers in the infinite variety of all the aspects of the clay, that Daum and Marinot seek their most beautiful results. Stuffs and carpets show us designs of geometrical inspiration, akin to the Berber style; and here, too, the material itself plays the essential part, and the amazing variety of dyeing processes allows a high degree of flexibility.

The Batik industry, borrowed from the Javanese, has enjoyed wide popularity. Dress itself has shed all useless frills and furbelows; it hangs straight, without folds, conforming with the form of the body itself, and giving liberty of movement. No more ceremonial toilettes to make one stiff and embarrassed; grace and beauty lose nothing from these more genuine forms, so much more adapted to everyday life. Jewellery aims at emphasising the worth of the stone itself; fine cutting and worthy mounting become the artist's goal. The complex forms inspired in 1900 by the return to nature have completely disappeared: no more hooks or tentacles, no more medusas or sirens, seahorses or gorgons, no more pine needles, no more thistles. The stone with sparkling facets is valued only for its brilliance. The transparency of diamonds, the whiteness of pearls, are wedded with the colour of jade or onyx or coral.

Book Production.—In book production, too, there is the same striving towards simplicity, where harmonious characters strike the keynote. Our publishers, like the decorators, aim for the *ensemble*, bringing the press work, the illustration and the binding, into one harmonious whole, the decorative quality of which borrows its value from the quality of the material, its geometrical design being often accompanied by fine tracery of gold and silver set in a delicately tinted leather. The poster is legible from a distance, its design strongly accentuated, and its composition cutting a clear pattern on the uniform whiteness of the background. It is associated with the bright lighting wherewith publicity is transforming the appearance of our streets, illuminated by lamps fewer in number, placed higher and of increased power. The theatre likewise can show us decorative schemes which produce their effect by what they suggest rather than what they reproduce. The subject-matter of the scenery counts less than the distribution of light, thus tending to give stress to the personality of the actor against the sobriety of the background. Russia, bringing us the renaissance in scenic decoration through Bakst and his ballets, points out the way we must follow towards the intensified movement of the figure grouping; scenic setting is no longer merely a support. (*See* BALLET; STAGE.)

Essentials of Modern Art.—From whatever angle one surveys modern art one discovers its common character. This is, as it were, a reduction to a scheme, indicating the essential lines without much heed to the detail. The artist is concerned less with reproduction in exact imitation of nature than with setting down its essential character, leaving detail on one side. This reaction against the excesses of the photographic conception of art has sprung from the extreme manifestations of Cubism itself. Painting turns more and more to seek decorative harmony, and sculpture sets itself to the representation of mass and volume; and the same tendency appears even in the figuration of the modistes' figures, which, freed from the banality of the old wax dummies, tend no longer to show a resemblance, but to hint at a gesture or to show off the draping of the material.

But while it is permissible to trace a tendency common to such various aspects, it would at the same time be foolish to exaggerate the universality of a formula. One style does not supplant another in a day. Art is not a meteorite, and has never indulged in processes of spontaneous combustion. For the most part our modern decorators are obliged to furnish houses which are not new. A house is not razed in order to modify a suite of its rooms. Among decorators themselves there may be affinities, but there are also differences. Men like Chareau, Francis Jourdain and Mallet-Stevens have broken deliberately with the existing traditions; but Groult has never shaken off the forms of the 17th century, Ruhlmann those of the Empire, Sue or Mare those of Louis-Philippe. Moreover, dates are not infallible oracles. Artists such as Lalique and Dufresne are very different from what they were in 1900. But nevertheless they are themselves; they have been modified, not metamorphosed.

Regional Art in France.—On the other hand, it is certain that the evolution takes on a different form in every province of a country. In France the capital tends to adopt a mode of uniform construction based on reinforced concrete. Does this mean that other regions will totally abandon their local traditions? The exhibition of 1925 proved that there is no ground for supposing so. Berry or Brittany, Alsace or Normandy, Provence or Franche-Comté, all give evidence of certain local traditions which none the less can be reconciled with the innovations. There exists an unmistakable renaissance of regional art. The drift toward Paris is doubtless more pronounced than ever it was, but it does not preclude the idea of return; between Paris and the provincial centres there is a constant interchange of ideas. A powerful contribution toward this was made by the creation, during the War, of a network of committees of the applied arts covering every part of the country.

This neo-regionalism is in no way a reversion to the fetish of the useless ornament. It is an effort to create forms appropriate to the needs of the modern world, making use of local materials and local processes. The achievement of the painter Lemordant in Brittany offers a striking example. The exhibition made it

plain that, in all countries, the character of modernity, international as it may be, does not imply the disappearance of national traditions. Thus it was that Poland transferred into her pavilion the decoration of her rustic scenes, from which Mme. Stryjenska had drawn the essential themes of the decoration of the *salon d'honneur*. The tapestries and rugs which adorned the main hall of the Czechoslovakian building were a glorification of the country in its soil, its products and its crafts. Side by side with the very boldest conceptions of its futurist architecture, Soviet Russia exhibited the varied picture of its work-people. Slovaks, Slovenes and Serbs gave a prominent place to women's woven products. Throughout infinite local diversities there exists a common tendency very sharply defined.

Middle Class Needs.—The organisers of the exhibition of 1925 have often been reproached for not having contrived to make the creations of modern decoration accessible to the middle classes, but in this connection the increased cost of materials must be taken into account. Moreover, in any case, models have at all times been created in the first instance for an elect minority, and to-day the court still leads the town in its train. But however great the proportion, too large, perhaps, of products reserved for the patronage of the wealthy few, nevertheless a considerable number of interiors were designed for middle-class needs. The palace was less prominent than in the past, but there were many more shops, shop-fronts and counters. The demonstration was not confined to furniture meant for show. Numerous types of kitchens and bathrooms gave token of more immediate requirements. Covering materials and domestic appliances showed obvious advances. Wooden houses in sections, perfectly well adapted to permanent habitation, certain sets of furniture at low prices, such as that shown by the Primavera establishment, pointed the path to be followed. Special pavilions brought together all the methods of lighting by gas and of electrical distribution.

A group of architects made a happy assemblage of all the elements of a village, a trifle theoretic perhaps, and bereft of local roots, but supplied with all the typical elements which modern life has at its command: the church and its graveyard, the town-hall and offices, workshops for the weaver, stonemason and cobbler, the inn, the pharmacy, the baker's oven, fish-market and the wash-house—all simple edifices, inviting, with forms at once practical and gracious, in coloured materials, with simple and stout furnishings. It is to be regretted that types of this kind were not more frequently adopted in the course of the reconstruction of the French devastated regions. The experiments made in the workmen's centres of the Nord Railway Co. were isolated examples.

Machinery and Its Influence.—These tendencies are an augury of an auspicious future. The time is past when Morris and Ruskin, the apostles of the artistic renaissance, denounced the use of machinery, and saw salvation only in the return to the traditions of the mediaeval craftsmen. To-day machinery imposes its own laws upon us. Uniform manufacture seems to be indispensable. There is no other formula which can assure the expansion of the necessary production and the lowering of the net cost. It would be vain to overlook the influence of mechanical discoveries on the development of the industries of art. The use of woodcutting machinery, the process of acetylene and electric welding, advances in the chemistry of dyeing, have profoundly influenced the transformation of our industries in the domains of furniture-making, ironwork and the manufacture of textiles.

But however perfect the technical accomplishment, this is valuable only through the creative imagination which guides it. The participation of important artists, such as the exhibition witnessed, in the production of certain subsidiary equipment of the dwelling-house, until then restricted to the current commercial models, window-fastenings, locks, door-handles, is a striking example of the influence of creative ideas on forms. Moreover, it is in no way a question of specialists. One of the successful exponents of these models of ironwork, M. Lebourgeois, founded his reputation on work carried out in wood. A man who has made a name for himself in stuffs or in large mural paintings finds fresh talents in ceramic designing. It might be said, in this sense, that the exhibition was the work of an infinite minority.

The Need for Training.—It is equally clear that the evolution of decorative art, in every country, is dominated by scholastic teaching. The poverty of invention, disclosed from the middle of the 19th century by all the critics of the different exhibitions, had shown the urgent need for artistic instruction. For the first time the Vienna Exhibition of 1873 reserved one class for education. Drawing inspiration from the British example, Paris prepared for the foundation of a museum of decorative art on the model of the South Kensington Museum; it was inaugurated in 1885. After the exhibition of 1878 national or municipal schools of art were set up throughout the whole of France, and at the same time the teaching of drawing was made obligatory in the *lycées* and primary schools.

For 20 years the instruction has definitely turned in the direction of decoration. The 1925 exhibition developed a series of practical programmes, adapted so far as possible to each region, and all the schools of the Beaux-Arts took part with distinction. A random glance at the programmes shows: at Bordeaux, a restaurant; at Dijon, a grocer's shop; at Lille, a chapel; at Lyon, a silkmercer's; at Nantes, a villa; at Nîmes, a workman's dwelling; at Rouen, a ship's cabin. Paris offered a complete and illustrative scheme of professional and primary instruction. The most modern and most original parts of their exhibits can be attributed to the schools of decorative art.

The facilities for comparison of the schools in different countries provided most suggestive comparisons. Alongside the schools of arts and crafts of London, Birmingham, Brighton, Cardiff, Sheffield and Swansea, several of which were originally organised as models, and the activities of which remained so diverse, stand the schools of Switzerland, nowadays turning, like the French schools, more and more towards practical applications: clockmaking at the Chaux de Fonds, ceramics at Berne, graphic arts at Zurich. In the Netherlands the three schools of Amsterdam, Haarlem and Rotterdam point in three quite different directions, the two first inclining towards a more theoretic art, the last more closely allied with maritime and colonial life, and by that circumstance more given over to a practical modernity.

Austria, under the direction of Joseph Hoffmann, has multiplied and brought up to date its instruction in all the decorative arts in Vienna, in building construction at Graz, in woodworking at Hallstatt, in ironworking at Waidhofen. Poland and Czechoslovakia have made far-reaching changes in the ground plans of their instruction. At Warsaw, Cracow and Zakopane, just as at Prague, the programmes have turned towards modern creations.

It can be said that in every country the existence of decorative art is linked with that of the school. It is this art which, by reason of its permanent contact with industry, has the power to maintain the quality of the professional formation which, under the old dispensation, was acquired in the close corporations. To unite, for one and the same work, the imagination of the artist and the hand of the craftsman would seem to be the essential law and the essential condition for the progress of modern decorative art. (*See* EXHIBITION.) (P. LN.)

II. DECORATIVE ART IN GREAT BRITAIN

In Great Britain the tendency of decoration has been much in the same direction as on the European continent, but in accordance with the characteristic British temperament there has been a slower and more deliberate development. Repeating patterns were based almost exclusively, at the beginning of the century, on natural forms and built up with mathematical formulae to secure such variety as was possible within the severe restrictions imposed by these conditions. Textiles and wall papers, to take the two chief examples, have moved away from these limits.

On the one hand, plain colour has come into favour, either without pattern of any kind or in panels relieved with vertical bands of simple ornament. On the other, masses of broken colour, irregular in form and superficially devoid of rhythm or apparent design—the so-called "jazz" patterns—have had a considerable vogue, responding to the feeling of unrest and rebellion against formalism which is one of the legacies bequeathed to the

EXAMPLES OF AMERICAN INDUSTRIAL ART AS SHOWN IN THE NINTH ANNUAL EXHIBITION, 1925, AT THE METROPOLITAN MUSEUM OF ART, NEW YORK CITY

DECORATIVE ART

FIG. 1. Design for bedroom at the Ambassade française, by André Groult. FIG. 2. Pendant, of carved crystal, onyx and brilliants. Design by A. Ragge. FIG. 3. Pendant, carved crystal mask, with emeralds and brilliants. FIG. 4. Ceiling design, by George P. Bankart. FIG. 5. Design for mosaic, by Gentil and Bourdet.

(Figs. 1 & 5. Exhibition of Decorative Art, Paris. Courtesy of M. Paul Léon. Figs. 2 & 3. Courtesy of M. G. Fouquet, Paris. Fig. 4. Photo, Lewis & Randall, Birmingham.)

arts by the World War. In the latter movement Roger Fry may be referred to as a pioneer of the new design. Similarly, the delicate tints of Walter Crane and his school have been replaced with strong, often crude colour, violently contrasted, barbaric in general effect, but by no means unsatisfactory as decoration when used in appropriate environment.

A Retrograde Movement.—Side by side with these efforts towards originality must be recorded a retrograde movement, one directly due to the influence of the museums and the growth of the cult of the collector. This has been manifested in the recrudescence of the historic styles, especially of the late 17th and 18th centuries. A large section of the public, whose education in taste has progressed only far enough to secure condemnation of Victorian types but has not yet so far advanced as to develop individual judgment, has welcomed the comparative security and undoubted efficiency of Queen Anne, Chippendale, Adam or Wedgwood models, where the newer patterns have scared, even shocked it. In mural decoration, the tendency, again, has been in the decoration of a scheme of vertical lines, with plain panels relieved with occasional bands of ornament; the latter throwing back, in character, mainly to the late Tudor or early English Renaissance style. Good work has been done in plaster, especially by the late Ernest Gimson and G. P. Bankart.

For the finest decoration in colour of our period, we have to thank the untiring genius and marvellous facility of Frank Brangwyn, R.A., whose great decorative painting in oils, "King John signing Magna Charta," done for the New Court House of Cleveland, Ohio (1912), may be selected as a specimen of his treatment of a historical subject in a technique thoroughly individualistic. The same artist's series of 16 decorative panels, in pure egg tempera, for the Chapel of Christ's Hospital, West Horsham, represents another phase of his art; the last subject, "Let the people praise Thee, O God," being perhaps the most representative example that could be chosen of a reverent but essentially modern treatment of a religious theme. The decorative work carried out by Robert Anning Bell, R.A., in the Houses of Parliament at Westminster and his mosaics in Westminster Cathedral, while more scholarly in style, are also far removed from mere convention. (E. F. S.)

III. DECORATIVE ART IN THE UNITED STATES

A refreshing rejuvenation of the spirit of decorative design and a liberal infusion of that renewed spirit into the complicated machinery of manufacture and distribution may be considered leading characteristics of the present state of decorative and industrial art in the United States. Still wrestling with problems following in the wake of a mechanistic century, America has found at last that the cargo of quantity production cannot be brought to port without the compass of design. The destructive influence of the machine has now been fully recognised by manufacturers and public alike as self-inflicted, the misuse of complex and cunning tools whose marvellous ability had seemed automatic.

This has led to a serious consideration of decorative design as an element not only in portable commodities but in all the arts that contribute to a more pleasurable existence, and we find progress in this regard not only among those who manufacture, but also among those who sell and those who use objects of decorative and industrial art, thus reaching producer, retailer and consumer.

To meet this increased interest we note decided modifications and a re-study of the methods of art teaching in the schools, a rapid growth in the number of museums of art and in their specialised educational work, a heavy increase in the number of shops selling objects of decorative art, a studious use of museum collections by manufacturers and designers as an aid in preparing their current material, an increase in the number of exhibitions of decorative art, both public and other, and, finally, a definite preference for better designed things by the purchasers who patronise leading shops in large cities.

Stylistic trends are still mainly historical, running in cycles of old motives applied to new uses and expressed in new materials. Yet there is discernible a triad of elements upon which reliance may be placed. There is, first, the appearance of a small group of thinkers and writers on the subject. Secondly, from the ruck of mass production we note the emergence of a limited number of manufacturers in small quantity whose products may be regarded as representative of the new organised craftsmanship which must set the pace for modern manufacture. Finally, and most recently, we record a new note of courage which can come only from conviction based on serious study, a willingness to use historic motives as the alphabet which itself has many forms, changing with time but serving to make always new words and languages.

No doubt this last is due in part to the general spirit of revolt which underlay the Exposition in Paris in 1925; but it is due more certainly to the fact that the United States as a nation has arrived at a point of cultural awakening, finding historic form a handmaid and not a copybook, realising fundamental values in Early American art as the beginning of a national culture, quickening to the consciousness of a throbbing life of to-day, which must express itself in its own way and yet must cleave to that line of stylistic continuity which is the standard of its progress and the assurance of its reasonable growth out of the realities of American life. (R. F. B.)

DEDEAGATCH (*see* 7.917), a port on the north coast of the Aegean Sea, west of the mouth of the River Maritza, and the natural outlet and inlet for the trade of the Maritza basin. Its population is about 4,000. The natural advantages of the port are few. It is an open roadstead with shallow water inshore. On the other hand, its geographical situation renders it of great importance to Bulgaria, since the upper valley of the Maritza covers a considerable portion of the total area of the Bulgarian state, while the railway connecting Central Europe with Constantinople via Sofia sends a branch down the western bank of the Maritza, which reaches the sea at Dedeagatch.

As a result of the Balkan Wars of 1912–3, Dedeagatch fell to Bulgaria; but under article 48 of the peace treaty between the Allied Powers and Bulgaria, which was signed at Neuilly on Nov. 27 1919, Bulgaria was compelled to cede to the principal Allied and Associated Powers the greater part of Western Thrace, containing her entire sea-board on the Aegean, including Dedeagatch. Bulgaria undertook to accept whatever disposal of this territory the Powers might make. On the other hand, the Powers undertook to ensure the economic outlets of Bulgaria to the Aegean Sea. On Aug. 10 1920 the Powers signed a Treaty under which they retransferred the ceded territory to Greece, and after this they withdrew their own troops and allowed the Greek Govt. to occupy and administer the territory.

Meanwhile, their pledge to ensure the economic outlets of Bulgaria remained unfulfilled. During the Lausanne Conference this question was raised by the then Bulgarian Prime Minister, M. Stambolisky, and the Conference appointed a sub-commission to deal with it. The sub-commission proposed that a permanent international commission should be set up with extensive powers for improving Dedeagatch as an international free port, and supervising the administration both of the port and of the railway, as far as the Bulgarian frontier. This proposal was rejected by the Bulgarian delegation on the ground that satisfactory economic facilities could not be secured unless Dedeagatch were removed from the political control of Greece. M. Veniselos then offered a Bulgarian free zone at Dedeagatch on the same lines as the Yugoslav free zone at Salonika, but this, too, was unacceptable to the Bulgarians, and since then the question has remained in suspense.

See.—*Admiralty Handbook of Macedonia*, pp. 463–4 (1920); *Survey of International Affairs*, pp. 338–40 (1920–3). (A. J. T.)

DE FILIPPI, FILIPPO (1869–), Italian scientist and explorer, was born in Turin April 6 1869. After graduating in medicine at the Turin University, he became assistant in the surgical clinic and lecturer in operative surgery in the University of Genoa, where he pursued researches of great value in physiological and biological chemistry. In 1897 he took part in the expedition of the Duke of the Abruzzi to Alaska as scientific observer and

ascended Mount St. Elias. Although he did not accompany the Duke to the Ruwenzori in Central Africa in 1906, Dr. De Filippi wrote the report of the expedition, which produced the first detailed map of the higher part of the range. In 1909 De Filippi joined the Duke's expedition to the Western Himalaya and Karakoram Mts., where a point 24,600 ft. high was reached on a ridge of the Bride Peak close to K2, which established a record of altitude unsurpassed until the exploits on Mt. Everest (1922 and 1924). He later (1913–4) organised and led an important scientific expedition to the Karakoram range in Central Asia, under the auspices of the Indian and Italian Govts., and for valuable researches was created in 1916 an hon. K.C.I.E. During the World War he served in the Italian Army medical service.

He published *The Ascent of Mount St. Elias, Alaska, by H.R.H. Prince Luigi Amedeo di Savoia, Duke of the Abruzzi* (1900), *Ruwenzori* (1909), *Karakoram and Western Himalaya*, (1909) 2 vol. (1912), and *Storia della spedizione scientifica italiana nel Himàlaia, Caracorùm e Turchestàn Cinese, 1913-1914* (1924).

DE FOREST, LEE (1873–), American inventor, was born at Council Bluffs, Ia., Aug. 26 1873. He was educated at the Sheffield Scientific School, Yale, receiving B.S. in 1896 and Ph.D. in 1899, and continued his studies at the Armour Institute of Technology, Chicago. His earliest employment was with the Western Electric Co., Chicago, in their experimental telephone laboratory. He was the first to use the alternating current generator and transmitter, which were later universally employed in wireless transmitting sets. He designed and installed the first five high-power radio stations for the U.S. Navy. The most important of his inventions was the Audion amplifier, which made possible long-distance telephony. His other inventions include the oscillating audion, or three-electrode tube, and the four-electrode tube. After 1921 he devoted himself to the development of the so-called phonofilm talking motion picture, involving the synchronising of sound and motion by the photographic representation of sound waves.

DEGAS, EDGARD (1834–1917), French painter (*see* 7.931), toward the end of his life, when he began to go blind, retired into private life, and gave up exhibiting in the Salons. The influence of his infirmity soon showed itself in his work; yet though his style lacked its former precision, it may be said to have gained in breadth of outlook. He now produced pastels, such as groups of dancers, which were remarkable for their plasticity, and modelled silhouettes of women and horses which were not cast in bronze until after his death. His engravings consist of etchings, copperplates and lithographs. A special room in the Luxembourg Collection, Paris, is given up to his paintings.

DEGOUTTE, JOSEPH (1866–), French soldier, was born April 18 1866 at Charney (Rhône). He entered Saint-Cyr in 1888 and joined the 4th Zouaves in 1890. After service in Madagascar, he distinguished himself in the Chinese expedition of 1900, was made a lieutenant-colonel in 1911 and sent to Morocco to take charge of the depôt at Casablanca. During the World War he became general of brigade in 1916 and led the Moroccan Div. during the Somme, Champagne and Verdun campaigns. In the summer of 1918, at the head of the VI. Army, he helped Mangin to carry through the counter-offensive against the German flank. He was made major-general on the staff of the King of the Belgians in the same year, and entered Brussels after the Armistice at the head of the Allied troops. From Oct. 1919 to Oct. 1924 he was commander-in-chief of the French armies on the Rhine, and in 1920 became a member of the Supreme Army Council.

DE GUBERNATIS, ANGELO, Count (1840–1913), Italian man of letters (*see* 12.667), published in his later years a series of lectures on Italian poetry, *La Poésie amoureuse et la Renaissance italienne* (1907), and a *Dictionnaire international des écrivains du monde latin* (1905–6). He died at Rome Feb. 26 1913.

DEHMEL, RICHARD (1863–1920), German poet, was born in Wendisch-Hermsdorf, Brandenburg, on Nov. 18 1863. He was educated in Kremmen, Berlin and Danzig, and in 1882 began to study philosophy, natural sciences and social economy, and also became editor of a provincial newspaper. From 1887–95 he was secretary of the Union of German Fire Insurance Companies. In 1891 he published his first volume of poetry *Erlösungen*. This was followed by *Aber die Liebe* (1893), and *Weib und Welt* (1896). From 1899 until 1902 he travelled in Italy, Greece, Switzerland, Holland and England, and afterwards lived in Blankenese, near Hamburg. In collaboration with his first wife, Paula Dehmel, he published some books for children including *Fitzebutze* (1907). He wrote a novel in lyrical form, *Zwei Menschen* in 1903, the epic composition *Die Verwandlungen der Venus* in 1904 and also dramas and pantomimes. He took part as a volunteer in the World War, and in 1919 published his diary, *Zwischen Kreig und Menschheit*. Amongst his dramas, *Die Menschenfreunde* (1917) was successful. His *Collected Works*, 10 vol. began publication in 1906. His vigorous lyric poetry was distinguished by deep thought and power of imagery, having for its main themes erotic and social questions. He died at Blankanese Feb. 8 1920.

See *Selected Letters*, 2 vol. (1922–3); E. Ludwig, *Richard Dehmel* (1913).

DELAGOA BAY, Portuguese East Africa (*see* 7.942), is commonly known by the name Lourenço Marques, the port on its northwest shore. (*See* Lourenço Marques.)

DE LA MARE, WALTER JOHN (1873–), British poet and novelist, of Huguenot descent, was born on April 25 1873, at Charlton, Kent, and educated in London at St. Paul's Cathedral Choir School. From 1889 to 1908 he was employed in the Anglo-American Oil Co., but he had already printed poems and prose, writing as "Walter Ramal" in *The Cornhill* and other magazines, and in 1901 his *Songs of Childhood* appeared, his novel *Henry Brocken* following in 1904. A grant from the Privy Purse enabled him to devote himself fully to literary work, and he gradually found a growing audience for his delicate and highly individual work. *The Listeners and Other Poems* (1912), *Peacock Pie* (1913), *Motley and Other Poems* (1918) brought him to the front rank of his contemporaries, and his *Collected Poems, 1901–1918*, appeared in 1920. A fairy play, *Crossings*, was published in 1921, and also further poems, *The Veil*. His long novel, *Memoirs of a Midget* (1921), showed his prose gifts at their highest; somewhat short of that came two books of tales, *The Riddle* (1924) and *Broomsticks* (1925).

DELAND, MARGARETTA WADE (1857–), American writer, was born at Allegheny, Pa., Feb. 23 1857. She studied in private schools and at Cooper Union in New York, and for a time was a teacher of drawing. She attracted wide attention with her first novel, *John Ward—Preacher* (1888), which dealt with religious and social questions after the manner of Mrs. Humphry Ward. Her numerous works include *Sidney* (1890); *The Story of a Child* (1892); *Philip and His Wife* (1894); *The Awakening of Helena Richie* (1906); *The Iron Woman* (1911); *The Rising Tide* (1916); and *The Vehement Flame* (1922).

DE LA REY, JACOBUS HERCULES (1847–1914), Boer soldier (*see* 7.944), who was concerned in the rebellion headed by Col. Maritz (*see* South Africa), was shot dead by a police patrol near Johannesburg Sept. 16 1914.

DELAWARE (*see* 7.947).—In 1920 the population of Delaware was 223,003, as compared with 202,322 in 1910, an increase of 20,681, or 10·2%. The number per sq. m. in 1920 was 113·5; in 1910, 103. In 1920 the urban population exceeded the rural for the first time in the history of the state. Of the total population in 1920, 77·5% were native whites, 8·9% foreign-born whites and 13·6% negroes. Of 10,508 illiterates in 1920, 4,700 were negroes, 3,373 foreign-born whites, and 2,427 native whites. The population of the chief cities and towns in 1920 was as follows: Wilmington, 110,168; Dover, the state capital, 4,042; New Castle, 3,854; Milford, 2,703; Laurel, 2,253; Newark, 2,183; Seaford, 2,141; Lewes, 2,074.

Manufactures.—The intense industrial activity of the World War period influenced Delaware greatly, especially Wilmington and its environs. The outstanding phase of this activity was the part taken by the du Pont powder interests in supplying the needs of the Allies and the U.S. Army. In 1919 the principal industries were leather, pulp goods, cars and general shop con-

struction and repairs by steam railway companies, iron and steel, canning and preserving of fruits and vegetables, and foundry and machine-shop products.

Agriculture.—After the passage of the Agricultural Extension Act (1911) the most significant movement was the development of co-operative associations, and especially (1918–21) the rapid growth of the Farm Bureau movement. In 1920 the number of farms was 10,140 as compared with 10,836 in 1910, a decrease of 696, or 6·4%. The preceding decade had shown an increase of 1,149 or 11·9%. Of the farms 6,010 were operated, in 1920, by their owners, 144 by managers and 3,986 by tenants. All land in farms in 1920 amounted to 944,511 ac., being 75·1% of the total land area of the state; 653,052 ac. were improved land, or 69·1% of the farm land. The value of all farm property in 1920 was $80,137,614, an increase of 26·8% over the figures for 1910. The value of all crops in 1919 was $23,058,906. The total value of cereals was $9,638,010, of hay and forage crops $4,366,174, of vegetables including potatoes $6,271,714 and of fruits and nuts $2,566,807. The total value of cattle, sheep, swine, horses and mules in 1919 was $7,373,260; of dairy products, excluding cheese, $2,442,253. The estimated total acreage in 1924 was 461,000.

Education.—During the period beginning in 1910 there was a distinct advance made in the field of education. Better facilities for the training of teachers were developed, and new school buildings erected in many parts of the state. In 1913 the Women's College was founded and affiliated with Delaware College in Newark, with the same administration and in part the same faculty, but entirely separate in buildings, classes and student organisations. In 1921 the two colleges were incorporated as the University of Delaware. The internal relations between the colleges, however, were left as before. The value of the university property in 1924 amounted to $1,986,000, the income for the fiscal year, 1923–4, was $506,000, and the total attendance in 1925 was 363 men and 293 women. Increased Federal appropriations under the Purnell Act to the Agricultural Experiment Station, also affiliated with the university, made possible greater expansion of education in better agricultural methods. An outstanding phase of educational development was the erection of school buildings in various parts of the state, made possible by gifts approximating $4,000,000 by Mr. Pierre S. du Pont to an organisation of citizens known as the Service Citizens of Delaware.

Finances and Taxation.—The cash receipts from all sources, including sales of highway bonds, during the fiscal year ending June 30 1924 amounted to $9,137,563. The two largest sources of revenue were the franchise tax and the corporation fees, the latter amounting to $736,191. Other important sources of revenue were the motor vehicle licence, motor vehicle fuel tax, income tax, the so-called filing fee, property tax, railway, insurance, inheritance and corporation taxes, merchants and manufacturers licences, and reimbursements for the highways in the form of aid from the Federal Govt., the counties and private sources. The total amount of expenditures for the fiscal year ending June 30 1924 was $7,870,969. Of this amount over $4,000,000 were expended upon the state highways and $2,000,000 were appropriated for schools. A state Banking Dept. was created (1919), with a banking commissioner and a deputy, whose duty it is to examine every bank at least once a year. In 1921 a budget plan was adopted for the state government, which became effective in 1923.

History.—The passage of a considerable number of modern and progressive laws and the post-War reconstruction work were the two dominant phases in the history of the state in the period from 1910 to 1925. In this period there were two progressive governors, Charles R. Miller and John G. Townsend. During the administration of the latter a number of important statutes were enacted, including a Child Labour law (1917), a Workmen's Compensation Act (1917), laws for the regulation of labour for women, an Income Tax law (1917), a Direct Inheritance Tax law (1917) and a thorough revision of the school laws, known as the New School Code (1919). In 1923 the Child Welfare Commission and the Tuberculosis Commission were combined with the state Board of Health. After 1910 the Republicans maintained their control of state executive offices, electing the following governors: Simeon S. Pennewill (1909–13); Charles R. Miller (1914–7); John G. Townsend (1917–21); William D. Denny (1921–5); and Robert P. Robinson (1925–).

Much of the time, however, the Democrats controlled the House of Representatives and also the Senate after the biennial elections of 1922 and 1924. In 1922 the Democrats elected Thomas F. Bayard to the U.S. Senate and William H. Boyce to the House of Representatives, but in 1924 Gen. T. Coleman du Pont was elected to the Senate by the Republicans to succeed Dr. L. Heisler Ball; and Robert G. Houston, also a Republican, defeated Mr. Boyce for the House. In the presidential election of 1912 the Democrats carried the state; in 1916, 1920 and 1924 the Republicans won by a considerable margin. A third characteristic of the period was the interest shown by public-spirited citizens in the advancement of education and the building of highways. The work of Pierre S. du Pont for education in Delaware had its counterpart in the building of a highway by Senator T. Coleman du Pont, upon which he expended upward of $4,000,000, and which he formally presented to the state on July 4 1924.

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DELBRÜCK, HANS (1848–), German historian (*see* 7.952). From 1899 to 1920 Prof. Delbrück edited the *Preussische Jahrbücher*, the most important political magazine in Germany. In the years directly preceding the World War he was emphatic in his warnings of the disastrous consequences which would ensue if Germany precipitated herself into a European conflict, and argued that national idealism, if carried too far, very soon degenerates into national fanaticism. During the early part of the War, however, he put up a strong defence of Germany's attitude. After the Armistice he endeavoured to prove that Germany could not be made solely responsible for the outbreak of hostilities. He was one of the delegates sent to the Peace Conference at Versailles to draw up a statement of the German case. In 1923, as one of the three experts in the Reichstag enquiry committee appointed to investigate the causes of the German defeat, he strongly criticised Ludendorff's 1918 offensive.

DELCASSÉ, THÉOPHILE (1852–1923), French statesman (*see* 7.953), emerged from retirement to censure the defective organisation of the navy after a series of disasters, and in 1909 presided over a commission of enquiry appointed by the Chamber. In March 1909 he became Minister of Marine in the Monis Cabinet, retaining this position in the cabinets of M. Caillaux (June 1911—Jan. 1912) and of M. Poincaré (Jan. 1912—Jan. 1913). On Aug. 24 1914 M. Viviani appointed him Minister for Foreign Affairs in his reconstituted Ministry. During the summer of 1915 Delcassé's schemes for winning Bulgaria over to the side of the Allies failed utterly to mature, and in Oct. he resigned, retiring from politics altogether in 1919. M. Delcassé, who played a considerable part in the evolution of the Anglo-French *Entente*, was possibly one of the greatest Foreign Ministers of the Third Republic, and rendered inestimable service both to France and to Europe. He died at Nice Feb. 21 1923.

DELHI, India (*see* 7.954), had a population in 1921 of 304,420. The planning and laying-out of a new Delhi has been in progress since 1912, as the outcome of the official transfer of the capital of British India from Calcutta, announced by King George V. at the Coronation Durbar on Dec. 12 1911. Two inauguration stones were laid by the King-Emperor on Dec. 15 1911. The first step was the appointment of a town-planning committee, and a site to the south of the old city was chosen. New cantonments to the west were occupied in 1923, and a temporary city, housing the official secretariats, has been built to the north.

The focal point of the new city is on Raisina Hill, and the buildings of the government centre are arranged symmetrically

about what is practically an east and west axis connecting the focal point with the north-western, or Talaki, Gate of the old fort of Indrapat, or Purana Kila. The two great blocks of secretariats are situated to the north and south of this focal point, with Government Court between them. Westward from Government Court, a raised platform, or forum, connects Raisina Hill with the high ground of the southern ridge, so that the whole government centre appears to be built on a spur of the ridge itself. This raised forum is known as the Viceroy's Court and at its western end is situated Government House. At the intersection of these roadways with the east and west axis of the court is the Jaipur Column surmounted by the Star of India. Below the eastern façade of the secretariats a forecourt, known as the Great Place, is laid out. Eastward again is a park known as the Central Vista, on either side of which are the houses of the members of council. A second principal avenue of the city intersects at right angles the Central Vista about midway in its length. In the four angles formed by this intersection were planned four large buildings, to accommodate, amongst other institutions, the Imperial Record Office, the Ethnological Museum, the Medical Research Institute, the Library and the War Museum.

On Oct. 1 1912, by proclamation, there was constituted the administrative province of Delhi, taken entirely from the old Delhi district of the Punjab. Delhi will be the seat of government from October to May; the hot weather will be spent at Simla, as in the past. It is proposed completely to occupy the new city for the first time in Oct. 1926, and it is anticipated that the houses for the officials and the secretariats will be ready by that date. Government House, however, and the great circular building for the Chamber of Princes, the Legislative Assembly and the Council of State will not be finished until the following March. The roads were metalled and planted with trees and the sewage and water-pipes and electric cables laid by 1924. Old Delhi was again visited by plague in 1918, and in 1919 there were riots in the city. A room in the Mogul Fort is now an archaeological museum. (O. J. R. H.)

DELISLE, LÉOPOLD VICTOR (1826–1910), French bibliophile and historian (*see* 7.964), published, in 1909, his edition of the *Rouleau Mortuaire du B. Vital, Abbé de Savigny*, and also *Les Actes de Henri II.* (vol. 2 appeared in 1916). He died at Chantilly July 21 1910.

See R. L. Poole, *Léopold Delisle* (1911); X. Delisle, *Lettres de Léopold Delisle* (1911–4).

DELIUS, FREDERICK (1863–), British musical composer, was born at Bradford, Yorks., Jan 29 1863, the son of Julius Delius, a German, who, in 1860, became a naturalised British subject. He was educated at Bradford Grammar School and the International College, Isleworth, London. Declining the business career offered him in Bradford he went to Florida as an orange planter, but devoted his spare time to such musical study as he could obtain from the books in his possession. In 1886 he left Florida for Leipzig and there underwent a more or less regular training from Jadassohn and came under the influence of Grieg, then living in that town. In 1893 his fantasia-overture *Over the Hills and Far Away* was done by Dr. Haym at Elberfeld. The work was ultimately recast and produced in London in 1907 by Theo. Szanto. His first concert of his own works was held at St. James's Hall, London, in 1899. In the intervals of opera composing Delius produced purely orchestral works or works for chorus and orchestra. *A Mass of Life* (1905), produced in London in 1909, is generally considered his finest achievement. He also composed incidental music to J. E. Flecker's *Hassan*, produced at His Majesty's Theatre, London, in 1923.

DEMOCRATIC PARTY (*see* 8.2).—By the election of 1912 the Democratic party placed Woodrow Wilson in the presidency, and gained control of the Senate. Two years earlier it had won a majority in the House of Representatives. The Republican defeat in the congressional elections of 1910 portended the Progressive party split under Roosevelt, and a consequent period of divided counsels and national impotence.

Wilson's Leadership.—The advent to power of the Democratic party under the compelling leadership of Wilson in all branches of the Federal Govt. (except the Supreme Court, which, for ordinary partisan purposes, need not be considered) was followed by an impressive list of legislative enactments. Among the more important of these were the Underwood Act, which revised the tariff downward and imposed an income tax, and the Federal Reserve Act, which re-organised the banking system of the country. In 1914 the trust problem was dealt with by the Clayton Act and the establishment of a Federal Trade Commission. This halcyon period of Democratic control was brought to an end by the imbroglio with the revolutionary government in Mexico and by the outbreak of the World War, which diverted the attention of the American people from domestic reforms to foreign relations.

The Campaign of 1916.—As the campaign of 1916 approached it became apparent that the breach which had divided Republicans and Progressives since 1912 was to be closed. Charles E. Hughes (*q.v.*), who received the Republican nomination for the presidency, had the support of Roosevelt, a support which, considering the candidate's more cautious attitude on the War, was given perhaps too belligerently. The Democrats renominated Wilson; their platform, in accordance with the usual party practice of the "ins," being one long paean of praise of the achievements of the Administration. The Republican platform roundly condemned the legislative activities of the Democrats, with the single exception of the Federal Reserve Act. President Wilson's policy on Mexican and European troubles was denounced as vacillating. Both parties declared for preparedness and peace, but there was one particular passage in the Democratic platform praising the President who has "kept us out of war" which played a considerable part in the campaign. Unfortunately for the Republicans, the country (in spite of the Underwood low tariff as they saw it) was prosperous, both agriculture and industry being drawn upon heavily for war orders. The election of 1916 was exceedingly close, but Wilson won by 277 to 254 votes in the electoral college, his plurality over Hughes in a popular vote of 20,000,000 being less than 600,000.

The War Period.—During the participation of the United States in the World War "politics were adjourned," superficially at least. Nevertheless intense partisan rivalries were being generated beneath the surface. The spark which caused their explosion was President Wilson's appeal of Oct. 24 1918 for the return of a Democratic majority to both the Senate and the House of Representatives. It was bitterly condemned by leaders of the Republican party, and in the November election the latter gained control of the House by 46 votes, and of the Senate by a plurality of one. A long-drawn-out controversy ensued between President Wilson and the Senate over the Versailles Treaty and the proposed entry of the United States into the League of Nations, the latter becoming the paramount issue in the campaign of 1920. The Democratic platform of that year favoured the League; the Republican platform proposed *an* international association instead of *the* League of Nations. Other influences largely affected the vote: discontent over the new burdens and taxes, the industrial dislocations and high cost of living caused by the War, also the national antipathies of foreign-born citizens, which had been greatly exacerbated by the European struggle.

Elections of 1920 and 1924.—In the presidential election of 1920 the Democratic candidate, Gov. J. M. Cox of Ohio, was defeated by an unprecedented majority. With the inauguration of President Harding the Republicans resumed control of all branches of the Federal Government. During the campaign of 1924 the Democrats sought to capitalise administrative scandals of a grave nature which had occurred in the departments of the Navy, Interior and Justice. They were severely handicapped, however, by the fight which broke out on the floor of the New York Convention between Klan and anti-Klan factions; also by the bitter rivalries between aspirants for the nomination, as a result of which it became necessary to take 103 ballots before John W. Davis of West Virginia was nominated. The campaign

of 1924 was further complicated by the emergence of the Progressive party under La Follette. President Coolidge, who had succeeded upon the death of Harding in 1923, received the Republican nomination, and was successful by a majority of 233 in the electoral college and of 2,000,000 in a total popular vote of nearly 30,000,000. In the 69th Congress, which was elected at the same time, the Democratic strength was again slightly reduced, the number of the adherents of that party being, in 1926, 40 in the Senate and 183 in the House of Representatives.

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DE MORGAN, WILLIAM FREND (1839–1917), British novelist (*see* 8.10), died in London Jan. 15 1917. His later novels include *An Affair of Dishonour* (1910); *A Likely Story* (1912); *When Ghost meets Ghost* (1914). In 1919 *The Old Madhouse* was published posthumously. His last but unfinished novel, *The Old Man's Youth*, was published, with additions by his widow, in 1921.

DENBY, EDWIN (1870–), American politician, was born at Evansville, Ind., Feb. 18 1870 and was educated there. In 1885 he went to China and entered the Chinese imperial maritime customs service. He returned to America in 1894 and, after graduating from the Law school of the University of Michigan in 1896 was admitted to the Bar, and practised in Detroit. On the outbreak of the Spanish-American War in 1898 he entered the navy. Later he was a member of the Michigan House of Representatives. From 1905 to 1911 he was a member of Congress and served as chairman of the House Committee on Naval Affairs. When America entered the World War in 1917 he enlisted in the marine corps. In Dec. 1920 he was appointed probation officer of the Detroit Municipal Courts. In 1921 he was appointed Secretary of the Navy by President Harding, and resigned this office March 10 1924, following a senatorial resolution urging the President to demand his retirement, because of his connection with the leasing of naval oil reserves at Teapot Dome.

DENIKER, JOSEPH (1852–1918), French naturalist (*see* 8.21), died in Paris March 18 1918.

DENIKIN, ANTON (1872–), Russian soldier, was born in humble circumstances Dec. 4 1872. He entered the Russian army in 1887, and during the World War rose to the rank of lieutenant-general. After the outbreak of the revolution he followed Kornilov and was arrested and imprisoned with him in Bykova. They escaped together and fled to the Caucasian shore of the Black Sea. There they joined Alexeyev, who was forming a small army of volunteers to fight the Bolsheviks. After Kornilov's death on March 31 1918, Denikin became military commander of the army, whilst Alexeyev was chosen "supreme leader" and organised recruiting and supplies. They successfully established contact with a Caucasian detachment led by Erdeli, with the Don Cossacks under Krasnov, and some 2,000 men led by Drozdovsky. By June the army counted some 12,000 men, and was able to attempt the reconquest of the Kuban territory. On Aug. 5 Gen. Alexeyev entered Ekaterinodar. By the middle of Sept. the army had increased to 60,000 men. On Sept. 25 Alexeyev died and Denikin took his place. The revolt of Siberia and eastern Russia against the Bolsheviks made victory possible for Denikin in the south. Stavropol was taken after a struggle and 35,000 of the Bolshevik army surrendered or were killed.

At the beginning of 1919 Denikin was at his zenith. After much discussion and many intrigues it was decided that for the conduct of the South Russian Govt. a "special council" should be formed combining legislative and executive functions. Most of its members were generals of the headquarters staff. The Government, however, did not succeed in achieving popularity. Denikin regarded the Assembly as a consultative organisation only. He insisted upon keeping military restoration and the liberation of Moscow from the Bolsheviks to the fore. At first his plans met with success, but his "white" armies by their drastic requisition of all available supplies and their failure to put an end to brigandage alienated the sympathies of the people. The movement for an independent Kuban republic in the southwest gained in force, and this hastened the disintegration of Denikin's army. Meanwhile, largely owing to the relentless discipline introduced by Trotsky, the Bolshevik resistance had stiffened. At the beginning of Nov. 1919 Budenny's cavalry broke through the "white" lines at Kupyansk and a general retreat set in. At the eleventh hour Denikin endeavoured to win back the Cossacks—Don Kuban, Tecek, Astrakhan—by promising a new Government on federal lines, but to no purpose. Early in 1920 Budenny retook Ekaterinodar and Rostov, the volunteer army dissolved and Denikin himself fled to Constantinople.

DENIS, MAURICE (1870–), French painter, was born at Granville, France, Nov. 25 1870. Although at first a disciple of Gauguin, he gave up symbolism in order to devote himself to decorative painting, following the example of the great Italian fresco painters of the 15th century. His most remarkable works are in the sphere of religious art, and mural decorations of this kind are to be seen in the churches of Le Vésinet and of St. Paul at Geneva as well as in the Priory Chapel at Saint-Germain-en-Laye. Maurice Denis decorated the ceiling of the Champs-Elysées Theatre, Paris; he has also illustrated numerous works including a translation of the *Little Flowers of St. Francis;* and has published two volumes *Théories, 1890–1910. Du Symbolisme et de Gauguin vers un nouvel ordre classique* (1912); and *Nouvelles théories sur l'art moderne, sur l'art sacré, 1914–1921* (1922).

DENISON, GEORGE TAYLOR (1839–1925), Canadian soldier and publicist (*see* 8.22), died at Toronto June 6 1925.

DENMARK (*see* 8.23).—A kingdom of northern Europe and a member of the League of Nations. Since the incorporation of North Slesvig (1,538 sq.m.), returned to Denmark in 1920 according to the Treaty of Versailles, the area of Denmark proper is 16,958 square miles. The population (1921) was 3,267,831. About 75% of the area is occupied by cultivated land, about 10% by woods and plantations, while the rest, 15%, is either uncultivated or is used as gardens, building lots, roads, etc. In addition, the Faeroes (540 sq.m.) and Greenland (a little more than 770,000 sq. m.) belong to Denmark.

I. POLITICAL HISTORY

After the Cabinet of J. C. Christensen had been forced by the Alberti catastrophe to retire, it was followed by three short-lived cabinets: Niels Neergaard, Count Holstein-Ledreborg, C. Th. Zahle, whereupon Klaus Berntsen (July 5 1910) formed a cabinet of the Left, which lasted until 1913. After violent contests on the defence problem, the Holstein Cabinet carried an arrangement whereby the army and navy were enlarged, Copenhagen's naval defences strengthened and the land defences were to be dismantled not later than March 31 1922.

The Zahle ministry prosecuted Christensen and Berg before the Rigsret for neglect of their ministerial duties in regard to Alberti (the former being acquitted, the latter sentenced to a fine). In 1910 the Left opened an agitation for a democratic amendment of the Constitution. The Right, which was strong in the *Landsthing* (Upper House) opposed, and no solution had been reached when the elections were held in May 1913. The Radicals and Socialists now held 63 seats out of the 114 in the *Folkething*, and united to force the reform under a new Zahle cabinet with Brandes as minister for finance, Rode minister for the interior, Erik Scavenias minister for foreign affairs and Munch minister for defence. The Right answered by obstruction in the *Landsthing*, which the Government then dissolved. The new *Landsthing* contained 38 supporters, 28 opponents of the constitutional amendment. No solution had, however, been reached when the War broke out. King Frederick VIII. died on May 14 1912, and was succeeded on the throne by his son Christian X.

The War 1914–8.—The European situation in 1914 caused Denmark great anxiety. On Aug. 1 the Rigsdag passed a number of emergency laws. The mobilisation of the emergency army, numbering in all about 70,000 men began on the same day. All political parties agreed in maintaining the neutrality of Denmark. An attack by Germany was especially feared. A difficult

situation arose on Aug. 5 in consequence of an inquiry from Germany as to whether the Danish Govt. intended to block Danish waters with mines, an inquiry which could only mean that if Denmark refused Germany would lay the mines. The Government had to consider Denmark's responsibility as a neutral Power, and after some hesitation decided to lay the mines. With this Germany was satisfied, and Britain sanctioned the action in view of Denmark's precarious position. It became apparent that the war situation might have serious effects upon Danish economic life, and the Government was therefore granted emergency powers. As in military affairs, the Government adhered to the policy of keeping the belligerent nations constantly informed of the measures adopted, these establishing with both sides confidence in Denmark's desire for real neutrality, and an understanding of the importance of maintaining effective industries. This in time resulted in fixed agreements with Germany and England as to exports.

When the first anxiety was allayed the constitutional problem was again taken up. As the opposition of the Right was weakening, a result was reached without great difficulty and June 5 1915 the King signed the new constitution. This introduced equal suffrage in the elections for both Houses, men and women being entitled to vote under identical conditions; the voting age was fixed at 35 years for the *Landsthing* and was lowered successively from 30 to 25 years for the *Folkething*. Of the 140 members of the *Folkething*, 93 are elected in individual districts, 27 in greater Copenhagen according to proportional representation, and 23 supplementary seats are divided among the parties that have received too few representatives at the other polls in proportion to their number of votes. The *Landsthing* has 72 members, of which 54 are indirectly and proportionally elected in the large districts, while 18 are elected by the retiring *Landsthing* according to the same principles. In the case of a constitutional amendment a referendum must take place, and 45% of the eligible voters must vote for it to give it validity. The constitution came into force on April 21 1918.

Other important legislative Acts of the first years of the War, which the Zahle Govt. succeeded in getting passed unanimously, were the Reform of the Administration of Justice (April 11 1916), which separated the administrative and judicial systems, and introduced oral proceedings and publicity—with trial by jury in criminal and political cases—and the Accident Insurance law (July 6 1916), which made it the duty of all employers to insure their employees. The privileged suffrage in elections to the *Amtsraad* (county councils) was abolished with the consent of all parties.

In the late summer of 1916 the Political Bill was succeeded by a bitter struggle on the Government's announcement that it had concluded a treaty with the United States ceding the Danish West Indies to that country for $25,000,000. Finally the cabinet was supplemented by representatives of each political party and a plebiscite taken on the sale. At the polls (Dec. 14 1916) 283,670 votes were cast in favour and 158,157 against, and shortly afterwards the *Rigsdag* ratified the cession. A similar, but less far-reaching bitter contest, arose over the rearrangement of the relation of Iceland to Denmark. With increasing force, Iceland demanded political independence and integrity. Despite the opposition of the Conservatives, the support of the other three parties sufficed to pass an Act of Union (Nov. 1918), in which Denmark acknowledged the independence of Iceland. The King is joint ruler of both countries, and Denmark takes charge of Iceland's foreign relations. The Act of Union is valid till 1940.

From 1917 onwards unrestricted submarine warfare, combined with the stricter measures of the Entente, caused increasing difficulties in the economic life of Denmark. The Government made further efforts, by means of maximum prices, export prohibitions and by the rationing of certain articles, to create tolerable conditions for the people. It sought to mitigate the effects of the increase in prices by an extensive policy of relief. Through an increase of the succession, income and personal property taxes, and the introduction amongst others of a tax on exchange business, the Government tried to cover these and the greatly increased military expenses. After the spring of 1918 the elections could no longer be postponed. At the elections for the *Folkething*, when women voted for the first time (68% voted to the men's 84%), 72 supporters of the Government were elected, 39 Socialists and 33 Radicals, and 68 opponents. The *Landsthing* was constituted as follows: 17 Conservatives, 26 Left, 13 Radicals and 15 Socialists.

1918–25.—At the time of the Armistice the old problems were viewed differently and new questions arose. The troops were quickly demobilised, the special defence works were razed and on March 17 1920, a law was passed abolishing the land defence and artillery of Copenhagen. In 1919 the special military administration of justice had ceased. The Government's economic policy, which had caused some dissatisfaction, but as a whole had been supported by all parties, became the object of very strong criticism, as the Opposition thought it time to abrogate the War-time legislation in this respect. Instead of improving, economic conditions became worse: small exports, the falling value of the Danish krone both at home and abroad and numerous strikes, partly caused by the syndicalistic agitation, characterised the industrial and economic situation until late in 1920.

The Allied victory affected Denmark chiefly through the prospects of a reunion with the Danish part of Slesvig, where plebiscites were held in the spring of 1920 (*see* SCHLESWIG). While the plebiscite results in Zone 1 satisfied Danish expectations, this was not the case with the results in Zone 2, which caused great disappointment. The Zahle Ministry had for months been vehemently attacked for its cool attitude towards the national propaganda in Central Slesvig, and its assailants made it responsible for the poor result of the plebiscite. Certain circles fostered a forlorn hope of preventing the final union of Central Slesvig with Germany by a so-called "internationalisation" of Zone 2, which, however, was not thought of in the Versailles Treaty. The political opposition combined with this nationalistic agitation, and when the Government refused to order new elections, in view of the necessity for a new electoral law, the King dismissed it. A Cabinet of non-politicians, formed by Liebe, March 30 1920, took the responsibility for the King's action, which was regarded by the supporters of the dismissed Cabinet as unconstitutional, and had caused the threat of a general strike from the Socialists. During this "Easter crisis" Denmark looked as if it were on the verge of a revolution. The mediation of the city council of Copenhagen and others conciliated the Crown and the Socialists, and on April 5 a new Ministry, consisting chiefly of state officials, was appointed to formulate an electoral law and to order new elections. The new law was based on proportional representation in the county districts (*Amtskredse*), and the supplementary seats system was retained in a slightly altered form.

At the *Folkething* elections (April 26 1920) the Left received 351,000 votes (49 seats), the Conservatives 201,600 (28), "Erhvervsparti" (trades party) 29,000 (4), against the Socialists 300,000 (42) and the Radicals 122,000 (17). Niels Neergaard formed the new Left Cabinet on May 5. The new *Folkething* elections were held on Sept. 21 1920. In these the people of North Slesvig took part, and the voting age was 25 years for the first time. The results were 412,000 votes cast for the Left (52 seats), 390,000 Socialists (48), 217,000 Conservatives (27), 147,000 Radicals (18), 27,000 "Erhvervsparti" (3) and 7,000 for the German candidates (1). The Neergaard Ministry continued to direct the policy of the country, supported by the majority which its own party, the Left, composed of Danish farmers, formed in conjunction with the Conservatives, the citizen class of the market towns, against an opposition consisting of Social-Democrats, Labour and the Radicals, the small-holders of the agricultural districts and some portion of the Liberals in the towns.

The first task before the ministry was the complete incorporation into Denmark of the restored North Slesvig territory; the old frontier should, if possible, be obliterated entirely, and the new one firmly established in its stead. Many legislative measures and administrative acts were required to attain this end; and

considerable financial sacrifices on the part of the former kingdom were needed to alleviate the manifold distress to which this portion of the former German Empire had been reduced by the War (*see* SCHLESWIG).

Denmark joined the League of Nations at an early date (March 8 1920); since then, a Danish delegation, representing all political parties, has taken part in the proceedings of the League. In 1920 also, negotiations were entered into with Soviet Russia, and, after a temporary interruption, led to a commercial agreement (April 23 1923), which was approved by the Rigsdag on June 8. The extension of the Danish monopoly in Greenland in 1921 to embrace the whole of that country led to some objections on the part of Norway, based on existing Norwegian interest in the East Greenland waters. After diplomatic discussions, negotiations began in Oct. 1923 and Jan. 1924, leading to an agreement of July 9 1924, whereby Norwegian subjects and Norwegian companies were guaranteed certain rights in East Greenland for a period of 20 years.

In Denmark, as elsewhere, it was the general economical development after the War, and its effect on home affairs, which presented the greatest difficulties. Unemployment, after a fall in 1920, had by Feb. 1922 reached 80,000. The Government could not therefore for a moment consider the essential reduction of Government grants to the unemployed which it had maintained as a necessity in face of the former ministry. Dr. O. Kragh, however, who had entered the cabinet in July 1921, as Minister of the Interior, succeeded in finding a method for reasonable restriction of the grant, while maintaining the principle that support of the unemployed in cases of extraordinary unemployment beyond the workers' control was a task for the State. Nor was it actually the purpose of the Government to renounce the social obligations assumed by the State and substitute retrogressive for progressive principles; it only sought to cut down expenses where they seemed to have risen too far, and to find a better basis. This was apparent, when, on Aug. 7 1922, Dr. Kragh succeeded in carrying an Old Age Pensions Bill, ensuring every man and woman on attaining the age of 65, a workers' pension from the State, amounting, for married couples without private means, to £56, and falling in proportion to such means until the right to pension becomes nil on the possession of a fortune amounting to 25,000 kr. (about. £1,500).

In 1922, however, the economical crisis reappeared in a more violent form. The rapid depreciation of the currency became the leading political question. It was generally feared that a continuation of the decline must reduce the nation to the same state of misery as Germany. The Government, however, took no measures to stop depreciation, considering that it must be a matter for the Danish National Bank to raise the value of the krone by suitable deflation with reasonable restriction of the note issue and of credit. It was urged, however, and rightly, that the Government was to blame for not taking measures to compel the National Bank to carry out this policy of deflation.

A new election to the *Folkething* took place on April 11 1924. The Social Democrats obtained 455,000 votes (55 elected), the Left 339,000 votes (45), Conservatives 213,000 (28), Radicals 166,000 (20) and the Germans 7,500 (1). The Social-Democratic party took over the Government on April 23 1924, forming the Stauning Ministry. This, though with a leading trade unionist at its head, consisted, for the rest, of the party's mainly academical members of Parliament, as Borgbjerg, Social Minister; Steincke, Minister of Justice; Bramsnaes, Minister of Finance and Fru Nina Bang, the first woman to hold office in a Danish Cabinet, as Minister of Education. The Danish Minister in Berlin, Count Moltke, also entered the Cabinet as Minister for Foreign Affairs. The new Government was at once faced with the task of carrying out the agreement with Norway; this was passed in June 1924 with the votes of the Left and Social-Democrats against the Conservatives and Radicals. The passing of this measure settled the question; and since then, England and France have sought and obtained from Denmark the same rights in East Greenland as Norway. The most important task, however, was the restoration of the krone. The Social-Democratic Government for the rest attracted most attention by passing through the Lower House a measure for the virtual disarmament of Denmark.

See Erik Arup, *Rids af Danmarks Historie* (1921); Fr. Nörgaard, *Danmark fra 1864 til Genforeningen med Sönderjylland* (1920); Alex. Thorse, *Grundrids of den danske Rigsdags Historie 1866–1915* (1920).

(ER. A.; H. LU.)

II. FINANCIAL AND ECONOMIC HISTORY

Denmark shared with the rest of the world in the general rise in values which culminated towards the close of 1913. Unemployment, which was 9·4% in 1911, fell in 1912 to 7·5 and in 1913 to 7·3%, and the production and export of agricultural products, especially butter, bacon and eggs, a factor of great importance in the economical life of the country, was on the increase. The total exports of home produce, to which agriculture normally contributes nearly 90%, amounted in 1911 to 537,000,000 in 1912 to 597,000,000, and in 1913 to 637,000,000 kroner.

The War Period.—Although a neutral country from first to last, Denmark experienced increasing economic difficulties throughout the World War. This was due primarily to the fact that it is necessary not only to import coal and the bulk of raw materials for industry, but also enormous quantities of oilcake and maize for agricultural purposes in the production of butter and bacon, as well as large quantities of fertilisers. It was therefore of the utmost importance to ensure a continuance of the most essential imports from overseas, not only for the maintenance of industrial employment, but also for the sake of agriculture, which had, on the one hand, to provide food for the population, and more especially, to maintain its exports in order to pay for imports required. As each of the two belligerent groups feared that these imports might find their way, directly or in a manufactured state, to the enemy, various commercial agreements were concluded, in which the two great central industrial organisations, the Industrial Council (Industriraadet) and the Committee of the Merchants' Society (Grosserer-Societetets Komite), guaranteed on behalf of their members that goods imported under the clause prohibiting export should not be dealt with contrary to the agreements.

These agreements did not at first include any provision as to limitation of the quantities imported; in course of time, however, rationing regulations were introduced for a whole series of commodities, and on the declaration of the unrestricted submarine campaign on Feb. 1 1917 imports were further reduced, while the American export restrictions and the blockade hindered the import of corn and fodder. In order to maintain the supply of necessary foodstuffs for the population, but more especially to maintain as long as possible a surplus of agricultural produce for export—still distributed in the same proportion west and south as before the War—rationing of bread and sugar was introduced at the beginning of 1917, and later also butter, bacon and lard were rationed. Various groceries were subsequently added to the rationing list as long as any supply of these remained in the country, which ceased to be the case early in 1918.

Foreign Trade.—The value, amount and prices of exports and imports for 1911–25 will be seen from the following table:—

Year	Imports, mill. kr.	Exports, mill. kr.	Import surplus mill. kr.	Quantitative index, 1913 = 100		Gross income shipping, mill. kr.	Wholesale price figure	Retail price figure
				Imp.	Exp.			
1913	855	721	134	100	100	119	89	..
1914	795	867	72[1]	88	114	102	100	100
1917	1,089	1,066	23	46	72	465	249	155
1918	946	758	188	33	33	563	302	182
1920	3,243	1,962	1,281	88	83	553	383	262
1921	1,697	1,564	133	89	88	205	253	237
1923	2,031	1,684	347	125	128	240	207	204
1924	2,366	2,154	212	126	130	270	233	214
1925	2,095	1,966	129	..	..	..	212	219

[1]Export Surplus.

The index figures for quantity show that the imports fell to a very low level in 1917–8, while exports even in 1919 were still not half the normal quantity. This was especially due to the after-effects of shortage in import of raw materials for agriculture, which led, *inter alia*, to the slaughtering of the entire stock of pigs. As regards industry, the stoppage of imports of raw materials sent up the unemployment percentage, which had been normal in 1915 and well below the normal in 1916, to 10% above normal in 1917, while in 1918 it was 106% and in 1919 still 24% above the average for 1909–13.

The table further shows that imports were only slightly in excess of exports during the actual years of war, and this excess was more than balanced by the income derived from shipping. In 1919–20, on the other hand, the excess was very high, partly because quantities of goods purchased during the War could now be brought home, and partly because of the anticipation of a great demand from Central Europe and the Baltic which, however, failed to materialise.

Rate of Exchange and Price Level.—These features in foreign trade were of great importance to the rate of exchange. The Danish krone rose above par in regard to the pound sterling and the dollar to such an extent that on Oct. 2 1917, the pound had fallen to kr. 13·00 (kr. 18·16 at par). Subsequently exports decreased greatly, and there was an expansion of credit, stimulated to no slight degree by the considerable loans advanced by the Note Bank and the leading private banks to German, English and French banks during the War, which resulted in an increase in the volume of purchasing power and helped to raise the level of prices and to move the exchanges against Denmark. At the end of the War, therefore, the value of the Danish krone fell below parity. During 1920, the value of imports rose to over 3,000,000,000 kroner, and the rate of exchange to the pound sterling mounted on Nov. 17 1920 to 25·86.

This again led to a rise in wholesale and retail prices, partly because the War-time price regulation arrangements were gradually being withdrawn, and also because the effects of the wage bonus granted in 1918 and 1919 to workers and civil servants were now being felt; and further, to some extent, owing to the fact that the State had to borrow extensively from the Note Bank. The deficit in the Budget was due partly to the fact that a low price for bread had been maintained also for the harvest year 1920–1, the State paying the farmers a fixed price based on that of the world market, and selling the corn itself to the millers at a reduced rate. Owing to the fall in prices which set in towards the close of 1920, however, the State did not, as had been anticipated, recover part of this expenditure by export, and the whole of the bread subsidy had therefore to be borne by the State.

Financial Policy.—The universal fall in prices, however, also had a very marked effect in Denmark; in 1921, unemployment was four or five times the normal, and the import surplus declined, as the table shows, to only 133,000,000 kroner. Before the middle of 1921, the pound sterling was almost at par. But this rate could not be maintained, and the exchange therefore rose again to 20–22 kroner. Here it remained during 1921 and for part of 1922, but the effects of the fall in prices now appeared, and several banks were in difficulties. The Landmandsbank, the largest in the country, was reconstructed with the aid of the National Bank. During 1923–4 the value of the pound sterling remained, with various fluctuations, about the level of 26 kroner. But there was still an active demand for a return to the old gold parity, and in March 1924, the National Bank commenced a systematic restriction of credit, which brought the gold value of the krone, measured in dollars, up to about 65 ore at the close of the year.

This financial policy was now supported by a law of Dec. 1924, authorising the Minister of Finance to levy extraordinary taxes for the covering of a loan with the National Bank in connection with the reconstruction of the Landmandsbank, and further, to give the State's guarantee for a cash credit of $40,000,000 taken up by the National Bank. This helped to support the financial policy introduced in March 1924, and in 1925 the value of the krone has risen very considerably, and has been for several months about 92 ore. The deflation which in 1925 sent the wholesale price level down from 243 to 176 naturally occasioned difficulties both for industry and for the banks, but the economic life of Denmark did not suffer any irreparable damage, owing primarily to the fact that the country's main source of revenue is agriculture, which, with its relatively low rate of wages, is far better able to maintain competition in foreign markets than is the case where the export of industrial products has to provide the bulk of the nation's income.

BIBLIOGRAPHY.—H. Westergaard, *Economic Development in Denmark before and during the War* (Oxford, 1922); also a series of articles by Einar Cohn in *Nationalökonomisk Tidskrift* (Copenhagen) during the period. (E. Co.)

III. AGRICULTURE

Under the Treaty of Versailles Denmark increased her area by the addition of a part of the old Danish districts in Slesvig comprising about 3,280 sq. km. of farm land and 14,364 farms. The number of holdings has been increased, partly by private parcelling out and partly by the establishment of many small holdings with state aid, so that the total number of agricultural holdings in 1920 was 205,929 as against about 172,000 in 1901.

As a result of the Land Laws of 1899 and 1919 about 9,000 new small holdings were created during the 15 years 1910–24. The average number of holdings established each year from 1920 to 1924 was about 1,000. The total number of holdings in 1925 was about 212,000 of an average size of about 18 hectares each. With the increase in the number of holdings there was a change in the mode of tenure, from tenancy to freehold. The law of June 30 1919 abolished leasehold as far as large and middle sized holdings were concerned. Leasehold is still allowed for small holdings, and in 1919 about 5,700 small holdings were held on lease or rented, the Slesvig part excluded.

TABLE I. *Size, Number and Mode of Tenure of Farms in 1919–20*

Group according to size	Number of holdings	Total	Per cent of total area	Mode of Tenure in percentages			
				Free-hold	Lease-hold	Ten-ancy	Not stated
hectares		hectares					
0·55– 3·3	43,891	92,586	2·4	85·7	9·9	1·7	2·7
3·3 –10·0	65,254	449,627	11·8	93·9	2·6	1·4	2·1
10 –15	25,494	365,722	9·6	95·4	1·2	1·8	1·6
15 –30	43,364	1,092,880	28·6	95·2	1·1	2·2	1·5
30 –60	22,552	1,063,144	27·8	93·6	1·4	3·4	1·6
60 –120	4,039	387,216	10·1	91·2	0·6	6·6	1·6
120 –240	916	185,227	4·9	79·2	0·5	18·8	1·5
Over 240	419	181,893	4·8	63·5	0·5	32·2	3·8
Total .	205,929	3,818,295	100·0	92·4	3·5	2·1	2·0

It will be seen that the middle-sized farms of from 10 to 60 hectares form the majority, comprising 66% of the total area. The small holdings of under 10 hectares form 14% and the farms of about 60 hectares form about 20%. In 1919 only 5·7% of all the farms were not worked by the owners as against 11·6% in 1901.

Production and Marketing.—The War and its after-effects naturally vastly influenced production and marketing. The great development in and industrialising of animal production characteristic of Danish agriculture during the last 30 years previous to the War have made Denmark more dependent on international trade than the agricultural activities of most other countries. In 1913 Denmark exported agricultural produce to the amount of about 550,000,000 kr., about 97% of the exports being animal products, and imported corn and feeding stuffs to the value of 181,000,000 kroner. The War seriously affected this development, especially after the submarine warfare began in Feb. 1917. The effect of the blockade and the post-War recovery may be deduced from the following table:—

TABLE II. *Number of Farm Animals 1909–25 (in 1000)*[1]

	Horses	Cattle	Cows	Pigs	Sheep	Fowls
1909	535	2,254	1,284	1,468	727	11,816
1914	567	2,463	1,310	2,497	515	15,140
1918	545	2,124	1,024	621	470	9,884
1919	558	2,188	1,042	716	509	12,134
1920	602	2,504	1,196	1,116	540	14,395
1922	576	2,525	1,311	1,899	442	19,184
1924	548	2,667	1,369	2,868	302	20,284
1925	538	2,756	1,390	2,546	265	20,134

[1]Since and including 1920 the figures include the Slesvig part.

The large decrease in the number of milch cows and pigs during the War does not show the full decrease in animal products. The annual yield per cow decreased from about 2,750 kg. milk in 1914 to about 1,810 kg. in 1919, and in terms of butter this means a decrease in production from 143 million kg. in 1914 to 76 million kg. in 1918. It was not until 1922 that the yield reached the 1914

level, but in 1925 it rose by an additional 250 kg. per cow, the average yield of milk per cow per annum being estimated to about 3,000 kilogrammes.

TABLE III. *Export of Animals and Animal Products in Certain Years*[1]

	1000 head of			Million kg. of					
	Horses	Cattle	Pigs	Butter	Cheese	Condensed milk	Bacon	Beef	Eggs
1910–3	26·8	143·0	..	88·5	0·3	2·5	116·2	17·6	25·2
1914	95·7	188·9	..	95·3	0·5	2·7	147·1	17·4	27·5
1916	16·1	305·4	..	95·8	4·5	3·3	104·7	18·2	28·9
1918	29·2	113·8	..	14·7	3·2	1·4	2·7	13·9	19·7
1919	1·4	32·3	0·4	36·6	2·6	1·7	0·9	8·3	20·4
1920	24·1	61·2	53·6	74·8	9·7	6·3	42·4	17·6	32·8
1922	19·7	82·5	10·0	95·5	8·9	23·4	111·4	20·5	44·2
1924	12·6	172·9	205·7	123·4	8·8	34·2	197·2	3·8	50·0

[1] Since and including 1920 the figures also include the Slesvig part.

The heavy reduction after 1917 was mainly due to the absolute cessation of the import of feeding stuffs, but partly to the very poor harvests during the years 1917–8 especially with regard to grain crops. These reduced the bacon export in 1919 to the minimum of 1,000,000 kilogrammes.

In the figures from 1920 the export from Slesvig is included. The export of animal products only reached pre-War level in 1923 and 1924. The increase is largest for the export of dairy produce, pigs, bacon and eggs, while the export of cattle and beef taken as a whole is smaller than before the War and there is a considerable decrease in the export of horses mainly due to difficulties experienced on the German market.

The large increase in the export, both during and after the War, of live pigs, cheese and condensed milk is very remarkable. There has been a corresponding decrease in the export of fresh milk and cream. The total value of the export of animal products was in 1924 1,589,000,000 kroner against 462,000,000 kroner during the five-year period of 1909–13. The gold value of the export for 1924 is 987,400,000 kroner or about twice the value of the pre-War export. The large decrease in animal production from 1914–9 also decreased the plant production, as farm manure plays a prominent part in Danish agriculture, and the decrease in manure is roughly proportionate to the decrease in the import of feeding-stuffs. Moreover, the import of nitrogen and phosphates was partly stopped during the years 1917–8.

TABLE IV. *The Harvest 1909–24 (in million crop units)*[1]

	Corn	Roots	Potatoes	Sugar beets	Hay	Total
1909–13	2·992	1·394	0·201	0·101	0·717	5·405
1914–18	2·476	1·395	0·222	0·112	0·546	4·751
1919–23	2·880	1·577	0·306	0·102	0·554	5·419
1924	3·188	1·862	0·167	0·119	0·538	5·874
do. incl. Slesvig	3·467	1·990	0·175	0·121	0·610	6·363

[1] 1 crop unit equals 1,000 kg. of corn, or its equivalent in feeding value or money in the case of other crops.

The above statistics do not include the yield of the grazing and green fodder area nor the yield of various crops grown for the purpose of commercial transactions. If these crops are also included the total production of 1924 will be about 8,000,000 crop units including Slesvig. The decrease during the War is specially noticeable with regard to the corn and hay crop but it is partly due to a decrease in the arable area of these crops, while the area of roots, potatoes and sugar beets was greatly increased during the same period, and this increase in roots continued after the War so that the area under these crops in 1925 was about 13·5% of the whole of the cultivated area against 10% in 1912. Feeding roots in 1924 were 31·3% of the total harvest as against 25·8% in 1909–13. This increase is of course closely connected with the great number of cattle.

Financial Returns.—After the long period of depression at the close of the 19th century, prices improved and the relatively few financial accounts which are available for the years 1910–3 show an average yield of interest on capital sunk in well-worked farms of about 4 to 5%.

During the first years of the War the prices of corn and seed as well as of live animals and meat rose very considerably, causing an increase in the yield of interest on capital sunk in large and middle-sized farms. During the following years the prices of dairy produce, bacon and eggs also rose considerably, which was of special importance for small farms. The increase in prices since the War is to a large extent due to the low rate of exchange which prevailed.

During 1917–8 and onwards regular inquiries have been made with regard to the economic position of large numbers of agricultural holdings of an average area of about 45 hectares each. The results of these inquiries are shown in Table V.

TABLE V. *Working Results of Agriculture in Certain Years*

Financial year	Gross returns kr. per ha.	Working expenses kr. per ha.	Net Profit		Net profit in gold kroner per ha.
			kr. per ha.	per cent of capital	
1911–4	435	360	75	ca.4·0	75
1917–8	699	482	217	6·8	245
1918–9	857	551	306	8·3	326
1919–20	1,024	743	281	7·4	213
1920–1	1,185	949	236	5·8	139
1921–2	831	798	33	0·9	22
1922–3	837	692	145	4·5	111
1923–4	1,023	813	210	6·1	136
1924–5	1,139	885	254	6·7	162

The great increase in gross returns and in net profit was noticeable as early as 1917–8, but while the increase in the gross returns was continued until 1920–1 the net profit was at its highest in 1918–9, decreasing until the critical year 1921–2, and rising again until 1924–5. During the spring of 1925 a new period of deflation began which developed quickly during the summer when the value of the krone rose in the course of three months from about 70 to 93% of its pre-War value. The fall in prices, which was almost as great as that of the autumn of 1921, has totally altered the favourable economic position of agriculture, and if deflation continues agriculture will be faced with heavy difficulties. It is to be hoped that during the good years some reserve capital was accumulated, and, if a market can be found for the increasing amount of animal products, Danish agriculture with its smooth-working co-operative organisations and its good position on the European market may be expected to tide over the crisis.

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(O. H. L.)

DENTISTRY (*see* 8.50).—The progress of dentistry in the years following 1910 was more rapid and more radical than in any previous period. The cause of this progress was the general advancement in knowledge due to the accumulation of data from scientific investigation and the application of the knowledge thus acquired to the prevention and treatment of disease.

Causes of Dental Disease.—Until comparatively recent times the extent to which abnormal mouth and teeth conditions are responsible for derangements of health was imperfectly understood. The pioneer studies of W. D. Miller, of Berlin, especially, as reported (1891) in a series of communications entitled *The Human Mouth as a Focus of Infection*, first called attention to the fact that the oral cavity is the habitat and breeding ground

for a large group of micro-organisms, many of them pathogenic, which under conditions of lowered resistance invade other parts of the organism and become the direct exciters of bodily disease. Miller also showed that the mouth is the common portal of entry for most of the disease-producing organisms that infect the human body, and further demonstrated that certain mouth bacteria, when injected into the circulation of a test animal, could pass through the blood stream or lymphatic system and establish metastatic foci of inflammatory action at points and in organs remote from the seat of inoculation (*see* THERAPEUTICS). These early findings were afterwards confirmed by other investigators, more particularly by Sir Kenneth Goadby, of London. Recognition of the significance and far-reaching importance of the principles underlying these results of scientific research was only gradually accorded by the general body of the dental profession, and then merely as interesting facts without direct utility in dental practice.

Septic Foci.—In several communications on septic dentistry, notably in an address delivered in 1910 at the opening exercises of the annual session of the Medical School of McGill University, Montreal, Sir William Hunter, physician and lecturer to the Charing Cross Hospital, London, criticised badly conceived and unskilfully executed dental restorative operations, especially in crown and bridge work and the treatment of pulpless teeth, which were performed without regard to surgical asepsis. In this connection Hunter brought clinical evidence to prove the soundness of his contention that operations so performed leave septic foci that cause septicaemic conditions, as well as infections in remote parts of the body.

Hunter's revelation impressed at once the dental and medical professions, and his criticisms immediately bore fruit. The general use of the X-ray as a means for study of the apical region of tooth roots, the development and application of specialised bacteriological technique for determining in pulpless teeth the identity and character of the exciters of disease action and similarly those responsible for inflammatory lesions of the retentive structures of the teeth (commonly designated *pyorrhea alveolaris*), all stimulated by the realisation of the profound clinical importance of mouth infections as related to bodily health, quickly followed the communications of Hunter.

Change of Interest and Development.—The total effect of this evidence, both clinical and scientific, upon the development of dentistry has been little short of revolutionary. From time immemorial it has been believed from empirical observation that an unclean and infected mouth cavity is a source of bodily ill health, and much direct evidence of a clinical character had accumulated to strengthen that belief, but the evidence now available has definitely established the facts.

Until this development of knowledge concerning the systematic relationships of disorders of the teeth and their related structures and their bearing upon the bodily health, the major feature of dental interest, upon which the attention of the profession was concentrated, was the development and perfection of manipulative procedure in restorative operations. The ingenuity expended and the excellence of the results attained became the outstanding characteristics of dental practice; and the restoration by prosthetic or operative means of the masticatory mechanism damaged by partial or total loss of teeth was its dominating ideal. There is now an enforced recognition in the professional, as well as in the lay mind, of the importance of the welfare of the tissues and organs of the mouth. In the dental profession the consequent changes of technical procedure and objectives have been fundamental. The ideal of mechanical perfection in the methods and appliances by which the dental surgeon restores the patient's power to masticate is now regarded as a remedial measure subservient to the larger ideal of normal mouth health.

Oral Hygiene in Schools.—One of the principal factors which extended and popularised this knowledge is the oral hygiene movement, an effort to demonstrate practically the fact that school children, relieved of the disabilities arising from infected mouths and diseased teeth which handicap normal development, will show improved physical and mental efficiency. The Cambridge experiment, inaugurated in 1907 by the late George Cunningham, of Cambridge, England, was perhaps the earliest practical test. The analogous work of Dr. Ernst Jessen, of Strasbourg, introduced oral hygiene into the public schools of a number of towns in Germany. In the United States the oral hygiene movement took practical form in the test of its utility in the Marion school of Cleveland, O., in 1910 and in 1919 there was completed, under conditions yielding accurate figures, a five years' test of applied mouth hygiene in the public schools of Bridgeport, under the direction of Dr. A. C. Fones.

In this test 20,000 children of the first five school grades were under observation and treatment. The average number of carious cavities was found to be over 7% per child; 30% claimed that they brushed their teeth occasionally; 60% frankly stated that they did not use a tooth-brush and 10% were found to have fistulas on the gums, showing outlets from abscesses from the roots of decayed teeth. Systematic application of oral hygiene, the intelligent and systematic use of the tooth-brush and the elimination of accretions, dental decay and suppurative conditions achieved striking improvement in general health and mental efficiency. The statistics of the Bridgeport Board of Health show that the most common fatal diseases among children in that locality were diphtheria, measles and scarlet fever. The decrease in deaths from these sources after the introduction of oral hygiene in the public schools is shown by the following table, the figures for 1914 showing conditions before the test:—

	1919	1914
Diphtheria	18·7%	36·6%
Measles	4·1	20·0
Scarlet Fever	0·5	14·1

Dental Disease and Mental Efficiency.—The improvement in mental efficiency is shown by the reduction in the percentage of retarded children, *i.e.*, children who are not less than two years older than the normal age for the school grade to which they should belong. The percentage of retarded children before and after the introduction of mouth hygiene in the Bridgeport schools is shown in the following table:—

Percentage of Retarded Children

Grade	Sept. 1912	Nov. 1918	Drop in retardation
I	16·5%	8·1%	51·0%
II	37·0	15·3	58·0
III	53·0	24·7	53·0
IV	59·5	31·7	47·0
V	61·0	33·1	45·0
VI	54·0	30·4	44·0
VII	39·0	19·3	50·0
VIII	27·0	12·5	54·0
Average	40·0	20·1	50·0

Retardation represents inability of the child to advance with his class, necessitates repetition of his grade work, and becomes an economic question of serious importance to the ratepayer. The cost of re-education in Bridgeport in 1912 was 42% of the entire budget, and for 1918 only 17%. Among the 20,900 children under observation in the schools of Bridgeport, 98% had various forms and degrees of malocclusion of the dentures, a condition now generally recognised as associated with asymmetrical development of the bones of the face and the brain case. Many children with malocclusion owing to the arrested development of the facial and cranial bones suffer from impeded nasal respiration, and develop adenoids and tonsillar hypertrophy, leading to infection with its systematic sequelae and the interferences with bodily nutrition incident to insufficient oxidation of the blood. Orthodontic treatment for the correction of malocclusion in children is a therapeutic and prophylactic measure having an important health relation rather than a procedure for the relief of deformity.

Work in Armies and Navies.—From small beginnings the U.S. Army and Navy Dental Corps rose to an allotment by law of one dental surgeon for each 1,000 of the army personnel, and before the

close of the World War provision was made to double that allotment. After 1918 full provision was made by the U.S. Govt. for the dental care of its enlisted men and of those demobilised from service suffering from dental defects of disabilities since demobilisation. The proportion of dental surgeons to army personnel in 1917, as given by officials of the British Dental Assn. (see "Man Power and the Army Dental Service," *British Dental Journal*, Feb. 15 1918) for some forces, was: Canadian Expeditionary Force, one per 1,000 men; New Zealand Expeditionary Force, one per 2,500 men; Australian Expeditionary Force, one per 2,600 men.

Satisfactory figures for the German Army dental service are not obtainable, but according to Dr. Ernst Jessen, head of the dental work in Strasbourg, quoted in *The German Dental Review*, there were 810 dental surgeons active in the field in 1915. France, during the World War, had at least 1,500 army dentists working in various parts of the lines as fixed units, in addition to the dental ambulances. During the latter part of the War, when the man-power of France was seriously depleted, over 250,000 effectives were mustered into the French service as the result of efforts instituted by Dr. Georges Villain, of Paris, by which that number of men who had been previously rejected because of loss of teeth, but were otherwise physically sound, were subsequently fitted with artificial dentures and sent to the fighting line. Great Britain created by Royal Warrant, issued Jan. 4 1921, a military dental service, the Army Dental Corps, which is administered by the Director-General, Army Medical Service (*see* MEDICAL SERVICE, ARMY), and is a joint service for the army and R.A.F.

Experience during the War clearly demonstrated to all the belligerent nations the importance of dental service as a means of mouth sanitation and the practical utility of the latter in maintaining the physical efficiency of the fighting personnel.

National Dental Service.—Undoubtedly the most notable example of comprehensive planning for the national extension of dentistry and oral hygiene as a factor of the public health service is that proposed in the interim report on the Future Provision of Medical and Allied Services, made to the British Ministry of Health by the Consultative Council on Medical and Allied Services, May 1920. This report recognises oral hygiene and dental service as factors of public health and as proper subjects for control and development by the state. Oral hygiene comprehends much more than the correction of dental defects and oral infection due to neglect of the tooth-brush; its aim is prophylactic as well as corrective. Corrective procedure merely arrests the progress of disease and mechanically restores damage already done. The entire energies and skill of the whole dental profession can cope with only a small fraction of the corrective work needed.

Personal Hygiene.—To establish the habit of personal care of the mouth in school children is a field of activity that has developed the specially trained dental nurse or hygienist as an adjuvant to dental service, whose calling is now legalised in the principal states of the United States. The work of the dental nurse is limited to the surface treatment of teeth, in the removal of deposits and accretions thereon, the training of school children in the systematic use of the tooth-brush and their education in the importance of mouth cleanliness. A child who has learned to use the tooth-brush exhibits increased self-respect, greater attention to bodily and mental cleanliness, closer compliance with school regulations and an awakened interest in attendance and studies. The present trend is toward making dental and oral hygiene service in all civilised countries a public health measure.

War Surgery.—The many head, face and jaw wounds during the World War created a new field for oral surgery and surgical prosthesis. Surgical measures alone were insufficient for the successful treatment of these cases, as the loss of tissue from gunshot wounds of the head and face, as well as the unsightly scars resulting from extensive lesions when surgically treated, left the patient in many instances with repulsive deformities. The resources of surgery and dentistry were called into co-operation. In this work the aid of dental prosthetic technique was often necessary. These experiences furnished convincing evidence of the need by each profession of a more intimate acquaintance with the work of the other, now recognised in the practice of adding a professional dental service to hospital staffs.

Relations with Bacteriology.—Bacteriological and histological investigation of dental and oral pathology by numerous investigators (*see* BACTERIOLOGY) has improved dental and oral surgical technique. Notable progress has been made in the study of dental and oral infections and of physical irritations of nerve terminals in and about the teeth, in their relation to mental disorders and reflex neuroses (*see* PSYCHIATRY) that cause disturbances of the special sense organs as well as spastic disorders of a local or general character. Attention has been directed to the endocrine relationships (*see* ENDOCRINOLOGY) of the teeth and oral tissues, especially as to the probable connection between the activities of the ductless gland system and the reactions of the salivary secretion, and to variations in the calcified structures of the teeth and their susceptibility or immunity to caries. Corresponding changes in the objectives, the character, the content and extent of dental education have taken place in harmony with these developments. Practical teaching approximates more closely to the fundamental ideals and methods of general medicine in so far as they represent the principles common to the whole science and art of healing.

Oral Prophylaxis.—Oral prophylaxis, in so far as it has been intrumental in securing cleanliness of the mouth and its contained dental organs, has undoubtedly prevented dental disease to a considerable degree, but has not been wholly effective. As research has thrown light upon the causes and mode of action of the phenomena of dental disease, attention has been increasingly focused upon means for its prevention. The factors of susceptibility and immunity are undergoing active investigation with strong indications that nutritional errors and faulty metabolism play a rôle of primary importance in the causation of dental disease. Correction of faulty food habits and a rational hygiene should contribute materially toward the prevention of those dental diseases, caries and periodontal necrosis, the most common and widely distributed of human disorders. Because of the recognition of the vital relations of the teeth, a rapid reorganisation of the dental educational system is proceeding toward a more efficient adaptation of the knowledge of health relations of the teeth to the ends of dental practice.

A systematic survey of the whole field of dental education has been made by the Carnegie Foundation for the Advancement of Teaching, with a view to recommending such adjustments as will bring systematic dental education fully up to the standard of present requirements from a public health standpoint.

General Developments.—While the most conspicuous progress in dentistry since 1910 has been in the direction of its vital and hygienic relations, its technical and engineering features have shown a similar development. Until this period the construction of artificial dentures for the prosthetic restoration of lost teeth was almost wholly an empirical procedure depending on the judgment, manual skill and good taste of the operator. Scientific studies of the engineering principles underlying the mechanism of the human masticatory function, initiated about 1890 by W. G. A. Bonwill, of Philadelphia, and since prosecuted by his numerous followers, have brought the knowledge of masticatory movements and of the relations of the teeth and their morsal surfaces thereto to a state of completeness that enables the prosthetist, by the aid of mechanical articulating devices, to reproduce in the artificial denture a mechanism with possibilities approximating, both functionally and artistically, those of natural dentures. In 1913, Charles H. Mayo, the distinguished surgeon of Rochester, Minn., expressed the opinion that the next great step in medical progress in the line of preventive medicine should come from the dental profession. A review of the progress since made would seem to indicate a reasonable prospect of the fulfilment of that prophecy. (E. C. K.)

DENVER, Colo., U.S.A. (*see* 8.54), had in 1920 a population of 256,491 (105·9 males to 100 females), including 6,075 negroes and 38,230 foreign born. In 1925 the estimate of the census bureau was 280,911. Denver had no great volume of war business, and consequently suffered only moderately from the post-War deflation; while the general increase in freight rates (1915–20) created advantages for all Western manufacturers and in some cases worked in favour of Denver. The aggregate value of manufactured products was $46,925,000 in 1909; $125,411,000 in 1919; $120,789,757 in 1923. Receipts at the stock yards increased from 1,360,000 head in 1914 to 3,238,900 in 1924, of which 2,039,600 were sheep. At the National Western Stock

Show founded in 1907 pedigree breeding stock is bought and sold in carload lots, " feeder " stock by the trainload. The volume of Denver's jobbing trade in 1924 was about $125,000,000; of its retail trade $120,000,000. It is estimated that tourists spent $12,500,000 in the city in 1924.

Denver is the administrative headquarters for many oil producers and refiners, for the Colorado coal corporations and many other mining companies, for all lines of insurance and for numerous branches of the Federal Government. Its growing importance as a financial centre is indicated by the increase in bank clearings; from $459,708,000 in 1914 to $1,611,164,000 in 1924. The advantages of the climate for the treatment of tuberculosis, and the large number of invalids who go to Denver, have combined to stimulate the building of many hospitals and sanatoria, which, together with the new medical school of the state university, make the city an important medical centre. The cost of living is relatively low (93·7% of the average for 31 American cities Dec. 1924). A unique attraction is the chain of 19 mountain parks, over 10 sq. m. in area, owned by the city and connected with it and with one another by 100 m. of boulevard. Illiteracy and child labour are low. School attendance is high. The death-rate is kept high by the influx of invalids from other parts of the country.

A serious street-car strike occurred in 1920, involving considerable violence, the loss of seven lives, the importation of armed strike breakers, and the intervention of Federal troops and military rule for a month. The commission form of government was adopted in 1912, but was abandoned in 1916 for the mayoralty form. The completion of the Moffat tunnel, authorised in 1922, will place Denver on a direct route to the West, shortening the distance to Salt Lake by 173 m., and will give access to untapped sources of raw materials.

DE PROROK, BYRON KUHN (1896–), American archaeologist, was born at Mexico City Oct. 6 1896. He was educated at Folkestone, England, and the University of Geneva. He devoted himself to archaeological study and exploration in Yucatan and northern Africa, later collaborating with Father Delattre, who for 40 years had been excavating the ruins of Carthage. In his investigations in northern Africa, particularly at the sites of Carthage, Djerba and the Hoggar, Utica, he made some remarkable discoveries, including the tomb of Queen Tin-Hinan, declared by the French Institute to be the most important tomb ever discovered in the Sahara. He received the support of archaeological societies and universities in the United States, his field work being done under the auspices of the French Service des Antiquités. In 1926 he received from the French Govt. permanent permission for carrying on archaeological research in North Africa. He published *Digging for Lost African Gods* (1926).

DERAIN, ANDRÉ (1880–), French painter, was born at Chatou (France), June 10 1880. For a considerable time he shared a studio with the landscape painter Vlaminck; he then made the acquaintance of Picasso, Georges Braque and the poet Guillaume Apollinaire. It was from this small group that Cubism developed. Yet Derain cannot be considered as a representative of the Cubist School; his best works adhere to the great traditions of the classic landscapes, and are formal in character and restrained in colour, while his figures exhibit a grandeur and serenity, which reveal an admirer of the great masters.

DERBY, EDWARD GEORGE VILLIERS STANLEY, 17TH EARL OF (1865–), British politician (*see* 8.69), was in Jan. 1915 created a Knight of the Garter. In Oct. 1915 he became director of recruiting for the army, and as such was responsible for a new scheme for a final effort on behalf of voluntary service known as the Derby scheme. In Feb. 1916 Lord Derby became chairman of the naval and military air service joint committee, but resigned in April, becoming under-secretary for war in July. On the formation of Mr. Lloyd George's Government in Dec. 1916 he became Secretary for War, and in April 1918 was appointed British Ambassador to France. He retired from the latter office in Nov. 1920. In Oct. 1922 he became Secretary for War in Mr. Bonar Law's Cabinet, retaining this position under Mr. Baldwin until Jan. 1924.

DERBYSHIRE NECK: *see* GOITRE.

DÉROULÈDE, PAUL (1846–1914), French author and politician (*see* 8.74), died at Mont-Boron, near Nice, Jan. 30 1914. In 1910 he published a collection of his patriotic speeches, and a volume, *La Ligue des Patriotes*, containing further extracts from them, appeared in 1916.

DESCHANEL, PAUL EUGÈNE LOUIS (1856–1922), French statesman (*see* 8.91). After presiding over the Commission of Foreign and Colonial Affairs (1905–9) and acting as reporter of the Foreign Office Estimates Committee, M. Deschanel filled many responsible positions. In Jan. 1920, he was elected President of the Republic, as being a " safer " candidate than M. Clemenceau, though the latter's popularity spoke strongly in his favour. In the autumn of the same year, however, failing health obliged him to resign office. He died in Paris April 28 1922, from the effects of a fall from a railway carriage.

DESIGN: *see* DECORATIVE ART.

DES MOINES, Ia., U.S.A. (*see* 8.98), increased in population 46·4% in the decade beginning 1910, reaching 126,468 in 1920, of whom 5,512 were negroes and 11,224 foreign-born. The state census of 1925 gave a population of 141,441. Des Moines has the highest percentage of home ownership among American cities (51·1% in 1920); its percentage of illiteracy is one of the lowest; its death-rate also is low. It was one of the first American cities to plan on a generous scale for beauty in its development. The Civic Centre, including a new city hall ($500,000), a new municipal court building ($600,000), and the Coliseum (seating 8,500) extends along the river front through the heart of the city. The State Fair attracts each year about 400,000 visitors; and the city entertains annually 150 conventions. In the six years after the close of the World War over $50,000,000 was spent in building operations, representing more than 12,000 projects. Manufactures showed an increase at each Federal census, even in 1921. The aggregate value was $23,585,000 in 1909; $59,831,000 in 1919; $72,287,732 in 1921; $102,919,098 in 1923. The average number of wage-earners in the factories increased from 5,383 in 1909 to 9,558 in 1923. The printing and publishing of newspapers and periodicals was the largest industry in 1919. The city ranked fifth (1925) in second-class mailings, and was the largest centre in the world for the publication of farm journals.

DE STEFANI, ALBERTO (1879–), Italian economist and statesman, was born at Verona Oct. 6 1879. After graduating in law at the University of Padua he devoted himself to the study of economics and became Professor of political economy at the Superior Commercial Institute of Venice. In 1921 he was returned to the Chamber as a Fascist and soon gained the confidence of Mussolini, who, on coming to power, appointed him Minister of Finance. Later he was also entrusted with the Treasury department and welded the two into a single ministry. He at once began to reform the financial system. He abolished useless expenditure and simplified the fiscal system, reducing innumerable taxes to three main sources of revenue, with the result that, in three years a deficit of 6,500,000,000 lire was converted into a surplus of 209,000,000. His measures for restraining speculation in the currency and stock markets during the financial slump in the spring of 1925 were less successful, and he was superseded by Count Volpi. It is generally recognised, however, that he rendered invaluable service by rescuing his country's finances from the chaotic state into which they had fallen.

DÉTAILLE, JEAN BAPTISTE ÉDOUARD (1848–1912), French painter (*see* 8.110), died in Paris Dec. 23 1912.

DETROIT (*see* 8.113).—Commencing with the recovery from the industrial depression of 1907–8, the city of Detroit entered upon a period of growth almost without precedent among large cities. The area of the city in 1926 is 139 sq. miles. The census of 1920 gave a total population of 1,088,853 within the city limits. In May 1925 Detroit proper had a population of 1,200,310. The addition of the enclosed cities of Hamtramck and Highland Park, with villages just outside the city limits, give for greater Detroit an estimated population of about 1,400,000.

In 1920 about 70% of the population was either of foreign birth or foreign parentage. Poles, Germans and Russians represented the largest numbers, though there were large accessions from southeastern Europe. In Dec. 1920, 55% of the pupils in the public schools were of American-born parentage, 50·5% being white, and 4·5% coloured. In the three years ending 1920, much work was done by the Board of Commerce, the Board of Education and leading manufacturers in teaching the English language and the elements of citizenship.

Manufactures.—The extraordinary growth of the city was mainly due to the expansion of its manufacturing industries. In 1914 it was surpassed only by New York, Chicago and Philadelphia, with a capital of $405,000,000; 141,188 employees; and products valued at $569,000,000. In 1919 the number of employees within the city limits had increased to 307,000 and the value of the product was $1,803,728,000. In 1923 the value of the product within the city limits was officially reported at $2,071,477,380. In 1924 the product in the metropolitan district, including Detroit and adjoining villages, was estimated at $2,500,000,000.

The most important of the manufacturing industries in this district is the making of motor-cars (*see* HENRY FORD). In 1926 there were 26 companies assembling cars and about 150 whose sole, or principal, business was the making of parts and accessories. They employed 200,000 persons, and in 1924 turned out 2,500,000 vehicles. Trucks and motor-buses constitute the most rapidly growing branches of this industry. During the period 1910–25 numerous changes took place in other industries. Freight-car building, for many years the largest of all, disappeared almost entirely. The carriage and furniture factories were for the most part changed to the making of automobile accessories, and clothing manufacture diminished. Meantime some of the metal industries, notably brass and aluminium, increased enormously. The city is in the front rank in the following lines: aluminium castings, adding machines, brass and bronze products, druggists' preparations, gas-engines, machine tools, soda ash and kindred alkalis, stoves, furnaces and varnishes.

Transport.—The industrial expansion necessitated a great enlargement of the transport system. The Michigan Central Railway Co. tunnelled Detroit river and built an immense new passenger station and office building. The same company made great additions to their freight yards, stations and sidings, as did also the Grand Trunk and the Père Marquette lines. The outer belt line was extended and the Pennsylvania lines were extended from Toledo to Detroit, with a belt line of their own round a portion of the city and ample freight and passenger facilities. The Detroit, Toledo and Ironton line, which was suffering from lack of capital and equipment, was purchased by Henry Ford, who greatly improved its service. The line has, since 1920, been practically rebuilt and in part electrified. There has also been a great development in motor-truck freight service which extends from 50 to 100 m. in all directions from the city. At the April election in 1920 a plan was approved for the municipal construction and operation of street railway lines. The city has since acquired the Detroit United Railway for $40,000,000 within the city limits, has added many more lines, and operates the whole system. The trolley service is supplemented by an extensive motor-bus system, both municipally and privately operated. A private air freight line is in operation between Detroit and Chicago.

Administration.—Under a charter adopted by popular vote, June 25 1918, the methods of municipal government were materially changed. In place of a board of education of one member from each ward, there was a board of seven members, elected two or three at a time on a general ticket and holding office for six years. The old board of estimates, consisting of two members from each ward and five at large, was abolished, leaving appropriations and bond issues to be determined by the mayor and common council. The mayor's final judgment was conclusive upon all appropriation items, unless reversed by a vote of seven out of the nine aldermen. The old common council of two aldermen from each ward was displaced by a council of nine members, all elected at one time on a general ticket. The mayor, city clerk and city treasurer were elected, but all other administrative officers and commissions were appointed by the mayor, without reference to the council, and were subject to dismissal by him without trial. Nominations, two for each office to be filled, were made at non-partisan primaries. Blanks for voting were also non-partisan, and the time of election was separated from that of the state and national contests. By special legislative enactment the police and recorders' courts were combined in one with seven judges, holding office for four years, and having jurisdiction of all criminal and ordinance cases. The judges were all chosen at one time on a non-partisan ticket. In 1925 legislation was secured to provide for the creation of a metropolitan district for administrative purposes to include Detroit and the adjacent villages; also for the creation of a port development area including Detroit and other towns bordering on the Detroit and Rouge rivers. (W. St.)

DE VALERA, EAMON (1882–), Irish politician, was born in New York City Oct. 14 1882. He was sent to his mother's home at Charleville, Co. Cork, as a child, and was educated at Blackrock College and the Royal University, Dublin. In 1913 he became an ardent supporter of the newly formed Irish volunteers and in the Easter rising of 1916 commanded a party of the insurgents. On April 30 he surrendered and was sentenced to death, but the sentence was commuted to penal servitude for life. On June 15 1917, however, he was released under the terms of the general amnesty.

In the same month he was elected to Parliament for East Clare, but in May 1918 he was rearrested in connection with another plot for a rising. Imprisoned in Lincoln, he escaped on Feb. 3 1919 and went to the United States. In 1920 he was elected for Co. Down in the Northern Parliament and in 1921 was nominated chancellor of the National University. In 1917 he was chosen president of the Irish Republic, but resigned in Jan. 1922 and led the Republican forces. In Aug. 1923 he was captured and once more imprisoned; being released in July 1924, he became in the same year president of Sinn Fein, but resigned in March 1926, after encountering strong opposition to his proposal that members of the Republican party might enter the Dail and the Northern Parliament if exempted from taking the oath.

DEVENTER, SIR JACOB LOUIS VAN (1874–1922), South African soldier, was born in the Orange Free State. Beginning life as a farmer, he achieved distinction in the South African War of 1899–1902, becoming second-in-command to Gen. Smuts during the latter's invasion of Cape Colony. A colonel on the permanent staff of the South African Defence Force, Van Deventer served in the campaign in German South West Africa, 1914–5, where he had a distinguished record in active service. His real gifts as a general, however, were not fully appreciated until he went to German East Africa, to fight in Gen. Smuts' campaign against the Germans. In 1917 he was appointed commander-in-chief of the forces in East Africa. He was then a major-general, and was given the temporary rank of lieutenant-general on becoming commander-in-chief. Shortly afterwards, he was created K.C.B. As commander-in-chief he showed the same qualities which had secured for him this high promotion and it was under his auspices that the campaign was brought to a successful end. He died Aug. 27 1922.

DE VILLIERS, JOHN HENRY, BARON (1842–1914), first Chief Justice of the Union of South Africa, was born at Paarl, Cape Colony, in June 1842. Descended from the Huguenots who settled in that part of the Cape, he was educated at the South African College, Cape Town, and went to Utrecht and Berlin universities. In 1865 he was called to the bar by the Inner Temple and in the same year returned to South Africa and began practice as an advocate of the Supreme Court of Cape Colony. Entering Cape politics in 1866, he was elected a member of the House of Assembly, became attorney-general of the Colony in 1872 and two years later was appointed Chief Justice of the Cape. In this capacity he succeeded, by his decisions, in adapting the Roman-Dutch law of the colony to modern requirements. De Villiers was knighted in 1880 and was created a

K.C.M.G. a year later. He was appointed President of the National Convention in 1908 and in 1910 was raised to the peerage on becoming Chief Justice of the Union of South Africa. He died Sept. 2 1914.

DEWAR, SIR JAMES (1842–1923), British scientist (*see* 8.137), died March 27 1923. He published (with G. D. Liveing) *Collected Papers on Spectroscopy* (1915). In 1916 he received the Copley Medal of the Royal Society; and in 1919 the Franklin Medal of the Franklin Institute of Philadelphia.

DE WET, CHRISTIAN (1854–1922), Boer general and politician (*see* 8.138), remained until 1914 a member of the Legislative Assembly and Minister of Agriculture in the Orange Free State. In 1912–3 he supported Gen. Hertzog in his separatist policy, seceded from the South African party and helped to form the Nationalist party. Soon after the outbreak of the World War, De Wet rebelled against the South African Govt., but after raiding a few towns in the Northern Free State was captured at Waterberg on Dec. 1 1914. On June 10 1915 his trial began on a charge of high treason and on June 21 he was found guilty on eight of the 10 counts. He was sentenced to six years imprisonment and fined £2,000, but in the following Dec. was released, on undertaking to abstain from political agitation. He died at Bloemfontein Feb. 3 1922.

DEWEY, GEORGE (1837–1917), American naval officer (*see* 8.139), died in Washington Jan. 16 1917, and three days later was buried in the Arlington National Cemetery. His body was transferred, on Mar. 28 1925, to the crypt of the Bethlehem Chapel of the National Episcopal Cathedral, Washington, D.C. By special provision Adm. Dewey was never retired, but continued in active service up to his death, being president of the General Board of the Navy for the last seven years of his life. To the end he continued to urge the building of large battleships, citing their superiority in the battle of Jutland. He published his *Autobiography* in 1913.

DEWEY, JOHN (1859–), American philosopher, was born at Burlington, Vt., Oct. 20 1859. He graduated from the University of Vermont, taking the degree of A.B., in 1879, and Johns Hopkins University, where he became Ph.D., in 1884. After teaching for four years at the University of Michigan he was appointed in 1888 professor of philosophy at the University of Minnesota, returning in a similar capacity the following year to the University of Michigan, where he was made head of the Department. In 1894 he was appointed head of the Department of Philosophy at the University of Chicago, and was, in addition, head of the school of education for two years (1902–4). In 1904 he became professor of philosophy at Columbia University. In the field of philosophy he is a pragmatist and as such has had a very great influence on the trend of modern thought. He was antagonistic to formalism of any kind. When at Chicago he developed a theory of education, embodied in his *School and Society* (1899), the aim of which is the utilisation, instead of suppression, of the impulses of childhood, and the substitution of practical experience in place of theoretical knowledge. In 1919 he visited Japan, where he lectured at the Imperial University of Tokio and other places, subsequently proceeding to China, where he made a prolonged stay and devoted his attention chiefly to educational problems.

Among his important works may be mentioned *Psychology* (1886); *A Critical Theory of Ethics* (1894); *How to Think* (1909); *German Philosophy and Politics* (1915); *Experimental Logic* (1916); *Democracy and Education* (1916); *Reconstruction in Philosophy* (1920); *Human Nature and Conduct* (1922); *Experience and Nature* (1925).

DIABETES (*see* 8.145).—The rapid accumulation of new facts which has increased our knowledge of diabetes mellitus makes it difficult to give a comprehensive definition of this disease. Diabetes is a condition in which the body is unable to metabolise sugars efficiently. It is believed that this condition is produced when there is insufficient available insulin in the body.

The first suggestion that the pancreas is necessary for the complete utilisation of carbohydrates in the animal body was made by Brunner in 1682. The relationship of the pancreas to diabetes was first suggested in 1788 by Cowley, an English physician. In 1889 Von Mering and Minkowski showed that the complete removal of the pancreas from animals resulted in a condition which is practically identical with diabetes mellitus in man. Although attempts were made to secure an anti-diabetic substance from the pancreas by scores of investigators, this substance was not proven to be present until 1921 (*see* INSULIN).

Diabetes mellitus is a very common disease. It has been stated that it occurs in 1% of the population of the United States. The cause of the disease is not definitely known. There are probably numerous factors which predispose to its development. It is not hereditary in the strict sense of the word. It is quite possible that certain children are born with insufficient insulin-producing tissue. Infection in the region of the pancreas seems to play a definite part in the aetiology of the condition. In elderly patients vascular sclerosis may be a factor. Obese individuals are more liable to develop diabetes than those whose weight is within the proper limits. In a few cases it appears probable that an injury in the region of the pancreas was the predisposing factor.

Symptoms.—The untreated diabetic patient suffers from extreme thirst, hunger, loss of weight and strength. He excretes abnormally large quantities of urine. He is very susceptible to infection and this condition, when established, is difficult to eliminate. The diabetic is unable to burn sugar. This sugar accumulates in the blood and is excreted in the urine. Not only are the sugars imperfectly metabolised, the fats are also not utilised in a normal manner and certain products of their abnormal or incomplete decomposition accumulate in the blood and produce the conditions of acidosis and coma.

The diabetic condition is suspected when a patient complains of one or more of the symptoms or signs mentioned above. An analysis of the urine for sugar should always be made. Diabetes may be present and sugar may be found in the urine when the patient is not aware of any of these symptoms. The routine analysis of the urine in life insurance examinations has resulted in the early diagnosis of many cases of diabetes. The prognosis of the early case is, of course, much better than the advanced case since treatment can be instituted earlier in the disease. The amount of sugar in the blood, under certain standard conditions, is a valuable indication of the severity of the disease. The presence in the urine of the acetone bodies formed from the abnormal breakdown of fats is a warning that acidosis or coma is imminent. The presence of these substances in the body can sometimes be suspected by the characteristic odour which they impart to the breath.

Treatment.—Patients suffering from diabetes mellitus are treated by dietetic measures, and if the condition is severe, by the administration of insulin. Before the discovery of insulin the methods of treatment introduced by Allen and Joslin of drastic restrictions in diet prolonged the lives of many severe diabetics. In many cases the necessary restriction in diet was so severe that marked under-nutrition was produced. Under-nutrition renders the patient more susceptible to other diseases.

Several important principles underlie the dietetic treatment of this disease. The diet must supply sufficient calories to the patient in order that his weight may be kept constant at the proper level. Protein, preferably as lean meat, eggs or milk, must not be reduced below a certain minimum value. If this substance is unduly reduced, the tissue protein of the patient's body is utilised. The carbohydrates and fats of the diet must be in a certain fixed proportion to each other. If the fats are present in excess of this proportion, there is danger of the production of the poisonous acetone bodies. In calculating the sugar in a diet, it is necessary to remember that sugar is formed from protein and to a lesser extent from fat, as well as from the carbohydrate of the diet. The diabetic patient is given as much sugar-forming food as he can utilise. Sugar in excess of what is utilised is excreted in the urine. The amount of excess sugar can therefore be determined by analysis.

Dietetic Measures.—The diabetic diet should consist as far as possible of easily available seasonable foods along the line of a normal diet. It is much more satisfactory for the patient to

obtain the essentials of his diet from among these natural foods than to be dependent upon specially prepared diabetic foods. Patients have been known to discontinue treatment because of the monotony of their diet. The diabetic diet need not be monotonous.

Mild cases of diabetes can be successfully treated by dietetic measures. If a patient excretes sugar on a diet which is sufficient only for his needs insulin must be supplied. The amount necessary is proportional to the severity of the disease. Insulin, which is distributed as a sterile, watery solution, is administered hypodermically. It is not effective when given by mouth. Insulin is usually administered twice a day, 15 to 30 minutes before breakfast and again before the evening meal. However, there is considerable variation in the different clinics on this point. Some patients require only one dose per day, while in very severe cases three doses are necessary.

If the diabetic patient is using a diet which is too high in fats or too low in sugar, coma may develop. A large percentage of diabetics died of coma before insulin was discovered. The treatment of coma was to put the patient to bed, to supply fluids and alkalis, heat and stimulants and to give sugar by mouth or into a vein. These measures are still necessary. Insulin has proved a specific drug in the treatment of this condition and, when administered sufficiently early, and in large doses, the results have been very successful.

Insulin is a very powerful drug. A very serious condition may be produced by the administration of an overdose. This may be avoided on the physician's part by a very careful balancing of diet against dosage of insulin employed, and on the patient's part by a close and intelligent observance of the diet, together with a thorough understanding of the premonitory symptoms of a beginning hypoglycaemic reaction. These symptoms of slight hypoglycaemia are sudden hunger, fatigue, a peculiar restlessness often described by the patient as a feeling of "inward trembling," pallor or flushing of the face, and an increased pulse rate which is a valuable sign in children. If the overdose of insulin is large and corrective measures are not taken, the patient may show profuse perspiration, tremor, emotional disturbances, collapse and unconsciousness. The treatment of mild degrees of hypoglycaemia consists of the administration of carbohydrate in any convenient form, such as sugar candy. Should the more serious symptoms develop, orange juice with sugar added, or corn syrup, may be given by mouth. In the very severe cases, sterile dextrose is given intravenously.

In the past, less than 20% of patients suffering from severe diabetes lived more than 10 years. Children, who usually have the disease in a severe form, seldom lived for more than 6 years. The diabetes which develops in individuals over 50 years of age is usually mild and the patients may live their allotted span of years. It is not possible to state definitely as yet the exact effect of insulin on diabetic mortality. It is certain, however, that thousands are now alive who would have died had it not been for insulin. In some cases it appears that patients need less insulin than they required when treatment with the material was commenced. In the great majority of cases, however, the insulin requirement has not been markedly reduced. The severe diabetic receiving insulin is now able to live practically a normal life, but the insulin treatment cannot be discontinued.

(C. H. B.)

DIAGHILEV, SERGEI PAVLOVICH (1872–), Russian ballet producer, was born in the province of Novgorod, Russia, March 19 1872. After studying law and music, he organised art exhibitions in St. Petersburg (Leningrad). In 1899 he founded the review *Mir Tskusstra* (The World of Art), to which Somov and Bakst contributed, and which exercised a powerful influence on Russian art. From 1907 onwards he occupied himself with musical and theatrical productions and organised a number of Russian concerts in Paris; there he produced in 1908 and 1909 Russian operas (*Boris Godunov* and *The Maid of Pskof*) and ballets. Subsequently he organised successful ballet and opera seasons in London, Paris, Berlin, America and elsewhere, many of his productions being of amazing beauty. One of his most successful operatic productions was that of Moussorgsky's *Khovanshtchina*. In England the originality of his conceptions may be said to have effected a revolution in choreographic art, and further put new life into stage dancing, which by the end of the 19th century had degenerated into a spectacular show of little artistic significance. Among his numerous successful ballets may be mentioned *La boutique fantasque* (1919), a charming fantasy composed of oddments from Rossini's note books; choreographic versions of Stravinsky's *Le chant du Rossignol* (1920), and *Petroushka; Le Pavillon d'Armide* (with decoration by Alexandre Benoit); and *Scheherazade* by Rimsky-Korsakov (1910). In 1904 M. Diaghilev produced a valuable book on the painter Levitsky. A collection of photographs and drawings illustrating the ballet, *Les Biches*, was published in 1924 by B. Koshno.

DIAGNOSIS (Greek διάγνωσις, a means of distinguishing), or the process of identifying the disease by consideration of the history (*anamnesis*), symptoms, physical signs and examination in every way of the patient, includes differential diagnosis or its distinction from other diseases.

Importance in Treatment.—Diagnosis is essential for rational treatment, for without a knowledge of its cause treatment of a morbid symptom is merely empirical or, as it is often called, symptomatic, and, if beneficial, is so for the time being only and is not curative. The ideal of diagnosis is the discovery, as early as possible, of the disturbing factor at work, so that it may be removed or neutralised before structural damage results. In most diseases symptoms precede the signs or evidence of organic change in the body; but correlation of the earlier symptoms with the later physical signs indicating the presence of structural change has made it possible to predict the nature, course and proper treatment of the disease.

This knowledge is more advanced in acute than in chronic diseases, in which the processes are less obvious and may be more complicated. It is therefore important to study the earliest manifestations of disordered function and by keeping the patient under observation to collect data for the recognition of the beginnings of chronic disease. This was one of the objects of the St. Andrews Clinic inspired and opened by the late Sir James Mackenzie in 1919. Diagnosis is a logical process based on all the available data and is the outcome of their analysis in the light of knowledge gained by experience; diagnosis therefore leads to prognosis.

Methods and Symptoms.—Diagnostic methods include investigation of the patient's past history and of his environmental conditions, of the symptoms of which he complains, and methodical examination of the patient and of his organs and of the manner in which they are performing their functions. This examination is physical and physiological; an example of the physical signs is a tumour which can be felt; the physiological method is seen in the estimation of the functional efficiency of the heart or nervous system by means of exercises or special tests. Physical examination detects gross organic changes; functional tests reveal the disordered action of the organs, which is present in the earlier stage of symptoms without physical signs, namely before structural damage has been produced.

But it must be admitted that the sequence of symptoms first and bodily changes with physical signs later is not invariable; for a slow change in the organs or tissues of the body may be accompanied by compensatory processes so complete as to prevent any functional impairment; thus an innocent tumour may grow to considerable size before it produces any symptoms, which may then be mechanical. A patient's past history is important not only as regards bodily illnesses, but with reference to mental experiences which having become subconscious memories may be responsible for neurosis; Freud and his followers, by means of the method of psycho-analysis (*see* PSYCHO-ANALYSIS) have brought the trauma buried in the subconscious into the field of consciousness when other psychotherapeutic means can be employed.

Use of Physical Signs.—Physical signs, in contradistinction to subjective symptoms of which the patient complains, are observed by the medical man. First, inspection in a good light may

give a shrewd idea of what is the matter—for example severe anaemia, the pigmentation of Addison's disease, the cachexia of advanced malignant disease, the bony changes in acromegaly, the swollen features of myxoedema and cretinism and the shrivelled, sharp-featured countenance of acute peritonitis (*facies Hippocratica*). Facial diagnosis without further examination is not without its fallacies, but an experienced practitioner may possess "clinical instinct" which, without a conscious logical process, at once tells him what is the matter, and is probably due to recognition by the subconscious mind of a similar condition seen years before but forgotten.

The use of vision in diagnosis has been greatly extended in recent years. The ophthalmoscope, invented by Charles Babbage (1792–1871) and modified by Helmholtz, enables the retina at the back of the eye, which is an expansion of the brain, to be seen in all its details; similarly the laryngoscope, and more recently the bronchoscope, oesophagoscope, sigmoidoscope, endoscope for lighting up and bringing before the observer's eye the interior of the bronchial tubes, the gullet, the lower part of the bowel, and of the urinary bladder, have greatly facilitated the detection of disease in these situations. Endoscopes have also been introduced into the chest (thoracoscopy) and into the abdomen (laparoscopy or coelioscopy).

Skiagraphy.—Skiagraphy or examination of the body by X-rays, discovered by Prof. W. K. Röntgen of Würzburg in Nov. 1895 (*see* ANATOMY; RÖNTGEN RAYS), has revolutionised diagnosis by rendering the greater part of the body translucent while the bony skeleton and certain abnormal formations remain opaque; X-rays provide a photograph or skiagram of great use in diagnosis; thus fractures can be shown, and similarly tumours, foreign bodies, certain morbid conditions, such as abscesses and collections of fluid, stones in the kidney and bismuth when introduced into the alimentary canal appear dark, while the surrounding parts are light. In this way malignant disease, aneurysms, tuberculosis and other diseases of the lungs and the condition of the alimentary canal can be recognised. Further by introducing air into the abdomen the picture produced is rendered much clearer; recently the ingestion of dyes (tetraiodophenolphthalein or tetrabromphenolphthalein) which are excreted by the liver into the bile have been found to show up the gall bladder (cholecystography).

Use of Instruments of Precision.—The well-established and obvious method of palpation or examination of the body by the hand has been greatly supplemented by the introduction of instruments of precision which record the movements of the heart, arteries and muscles; graphic records of the pulse by the polygraph, of blood pressure by the sphygmomanometer and of the heart by the electrocardiograph have added accuracy to the unaided but trained senses. The various forms of cardiac irregularity have thus become clearly unravelled, and fresh information about the condition of the heart muscle and its beats, such as the *pulsus alternans* and auricular fibrillation, has been secured. The electrocardiograph requires special technical skill (*see* HEART, DISEASES OF THE); but when once the existence of the underlying condition has been definitely established in diseases also accompanied by more obvious manifestations, the presence of the latter has now become sufficient to justify a diagnosis of the primary cause, and so to indicate its prognosis and appropriate treatment. This simplification of diagnosis by associated phenomena will, it is to be hoped, follow in many diseases in which the full explanation can originally be provided only by laboratory methods too elaborate or time-consuming for ordinary bedside practice. Percussion of the chest, initiated by Leopold Auenbrugger in 1761, did not receive due attention until his book was translated into French by J. N. Corvisart in 1808, when in conjunction with Laennec's method of auscultation (1819) it brought about a new epoch in the diagnosis of diseases of the lungs and heart.

Laboratory Tests.—These methods of physical diagnosis are clinical and have been increasingly supplemented by tests adopted from those carried out in laboratories. The distinction between the clinical and laboratory methods of diagnosis is one of degree, for some, such as the counting of blood corpuscles and the detection of various animal parasites, do not require the help of a specialised laboratory; hence clinical laboratories have now become an essential part of the equipment of a modern hospital or clinic. But other valuable tests are not possible in less favourable circumstances. The chemical examination of the blood for its content of sugar and non-protein nitrogen has an invaluable bearing on diabetes and renal disease; the examination of the blood for antibodies has enabled the diagnosis of infectious diseases to be made when ordinary clinical methods fail, for example the Wassermann reaction in the detection of syphilis, and the Widal (also a complement-fixation) test in the diagnosis of enteric fever. Bacteriological examination of discharges and excretions, such as swabs from the throat in diphtheria, of the expectoration in pulmonary consumption, of the urine and of the blood, of the cerebrospinal fluid and of the faecal excreta, has enormously advanced the exact diagnosis of infectious diseases. Thus to take an example, diseases which formerly were sometimes with difficulty distinguished by clinical examination (enteric fever, generalised tuberculosis, malaria and malignant endocarditis) can now be identified readily by examination of the blood. Chemical investigation of, and examination of the cells in, the blood, the fluids already mentioned and especially of the gastric juice by the method of fractional test meals have also rendered eminent service in the diagnosis of many diseases of the blood, nervous system, stomach and other organs.

Immunity Tests.—Immunology (*see* IMMUNITY) or the science of the reactions given by persons who are immune or susceptible to certain infections or poisons has made it possible to say whether a person is liable to contract certain infections; thus by the Widal complement-fixation test to determine whether or not an individual is protected against enteric fever, by the Schick test against diphtheria and by the Dick test against scarlet fever. In the two latter the diphtheria toxin or the scarlatinal haemolytic streptococcus toxin is injected between the layers of the skin; a local reaction shows that the individual is susceptible to the disease, against which he can then be protected by injections into his muscles of the corresponding toxin. This may be regarded as protective diagnosis, and no doubt will become more general in its application.

Individual Idiosyncrasies.—The exact cause of idiosyncrasies to certain foods, for example eggs, or to animal or vegetable substances, such as hair, feathers and pollen, can be determined by rubbing on the abraded skin extracts of substances likely to be the exciting cause of one of the "toxic idiopathies," such as asthma or nettlerash. If an individual suspected to be hypersensitive to, say, the dandruff of horses, is thus tested with such an extract, the appearance at the point inoculated of a red area or wheal, much larger and more prominent than that produced on a control area of skin similarly treated, except that saline solution is applied, strongly suggests that the disorder, such as asthma, is due to hypersensitiveness to this particular foreign protein.

General Disease.—General ill-health (dis-ease, want of ease), often of a vague character as shown by undue fatigue, but sometimes severe and prominent, such as pernicious anaemia or malignant endocarditis, and also local affections, such as arthritis, are commonly due to some primary condition often in a distant part of the body, such as disease of the tonsils, in connection with the teeth, the gall bladder or the vermiform appendix; the symptoms are frequently, especially in the examples first mentioned, due to some local infection providing micro-organisms or their poisons only, which when carried to other parts of the body, *e.g.*, the central nervous system, the blood-forming organs, the heart or the joints, set up changes and attract attention, while the *fons et origo* remains latent. In such cases, and they are numerous, of secondary disease, search for the primary infective focus is the scientific method of diagnosis, and may require expert advice from the laryngologist, dentist, the radiologist or other specialists. In other instances the primary cause sets up, through the nervous system, symptoms often in a comparatively remote part, which are described as due to disordered reflex action; just as a decayed tooth may cause headache, a blow

on the ulnar nerve at the elbow (the " funny bone ") tingling and pain in the little finger, so may a stone in the kidney show itself by pain in the testicle on the same side, or a chronically inflamed appendix or gall bladder be responsible for dyspepsia.

Conclusions.—The foregoing examples show that with the advance and necessary specialisation of medicine diagnosis may make demands which no one man can efficiently meet, and that in certain cases a satisfactory solution can be obtained only after examination and report by specialists. He is a wise man who knows enough to recognise his limitations and to call for such assistance, whereas the converse course leads to the empirical treatment of symptoms, the continued discomfort and dependence, if nothing worse, of the patient and eventually perhaps to the doctor's discredit. Recognising this, hospitals have long carried out the combined diagnostic method, and more recently, especially in America, groups of doctors, each proficient in some branch of the healing art, have amalgamated to form " diagnostic clinics " and to practise " group medicine." (H. Ro.)

DIAZ, ARMANDO (1861–), Italian general, was born in Naples Dec. 6 1861. He served in the Italo-Turkish War, and in 1914 was promoted to major-general. On Italy's entry into the World War he was chief of the operations department, and in 1916 became lieutenant-general in command of the 49th Division. In Nov. 1917, after Caporetto, Diaz became chief of the general staff, and under him the battle front was successfully reconstituted and the Austrian armies were destroyed by the battle of Vittorio Veneto (Oct.—Nov. 1918). In Nov. 1919 he was nominated army general, and later became vice-president of the army council. In 1921 he was created Duca della Vittorio. On the advent of the Fascist Govt. he was appointed Minister of War, and held that appointment until ill-health obliged him to resign in April 1924. On Nov. 4 1924 the newly created rank of marshal was conferred on him.

DIAZ, PORFIRIO (1830–1915), president of Mexico (*see* 8.172), died in Paris July 2 1915.

DIBELIUS, WILHELM (1876–), German scholar, was born in Berlin April 23 1876. He took up his residence as lecturer in Berlin in 1901, and in 1903 became professor at the Academy of Posen. He became professor of English at Hamburg in 1911, and in 1918 went to Bonn in the same capacity. In 1924 he was appointed professor of English language and literature at the University of Berlin. He published *John Capgrave und die englische Schriftsprache* (1901); *Charles Dickens* (1916); *England* (2 vol., 3rd ed., 1924).

DICEY, EDWARD (1832–1911), British jurist (*see* 8.178), died in London July 7 1911. His brother, Albert Venn Dicey, died April 7 1922.

DICTOGRAPH: *see* OFFICE APPLIANCES.

DIERX, LÉON (1838–1912), French poet (*see* 8.210), died in Paris June 11 1912. His *Poésies Posthumes* appeared in 1913.

DIESEL, RUDOLF (1858–1913), German engineer, was born in Paris March 18 1858. His principal achievement was the invention of the Diesel oil engine (*see* INTERNAL COMBUSTION ENGINE; MARINE ENGINEERING), though he did not live to see its possibilities fully exploited. He fell overboard the Antwerp-Harwich mail steamer on the night of Sept. 30 1913.

DILKE, SIR CHARLES WENTWORTH (1843–1911), British politician (*see* 8.271), died in London Jan. 26 1911. He was succeeded as 3rd baronet by his son, Charles Wentworth Dilke (1874–1918), who died in London Dec. 7 1918, when the title passed to a cousin, Fisher Wentworth Dilke (b. 1877).

DILLON, JOHN (1851–), Irish politician (*see* 8.273), was prominent in 1902 in Parliament in his attacks on the Government for the revival of the Crimes Act, and in the following year he helped forward Mr. Wyndham's Land Purchase Act. With the return of a Liberal government to power, Mr. Dillon, with Mr. Devlin of Belfast, was associated with John Redmond in the leadership of the Nationalist Party. In this capacity, like other Irish members, he presented to Parliament the grievances of evicted tenants and of the small farmers whose desire for land led them to indulge in " cattle driving " on the larger holdings devoted to grazing. For the preparation of the Home Rule Bill of 1912, he was almost as responsible as were ministers themselves. Nor were his interests confined to Ireland. He spoke frequently in the House on foreign questions; and while his attitude was critical of what he considered to be the imperialism of Sir Edward Grey's foreign policy, he was heard with respect and attention. In July 1914, he was invited by King George V. to accompany Mr. Redmond to the Conference at Buckingham Palace which attempted to settle the Irish Controversy. When war broke out, he immediately placed his whole influence behind the British Govt., speaking in this sense at the meeting in the Dublin Mansion House on Sept. 25 1914. He took an active part, moreover, in recruiting and, with Mr. Redmond, consulted with the War Office as to the best way of adapting this campaign for volunteers to Irish susceptibilities. The progress of Sinn Fein in Ireland steadily undermined the Nationalist position and John Dillon suffered with the rest. He was convinced that the enforcement of conscription in Ireland would merely aggravate the disaffection. He was completely sceptical of the press campaign in favour of a munitions department and believed that the revolt against Mr. Asquith, as the Prime Minister responsible for conducting the War, was unfair and factious. He succeeded Redmond as leader of the Nationalist Party which by that time was *in extremis*. In his desire to maintain the constitutional party against Sinn Fein, he denounced the measures of repression which followed the Eastern Rebellion of 1915, and brought forward a resolution suggesting that this coercion, as he regarded it, was inconsistent with the principles on which the Allies were fighting the War. At the General Election of Dec. 1918, he shared the general obliteration which overwhelmed the Nationalist Party.

DIPHTHERIA: *see* INFECTIOUS FEVERS.

DIPLOMACY (*see* 8.294).—The events of the years 1910–25 have created in the popular mind some misconception of the true nature of diplomatic practice. In particular, the controversy between the defenders of the " old " diplomacy and the supporters of the " new " has suggested an academic, and to some extent a false, distinction, or even conflict, between professional diplomacy and democratic control.

A theory has gained wide acceptance that diplomacy possesses some detached or independent identity, parasitic and not organic to the living growth of the state. Such conceptions are misleading: the history of diplomacy shows no such dramatic break in continuity; it shows merely a constantly fluid or organic process of adjustment, a constant endeavour to reconcile the maximum of representation with the maximum of efficiency. By " representation " is meant the recurrent necessity of adjusting the methods and the personnel of negotiation in such a manner as to render them fully representative of the ultimate sovereign authority of their national state; by " efficiency " is meant a constant endeavour to ensure that international intercourse is so conducted as to minimise the risks of misunderstanding, uncertainty or hasty action. It is the interaction of the impulse toward exact representation and the impulse toward increased efficiency which has since the 14th century constituted the main influence formative of diplomatic practice; the conflict between the " old " and the " new " diplomacy is thus no sudden development but merely this age-long process of adjustment presented in an increasingly intricate form.

Diplomacy may therefore be defined as representing those methods of international procedure which commend themselves to sensible men as being at any given period the most representative and the most efficient for conducting negotiations between sovereign states. If viewed as the logical continuation of this unceasing process of adaptation and adjustment, the changes introduced during the period under review fall into a more reasonable perspective.

Ratification.—The most important of recent developments is the insistence of the Legislature on a right to refuse ratification. In the United States this right is explicitly accorded to the Senate by the constitution. In Great Britain, as in most European states, ratification is the prerogative of the sovereign, and treaties have not been submitted to the Legislature unless money

clauses formed part of the instrument. It was generally assumed that the signature of a treaty by a fully accredited representative of a sovereign state implied as a merely formal corollary the ratification of that instrument, and it was only with the rejection by the United States Senate of the Treaty of Versailles that this assumption was seriously challenged in Europe. Since then the conception has become firmly established that no important treaty, whatever the wording of its ratification clause, can be considered to have been concluded until it has been ratified by the legislatures of the leading signatory states.

Clearly this is a great gain in the direction of exact representation, while the loss in efficiency may not ultimately prove so serious as might be supposed. It is unlikely on the one hand that any responsible modern Govt. would in any case authorise the signature of a treaty unless they had good cause to count on the eventual approval of the Legislature. On the other hand it must be admitted that this potential veto of the Legislature introduces what, in some circumstances, might prove a dangerous element of uncertainty and delay; that it may seriously hamper the free and rapid exercise of judgment on the part of the executive; and that negotiations may thereby be unduly and protractedly exposed to the influence of popular ignorance, electoral excitement, party manoeuvres or press misrepresentation.

Open Diplomacy.—It is not impossible that when once the Legislature's right of veto on an international commitment entered into by the executive is fully established and realised, the old agitation for "open diplomacy" will subside. The existence of this veto and the prohibition embodied in the Covenant of the League of Nations will in future render any secret treaties but a precarious instrument in which to embody international agreements; nor is it unreasonable to hope that when once modern democracies feel safe-guarded against the obligations of such secret treaties, they will recognise that the battle has been won, and that it is unnecessary and highly inconvenient to insist that open covenants should also be openly arrived at. The admirable balance between representation and efficiency, between publicity and discretion, achieved at the Conference of Locarno in Oct. 1925, is likely to serve as a model of how to adjust the requirements of modern democracies to the smooth working of international negotiation.

The Democratic Control of Diplomacy

Apart from the very effective control which can be exercised by the Legislature through its veto on treaties which have been already signed by the executive, there exists in many countries a strong body of opinion which demands some more continuous form of parliamentary supervision over the foreign policy of the Govt. and its servants. In Great Britain this movement has concentrated on the demand for a Foreign Affairs Committee of the House of Commons endowed with the same privileges and prestige as the Foreign Relations Committee of the Senate in the United States, or the analogous parliamentary committees in France and Germany. The advantages of such committees are that they enable the Foreign Secretary accurately to gauge parliamentary opinion, while they provide Parliament with a safety-valve for criticism or suggestion which might be unsuitable for public debate. The disadvantages are that they entail extra labour on the Foreign Secretary, that they often seem to emphasise difficulties and disagreements which might otherwise be solved automatically, that they introduce into the conduct of foreign affairs a party and sometimes a personal element, that they constitute a channel through which financial and commercial interests may endeavour unduly to influence policy, and that they lead invariably to indiscretions and disclosures.

Diplomacy and the Press.—One of the most delicate problems of modern diplomacy is that of publicity. Full publicity is inimical to negotiation, partial publicity is apt to cause misunderstanding. When editors and correspondents have some sense of responsibility the problem is comparatively simple: they can be told the whole story and informed exactly why certain portions thereof are unfitted for publication. Unfortunately in moments of international excitement the discretion and integrity of every journal cannot always be relied on; nor can all negotiators resist the dangerous temptation of utilising their own press in order to reinforce their arguments by the excitation of their national opinion. The dangers of misdirected publicity are especially apparent during international conferences, and the greatest difficulty is experienced in maintaining a united front of discretion as between the several delegations. The more recent tendency is to throw on the Press itself the responsibility of using with good sense and discretion the material with which it is provided: but in the case of sensational or violently prejudiced journals, the temptation to abuse this gesture of confidence is obviously very great.

Diplomacy and Commerce.—Great progress has been made during the last few years in bringing the diplomatic services into close contact with the commercial needs of the peoples whom they serve. So long as this tendency develops on the lines of justifiable support for reputable commercial enterprises, and of the provision of full trade statistics and information, nothing but good will result. The institution by the British Govt. of the Dept. of Overseas Trade, and the analogous creation by the U.S. Govt. of the Bureau of Foreign and Domestic Commerce, both with their representatives in foreign trading centres, are important steps in the right direction. On the other hand, a tendency has arisen in certain states to expect from their representatives abroad a greater measure of commercial activity and intervention than is wholly consonant, either with their own prestige and political interests, or with the maintenance of harmonious relations with other competing countries. This tendency, if pursued, cannot contribute to the amity of nations.

Democratisation of the Diplomatic Services.—An interesting commentary on the constant iteration upon diplomatic practice of the concurrent needs of representation and efficiency is furnished by the reforms which have since 1919 been introduced into the foreign services of the United States and the British Empire. In Great Britain the Foreign Service was found to be too professional and not sufficiently representative; in the United States of America the Foreign Service was found to be too representative and not sufficiently professional. In Great Britain the Royal Commissions of 1861, 1871, 1886 and 1914 successively made recommendations tending to give to the British diplomatic service a more representative and less exclusive character. The regulations adopted as a result of the 1914 recommendations are of particular importance in that admission to the British Foreign Service was thereby to all intents and purposes thrown open to public competition, the examination being assimilated to that of other branches of the Civil Service. The old property qualification, which had in practice restricted recruitment to the richer classes, was abolished, the salaries and foreign allowances were graduated with the object of enabling a diplomatist to be independent of private means, and the Board of Selection, which had been instituted in 1907 to select candidates for examination, was reconstituted on a more representative and democratic basis. In the United States, on the other hand, the tendency as shown by the Reorganisation Act of May 24 1924 has been to abandon the extreme representative or "spoils" system (under which the whole personnel of the Foreign Service were adherents of the political party in power), and to create in its place a professional or standing Foreign Service.

Diplomacy and the British Dominions.—The international status acquired since 1914 by the British self-governing Dominions has faced the British Empire with a new and highly complicated aspect of the old problem of reconciling representation with efficiency. This new issue, although it is engaging anxious thought, has as yet been dealt with primarily by the expedient of keeping the Dominion Govts. fully informed of any important diplomatic developments. Some machinery for rapid consultation, probably in the form of increased liaison, will doubtless be devised in the near future. For the moment it can only be said that the present system is unsatisfactory, and that it can only be regarded as provisional. (*See* British Empire.)

In so far as the changes noted above render diplomatic practice more exactly representative of modern conditions, they clearly

contribute to the greater efficiency of international intercourse. Nothing leads more surely to confusion and uncertainty than any failure on the part of the negotiator to identify himself with the ultimate sovereign authority in his own country. On the other hand, successful diplomatic negotiation necessitates a certain detachment from herd-emotion, and it has always, and will always, be found that diplomacy works most efficiently when conducted on the lines which the experience of generations has evolved as being the most convenient. It is for this reason that so few permanent changes have been introduced during the period under review into the actual formalities of diplomacy.

The perpetual servitudes and moral judgments introduced into the Treaty of Versailles will not form a precedent; the spasmodic revival of the old practice of direct personal correspondence between Foreign Ministers is a too dangerous method to become habitual; the attempt to render diplomacy bilingual will be maintained only with difficulty; the war habit of propaganda may well prove too invidious and expensive for continuance; the increased facilities of communication may well modify, but will certainly not diminish, the value of personality in diplomatic representatives abroad; the wholesale appointment to embassies and legations of men outside the profession is not, as the U.S. Govt. has found, a practice which contributes to general efficiency. Equally transitory may well prove the system of "diplomacy by conference," which has since 1915 become so frequent a feature of international intercourse. Such *ad hoc* conferences were essential during the War, and in the period of post-War liquidation. But when once the Concert of Europe is re-established, it will probably be found that these dramatic meetings will be abandoned and that personal contact between the various Foreign Ministers (a system which, if not exaggerated, is highly useful) will be maintained at the periodical meetings of the Council and the Assembly of the League of Nations.

It is too early as yet to estimate the effect upon diplomatic practice of the institution of the League of Nations (*q.v.*). Until 1925 that body, however admirable its ideals and intentions, was in essence representative only of the will of the Allied Coalition. With the entry of Germany it will approximate to the old Concert of Europe with these important differences, namely, that it will possess a trained international secretariat, and that it will hold periodical meetings. Diplomacy, therefore, which, whatever its critics may contend, is the art of preserving international peace, may well find in the League of Nations a highly efficient instrument for the attainment of its objectives.

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DIRECTOR FIRING: *see* GUNNERY.

DISARMAMENT.—The word disarmament is used to cover two distinct conceptions: first, the complete abolition of all military armament, desired by a certain school of advanced thinkers; second, the reduction and limitation of national armaments by a general international agreement accepted by all, or almost all, states. In the former sense of the word, disarmament cannot yet be said to be practical politics. In the second sense it is one of the great problems of the day.

Partial Disarmament by Treaty.—Some attempts to achieve a concrete reduction and limitation of armaments were made before the World War of 1914–9. In isolated instances, where agreements were made between countries geographically remote from the rest of the world, a measure of success was obtained. Thus some South American republics reduced their armaments in accordance with arrangements made by treaty, while in a number of cases two countries agreed to the demilitarisation and sometimes to the actual neutralisation of the zone surrounding the frontier between them. The most striking example of disarmament by friendly agreement is that of the 3,000 m. land frontier between Canada and the United States, which has been demilitarised since 1818. Another is the frontier between Norway and Sweden, which was neutralised when the two countries separated in 1905. Early in 1870 Britain proposed such disarmament to France and Germany, but Germany refused to discuss the matter.

But whenever any attempt was made to reach a general agreement on disarmament, as for example, at the Hague Conferences of 1899 and 1907, failure was immediate and complete. Owing to the attitude of Germany all definite plans were prevented; during the 20 years preceding 1914 all the more powerful governments spent an ever-increasing proportion of their national wealth and resources in building up greater and greater fleets and armies.

It was widely believed that as soon as the World War was over, and the German menace was removed, disarmament would be brought about almost by itself; but in fact the burden of armaments remained almost as oppressive as before. Nevertheless, although great armaments were still maintained after the War, disarmament in the second sense did become a matter of practical politics.

Disarmament under the Peace Treaties of 1919.—In the first place, the principle of disarmament was effectively applied to the states defeated in the War. Under the treaties of peace, Germany, Austria, Hungary and Bulgaria accepted an immense reduction and a rigid limitation of the armed forces which they respectively maintained. The treaty clauses relating to these armed forces were worked out in the greatest possible detail and laid down the number of men, the equipment, the transport and the armament which each of the four states was allowed to maintain, Germany's army being fixed at a total of 100,000 men. Moreover, conscription was abolished and both armies and navies were to be recruited on the basis of long-period voluntary service. The manufacture of arms in the ex-enemy countries was forbidden, and a rigid control by the victorious Allied Powers was established to see that the disarmament provisions were carried out. It was hoped that in this way the ex-enemy states would be bound down to a fixed scale of armament, and that they could be prevented from building up great secret reserves, either of man-power or material.

Although it was one-sided, this disarmament of the ex-enemy Powers was nevertheless a considerable factor in the general post-War situation and in itself did much to make general disarmament practically important. For, apart from its obvious political effect, it was expressly recognised in the peace treaties that the disarmament of the ex-enemy Powers was only preliminary to a general reduction and limitation of armaments by the world at large. The preamble to Part V. of the Treaty of Versailles, for example, says:—

> In order to render possible the initiation of a general limitation of the armaments of all nations, Germany undertakes strictly to observe the military, naval and air clauses which follow.

Provisions of the Covenant.—Secondly, specific obligations with regard to disarmament were imposed upon all the members of the League of Nations by Article 8 of the Covenant. In this article, recognised by the authors of the Covenant to be fundamental to the successful working of the League, the Members

> recognise that the maintainance of peace requires the reduction of national armaments to the lowest point consistent with national safety and the enforcement by common action of international obligations.

The article goes on to provide that the Council of the League

> shall formulate plans for such reduction for the consideration and action of the several governments. . . . After these plans shall have been adopted by the several governments the limits of armaments therein fixed shall not be exceeded without the concurrence of the Council.

To this must also be added the Final Act of the Conference of Locarno, in which new undertakings to carry out Article 8 were made by the Great Powers there assembled.

Third, these are not merely paper obligations. Since the end of the War it has been recognised more and more widely that Article 8 *must* be carried out if the League of Nations is to fulfil the purposes for which it was created. British statesmen have made the strongest possible declarations on the subject. Lord Grey, Lord Cecil, Mr. MacDonald, Mr. Baldwin, Mr. Austen Chamberlain, among others have declared that both in the interests of the British Empire and of the world at large it is necessary to secure a general and mutual reduction of armaments without delay. Lord Grey summed up their arguments in a single sentence by saying that "if civilisation cannot destroy armaments, armaments will destroy civilisation." He claimed to be expressing an almost universal conviction that armaments are not only a result, but also a cause of policy; that they not only arise from a sense of insecurity but that they increase that sense of insecurity and thus cause war among nations.

Article 8 of the Covenant is an undertaking by the Members of the League to co-operate in preparing a plan of disarmament and in making the treaty required to bring that plan into effect. In the fulfilment of this task the principal rôle is assigned to the Council, which has first to prepare a plan for the "consideration and action of the several governments," and which is subsequently to control its observance.

The Temporary Mixed Commission.—It was not the Council, however, but the Assembly of the League which took the first important step towards executing Article 8. At the First Assembly in 1920 a resolution was adopted calling for the creation (by the Council) of a special committee of experts of various kinds to study disarmaments and to draft a scheme. On this committee, the "Temporary Mixed Commission," there were appointed military, naval, air, economic and financial experts, and to them were added also some persons of political experience. It first met in 1921 and early in its discussions Lord Esher produced a scheme, restricted to the limitation of the land-armaments of Europe. Lord Esher's plan, to which perhaps no very great consideration had been given, was founded on the principle that equal proportionate reduction of the armaments maintained by different countries in time of peace would affect the different countries equally and, therefore, while affording them all relief from a considerable burden, would not alter their relative military strength. This, of course, is the classical argument for a general reduction of military forces; but, although at first sight it seems an obvious proposition, it was not agreed to by all the members of the Temporary Mixed Commission.

On the contrary, the European members of the Commission almost unanimously rejected it. They contended that, while it may once have been true that proportionately equal reductions of military armaments and forces by international agreement would leave countries relatively as strong as they were before, in modern conditions this would no longer necessarily be so. They maintained that the application of science to war had introduced such changes in methods and weapons that no disarmament agreement could now include and limit all the vital factors on which military strength depends, since many of these vital factors are important elements in the normal peace-time economic life of the nations of the world. After prolonged and difficult discussion of these arguments, it was recognised by the Temporary Mixed Commission that reduction of armaments could not come alone but that it must be accompanied by arrangements, supplementary to those of the Covenant, for ensuring the security of Members of the League against aggressive attack. This conclusion was summarised in four resolutions adopted by the Temporary Mixed Commission and subsequently by the Third Assembly in 1922, the gist of which was that disarmament to be effective must be general, and that "security" and disarmament must go together.

Security Negotiations.—On the foundation of these four important resolutions the Temporary Mixed Commission proceeded in the following year to draw up the Draft Treaty of Mutual Assistance. The purpose of this Draft Treaty was to provide a system of general security which would permit the calling of a disarmament conference. Disarmament was intimately linked to the general scheme by the provision that none of its undertakings of mutual guarantee would come into effect until a plan of disarmament had been actually adopted and carried out. The treaty of mutual assistance was not, in fact, adopted by the succeeding Assembly, but the Fifth Assembly in 1924 elaborated the Geneva Protocol, which was founded on the same principles, and in which again the coming into force of a security system was made conditional upon the previous adoption at a disarmament conference of a general plan for mutual reduction and limitation of national armaments by the important countries of the world (*see* SECURITY).

The Geneva Protocol, in its turn, failed to secure sufficient acceptance by leading governments to bring it into force, and instead, the method of regional pacts was attempted by the British Foreign Secretary, Mr. Chamberlain. Once again, when his negotiations ended in the conclusion of the Locarno agreements, the Final Act of the Conference contained a new pledge that the Security Pacts should be followed by the adoption of a general plan of reduction and limitation.

Thus the whole course of the discussions and negotiations on the subject between 1919 and 1926 proved conclusively the essential connection between security and disarmament. On the problem of security those years witnessed much progress. In other respects, however, less progress was made. Quite apart from the problem of security, disarmament itself in its technical and technical-political aspects is an extremely intricate matter. It can hardly be expected that other governments will freely accept the simple but drastic system imposed on Germany and her allies, desirable though it might be that they should do so.

Technical Difficulties.—But the technical difficulties of a more elastic system are very great. How is the total strength of one country to be compared with that of another, or the power of one weapon to be measured against the power of another? How are weapons to be limited at all? How can secret preparation and storing of arms be stopped? How can the ratio of strength between different Powers be settled? What arrangement can be made for the simultaneous carrying out of disarmament provisions when they have been accepted?

These are formidable questions and the complicated technical problems which they raise were hardly touched on in the earlier discussions on the subject. The success of the Washington Naval Conference (*see* WASHINGTON CONFERENCE) does not give any indication of the lines on which they could be solved, for not only is naval disarmament infinitely simpler than military and air disarmament, but even among naval units the Washington Treaties dealt with only two categories of fighting ships. At length, however, the Sixth Assembly of the League recognised the importance of this side of the matter and decided that its study should be begun in order that, when security had been obtained, the work of the disarmament conference might be rapidly carried through. It remains to be seen what success will attend the League commission, on which it should be noted, the United States has a seat.

In conclusion, it may be said that the negotiations on disarmament which have so far taken place have been based on the following accepted principles:—

1. That general security is a necessary condition of general disarmament;
2. that the organisation of a system of sanctions through League of Nations machinery is the only road to security;
3. that to this end the "gap" in the Covenant, by which recourse to aggressive war is in certain cases legitimate, must be abolished, and aggressive war in all cases made an international crime;
4. that no scheme of disarmament can succeed unless it is accepted by all or almost all governments and unless it covers every kind of weapon and military preparation;
5. that only through the permanent machinery of the League can the necessary preliminary preparation for a disarmament conference be carried out; and
6. that no plan for general disarmament will give confidence to

governments and peoples unless it is supported by an imperial international system of control and supervision, which again can only be organised through the machinery of the League.

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DISTRIBUTION OF ANIMALS (*see* 28.1002).—Just as the main interest of animal classification is not the framing of diagnoses but the tracing of relationships, so the modern study of geographical distribution is less concerned with the definition of regions and provinces than with finding out the meaning of faunistic resemblances and differences, to what extent they are due to present conditions, to what to past events.

I. LAND AND FRESHWATER ANIMALS

The importance of a group of animals in relation to problems of distribution depends on the extent to which the classification has been worked out, the palaeontological history discovered and the methods of dispersal ascertained. Especially valuable are animals for which the sea is generally an impassable barrier, such as the mammals and the freshwater fishes, and we propose to consider how the ideas as to former continental connections and ancient lines of severance that come from a study of mammalian distribution are confirmed or modified by the distribution of freshwater fishes. The statement that the distribution of freshwater fishes must be represented by a different scheme from that proposed by Wallace and Sclater for the mammals is incorrect; each of the great regions, Palaearctic, Nearctic, Neotropical, African, Indian and Australian, is well defined by its freshwater fish fauna.

Australia.—The distinctness of the Australian region, with its peculiar marsupial fauna, is well known; the placental mammals are almost entirely absent, being represented in Australia itself by a few small rodents, a group peculiarly liable to accidental transmission, and by a dog, which must have been introduced by man. The freshwater fishes emphasise this distinctness, for the Ostariophysi, an order comprising more than 4,000 species and dominant in the fresh waters of the rest of the world, are absent from the Australian region, except for two families of cat-fishes, Ariidae and Plotosidae, the only marine families of the order; these are represented by a number of freshwater genera and species in the rivers of Australia and New Guinea. It is evident that the Australian region was cut off from the rest of the world long ago, probably not later than the beginning of the Cretaceous, before placental mammals or Ostariophysi had developed.

Wallace's Line.—Wallace's Line, between Borneo and Celebes and Bali and Lombok, was long accepted as the boundary between the Indian and Australian regions, but some modern authorities minimise its importance and would place Celebes in the Indian region. Max Weber, indeed, asserted that the freshwater fish-fauna of Celebes is an impoverished Indian one, and, in support of this, listed five widely distributed Indian species that occur in the island. But the presence of the same species, if it were due to a land connection, would mean a connection between Borneo and Celebes as late as the Pliocene, or later, which is quite out of the question. And we find that one of these species (*Anabas scandens*) not only crosses Wallace's Line, but Weber's Line also, reaching the Moluccas, and another (*Symbranchus bengalensis*) extends to Western Australia and to New Guinea!

The explanation is that three of the five species are valued as food-fishes because they can live out of water and can be carried about alive in jars without any water; these must have been introduced into Celebes, and the others are not true freshwater fishes, but are characteristically estuarine and can cross the sea. The contrast between Borneo, with hundreds of species of carps, loaches, cat-fishes, labyrinthic fishes, etc., and Celebes, without a single indigenous true freshwater fish, is a striking one. It may be that Wallace's Line is the ancient line of severance between Asia and Australia, and that the animals that have crossed it since the separation occurred have special means of dispersal or have been able to take advantage of special circumstances.

Australia and South America.—Some authorities believe that in early Tertiary times Australia was connected with South America via Antarctica, but the evidence in favour of this conclusion is very slight, and that against it weighty. A family of frogs, Cystignathidae, was said to be peculiar to Australia and South America, but this family is now included by Noble in the Bufonidae, a cosmopolitan group, and it is certain that the Australian and South American genera are not at all closely related. *Thylacinus* is a typical member of the Australian family Dasyuridae and has nothing in common with the Sparassodonts of the Miocene of Patagonia, except the carnivorous dentition. The South American and Australian tortoises of the extinct family Miolaniidae may well be placed in different genera, and this family may be a very ancient one that had a wide range in secondary times. The long isolation of the Australian region may be regarded as established.

Madagascar and Africa.—Madagascar, like Australia, has no Ostariophysi (except a peculiar genus of Ariidae) nor indeed any true freshwater fishes. This reinforces the purely geological evidence that the separation of Madagascar from Africa may have taken place as long ago as that of Australia from Asia. The mammals of Madagascar are placentals, but are very peculiar and have evidently evolved in the island from a few ancestral types, which may have reached it from Africa in early Tertiary times, either by means of a temporary and narrow land connection which did not suffice for the passage of freshwater fishes, or more probably, as Matthew has suggested, across the sea, *e.g.*, on drifting timber or by swimming, perhaps at periods of elevation which brought the north end of the island nearer to Africa than it is at present.

Dispersal of Mammalia.—The importance of the mammalia for the study of geographical distribution resides in the fact that for many of the groups their evolution and migrations during the Tertiary period are well ascertained, and that for the majority of them the sea constitutes an impassable barrier. It is generally accepted that in the Eocene North America was separated from South America and from Eurasia, and that a wide sea extended from the Mediterranean eastwards, cutting off Africa from Europe and India from northern Asia. In other words, during the Eocene the continents were isolated, and each was able to develop its own peculiar mammalian fauna. Thus, taking the orders generally grouped together as Ungulates, we have evidence that during this period the Proboscidea, Sirenia and Hyracoidea became differentiated from each other in Africa, the Litopterna, Toxodontia and Typotheria in South America, the Artiodactyla and Perissodactyla in the north. At the end of the Eocene nearly the present relations of the continents became established, and in addition North America and Eurasia were united across the Bering Sea, and perhaps also via Greenland and either Iceland or Spitsbergen; thus extended migrations became possible, the elephants spread northwards and the northern groups entered Africa and South America; in the last-named, perhaps as a result of this invasion, many of the original native groups became extinct, or were reduced, *e.g.*, Edentata.

Dispersal of Freshwater Fishes.—True freshwater fishes, that is, those belonging to groups that have evolved in fresh water, resemble the mammalia in their inability to cross the sea, but differ from them in that their distribution is a relatively slow process, dependent on hydrographical changes, such as the union of rivers formerly distinct, the capture by one river of the tributaries of another, etc. It seems that for mammals migration is easy, but survival difficult, whereas for freshwater fishes migration may be difficult, survival relatively easy. Our knowledge of the Tertiary history of freshwater fishes is incomplete, but we know that species closely related to the modern pike, tench and dace inhabited Europe in Oligocene times, and that in the Eocene of North America are representatives of some of the families

characteristic of that continent at the present day, namely Catostomidae, Amiuridae, Percopsidae, Percidae and Centrarchidae. Clearly the main distribution of freshwater fishes was already determined in early Eocene times.

South American Ostariophysi.—The distribution of the Ostariophysi, to which order the great majority of the freshwater fishes of the world belong, is full of interest. The South American Ostariophysi exhibit the greatest diversity, and must have evolved in that continent for a very long time; there are five families of Characins, the most generalised group of the order; four of these are restricted to South America, and one is found also in Africa. The Gymnotiformes (electric eels) are an endemic neotropical group, and the South American Siluroids, or catfishes, belong to nine families, all endemic.

There is no relationship whatever to North America, and the freshwater fish fauna of South America is as peculiar and distinctive as the mammal fauna would have been if the connection with North America had never been formed; this connection has not enabled a single Nearctic freshwater fish to reach South America, but the ancient Lepidosteus has got as far as Panama. Nor have the neotropical types been more successful in spreading northwards; a few families have entered Central America, but none has reached the Mexican plateau, although in the lowlands of the Atlantic slope one species of the Characinid genus *Astyanax* had got so far north as the Rio Grande.

FIG. 1.—Distribution of Characins.

Africa and South America.—Although Africa and South America have no genera in common, there is a certain relationship. The Characins are restricted to these two continents, and of these the South American Brycon appears to be closely allied to the African Alestes. Also the Pimelodidae, the most generalised neotropical Siluroids, are very near to the Bargridae of Africa and India. These facts, added to the distribution of the Lepidosirenidae (Protopterus in Africa, Lepidosiren in South America), fishes specialised for freshwater life in the tropics, strongly suggest that in Cretaceous times South America and Africa formed one continent and that in it the Ostariophysi originated and evolved. Probably these continents became separated towards the end of the Cretaceous. The distribution of the Cichlid perches, a more modern group than the Ostariophysi, was at one time thought to support the view that this connection might have persisted into the Eocene; but it is now known that some Cichlids frequent brackish lagoons and estuaries, and two or three have even been found in the sea; moreover, the presence of fishes of this family in Madagascar, where none of the other freshwater families of Africa occur, is evidence that their distribution is not subject to the same restrictions as that of true freshwater fishes.

The Cypriniformes.—The Indian region, India and southeast Asia, is the headquarters of the Cypriniformes, a group more specialised than, and evidently derived from, the Characins. In this area, the Cyprinidae are represented by a great number of divergent genera, including those that most nearly approach the Characins in structure. The Characin ancestors of Cyprinidae must have come from Africa, and a direct Cretaceous connection between Africa and India may be inferred. In southern Asia the Cyprinidae gave rise to two families of loaches, fishes specialised for life in mountain streams, Homalopteridae and Cobitidae; of these the latter spread northwards. The Cyprinidae themselves must have extended northwards at an early date, for before the Eocene the ancestors of the Catostomidae had reached North America. The African Cyprinidae, although numerous enough, belong to a few Indian genera which have evidently reached Africa since the Eocene; most of the Palaearctic species are Leuciscines, a group that appears to have entered North America from Asia since the Eocene. The Indian region has six families of Siluroids, three endemic and three in common with Africa; of these the Bagridae must have reached it at an early date, for the Amiuridae, which are specialised Bagridae, were already present in North America in the Eocene.

Freshwater Fishes and Mammals Compared.—The freshwater fishes tell the same story as the mammalia, due allowance being made for their greater persistence and more limited powers of dispersal. The majority of the families characteristic of the great regions at the present day must have already been present in the same areas in Eocene times, and the connections established since the Eocene have produced but a small effect, in striking contrast to the rapid spread of the mammalia, the constant interchange between North America and Eurasia and the invasion of Africa and South America by groups of northern origin. Some authorities, impressed by the fact that the greater part of the present mammalian fauna of Africa and South America is derived from immigrants from the north, have accepted northern origin and southward migration as a general principle. But this generalisation, only partly true for the mammals of the Tertiary period, should not be applied to other groups and to other times without strong evidence to support it. The Ostariophysi entered North America from Asia, the Catostomidae and Amiuridae or their ancestors towards the end of the Cretaceous, the Leuciscines since the Eocene; the supposition that the ancestors of the completely different South American members of the order came from North America is unsupported by any evidence and is highly improbable. The conclusion that Africa and South America were connected in Cretaceous times, and that the Ostariophysi had a southern origin, is neither contradicted nor supported by the mammals; but it is at least as likely that the ancestors of the endemic South American orders came from Africa as from North America, that the Litopterna and Toxodontia, for example, may have evolved from the same southern group of primitive Ungulates as the Proboscidea and Sirenia.

Generalisation and Specialisation.—Matthew is responsible for another hypothesis, namely, that the most primitive living members of a group indicate the limits of its migration and the most advanced forms its original habitat. This appears to be true for certain groups of terrestrial animals, but not for others; it has no general value and cannot be applied to freshwater fishes, in which the most generalised types often persist in the region where the greatest diversity and specialisation are found.

Wegener's Hypothesis.—The bearing of Wegener's hypothesis on problems of geographical distribution has been much discussed in recent years. Wegener's main thesis, that the continents are masses of lighter and more solid material floating in a heavier and more fluid substratum, and that their present position is the result of "drift," is a matter for geologists and geophysicists to pronounce on (*see* GEOLOGY). If his ideas as to the distribution of land and water in the past were a necessary consequence of his hypothesis, zoologists would have to reject it. It is evident, however, that these ideas are not an integral part of the hypothesis, but are the result of what Wegener has learnt about geographical distribution; his Eocene map, for example, shows Australia connected with South America by Antarctica and Madagascar united to India. The conclusion is that Wegener's hypothesis has at present nothing to do with geographical distribution. The zoogeographer who has reason to believe that South America and Africa were formerly united is indifferent whether they became separated by submergence of the intervening land, or by breaking and drifting apart.

FIG. 2.—Mean annual surface isotherms of 6°, 12° and 20° C., approximating to boundaries of zones of marine distribution. The dotted areas show the distribution of pilchards (Sardinia).

II. MARINE DISTRIBUTION

Coastal.—During the present century the collections made by the British, French, German, Belgian and Swedish Antarctic expeditions have made known for the first time the marine fauna of the coasts of the Antarctic continent and the adjacent islands, with some results that were unexpected, for example the affinity, almost identity, of the South Georgia fauna with that of Graham Land, and its dissimilarity from that of the Magellan-Falklands area. It was found that nearly all the coastal fishes of Antarctica, South Georgia and other islands south of the mean annual surface isotherm of 6° C. belonged to a single group, Notothenii-formes, and that most of the genera and nearly all the species of this region were restricted to it. The Antarctic zone may be considered to be bounded by this isotherm and may be further subdivided into a glacial zone (Antarctica, South Georgia) within the limits of pack ice, and a periglacial zone (Kerguelen, Macquarie Is.) outside these limits. The peculiar and diverse Antarctic fish fauna must have taken a long time to evolve and justifies the belief that Antarctica has been surrounded by a cold sea for a long time, probably throughout the Tertiary.

Between the isotherms of 6° and 12° C. lies the subantarctic zone in which Notothenüiform fishes are represented by Bovichthyidae and species of Notothenia; there are two main areas, Magellan and Antipodes. The south temperate zone, between the isotherms of 12° and 20° C., has five districts, Chilean, Argentinian, South African, South Australian, New Zealand. South of the tropics the currents are not deflected by land masses to the extent that they are in the north, the isotherms are more nearly parallel and the zones of distribution are better defined. A remarkable example of the influence of temperature and currents on distribution is that two small islands, Tristan da cunha and St. Paul, some 4,000 m. apart, have species of fish in common that are found nowhere else in the world; these islands are on the same isotherm and the Antarctic Drift runs direct from one to the other. The Antarctic and Subantarctic coastal fishes are mostly quite unlike any found in northern regions, but there are a number of genera common to the north and south temperate zones, and the Cape fauna has many similarities to that of the Mediterranean.

Tropical Zone.—The tropical zone, bounded by the mean annual surface isotherms of 20° C., is far richer than any other; there are two main regions, American and Indo-Pacific. The similarity between the tropical fauna of the Atlantic and Pacific coasts is due to the Eocene connection of the Caribbean Sea with the Pacific; few species are identical on both coasts, but many Antillean species are represented by closely related forms on the Pacific side. West Africa has a mixture of Indian and Antillean types, but there is little that is distinctive in this district, perhaps because its area is relatively small and uniform, perhaps also from extinction in glacial times. Certain families and genera now restricted to the Indo-Pacific (*e.g.*, Triacanthidae, Amphisilidae, *Scatophagus*, *Mene*) have been found fossil in Eocene and Oligocene deposits in southern Europe and indicate that in early Tertiary times the Mediterranean, which then extended eastwards to the Pacific, had a tropical Indo-Pacific fauna, which would have ranged to West Africa also.

Northern Zones.—The greater seasonal variations make it more difficult to define the northern zones than those in the south, but the same isotherms may conveniently be used. These correspond very closely to P. Schmidt's faunal divisions of the east coast of Asia, and in the North Atlantic the isotherm of 12° C. runs to the mouth of the Channel, the region where the pilchard replaces the herring, the hake and the cod, and that of 6° marks the southern limit, as a marine fish, of such a typically Arctic species as the char and is near the northern boundary of many British species. The identity or near relationship of many subarctic species in the Atlantic and Pacific indicates their former continuous range along the northern coast of Eurasia under milder climatic conditions in the Arctic Ocean, and also establishes that the post-Eocene connection between North America and Asia must have been broken more than once since its formation.

In both the Atlantic and Pacific oceans the tropical zone is expanded on the western side and contracted on the eastern and in both oceans the north temperate and subarctic zones are narrow to the west and broad to the east. These facts may have an important bearing on distributional problems; off the Atlantic coast of America, for example, in the region where the Labrador current meets the Gulf Stream, there is an almost abrupt transition from subarctic to tropical conditions.

Bank, Coast and Continental Slope.—Under the heading "coastal" are included the pelagic animals that frequent the neighbourhood of the coasts as well as the benthic animals that live on the bottom, either near the shore or on the continental shelf, the edge of which corresponds to a depth of about 200

metres; it is within this depth that the greatest abundance and variety of life occurs. Hjort has shown that on the Atlantic slope of Europe and Africa the number of fishes decreases toward the abyssal plain and moreover that the fauna changes, the deepest part of the slope, from about 700 to 1,500 metres, having its own types, the uppermost part having also its own species, including some representatives of the fauna of the coast banks, or continental shelf. The zones and regions of distribution mentioned above apply especially to the surface-swimming fishes and to the bottom-living species within the 200 metres line; the fauna of the continental slope, particularly of its deeper parts, appears to be much more uniform over wide areas, as might be expected from what is known of temperature at these depths.

Oceanic Life.—Our knowledge of oceanic life has been greatly increased by the results of the German "Valdivia" expedition and especially by the "Michael Sars" expedition across the Atlantic under Hjort and the voyages of J. Schmidt in the Atlantic and Mediterranean in the "Thor" and "Dana." Hjort has put together his main results in a book *The Depths of the Ocean* (1912); he has come to the conclusion that the abyssal fauna is a poor one, and that the majority of the fishes recorded by the "Challenger" from great depths were taken in the nets on their way to the surface. He found that dark-coloured fishes, deep-red prawns and other organisms were bathypelagic, characteristic of a region extending downwards from a depth of about 500 metres below the surface, although in subarctic waters some of them may be found nearer the surface.

The region between 150 and 500 metres is inhabited by another association of organisms, small, silvery fishes with large eyes, and numerous small crustaceans, pteropods, etc.; with few exceptions the fishes of this region appear to be restricted to the tropical and temperate zones, and the few found in colder waters are generally specifically distinct. From the surface down to 150 metres are found large, swift, predacious fishes, tunny, sword-fish, etc., as well as smaller forms, of which the Myctophidae are typical and most abundant, with hosts of Foraminifera, Radiolaria, Copepoda, Pteropoda, Medusae, Siphonophora and Salpae. This fauna belongs mainly to the tropical and temperate zones, especially the former where both species and individuals are most numerous; the fishes are generally silvery, with blue backs, the invertebrates mostly transparent and colourless.

Eels.—Schmidt has not given a summary of his researches in book form; he has been concerned mainly with the influence of hydrographical conditions, temperature, salinity, currents, etc., on the distribution of pelagic organisms. As a typical example of his work we give that on the distribution of the eels (*Anguilla*), a research that has been carried on continuously since 1904 and is still in progress. Schmidt finds that there are five temperate and 16 tropical species of the genus *Anguilla;* these are littoral and freshwater fishes that migrate to the ocean to breed; the pelagic larvae are transparent and strongly compressed; on reaching the coastal waters these undergo a metamorphosis and become elvers, or young eels, which make their way into the bays and up the rivers. By collecting and comparing eel larvae from the North Atlantic and Mediterranean Schmidt has demonstrated that the European eel crosses the Atlantic to breed in an area to the south of Bermuda, and that the larvae travel eastwards, reaching the coastal waters of Europe when they are about $2\frac{1}{2}$ years old and 3 in. long; here they change into elvers, those that enter our rivers in the spring being about 3 years old. Thus the distribution of the European eel, from Iceland and northern Norway to Morocco, and throughout the Mediterranean, represents the coasts reached by the larvae in their journey from the breeding area and those further regions to which the elvers can make their way.

The Gulf Stream is an important factor in bringing the larvae to Europe, but in this connection it is interesting to note that there are a number of fishes with pelagic larvae common to the Atlantic and Mediterranean, but, unlike the eel, these are divided into Atlantic and Mediterranean races, breeding in these areas; also there are Atlantic species not represented in the Mediterranean. Schmidt has found that although the larvae of the Atlantic species and races are abundant in the upper layers of the ocean in the neighbourhood of Gibraltar, and although there is a strong surface current eastwards through the Straits, none of these larvae enters the Mediterranean. He has expressed the opinion that the eel-larvae go into the Mediterranean because they want to, and the others do not because they do not want to.

The breeding place of the American eel overlaps that of the European eel, but is somewhat southwest of it. In the western Atlantic larvae of both species occur together, but Schmidt has found that the larval life of the American eel is relatively short, the elvers being only one year old, and he believes that this is true of the Japanese eel also; thus the long larval life of the European species is regarded as a special adaptation, related to the great distance of the breeding place from the coasts. There is reason to believe that eels breed at a depth of about 400 metres below the surface, and Schmidt has suggested that their breeding places are oceanic areas in which the temperature at this depth is high, above 13° C. This short summary of this fine piece of work will show that the anomalous distribution of the species of *Anguilla* on coasts and in rivers may be related to their life-history, to the temperature of the ocean at a particular depth and to the direction of the surface currents.

Micro-plankton.—The microscopic plants of the upper waters of the ocean obtain their food directly from inorganic substances dissolved in the water, building up their living substance from these, water and carbon dioxide. These minute plants form the food of the animal plankton, including small Crustacea, larval fishes, etc., which are eaten by pelagic fishes such as pilchards and mackerel, that form the prey of larger pelagic fishes. In coastal waters the plankton organisms form the food of many bottom-living invertebrates, which in turn are eaten by fishes. Thus it follows that the distribution of fishes may to a large extent depend on the microscopic plants floating in the surface waters, and the study of these, their distribution, quantity and the conditions of their existence has become of practical importance. One result that has been obtained is that these minute plants are generally abundant near the coast, but that in the open ocean they are far more plentiful in the colder waters than in the tropics; this is rather remarkable when it is considered that it is in the tropics that oceanic fishes are most abundant. It must be remembered, however, that a quantitative comparison of this sort, made at a season favourable to the colder waters, is no real index of annual production, that in the tropics growth is more rapid, and seasonal changes are less marked.

Detritus.—It is an open question whether the importance of the Phytoplankton as the basis of fish-life has not been overestimated, except for the pelagic fishes that are plankton-feeders and whether seaweeds, especially in the tropics, and organic detritus from the land are not equally valuable. Petersen especially has elucidated the part played by organic detritus from seaweeds and from the land as food for the bottom-living invertebrates that are eaten by bottom-living fishes of coastal banks.

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DIVING (*see* 8.326).—Several years before the World War, Gall of Württemberg invented a rigid copper armour, in which the diver, being exposed only to ordinary atmospheric pressure, could descend to depths hitherto unapproachable.

An Apparatus Described.—Messrs. Neufeldt & Kuhnke of Kiel, Germany, have developed a practical apparatus for commercial use, which consists mainly of an armour of steel and aluminium alloy which protects the diver against the pressure of

the water. The body, joined at the hips, and held together by bolted flanges, affords the necessary resistance against mechanical or chemical destructive action. The upper part of the body, with observation windows at the front and at the sides, contains the signalling devices, the regulating valves, as well as the necessary instruments like depth gauge, pressure gauge, compass, etc. The lower part of the body affords space for the necessary balancing weights, and is provided with a seat like a bicycle saddle. The arm and leg coverings are so designed that the movements of the man's limbs may be as free as possible. Different sorts of artificial hands or tong-like devices are inserted in the arm stumps and operated by the diver from inside for all ordinary work like fixing or removing a shackle, placing a bolt in position, tying different knots, etc. The movable legs enable him to walk about, to lie down and get up, and perform every necessary movement. He can withdraw his arms from the armoured coverings and operate the different valves, the light, etc.

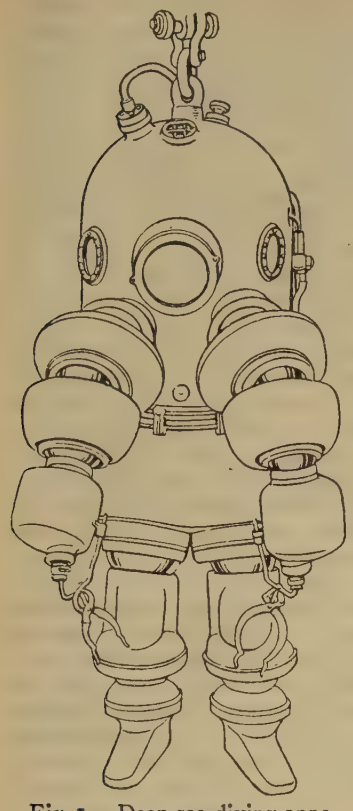

Fig. 1.—Deep sea diving apparatus, of steel armour and aluminium alloy.

Breathing Mechanism.—The breathing mechanism resembles that of a submarine. The diver does not depend on air pumped from above, as he has with him a sufficient quantity of oxygen stored in bottles, to last for about four hours. The carbonic acid exhaled is absorbed by special cartridges. As in a submarine, tanks are provided to enable the diver to rise or go down as he pleases. He is connected with the vessel, from which he descends by means of a steel cable sufficiently strong to lower him from the ship or raise him to it. The cable contains three independent telephone wires. If the connecting cable becomes entangled in some obstacle, and the diver is unable to clear it, he can detach the cable from inside the apparatus and rise to the surface independently by blowing out his tanks.

Behaviour Under Tests.—The whole apparatus, including the flexible joints, has been tested to stand a pressure of 25 atmospheres, corresponding to a depth of about 750 feet. At tests carried out in Lake Walchensee (Bavaria), the divers went down to a depth of 525 ft., and the ordinary diver's work was performed at the depth of 450 feet. No difficulty in breathing or manoeuvring was experienced in any of the tests.

Advantages.—For the diver working with this apparatus, depth is of no importance. As the increasing pressure of the water is borne by the apparatus, he feels no inconvenience whether he is working at a depth of 50 or 500 feet. The diver in the ordinary rubber suit requires about one hour to be raised or lowered in order to enable his body to adapt itself to the diminishing or increasing pressure. Any hurried movement in either direction would seriously affect, or even kill, him. With the new apparatus he can go down to a depth three times greater within a few minutes and come up at the same speed. As diving with this apparatus does not require any physical training such as divers have hitherto had to undergo, a supervising engineer or officer may go down at any time himself to inspect whatever may be the subject of inquiry.

Future Use.—The deep sea diving apparatus opens up new prospects for the exploration of the bottom of the sea. Scientific research formerly depended entirely on the results given by ground-nets, water and ground tests. Oceanographic and biological institutes will benefit by this addition to their equipment. Great economic importance attaches to this apparatus, for salvage, as well as pearl and sponge fishing. Work beyond a depth of 100–130 ft. was impossible with the ordinary rubber diving suits, but is now feasible. With the help of a new underwater oxygen cutting device, bullion from sunken ships lying at great depths can now be recovered, and pearl fishing is no longer limited to the almost exhausted grounds in shallow water.

Salvage of M1.—The first practical use of the apparatus for salvage work in the open sea was made by request of the British Admiralty in connection with the sinking of the ill-fated submarine M1 on Nov. 12 1925. As soon as it was certain that the submarine must have met with some accident, and most probably was lying at a depth of about 240 ft., the British Admiralty dispatched a destroyer to fetch from Messrs. Neufeldt & Kuhnke's works at Kiel two sets of diving apparatus, which, with the necessary crews, were immediately put at their disposal. The men and apparatus were hurried over to Portland and immediately transferred to the salvage ships "Moordale" and "Southdown," but on arrival at the scene of the disaster they encountered such rough weather and high seas that diving was out of the question. In the meantime, British destroyers and mine-sweepers were busy searching the water with dredging gear for any obstructions, and locating them.

In spite of heavy seas which would have absolutely prevented the use of ordinary divers irrespective of the depth, diving was begun on Nov. 20 and was continued until Dec. 2. During this time a considerable number of daring dives were made by different German divers, who stayed at the bottom as long as an hour and a half, and sometimes were able to search a considerable area by walking. As however the obstructions located by sweeping and on which diving took place were not the missing submarine, and as the salvage ship, "Moordale," encountered many difficulties owing to the bad weather in the Channel, the divers were not able to reach the sunken submarine. When it was established beyond doubt that the M1 had been rammed by the Swedish ship "Vida," and as the reason of the disaster was thus made clear and not the faintest hope of saving life could be entertained, the Admiralty decided to abandon the search for the time and to postpone it to a better season. It had been proved that the apparatus employed fulfilled all reasonable expectations, but failed to get definite results by reason of circumstances outside the control of the German expedition. (F. W. Ha.*)

DIVORCE: *see* MARRIAGE LAWS.

DJEMAL PASHA, AHMED (1861–1922), Turkish politician, was born at Constantinople May 1 1861. He entered the army, and later became an influential member of the Committee of Union and Progress. In 1908 he was promoted lieutenant-colonel, and was appointed military governor of Adana. He was appointed governor-general of Baghdad in 1911, and commanded a division during the Balkan wars the following year. In 1913 he commanded the I. Army Corps, and was made Minister of Public Works. In 1914 he became Minister of Marine; in the same year he took over the II. Army, and was afterwards sent to Syria in command of the IV. Army. Owing to dissensions with Enver Pasha and von Falkenhayn he returned to Constantinople in 1917, where he retained the portfolio of the Marine until the Armistice. On the downfall of the Ministry in Oct. 1918 Djemal was forced, with other members of the Committee of Union and Progress, to seek refuge in Germany and Switzerland. Later he visited Russia, and thence proceeded to Afghanistan, where he exercised a powerful influence. He was assassinated by Russians at Tiflis July 22 1922. Djemal did much to awaken the spirit of nationalism in the Mahommedan countries of Central Asia. An able leader and an efficient organiser, many of his reforms were definitely constructive; but he was frequently cruel and tyrannical.

His writings include a volume in French, *Le Carnet de route du Colonel Djemal Bey*, and works in Turkish on Plevna and the Crimean Campaign. Another work, *Memories of a Turkish Statesman, 1913–9* (1922) appeared in English and in German.

DOBRUJA (*see* 8.351), a province of Rumania which is bounded east by the Black Sea, north and west by the Danube and south by Bulgaria. Its area, 8,993 sq. m., comprises the four districts of Tulcea, Constantsa, Bazargic and Durostor. Population 635,000. The Dobruja was assigned to Rumania by the Treaty of Berlin (1878), and soon radically changed its economic and ethnographical character. Part of the Turkish population voluntarily emigrated to Asia Minor, their place being taken by Rumanians who so developed these barren but fertile lands that to-day they form one of the most important wheat-growing regions of Rumania.

In 1911 the population numbered 338,267 inhabitants, of which 186,334 were Rumanians, the rest being composed of 48,963 Bulgarians, 10,836 Turks, 25,086 Tartars and 67,048 various other nationalities (Russians, Armenians, Greeks, Jews, etc.). The port of Constantsa (60,000 inhabitants) developed rapidly after the building of the bridge over the Danube and the opening of the railway line which links Dobruja with the rest of the country. Constantsa is to-day the principal port of export for the main products of Rumania (cereals, timber and oil), especially in winter when the Danubian ports are ice-bound. The oil is conveyed to the port through a pipe-line which connects Constantsa with the oil-fields in the Prahova district.

By the Treaty of Bucharest (Aug. 10 1913) Bulgaria ceded to Rumania two districts (Bazargic and Durostor) with an area of 2,877 sq. m. and a population of 289,131 inhabitants, of which, according to Bulgarian statistics, 134,731 were Bulgarians, the rest being composed of Turks, Rumanians, Greeks, Tartars, etc. The second Treaty of Bucharest (May 7 1918) deprived Rumania of the entire Dobruja. The southern part was to be ceded immediately to Bulgaria; the northern portion was, as a provisional measure, to be placed under the joint administration of Germany, Austria-Hungary, Bulgaria and Turkey. Rumania was to retain a commercial outlet to Constantsa. The Treaty of Neuilly (signed Nov. 27 1919) annulled these terms and by it the Bulgarian-Rumanian frontier was restored to the line of 1913 (*see* RUMANIA). (G. Bo.)

DOBSON, FRANK (1887–), British sculptor, was born in London on Nov. 18 1887. He received his early training with the sculptor W. Reynolds-Stephens, and later obtained a scholarship at Hospitalfield, Arbroath, New Brunswick. After further study in the City and Guilds Schools at Kennington, London, he lived in Cornwall and worked with the granite cutters. He was thus technically well equipped for a sculptor's career. His early works, both in painting and sculpture—few of which now exist—show definitely the attraction of the first Post-Impressionist Exhibition held in London in 1909. After war service he exhibited his first important work in stone "The Concertina Man" (1919), which was followed in 1921 by "Two Heads" in red Mansfield stone and the more complex Portland stone group "The Man Child." In 1923 he competed unsuccessfully for the Welsh National Memorial at Cardiff with his recumbent figure, "Cambria." To the next two years belong the white marble figure of a woman (1924), the seated nude "Susanna" and "Morning" (1925). His portraits include the bronze bust of the Earl of Oxford and Asquith (1921), the polished brass head of Osbert Sitwell (1923) and the plaster head of a young girl (1925)—the two last named in the National Gallery of British Art—the bronze half-length of Madame Lydia Lopokova (1924) and heads of L. H. Myers (1925), Robert McAlmond and Robin Sinclair. He was a founder of the X group, and in 1923 became president of the London group.

See Roger Fry in *The Burlington Magazine*, vol. 46, p. 171 (1925); Clive Bell in *The Architectural Review*, vol. 59, p. 41 (1926).

DOBSON, HENRY AUSTIN (1840–1921), British poet and man of letters (*see* 8.352), died at Ealing, London, Sept. 2 1921. His later work consisted of prose essays, notably *At Prior Park* (1912), *Rosalba's Journal* (1915) and *Later Essays* (1921), all studies of the 18th century; and *A Bookman's Budget* (1917).

DOCKS: *see* PORT ENGINEERING.

DODDS, ALFRED AMÉDÉE (1842–1922), French general (*see* 8.369), died in Paris July 18 1922.

DODECANESE (Twelve Islands), a term which first appears in the 9th century, was used in the Middle Ages for the Cyclades. Since the Italian occupation it has been applied to "the 13 Southern Sporades," consisting of the 13 (not 12) islands of Rhodes, Kos, Kalymnos, Leros, Nisyros, Tēlos, Symē, Khalkē, Astypalaia, Karpathos, Kasos, Patmos and Lipsos. The two first and the last were not included in the medieval "Dodecanese," which, however, comprised Nikaria and Castellorizo (Meyis). Turkish firmans from 1652 to 1835 conferred or confirmed their fiscal privileges, and local Greek authorities collected a lump annual sum as tribute to the Porte. These privileges, despite occasional infringements in 1869, 1886 and 1893, continued down to the Turkish revolution. The Young Turks, in 1909, abolished them, but in 1912, when the islands ceased to belong to Turkey, this decision had not yet been carried out.

In that year the Italians, then at war with Turkey and meeting with difficulties in Libya, occupied the 13 islands after a single battle at Psinthos in Rhodes, in which they were aided by the islanders, believing in the promises of General Ameglio and Admiral Presbitero, that "autonomy" would follow the abolition of Turkish rule. Indeed, an Insular Assembly met at Patmos, and proclaimed the "Autonomous State of the Aegean" with its own flag. The first Treaty of Lausanne, in Oct. 1912, pledged Italy to evacuate the islands as soon as the Turks had evacuated Libya. The Italian occupation was, therefore, to be provisional, but the French proverb tells us that *ce n'est que le provisoire qui reste.*

Signor Giolitti, when Premier, sincerely repudiated the idea of "annexing territories of Greek nationality" and Sir Edward Grey, in 1913, declared that their fate "interested all the Great Powers." Nevertheless, the 8th article of the secret Treaty of London of 1915, which secured Italy's entrance into the European War, gave her full sovereignty over the islands, which, had they been Turkish, during the first Balkan War, could all have been captured by the Greek fleet. Indeed it was only the Austrian veto which had prevented Italy from occupying Chios and Lesbos as well.

A convention was, however, made between M. Veniselos and Senator Tittoni (then Foreign Minister) on July 29 1919, which was to have simultaneous effect with the subsequent Treaty of Sèvres, and which ceded 12 of the islands to Greece, and provided that Rhodes, the thirteenth, should have "a wide local autonomy." A further treaty was signed on Aug. 10 1920 by M. Veniselos and Count Bonin at Sèvres. It confirmed the above, and added that Rhodes should, 15 years later, become Greek also if Great Britain should have ceded Cyprus to Greece, and a Rhodian plebiscite, held under the supervision of the League of Nations, should have decided for union. Meanwhile Italy pledged herself to give to the islands within two months a "wide local autonomy."

In 1922, however, Senator Tittoni's successor, Count Sforza, denounced these agreements on the ground that circumstances had changed, and the fall of M. Veniselos strengthened the determination of the Italians to remain, despite Lord Curzon's stiff note of Oct. 15 1922, intimating that the cession of Jubaland by Great Britain to Italy was conditional upon the Italian settlement of the question of the Dodecanese with Greece. This position was, however, abandoned by Mr. Ramsay MacDonald, Lord Curzon's successor. Meanwhile the Treaty of Sèvres had formally assigned the Dodecanese to Italy, which by article 15 of the second Treaty of Lausanne not only obtained the recognition by Turkey of her full sovereignty over "the 13 islands" but also the ratification of her occupation (during the World War) of Castellorizo.

The Metropolitan of Rhodes was expelled in 1921, and, after an exile of three years, was allowed to return and remain only on condition that he severed his connection with the Oecumenical Patriarch. The Italian plan was to create an autocephalous church for the Dodecanese on the mistaken precedent of Cyprus, which was ecclesiastically autocephalous many centuries before the British occupation. The death of the Patriarch, however, prevented the execution of this arrangement, which would have

been uncanonical without his consent and contrary to the example of Protestant England in the Ionian Islands and of Catholic Austria in Bosnia and Hercegovina.

Another regulation in 1925 compelled all inhabitants of the Dodecanese to take Italian nationality, although, with the exceptions of the Moslems and Jews in Rhodes, they are all practically of Greek race. Latterly negotiations have gone on between the Italian Legation in Athens and a leading Dodecanesian, but with no result, whereas the fortification of Leros as a naval base and the establishment of a university at Rhodes point to the permanence of the Italian occupation, which is the chief obstacle to Greco-Italian friendship. The islands, with the exception of the sponge-fishing industry of Kalymnos and Symē, have small economic value, and the prohibition of sponge-fishing off the north coast of Africa by the Italians in 1916, since withdrawn, not only injured the islands economically but also diminished their population, now only about 80,000, by emigration. Besides, however, the strategic importance of Leros in view of possible Italian expansion in Asia Minor, Astypalaia has two harbours.

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(W. MI.)

DOGGER BANK, BATTLE OF THE.—This naval action of the World War was fought near the Dogger Bank in the North Sea on Jan. 24 1915, between British and German battle-cruisers.

Reports from America at this time had led the Germans to think that a plan for blocking their harbours was afoot and Rear-Adml. Hipper was despatched at nightfall on Jan. 23 to reconnoitre off the Dogger Bank. His force consisted of four battle-cruisers of the 1st scouting group, "Seydlitz" (flag), "Derfflinger," "Moltke" and "Blücher," with four light cruisers and

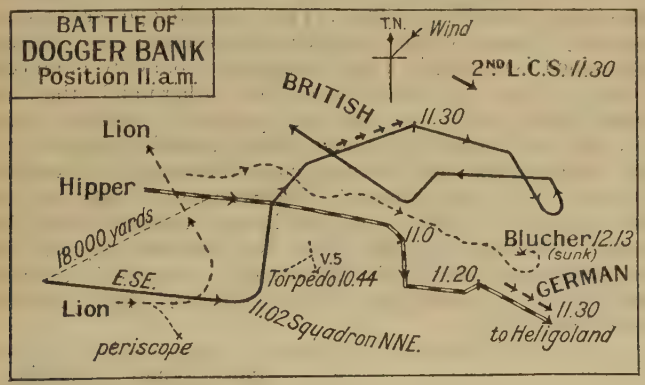

FIG. 1.

19 destroyers. Before the ships left the Jade, their strength and intentions had been revealed by their own wireless and Vice-Adml. Beatty left the Forth to intercept them at 6 P.M. on the 23rd. With him were the five battle-cruisers of the 1st and 2nd Battle Cruiser Squadrons, the "Lion" (flag), "Tiger," "Princess Royal," "New Zealand" and "Indomitable," and the four light cruisers of the 1st Light Cruiser Squadron under Comm. W. E. Goodenough in the "Southampton." He was to proceed to a rendezvous in lat. 55 deg. 13 min. north, long. 3 deg. 12 min. east, 180 m. from Heligoland, where he was to meet Comm. Tyrwhitt with three light cruisers and 30 destroyers of the Harwich force. The 3rd Battle Squadron, of seven "King Edwards," left Rosyth and Admiral Jellicoe put to sea from Scapa with the battle-fleet at 9 P.M. In heavy guns Beatty's force was decidedly superior, mounting 24 13·5 in. and 16 12 in. against Hipper's 8 12 in., 20 11 in., and 16 8·2 in.

The Fight Begins.—Beatty reached the rendezvous at 7 A.M. It was a crisp winter morning with a calm sea and good visibility. The battle cruisers were in single line ahead with Goodenough's light cruisers two miles on the port bow. Course was then altered to south by west at 18 knots. Ten minutes later "Arethusa," Tyrwhitt's flagship, was sighted southeast about seven miles on the port bow. She had hardly been identified when the flash of guns was seen to the south-south-east. "Aurora," some 15 m. behind Tyrwhitt, had met and engaged the German light cruiser "Kolberg," on the port bow of Hipper's squadron coming from the southeast. Each received a couple of hits and "Kolberg" retired at 7.25 A.M.

At the sound of the guns, Beatty ordered the light cruisers to chase to south. "Southampton" had barely gone two miles when she sighted "Aurora" on her starboard bow and, a few minutes later, German battle-cruisers on the port bow to the southeast. Dense clouds of smoke were pouring from their funnels and they were evidently raising steam for full speed. It was then 7.50 A.M. Beatty's appearance had come on Hipper as a surprise and, turning to the southeast, the latter ran for home.

Pursuit of the Germans.—At 8.30 A.M. Beatty's position was lat. 54 deg. 50 min. north, long. 3 deg. 40 min. east, and the two had settled down to the long rush for Heligoland, 140 m. away. The British battle-cruisers were in single line ahead on a south-east by south course, working up to full speed. Hipper was 11 m. sharp on "Lion's" port bow, in full flight on a south-south-east course. In speed Beatty's squadron had a decided superiority. It was able to maintain a seagoing speed of 26 knots, while Hipper was limited at first to 23 or 24. At 8.52, when the range of "Blücher" had come down to 22,000 yd., "Lion" opened fire and at 9.05 hoisted the signal to engage. The German battle-cruisers were then forming a line of bearing to port. At 9.09 Hipper opened fire as "Lion" scored her first hit on "Blücher."

The action ran on to the southeast with the range gradually decreasing, but it was not till 9.28 that the Germans scored their first hit on "Lion," sending an 11-in. shell through her water-line aft. At 9.43 a 13·5-in. shell crashed through the quarter deck of "Seydlitz," penetrated the after turret and exploding inside set fire to the charges in the working chamber. The flames went roaring through the turret, passed through a small door into the adjoining one, set fire to the charges there and, wrapping both turrets in a sea of flame, slew at a stroke every man inside. "Blücher" was having trouble with her engines at this time and about 10 A.M. drew out of the line, going heavily.

At 10.22 Beatty, to bring the rear of his line into action, ordered the battle-cruisers to form on a line of bearing north-north-west and to proceed at utmost speed. "Lion" had eased to 24 knots to let the ships in the rear come up, and, as the enemy had turned slightly away, the range was increasing. At 10.30 a salvo fell on "Blücher"; a shell penetrated the central ammunition passage, set fire to the cartridges and sent a sheet of flame through the fore turrets. The main steam pipe was damaged, her speed came down to 17 knots and she gradually dropped behind, enveloped in smoke.

"Lion" out of Action.—But "Lion," too, had been badly hit at 10.35 at a range of 16,400 yd. and at 10.45 she was beginning to lose speed. Beatty then made a signal to close the enemy as rapidly as possible, keeping all guns bearing, but in the smoke of battle it failed to get through. About 10.50 she received a hit on the port side aft, which holed the feed tank and brought the port engines to a stop. The wash of what was thought to be a periscope was seen on the starboard bow, possibly a torpedo fired by V5 at 10.44, and Beatty made a signal to alter course eight points to port. This was hauled down at 11.02 and the squadron turned to north-north-east.

But "Lion" could no longer lead it. Her wireless was out of action, electric power had failed for a time and she had fallen out of the line. The squadron drew away to the northward, with Rear-Adml. Moore, the second in command, in "New Zealand" some distance in rear. To resume the chase Beatty ordered three signals to be made; the compass signal "course northeast"; "attack the rear of the enemy," and a third "keep nearer the enemy," but only the first two were received by Moore, and he unfortunately read them as an order to attack "Blücher," which was then bearing roughly northeast. Hipper at 11 A.M. turned to the southward with his broadside bearing for 12 min.

at a range of 16,500 yd. and obtained seven hits on "Tiger." He signalled to his destroyers to attack, but the British turn to the north had robbed them of any chance of success.

At 11:12 Hipper turned to east-south-east and drew rapidly out of range. The British battle-cruisers were then sending shot after shot into "Blücher" whose fate was sealed. At 11:38 "Arethusa" came up and fired two torpedoes into her. She ceased firing, listing heavily with fires raging fore and aft, and sank at 12:13. Hipper was already some 15 m. off and at 11:52 Moore made a signal to form single line ahead and steer west.

Beatty by this time had transferred his flag to "Attack" and was racing after his squadron. He reached "Princess Royal" at 12:30 and hoisted his flag, but pursuit was then hopeless. A warning was received of the approach of the High Sea Fleet, and at 12:45 P.M. the squadron turned back. Hipper made for home and got in touch with the High Sea Fleet about 2:30 P.M. "Blücher" had been lost, "Seydlitz" seriously damaged and "Derfflinger" hit. On the British side "Lion" had been put out of action and "Tiger" damaged.

Adml. Jellicoe with the battle-fleet met Beatty at 4:30 P.M. "Lion" was taken in tow by "Indomitable" and, screened by light cruisers and destroyers, reached Rosyth safely the next morning. On the British side the result was regarded as disappointing, but it must be remembered that, with the exception of "Blücher," the enemy's speed was not seriously diminished when the action was broken off.

The forces engaged were as follows:

BRITISH

1st Battle Cruiser Squadron.
"Lion" (flag), Vice-Adml. Sir David Beatty, Capt. Alfred Chatfield, 28 knots.
"Princess Royal," Capt. Osmond de B. Brock, 28 knots.
"Tiger," Capt. Henry B. Pelly, 30 knots.
Armament 8 13·5-in., 16 4-in. ("Tiger" 16 6-inch).

2nd Battle Cruiser Squadron.
"New Zealand" (flag), Rear-Adml. Sir Archibald Moore, Capt. Lionel Halsey, 25 knots.
"Indomitable," Capt. Francis W. Kennedy, 25 knots.
Armament 8 12-in., 16 4-inch.

1st Light Cruiser Squadron.
"Southampton," Comm. W. E. Goodenough, Comm. E. A. Rushton.
"Birmingham," Capt. Arthur A. Duff.
"Nottingham," Capt. Charles B. Miller.
"Lowestoft," Capt. Theobald W. Kennedy.
Armament 9 6-in., "Southampton" 8 6-in., 25·5 knots.

Harwich Flotillas.
"Arethusa," Comm. Reginald Tyrwhitt.
10th Flotilla: "Meteor" (Comm. Hon. Herbert Mead), "Miranda," "Milne," "Mentor," "Mastiff," "Minos," "Morris," speed 34 knots.
3rd Flotilla: "Undaunted" (Capt. Francis St. John), "Lookout," "Lysander," "Landrail," "Laurel," "Liberty," "Laertes," "Lucifer," "Lawford," "Lydia," "Louis," "Legion," "Lark," speed 29 knots.
1st Flotilla: "Aurora" (Capt. Wilmot S. Nicholson), "Acheron," "Attack," "Hydra," "Ariel," "Forester," "Defender," "Druid," "Hornet," "Tigress," "Sandfly," "Jackal," "Goshawk," "Phoenix," "Lapwing," speed 27 knots.

GERMAN

1st Scouting Group.
"Seydlitz," Rear-Adml. Hipper, 10 11-in., 12 5·9 in., 26·5 knots.
"Derfflinger," 8 12-in., 12 5·9-in., 26·5 knots.
"Moltke," 10 11-in., 12 5·9-in., 25 knots.
"Blücher," 12 8·2-in., 8 5·9-in., 24 knots.

2nd Scouting Group.
"Graudenz," "Stralsund," "Kolberg," "Rostock."

Casualties.—"Blücher," which sank, received about 40 hits and 2 torpedoes, had 792 of her crew killed, 45 wounded and 189 taken prisoner. "Seydlitz" sustained 3 hits, had 159 killed and 33 wounded. "Derfflinger" was only hit once, and "Kolberg" twice, the latter having 3 killed and 2 wounded.

On the British side "Lion" was put out of action with 12 hits; 1 killed and 20 wounded. "Tiger" received 7 hits, having 10 killed and 11 wounded; "Aurora" received 2 hits and "Meteor" sustained 1 hit, with 4 killed and 1 wounded. The British fired 1,154 rounds of heavy gun ammunition, of which 708 were armour-piercing shell, 77 common, 365 high explosive and 4 shrapnel. The Germans fired 976 rounds from their heavy guns.

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DOHERTY, CHARLES JOSEPH (1855–), Canadian politician, was born at Montreal May 11 1855 and educated at McGill University. Called to the Quebec bar in 1877, he became a Q.C. in 1887 and a puisne judge of the Superior Court of Quebec in 1891. He was first elected to the House of Commons as a Conservative member for the St. Anne's Division of Montreal in 1908 and became Minister of Justice in Sir Robert Borden's Govt. in 1911. He joined the Unionist Govt. in Dec. 1917 and, as acting Prime Minister and Minister of Justice, he had the difficult task of administering the Military Service Act. In 1918 he accompanied the Prime Minister to the Peace Conference at Paris, and in 1920 was one of the Canadian representatives at the League of Nations. He was appointed to the Privy Council, London, in the same year.

DOHNÁNYI, ERNST VON (1877–), Hungarian composer, pianist and conductor, was born at Bratislava (Pressburg) on July 27 1877. He studied at the Budapest Musical Academy, and was for some time a pupil of Eugen d'Albert. He attracted notice by his first piano quintette as early as 1895. He was appointed professor of piano at the state academies for music of Berlin and Budapest and was for a time director of the latter. He became conductor of the Philharmonic orchestra of Budapest, and conducted with notable success in the United States. The style of his compositions is conservative and carries on the romantic traditions of the 19th century. Among his principal works may be mentioned *The Veil of Pierrette* (pantomime); *Aunt Simona* (comic opera, 1912); *The Castle of Woijwoden* and *The Tenor* (operas); also orchestra and chamber music and songs.

DOLLAR STABILISATION.—Under the existing currency system, the so-called "level of prices" is largely at the mercy of monetary and credit conditions. The purchasing power of money has always been unstable, because a unit of money, as at present determined, is not a unit of purchasing power but only a unit containing a certain weight of gold or silver. Other units—the yard, pound, bushel, etc.—were once as unstable as monetary units, but, one after another, they have all been stabilised or standardised. Short weights and measures cheat the buyer; long weights, the seller. So a unit of money which changes in value or purchasing power is always playing havoc between contracting parties. The following table shows how the level of prices and the purchasing power of the dollar have fluctuated in the past half century, according to Prof. Irving Fisher's index number of wholesale prices.

	Index Number of Prices in % of pre-War, *i.e.*, 1913 = 100 %	Purchasing Power of the Dollar in pre-War cents, *i.e.*, 1913 = 100 %
1860	96	105
1865 (high)	205	49
1896 (low)	66	152
1913	100	100
1920, May (high)	247	40·5
1922, Jan. (low)	138	72·5
1923, April (high)	167·0	59·9
Dec. (low)	150·6	66·4
1924, June (low)	143·1	69·9
Dec. (high)	155·9	64·1
1925, Feb. (high)	162·6	61·5
April (low)	156·4	63·9
1926, First quarter avg.	156·3	64·0
April avg.	150·9	66·3
May, 1st week	151·2	66·2
2nd week	152·3	65·7

An Unsatisfactory System.—When prices are rising, *i.e.*, when the purchasing power of the dollar is falling, creditors and recipients of fixed incomes suffer injustice. The sufferers include savings-bank depositors, bondholders and salaried classes. On the

other hand, when prices fall, it is other classes, such as debtors, stockholders, farmers and independent business men generally, which suffer. The indirect effects of falling or rising prices, *i.e.*, of a rising or falling dollar, are equally bad. These indirect effects include industrial discontent, due either to the high cost of living or to unemployment and economic crises.

Hitherto there was ample excuse for the unstable monetary units of various countries, in that no instrument for measuring their aberrations had been devised. Likewise, until weighing scales were invented weights could not be standardised, and until instruments for measuring electrical magnitudes were invented, electrical units could not be standardised. But for some 10 years the index number of prices has provided a fairly accurate instrument for measuring the value of the dollar in terms of its power to purchase goods. An index number of prices is a figure which shows, for a specific period of time or on a specific date, the average percentage increase or decrease of prices. One of the most suggestive signs of the times is that this instrument for measuring changes in the purchasing power of money has been utilised in adjusting wages and salaries to the cost of living, and a number of industrial and financial concerns, and some private and official agencies, have amended wages on the basis of an index number of the prices of commodities. The principle was also employed in adjusting the terms of the Dawes Settlement for Germany, and in connection with at least one bond issue, that of the Rand Kardex Co., and one lease contract.

It has been contended by some economists that this principle may be utilised more generally in the future to safeguard the parties to agreements made at one date to pay money at another date. Such corrections would gradually break down the popular superstition that " a dollar is a dollar," for every time the dollar is corrected it is convicted of needing corrections; ultimately the correction might be applied, not, as at present, as a patch on the dollar from the outside, but by incorporating it in the dollar itself. Various methods for this have been proposed.

A Suggested Remedy.—The one perhaps best known is Prof. Irving Fisher's proposal to vary the weight of the gold dollar so as to keep its purchasing power invariable. Instead of a gold dollar of constant weight and fineness and varying purchasing power, what is needed, he contends, is a dollar of constant purchasing power, and, therefore, of varying weight. It is not proposed, of course, to remint gold coins, but simply to count an ounce of fine gold as being the equivalent, not always of $20·67 (as at present), but of as much more or less than that sum as is required from time to time to keep the purchasing power of the dollar constant. In other words, the proposal is to vary the price of gold according to its worth relative to other commodities, instead of, as at present, keeping it artificially constant at $20·67 an oz. pure, or £3 17s. 10½d. an oz. $^{11}/_{12}$ fine.

Thus, if Mexico should adopt the monetary unit of the United States, instead of its present unit containing half the weight of gold in the United States dollar, the price level in Mexico, other things being equal, would be halved. Again, if the United States should adopt the Mexican dollar as its monetary unit, the price level in the United States would be doubled—that is, the buying power of the dollar varies with the amount of gold in it. If this principle be admitted, Prof. Fisher contends that it follows that the dollar's buying power—that is, the level of prices—can be controlled. It can be kept from changing greatly just as easily as it could be made to change by periodical adjustments of the price of gold, each adjustment being made in accordance with the index numbers of prices. By this method, in conjunction with a sound banking system, Prof. Fisher contends that variations of more than one or two per cent could easily be prevented, except under the most extraordinary conditions.

It is also highly desirable that co-operation in the shape of credit control should exist in banking systems. This of itself can be an effective method of stabilising the dollar without any gold adjustments so long as there is a superabundant reserve of gold kept out of use. This method of control is already being practised by the Federal Reserve System and by the Bank of England, in accordance with the recommendations of the Genoa Economic Conference of 1922. This should prepare the way for a more complete stabilisation later. When a superabundance of gold no longer exists, deflation may become imminent unless the number of gold dollars can be increased by a reduction in the gold weight of the individual dollar. (*See* CURRENCY; INDEX NUMBERS.) (I. F.)

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DOMESTIC APPLIANCES: *see* HOUSEHOLD APPLIANCES.

DOMINICAN REPUBLIC: *see* SANTO DOMINGO.

DONALDSON, SIR JAMES (1831–1915), British scholar (*see* 8.406), died at St. Andrews, Scotland, March 9 1915.

DOUGHERTY, DENNIS J. (1865–), American Roman Catholic divine, was born at Girardville, Pa., Aug. 16 1865. He studied at St. Mary's College, Montreal, and the American College, Rome, and was ordained priest in 1890. After being connected with St. Charles' Seminary, Overbrook, Pa., for 12 years, he became Bishop of Nueva Segovia in the Philippine Is. in 1903, and later Bishop of Jaro. He was appointed Bishop of Buffalo, N.Y., in 1915 and in 1918 was made Archbishop of Philadelphia and metropolitan of Pennsylvania. He was created cardinal priest by Pope Benedict XV. in 1921, taking over the titular church of St. Nereus and Achilleus at Rome.

DOUGHERTY, PAUL (1877–), American painter, was born at Brooklyn, N. Y., Sept. 6 1877. He was educated at the Brooklyn Polytechnic Institute and the New York Law School, where he took the degree of LL.B. in 1898. He then spent five years in Europe, devoting himself to the study of art, and his first picture was exhibited at the Paris Salon in 1901. He was chiefly concerned with marine subjects, in which he achieved great success, being awarded the Osborne Prize (1905), the Innes Gold Medal and the Carnegie Prize, National Academy of Design (1913), the gold medal at the San Francisco Exposition (1915), and the Altman Prize (1918). Among his more important pictures are " October Seas," " The Road to Cayey," and " Lake Louise," in the Metropolitan Museum, New York City; " The Land and the Sea," in the Corcoran Gallery, Washington; " Flood Tide," in the Carnegie Institute, Pittsburgh; " Moonlight Cove," in the Toledo Museum; " Sun and Storm," in the National Gallery, Washington; and " A Freshening Gale," in the Albright Art Gallery, Buffalo.

DOUGHTY, CHARLES MONTAGU (1843–1926), British traveller and writer (*see* 2.257) younger son of Rev. C. M. Doughty of Theberton Hall, Suffolk, was born on Aug. 19 1843. Prevented by an impediment in speech from entering the navy, his education was continued at King's College, London, and at Caius and Downing Colleges, Cambridge, where he graduated in natural science in 1865. He turned then to independent travel and study, freely adventuring in his chosen fields of geology, archaeology and philology. And he did so in no half-hearted way: in Norway, Oxford, Leyden, Louvain, Italy, Spain, North Africa and Greece he served a long novitiate in wandering and scholarship which led him at last to Syria, Palestine and his adventures in Arabia.

In Nov. 1876 Doughty set out from Damascus with a pilgrim caravan. At Madâin Sâlih he left the Haj, and surveyed the Al Hajar monuments and inscriptions. He then decided to reach independently the oasis of Khaibar, and to this end attached himself to wandering Bedouins. Dependent on their movements, his dangers were now multiplied and his life was repeatedly endangered by the inevitable suspicion, fanaticism and treachery which on occasion broke through the respect and hospitality which Doughty's courageous personality compelled. He reached Khaibar from Taima in the summer of 1877, was sent back to Hail, thence to Al Qasim, Buraida and 'Anaiza. From there, after some months, he travelled southwards towards Mecca and reached safety at Jidda in Aug. 1878. The story of this

great journey, which threw many fresh lights on the geology, hydrography and ethnology of Arabia, Doughty told in *Travels in Arabia Deserta*, published in 1888. The book was the fruit of a literary labour hardly less arduous than the journey whereof it treated. Doughty was less concerned to produce a chronicle or work of information than to create, out of his unique experience, an unique monument of what he considered pure English prose. To him, this meant the achievement of an Elizabethan directness of utterance and the renunciation of all post-Elizabethan growths in syntax and vocabulary. He succeeded. His profound literary sense had told him aright when it inspired him to treat his remote and lonely adventuring in this bare, majestic style.

The later years of Doughty's life, mostly spent in England, were given over to poetry. Essentially, indeed, he was always a poet, in his deep comprehension of the values of words no less than in his power of penetrating into the living past, whether of a country's physical structure or of its people and their life. Fourteen years' labour produced his epic, *The Dawn in Britain* (1907), his other long poems and poetic dramas including *The Cliffs* (1909), *The Clouds* (1912), *The Titans* (1916) and *Man-soul* (1920). Like *Arabia Deserta*, the poems he wrote reflect his Elizabethan predilections. He died at Sissinghurst, Kent, Jan. 20 1926.

(H. Mi.)

DOUMER, PAUL (1857–), French politician, (*see* 8.450), returned to active politics in 1912 as Senator for Corsica. In 1917 he was a Secretary of State in the Painlevé Cabinet. In the Briand Cabinets of Jan. 1921—Jan. 1922 and Dec. 1925—March 1926, he was Minister of Finance.

DOUMERGUE, GASTON (1863–), French politician, was born at Aigues-Vives on Aug. 1 1863, and was educated at the lycée at Nîmes. He studied law, became a barrister, and, after holding magisterial appointments in Cochin China and Algiers, was elected deputy for Nîmes in 1893. In the Chamber he spoke with authority on colonial questions and from 1902 to 1905 was Minister for the Colonies in the Combes Government. When this administration fell, he was elected vice-president of the Chamber. In 1906 he was Minister of Commerce in the Sarrien Cabinet, retaining his portfolio in the succeeding Clemenceau Government. When M. Clemenceau reconstituted his Cabinet, M. Doumergue became Minister of Education and held the same post in the following Briand Ministry which lasted from July 1909 to Nov. 1910. In the latter year he became Senator for the Gard Department and attracted notice by his strong advocacy of the Three Years' Military Service Bill.

On the fall of M. Barthou's administration in Dec. 1913, M. Doumergue formed a Cabinet in which he himself took charge of Foreign Affairs. He was forced to resign, however, after the general elections of May 1914, which resulted in a majority in the Chamber opposed to the Three Years' Military Service law. On the outbreak of the World War he again became Minister for the Colonies in the Viviani Govt. of national defence. In 1917 he left the Government, and was sent on a mission of inquiry into conditions in Russia. On his return he re-entered the Senate. After the resignation of M. Léon Bourgeois on Feb. 22 1923, M. Doumergue was elected to succeed him as President of the Senate, and after his inauguration he made it clear that he supported the policy of M. Poincaré with regard to Germany and the Ruhr. On June 13 1924 he was elected President of the Republic by the French National Congress on the first ballot, securing 515 votes to M. Painlevé's 309.

DOVER, England (*see* 8.453), had a population in 1921 of 39,985, estimated in 1923 at 40,740. The municipal boundaries were extended in 1921, bringing the area of the borough up to 20,620 acres. Two new churches have been built, Charlton Church and St. Barnabas, and the remains of the tiny church of the Knights Templars on the western heights restored. Remains of a 12th-century church were found during alterations to the Shakespeare Hotel in 1924. In that year part of the ancient Archcliffe Fort was sold to the Southern Railway by the War Office. The Connaught Barracks near the Castle were finished in 1915. The War Memorial adjoins the old Maison Dieu, part of the municipal buildings, and an obelisk in memory of the Dover Patrol has been erected on the cliffs above St. Margaret's Bay. A bell taken from Antwerp by the Germans and used as an air-raid warning at Zeebrugge was presented to Dover by the King of the Belgians after the War and hung in a turret outside the Town Hall. Parliamentary sanction has been obtained for building a road up the East Cliff and along the cliffs to St. Margaret's Bay, with a light railway.

The Dover Harbour scheme, including the reclamation of about 11 ac. to the east of the Admiralty pier to provide a new marine station and a number of additional berths, was carried out in time to be of service during the World War. Silting has taken place in the harbour, primarily due to the sinking of a vessel during the War. This has prevented the calling of large liners sailing between Hamburg and America; but work in contemplation will enable these services to be resumed. In 1919 the naval base at Dover was given up, and in 1923 the Admiralty Harbour was transferred to the Harbour Board for commercial use. In 1925 plans were being considered for another large dock at the east end, and a landing stage the whole length of the Admiralty pier. The Channel-Tunnel scheme was vetoed by the Committee of Imperial Defence in 1924.

During the earlier part of the War numbers of barges were towed across the Channel from Dover, and taken by the French canals to depôts near the firing line. Some 180 bombs were dropped on Dover during the War, and in 1918 it was bombarded by a German submarine; 14 people were killed and about £30,000 of damage was done.

(O. J. R. H.)

DOWDEN, EDWARD (1843–1913), British writer (*see* 8.456), died in Dublin April 4 1913. His *Letters*, edited by E. D. and H. M. Dowden, appeared in 1914.

DRAMA (*see* 8.475).—The period 1910–25 was one of paramount importance in the history of the drama and of the theatre, both in Europe and in America. In those 15 years the theatre passed through several grave vicissitudes. It rose and fell and rose again. The revolution made by Ibsen had become almost a convention, and a most diversified drama was everywhere being performed, except in France, where the theatre in every respect remained unaffected by the march of events.

A General Survey

Dramatists were tiring of old themes and were assiduously searching for new ones. They were not any longer content to repeat worn stories in worn words, but were striving to extend the range of their interest and thought. Old machinery was either being repaired or broken. The method of producing a play, whereby the actor was largely left to his own devices, was being replaced by a new method, whereby the actor was directed in every detail of his performance by a "producer," who professed to interpret the play in accordance with the intentions of the author. Attempts were made, with success, to obtain balanced performances by moderating the transports of the "star" system, under which balance and nearly everything else were sacrificed to the vanity of the principal performer. New sorts of scenery were invented, some of which were effective and beautiful, many of which were neither one nor the other, and "production" became, for a time, more important than the play itself or the performance.

Reformers were often excessively zealous, and in their impatience with obsolete machines were rash enough to destroy them before they had properly installed new ones or mastered their technicalities or, more important, perhaps, made the public accustomed to them. Audiences which had been nourished on *East Lynne* and *The Lights of London* and "actor-managered" Shakespeare suddenly found their diet changed to *The Tragedy of Nan* and *The Doctor's Dilemma* and Shakespeare done in his entirety before curtains of a dismal hue. Lovers of musical comedy and melodrama were invited to transfer their affections to Sophocles and Ibsen and Strindberg and John Galsworthy and Bernard Shaw. In the consequent confusion of mind, tempers and money were lost; the reformers became more scornfully didactic and educative and professorial; and the modest multitudes, obstinately resolved not to be improved by anybody,

departed to the music-halls and the cinemas. Nevertheless, improvement was made. In England, the long and valuable dominion over the theatre held by Sir Arthur Pinero and Henry Arthur Jones yielded to the different dominion of George Bernard Shaw and John Galsworthy. Conservative managers received original work with less hesitation and hostility than had formerly been their habit. There even were managers who encouraged the revolutionaries.

The Influence of Moscow.—In Russia, the theatre had been reformed in a singular and successful manner. The activities of a band of amateur actors and actresses, performing at first in a barn on a country estate and afterwards in any available hall, culminated in the establishment of the Moscow Art Theatre by Constantin Stanislavsky and Vladimir Nemirovich-Danchenko, of which a most valuable account is given in Stanislavsky's book, *My Life in Art.* This theatre resembled many others that were widely influential—for example the Abbey Theatre in Dublin and the Theatre Guild of New York—in this respect, that it was founded by lovers of the theatre who were technically entitled to be called amateurs. There was not a professional man of the theatre among them. None of them had any "practical" experience of management or production, or acting. Their chief assets were enthusiasm and malleable minds. They had hardly any money and were often in danger of dissolution through debt. "Practical" men of the theatre openly derided them, but in the end it was the "practical" men who either were ruined or had to surrender to the inexperienced amateurs. The "practical" men were found to be living on the experience of others, whereas the amateurs were busy making experience for themselves.

The Moscow Art Theatre has profoundly influenced the theatre throughout the world. It changed the theatre in Russia. The old, rhetorical style of acting quickly gave place to the new and veracious style, called naturalistic acting. There was even a tendency to be over-natural: actors forgot that acting is not an exhibition of ordinary behaviour, but an intensified representation of ordinary behaviour—life, as it were, shown under a magnifying-glass. The old sin was excess: the new sin was insufficiency. Formerly the actor ranted and roared; now he mumbled and whispered. Over-emphasis was replaced by under-statement, and mechanically neat performances gave way to slovenly ones. These were faults which endangered the new theatre, but they were detected in time to be corrected. Producers still try to treat the actor as a puppet to be directed in every detail of his performance, but that, too, is a fault which is less common than it was in the first days of the revolution.

The Moscow Art Theatre had an indirect influence on the English theatre. It was in its turn brought under English influence. Acting in England became steadily more natural and easy until it was made into a nearly perfect instrument for the performance of polished comedy. Testimony everywhere was unanimous that English actors had an assurance in comedy far beyond that of any other actors. This ease, however, made them less capable of acting in tragic or poetic plays, and a result of it was that a demand for light and pleasant pieces dealing with the customs and manners of the upper classes was made by managers, and the note of the English theatre became in time predominantly that of agreeable and accomplished comedy. That was not the effect of naturalistic acting in Russia where the comedy, when there was any at all, became introspective and perturbed.

The Influence of Chekhov.—Out of the storm made by the Moscow Art Theatre came the figure of Anton Chekhov (*q.v.*) to be the master that others should follow; but his laughter was so acrid and his satire so terribly and uncompromisingly true that he is still considered to be pessimistic and gloomy. If naturalistic acting in England resolved itself more and more into a drawing-room entertainment in which expensively dressed people lived and ate and idled in an expensive manner, it resolved itself in Russia into a painful foreboding about the future until every realist seemed to be a prophet of woe and disaster. This bitter satire was, oddly enough, observable in Ireland where the dramatists became more and more acutely critical of their countrymen as their countrymen became more secure and prosperous until at last, after the establishment of the Irish Free State, a dramatist, Mr. Sean O'Casey, arose from the ranks of Dublin working-men and poured out the common feeling in profuse strains of premeditated bitterness and disillusionment. One could make a comparison between the Irish and the Russian people which would show them to be remarkably alike in many respects, and Mr. O'Casey's plays, *The Shadow of a Gunman* and *Juno and the Paycock*, would support the comparison. The manner of Mr. O'Casey, making allowance for differences of habit and local circumstances, resembles the manner of Chekhov. Each is a humorist who surveys the human scene with such fidelity to fact that he seems to be in irredeemable despair. There is laughter in their work, but it is laughter that is full of pain.

Reinhardt and Gordon Craig.—In America, the theatre was a cauldron wherein was boiled the drama of Europe in the hope that something American might emerge. In Germany, the drama was mainly a matter of grouping and lighting and experimental acting. People talked less of Gerhardt Hauptmann and Hermann Sudermann than they did of Max Reinhardt. Reinhardt, of whom there is an excellent account in *Reinhardt und seine Bühne*, by Ernst Stern and Heinz Herald (Berlin), derives, as indeed do nearly all the revolutionary producers and scenic artists, from Edward Gordon Craig, the son of Ellen Terry. Craig has been less fortunate in finding opportunities to work in the theatre than his followers, but he has profoundly affected the work of the theatre everywhere. Reinhardt is his greatest and best-known disciple. One of the most impressive productions made by the Moscow Art Theatre was Craig's production of *Hamlet* in 1911. It was full of the faults that seem to be associated with all Mr. Craig's work, due mainly to a wilful disregard of the limitations of material things, but it undoubtedly impressed all who saw it by its beauty. In England, Craig's influence is widely felt and acknowledged. Decorative artists, such as Norman Wilkinson, Claude Lovat Fraser (d. June 18 1921), Hugo Rumbold, Charles Ricketts, Albert Rutherston, George Sheringham, derive from him, as do producers such as Harley Granville-Barker, Nigel Playfair, James Bernard Fagan and Basil Dean. His authority is freely acknowledged in America, among others by Lee Simonson, Robert Edmond Jones and Rollo Peters, although in that country a later school of producers, infected by the opinions of the German Expressionists who rose to authority after the end of the World War has arisen. These may be called neo-Craigians. The work of these artists and producers will be considered later. It is now mentioned only because of the importance attached to it during the period under review in Germany.

Great Britain and Ireland

In Great Britain, the period under survey was perhaps one of greater change than in any other country. Apart from the temporary, but substantial effect of the World War, other causes of wide influence profoundly affected both the drama as a part of literature and the theatre as a commercial organisation during that period. In the United Kingdom great changes in the constitution of theatrical enterprises were brought about abruptly and almost catastrophically. The government of the theatre by actor-managers ceased with dramatic suddenness and was replaced by the government of syndicates concerned primarily, if not exclusively, with the production of large profits quickly returned. In those theatres where the actor-manager was not replaced by a commercially minded syndicate, his place was taken by what may be called the producer-manager.

The three great actor-managers of the English theatre, Sir Herbert Beerbohm Tree, Sir George Alexander and Sir Charles Wyndham, did not outlive their reign; the era of the actor-manager ended simultaneously with their decease. Tree died July 2 1917; Alexander March 16 1918 and Wyndham Jan. 12 1919. In 18 months the actor-managerial system, which had been immensely powerful, was in ruins, and its chief protagonists, men of ability and taste, were dead, spared from the humiliation of neglect and supersession. It was a system undeniably disadvantageous to the drama as an art, since it tended to make the play subordinate to the player and restricted many dramatists

to the production of plays with good parts for particular persons, but there is no doubt that the actor-managers, especially the three named, were possessed of ambition and much taste and that they worked successfully to restore dignity to the theatre. They were directly associated with many of the most interesting plays that were written during their reign, and Tree, Alexander and Wyndham could claim exemption from the charge so frequently and justly brought against Irving, of doing nothing whatever to encourage the work of meritable modern English dramatists. Sir Herbert Tree's annual Shakespearean festival held often at grave financial disadvantage to himself, was a real tribute to taste and culture, despite the serious complaints fairly made about his methods of production. Sir George Alexander, more than anyone else, made the way to the stage easy for the writer of distinguished comedy and was chiefly responsible for the career as a dramatist of Oscar Wilde. Sir Charles Wyndham, less consistently ambitious than his colleagues, followed an honourable tradition and was responsible for the redemption of farce from buffoonery.

The decline and fall of the actor-managerial system coincided with the disappearance from the centre of London of the older type of music-hall and with the great growth in popularity of the cinema, or picture-palace, or " movies." Almost all of the London suburban theatres and many of the provincial theatres, especially in small towns, became picture-palaces. A variety of reasons caused this change to take place, some of which were financial and others connected with altered taste. The cinemas were at once cheaper and more comfortable than the theatres and they offered a more consistently attractive programme. The inhabitants of a London suburb or a small provincial town were able to see as good a film at the local cinema as could be seen in a cinema in the centre of London, but they could not hope to see a play performed at the local theatre by a company as capable as that acting in the same play in the West End.

Adverse Effect of the War.—The situation, then, at the outbreak of the World War was one of extraordinary interest in the English theatre. The theatrical season 1913–4 had closed with considerable brilliance. Plays of merit had been extensively performed in London and in the provinces, and the repertory theatres were in a fairly healthy condition. A rich level of acting had been discovered. Production was on a genuinely artistic scale. The season of 1914–5 seemed likely to open still more brilliantly than the season just concluded. There was even talk of a national theatre at which the plays of Shakespeare would be permanently performed. On Aug. 4 1914 Great Britain declared war against Germany and immediately the great revival of the English theatre languished and seemed at first in danger of total collapse. Many of the repertory theatres soon ceased to exist.

In 1921 the Gaiety Theatre, Manchester, passed from the hands of Miss Horniman to a cinema syndicate. A gallant effort to maintain a decent standard of plays was made by some managers; Sir Herbert Tree revived L. N. Parker's pageant piece, *Drake*, and Mr. (now Sir) Frank R. Benson revived *Henry the Fifth* in the laudable desire to satisfy patriotic cravings with something of value. Granville-Barker produced a number of scenes from Thomas Hardy's *The Dynasts* at the Kingsway. But these attempts to keep the theatre on a high level were not successful, and very soon began the process of degeneration which was maintained for the whole period of the War. Some of the managers gave up their efforts to save the tradition they had established: Sir Herbert Tree and Cyril Maude went to America. Others such as Gerald du Maurier remained in London and, with great courage, made a fight for decent drama. Among the plays produced by Gerald du Maurier during the War was a strange piece, very popular, entitled *Dear Brutus* by Sir James Barrie, and a revival of the same author's *A Kiss for Cinderella*. Du Maurier, more than anyone else during the War, kept faith with fine things finely done.

For the first two years of the War, the form of entertainment inaptly described as " revue " was very popular. Farces of a bold and even indecent character were next to the revues in popular esteem. Oddly enough, certain plays commonly called " highbrow " became popular during the War for reasons which were not concerned with literature. Brieux' banned play, *Les Avariés*, known in England as *Damaged Goods*, was licensed by the censor for public performance on the representations mainly of medical men and sociologists, and it was widely patronised in London and the provinces. The artistic value of *Damaged Goods* is slight, but its sociological value is indisputably great, and it brought a degree of publicity to the discussion of evils which would have been impossible in England prior to 1914. The success of this play led to the public performance of Brieux' play. *The Three Daughters of M. Dupont*, and of Ibsen's *Ghosts*, from which also the ban was removed by the censor. The latter play, however, is not, like *Damaged Goods*, a propaganda play and it received little support in spite of its being labelled " A Play for Adults only." The rule of the censor was considerably relaxed during the War and his ban was removed from Shaw's one-act play, *The Shewing-up of Blanco Posnet*, but attempts to obtain a licence for *Mrs. Warren's Profession* were unsuccessful. Since the conclusion of the War the censor's rule has been tightened again, but, as a result of the changes made on the recommendations of the Joint Select Committee on Stage Plays (censorship) 1909, the rule bears rather less arbitrarily on meritable work than it formerly did.

The end of the War found the stage in a chaotic condition. The demand for entertainment during the hostilities had been so great that theatre rents rose rapidly to absurd figures: a common rent at any time between 1915 and 1921 for a theatre in the centre of London was £400 to £500 per week. All other expenses, owing to the high cost of living, increased proportionately, but the price of admission, apart from the entertainment tax imposed during the War (which did not benefit, but rather harmed, the theatre manager) remained at the pre-War figure. Slight increases, after the Armistice, were made in one or two cases, but in 1921 the economic situation in the theatre was that the revenue remained at the pre-War figure while the expenditure was on the post-War scale. Such a situation as that is only endurable when the theatre is filled with an audience, each member of which has paid for his seat. The financial burden was too heavy to be borne; and for this reason many meritable pieces which might have been " nursed " into popularity were withdrawn almost immediately after production because they had not at once taken hold of popular fancy. The plays which suffer from this economic situation are undoubtedly the better kind of plays. Those which profit from it are the plays without merit other than that of a spectacular character. The best illustration of the effect of this situation on the drama is to be found in the remarkable popularity of *Chu Chin Chow*, an eastern spectacle written by Oscar Asche. This piece, a variant of the theme of *Ali Baba and the Forty Thieves*, was produced at His Majesty's Theatre, London—a theatre with a serious tradition—on Aug. 31 1916. It ran for nearly five years, creating a record of over 2,200 consecutive representations. Every device of colour and light and costume was used in this production. The appeal made was almost exclusively to the eye, very little to the ear and not at all to the mind. *Chu Chin Chow* broke all record for consecutive performances at one theatre and earned large fortunes for those who were concerned in its production.

In spite, however, of the difficult economic situation, of the change in tradition and government of the theatre, there was a remarkable recovery of quality on the English stage after the signing of the Armistice, and plays of quality began to appear, not timidly, but almost arrogantly. A play by Galsworthy, *The Skin Game*, dealing with the conflict between aristocracy and plutocracy (in which both sides are badly besmirched) and susceptible of allegorical application to the War and the treaty of peace, was performed with great success at the St. Martin's; and a political comedy, entitled *The Grain of Mustard Seed*, by H. M. Harwood, produced at the Ambassadors' had a singularly successful " run," singular because of the fact that political plays are rarely acceptable to English audiences. Sir James Barrie's *Mary Rose* was performed at the Haymarket with enormous success. In this play he treated the problem of life after death in

a fashion which divided playgoers sharply into complete devotees or complete sceptics. *The Skin Game* was successfully produced in America, but *Mary Rose* hardly won the favour in New York that it had won in London. The most interesting post-War success was the popularity with which Gay's *The Beggar's Opera* was revived at the Lyric Opera House, Hammersmith. It was not, however, a success in America. Rostand's *Cyrano de Bergerac* was revived with notable success by Robert Loraine, and Bernard Shaw's *Arms and the Man*, also revived by Loraine, had astonishing success with ex-soldiers on account of its anti-romantic treatment of war.

Shakespeare's plays were extensively produced. A working-class theatre in the Waterloo road, London (popularly known as the "Old Vic."), had maintained the standard of good drama throughout the War, and this theatre, handicapped by lack of funds and rather amateurish acting, steadily built up an audience for good plays. After the Armistice its work was amply rewarded. The audiences steadily increased in size until at last the theatre was well occupied at every performance and, on many occasions, was full. The King and Queen made a formal visit to the theatre which draws its audience not only from the surrounding slums, but from every part of London. The whole of Shakespeare's plays, in their entirety, have been produced at the "Old Vic." before large audiences, in addition to a variety of classical plays, ranging from Greek tragedies to Goldsmith's *She Stoops to Conquer*. The activities of the theatre are not confined to the production of plays. Opera alternates with drama, so that its patrons are able to see not only the best plays, but to hear the best music. The production of Shakespearean plays in their entirety was begun soon after the outbreak of the World War in 1914 by the manager of the theatre, Miss Lilian Baylis, in face of the utmost discouragement from every person whom she consulted.

Her courage was signally rewarded. In 1923, the London County Council which had treated the theatre with great forbearance announced that it could no longer consent to let the "Old Vic." remain open unless certain necessary structural alterations and repairs were made. An appeal for £30,000 was made to the public by an influential committee, and about six or seven thousand pounds were soon raised, chiefly in small sums. Then the appeal was repeated in the London Sunday newspaper, *The Observer*, and as a result of it, Mr. George Dance, a well-known and successful theatre-manager, made a gift of £30,000 to the theatre, which was relieved of its structural troubles. Mr. Dance was knighted. In 1926, an attempt was made to establish another "Old Vic." on the north side of London in the theatre popularly known as Sadlers' Wells. The building was acquired, and a considerable sum of money raised.

Progress since 1921—The recovery of the theatre from the depression caused by the War did not continue without interruption. A relapse took place, for which profiteering in rent was mainly responsible. The cost of production was so high that only the most popular pieces had any hope of making money for their producers, none of whom was now in a position to "nurse" a play into success. Plays which were not profitable from the beginning of their "run" were almost immediately withdrawn. This state of indecision and uncertainty and bewilderment helped to intensify the misfortunes of the theatrical situation. Actors demanded larger salaries than they were formerly accustomed to receive, not because the cost of living had increased, but because the conditions of their employment were intolerably insecure. A player might rehearse without salary for as many as six weeks, only to find that the piece in which he was acting was withdrawn at the end of two or three weeks. There were a number of instances in which withdrawal took place after two or three performances. Dramatists, too, were discouraged from writing plays when they found that pieces drawing, perhaps, £1,000 per week to the box office had to be withdrawn because they were not making any profit for their producers. They turned their abilities to other ways of writing or abandoned all efforts to experiment in new forms. This set-back, however, was temporary so far as the quality of the plays and the playgoers were concerned, and a second time the process of recovery was begun, this time with more lasting effects. The profiteering in rent continued, making production of meritable plays difficult, but even the profiteers were obliged to consider the quality of their productions more carefully than they had done between 1914 and 1920.

In 1921 there was a perceptible improvement in the quality of the plays publicly performed. Mr. John Drinkwater's *Abraham Lincoln*, Mr. C. K. Munro's *At Mrs. Beam's*, Maeterlinck's *The Betrothal* (produced at the home of musical comedy, the Gaiety), Clemence Dane's *A Bill of Divorcement*, Bernard Shaw's *Heartbreak House*, Lord Dunsany's *If*, A. A. Milne's *The Truth About Blayds*, Clemence Dane's *Will Shakespeare* were all produced in this year, and most of them were very popular.

In 1922 the improvement was not so marked, but it continued. In that year, Shelley's *The Cenci* was released from the Censor's ban and performed by Sybil Thorndike for a fortnight at the New Theatre. The following meritable plays were also performed: A. A. Milne's *The Dover Road*, Somerset Maugham's *East of Suez*, Sir Arthur Pinero's *The Enchanted Cottage*, Gilda Varesi and Dolly Byrne's *Enter Madame*, Alfred Sutro's *The Great Well* and *The Laughing Lady*, Edward Percy's *If Four Walls Told*, Roland Pertwee's *I Serve*, St. John Ervine's *Jane Clegg*, John Galsworthy's *Loyalties*, John Drinkwater's *Mary Stuart*, John Galsworthy's *Windows*, and a number of uncommonly good musical plays, of which *Lilac Time* was the most notable.

In 1923 Eugene O'Neill, some of whose plays had been performed at the Everyman and in the provinces, reached the West End with *Anna Christie*. The play had much popularity at the beginning of its run, chiefly because of the admirable acting of Pauline Lord and George Marion, but its popularity did not last long. Frederick Lonsdale, who was previously known only as the author of musical comedies, began what proved to be a successful career as a writer of social comedies with *Aren't We All*. The play called *Back to Methuselah* by George Bernard Shaw, which had been done in New York by the Theatre Guild, was produced for the first time in England by the Birmingham Repertory Company in Birmingham and subsequently at the Court, London. Flecker's poetic play, *Hassan*, was a great success in London, but an immediate failure in New York. A play called *Havoc*, by Harry Wall was produced by the Repertory Players and transferred to the Haymarket. It was notable for the fact that it was the first play to deal seriously with theWar, but it was marred by its story. *The Insect Play* and *R.U.R.* by the Brothers Capek, *The Green Goddess* by William Archer, *The Lie*, by Henry Arthur Jones, *The Likes of Her* by Charles M'Evoy, *The Lilies of the Field* by J. Hastings Turner, *Melloney Holtspur* by John Masefield, *Oliver Cromwell* by John Drinkwater, *Our Betters* by Somerset Maugham, *The Outsider* by Dorothy Brandon, *Outward Bound* by Sutton Vane, *Robert E. Lee* by John Drinkwater, *Taffy* by Caradoc Evans, and *The Young Idea* by Noel Coward were outstanding plays of this year.

The Shaw Revival.—In 1924 Miss Sybil Thorndike produced Bernard Shaw's five-act play, *Saint Joan*, at the New Theatre in London. The play, which had been successfully performed for the first time on any stage by the Theatre Guild of New York some months before this, was immediately successful and ran for a very long time. It was acclaimed as the greatest play Shaw had written and was said to be one of the masterpieces of English dramatic literature. *Saint Joan* has been translated into many languages and has been performed with great success in almost every European country. The very remarkable success of *Saint Joan* was followed by a "boom" in Shaw plays both in England and America, as well as in various foreign countries. A London theatre, The Regent, was devoted to the revival of them, one after the other, and here in 1925 *Mrs. Warren's Profession* was publicly performed for the first time in England. The play had lain under the censor's ban for more than a generation. It was found to be entirely innocuous and even old-fashioned.

The years 1924 and 1925 were undeniably Bernard Shaw's, but they were shared by Noel Coward, a young actor-dramatist who at the age of 25 had made himself an international figure by his power of portraying the shallow cleverness of neurotic Society people. Most of Coward's plays are short, slight pieces, so flimsily constructed that they seem almost to be charades. *Fallen Angels*, which caused some scandal on account of its main situation in which two women are shown drinking themselves into a state of intoxication, and *Hay Fever*, an immensely amusing play, brilliantly acted by Marie Tempest, are so slight that some critics saw in them no more than revue sketches hastily lengthened into three-acts.

Coward has remarkable facility in dialogue and a genuine sense of the theatre, but he seemed at first to lack depth and sincerity. These defects of his work, however, were no more than the immaturity of a young writer, for when *The Vortex* was performed his sternest critics were compelled to acknowledge that he could write sincerely and feelingly. This play was successful in London and New York.

Frederick Lonsdale was responsible for a very successful comedy, *Spring Cleaning* and, in 1925, for a still more successful one, entitled *The Last of Mrs. Cheney*. His plays are notable for the skill with which they are made and for the easiness of their dialogue. They sound no depths, nor are they intended to be more than they are, diverting pieces of the theatre. Other plays of quality done in 1924 were *The Comedy of Good and Evil* by Richard Hughes, *The Conquering Hero* by Allan Monkhouse (another war play), *The Fake* by Frederick Lonsdale, *The Farmer's Wife* by Eden Phillpots (which ran for more than two years), *Fata Morgana* by Ernest Vajda, *The Forest* by John Galsworthy, *Judas Iscariot* by E. Temple Thurston, *The Man with a Load of Mischief* by Ashley Dukes

(originally produced by the Stage Society and afterwards transferred to the Haymarket, where it ran for seven months), *The Mask and the Face* by Luigi Chiarelli, *No Man's Land* by François de Curel, *Old English* by John Galsworthy, *The Pelican* by H. M. Harwood and F. Tennyson Jesse, *The Show-Off* by George Kelly (an American play which unaccountably failed in London), *Storm* by C. K. Munro, *Tiger Cats* by Karen Bramson, *To Have the Honour* by A. A. Milne, *The Way Things Happen* by Clemence Dane, *White Cargo* by Leon Gordon, and *Young Imeson* by J. R. Gregson.

There was also a remarkable production of *A Midsummer Night's Dream* at Drury Lane, done by Basil Dean who, for a short while, succeeded Arthur Collins at that theatre as director. The Birmingham Repertory Theatre, whose director, Barry Jackson, was knighted in 1925, transferred some of its activities to London where, among other pieces, an interesting production of *Romeo and Juliet* was done. This organisation was also responsible for the production in London of Rutland Boughton's opera, *The Immortal Hour*. Nigel Playfair at the Lyric Opera House, Hammersmith, revived Congreve's *The Way of the World* in which Edith Evans gave a distinguished performance, and developed his policy of reviving 18th century operettas, *The Duenna* and *Lionel and Clarissa* winning much of the popularity with which *The Beggar's Opera* and *Polly* had been received.

Repertory Theatres.—In addition to these productions, there was an immense amount of activity among private play-producing societies, which had increased in number to such an extent that there was almost a performance on every Sunday in the theatrical season. The repertory theatres, which had suffered severely in the War, began to revive, and "little theatres" of which the most successful was at Bristol, under the management of Rupert Harvey, were started all over the country. The Liverpool Repertory Theatre, which had courageously carried on its work throughout the War and the depressing period which followed it, entered into comparative prosperity under the management of William Armstrong.

In 1910 there were three repertory theatres in the British Isles, one in England (the Gaiety Theatre, Manchester, owned by Miss A. E. F. Horniman), one in Scotland (the Royalty, directed by Alfred Wareing) and one in Ireland (the Abbey, directed by Lady Gregory and W. B. Yeats). The last was the oldest as it has proved to be the most durable of the three. In addition to these three repertory theatres, there was a most ambitious attempt to establish one in London, at the Duke of York's theatre, where the late Charles Frohman (who was drowned in the "Lusitania" when it was torpedoed by the Germans May 7 1915) enlisted the services of Harley Granville-Barker and Dion Boucicault. The scheme was to establish a repertory theatre more nearly corresponding to the strict definition of one than any of those operating in the provinces, which were identical with what used to be called "stock" companies. Mr. Frohman's gallant enterprise failed. It lasted for 17 weeks, from Feb. 21 to June 17 1910, and during that period eight new plays and two old ones were produced. The names of the plays and their authors are as follows: *Justice* by John Galsworthy; *Misalliance* by Bernard Shaw; *Old Friends* by J. M. Barrie; *The Sentimentalists* by George Meredith; *The Twelve-Pound Look* by J. M. Barrie; *The Madras House* by H. Granville-Barker; *Helena's Path* by Anthony Hope and Cosmo Gordon-Lennox; *Chains* by Elizabeth Baker; *Trelawney of the Wells* by A. W. Pinero and *Prunella* by H. Granville-Barker and Laurence Housman. Three of these plays were in one act (the third, fourth and fifth in the list).

The original scheme, of a strictly repertory theatre similar to the Comédie Française, was not maintained, nor does the history of the repertory theatres in Great Britain and Ireland indicate that such a scheme is ever likely to succeed in a country where the people are disinclined to make the research through newspaper advertisements which a programme of irregular performances involves. For good or ill, the system of continuous performances has obtained a hold on the British theatre which will not easily be shaken off and may never be shaken off. *Trelawney of the Wells*, the most popular of the plays produced during the season, was performed 42 times in a season of 17 weeks, which clearly signifies that the promoters of the scheme had to revise their plan, partly to satisfy the public demand and partly to recoup themselves for the losses sustained on the unpopular pieces. A similar history has attended the establishment of other repertory theatres on Comédie Française lines in England, for example, the Everyman Theatre at Hampstead, established in 1920 by Norman MacDermott and carried on by him until 1926.

The repertory theatres steadily increased in number until, at the outbreak of the World War, there were seven of them operating regularly and a number of others operating for short periods during each year. None of these theatres earned large sums of money. Some of them, indeed, were constantly embarrassed by insufficient funds. But they performed a most valuable service to young actors and young dramatists: to the first, by giving them continuous and varied employment which, although not highly remunerated, enabled them to become accomplished in their craft; to the second, by giving them the greatest of all instruction to a dramatist, the public performance of his work, and by bringing before them the work of established dramatists, British and foreign, which otherwise they would not have known except in book form. Ibsen, Strindberg, Hauptmann, Schnitzler, Maeterlinck, Rostand, Verhaeren, Sudermann, Tolstoi, Chekhov, Shaw, Galsworthy, St. John Hankin, Granville-Barker, Arnold Bennett and John Masefield among the moderns; and Euripides, Shakespeare, Ben Jonson, Congreve, Beaumont and Fletcher, Goldsmith and Sheridan among the classics—the work, in quantity, of all these writers was brought to the knowledge and even to the intimacy of provincial playgoers who, but for the repertory theatres, would have had to subsist in the theatre on the more popular of the pieces produced in London and sent on tour. A similar service is performed in America by what are called "little" or "community" theatres.

Synge and the Abbey Theatre.—Out of these repertory theatres came a number of young dramatists, many of them resident in the city in which their plays were first performed, of whom at least one man was a genius, John Millington Synge (d. 1909) and three men of distinction, Stanley Houghton (d. 1913), John Drinkwater (b. 1882) and Lennox Robinson (b. Oct. 4 1886). Synge has been the subject of several biographies of which the principal and most authoritative one is *John Millington Synge and the Irish Theatre* by Maurice Bourgeois. He wrote six plays, a book of poems and translations and some impressionist articles of a newspaper character. Two of the plays are in one act, *In the Shadow of the Glen* and *Riders to the Sea*. The latter is commonly regarded as the best of his work. One of the plays, *Deirdre of the Sorrows*, is unfinished. Of the remaining three, *The Tinker's Wedding* (in 2 acts), *The Well of the Saints* (in 3 acts) and *The Playboy of the Western World* (in 3 acts), the last-named is the most widely known, partly because of its merits, but chiefly because of the anger which it aroused among the more sentimental of the Irish people who, accustomed to the romantic delusions in which subject or oppressed peoples live, could not endure the romantic realism of this play. A long succession of poets had insisted on one aspect of the Celtic character, its idealism and generosity and romance, with the result that people disbelieved in the other aspect of it, the cruelty and greed and treacherous materialism. Synge, a man without prepossessions or creed, set down what he saw in words of acrid beauty, and the Irish people, horribly shocked, pronounced him to be a liar, a degenerate and even a traitor. The violence of their anger against *The Playboy of the Western World* died down in time, especially as the play was performed as a farcical comedy, but Synge is a man of genius of whom his countrymen, when they take pride in him at all, remain reluctantly proud. He and Lennox Robinson are the principal products of the Abbey Theatre, Dublin, which includes among its minor dramatists Lady Gregory, the late William Boyle, T. C. Murray, Padraic Colum, the late Seumas O'Kelly and St. John Ervine. W. B. Yeats has written plays for the Abbey, but dramatic form is intractable in his hands.

The World War affected the Abbey, but not to as great an extent as it was affected by the internecine war in Ireland itself. Out of that welter of misery came a new dramatist, a working plasterer, Sean O'Casey, who wrote two plays, *The Shadow of a Gunman* and *Juno and the Paycock*, which despite their topical quality, have something of the universal in them. The second of the two plays was produced in London at the Royalty Theatre in 1925, and had a long run. A third play by O'Casey, called *The Plough and the Stars* was done at the Abbey in 1926, and resulted in a riot in the theatre caused by Irish Republicans who asserted that O'Casey had insulted their dead. The establishment of the Irish Free State considerably altered the status of the Abbey which began to be regarded, unofficially, as a national theatre; and in 1925 the Irish Govt. made an unconditional grant of £850 to the Abbey and of £600 to the Gaelic Players (An Comhar Drámuíochta). These grants are not annual, but will be considered each year. The grant to the Gaelic Players is officially described as a "Grant in Aid . . . towards the publication and production of plays in Irish." These grants are notable because they are the first governmental subsidies given to theatres in modern English-speaking communities

The Intellectual Drama.—The record of the English repertory theatres up to the time the World War began was honourable and promising. We have now to consider the record of the ordinary commercial theatre, and here we discover that the standard of plays produced had been greatly raised. The authority of Sir Arthur Pinero and Henry Arthur Jones, already diminished by the work of Oscar Wilde, was now yielding to that of Shaw and Sir James Matthew Barrie and John Galsworthy. A number of young dramatists of varying quality were appearing, whose allegiance was more definitely given to the school led by Shaw than to the school led by Sir Arthur Pinero, and these included Granville-Barker, the late St. John Hankin (d. 1909), Charles McEvoy, Arnold Bennett, John Masefield, Cicely Hamilton, Githa Sowerby and Elizabeth Baker. What was called the "intellectual" drama seemed to be established not on a broad basis, but on a basis sufficiently wide to make it steady. Shaw and Bennett were even able to obtain long "runs" for their plays, and Cicely Hamilton made a popular success with *Diana of Dobson's*. It is true that the "intellectual" drama did not make fortunes for its producers, but it is true also that it did not cause any bankruptcies, and probably, if an accurate statement of accounts could be prepared, the "intellectual" drama would be found to have caused less loss of money, relatively and absolutely, than the commercial drama. It might even be found to have paid

its way. Following on the heels of the "intellectual" dramatists cited above came still younger dramatists, also of the school led by Shaw, whose intellectuality was perhaps less arid or severe, and these young dramatists contrived to write plays definitely of the "intellectual" school which made much profit for those who produced them. They have already been named in connection with the repertory theatres. Their lack of aridity is due, possibly, to the fact that the stage is their first concern, whereas most of the generation between them and Shaw came to the theatre from the novel and the sociological survey.

Outside the "intellectual" or "highbrow" school, in what is called the commercial theatre, there was observable a great increase in the quality of the plays produced. The younger dramatists who were without any intellectual pretensions were indirectly affected by the work of Shaw, even when it was repudiated by them. Plays by Hubert Henry Davies, Rudolf Besier, Alfred Sutro, Bernard Fagan, Somerset Maugham and J. E. Harold Terry were notably better in quality than plays written by their predecessors at any time during the century immediately preceding their appearance in the theatre. The work of Besier in *Don* and *Lady Patricia* had a flavour of letters and a technical excellence which made it appear almost equal to the best work of Sir Arthur Pinero and Henry Arthur Jones and superior to the best work of Sydney Grundy. Somerset Maugham, who began his career with a sombre play, *The Man of Honour*, changed his *métier* completely and very soon reached a high and profitable position as a writer of light comedy. He is the most skilful writer of the comedy of manners now working for the English theatre and his plays, *Home and Beauty* (re-named *Too Many Husbands* in America) and *The Circle*, put him in direct line of succession to Congreve. J. E. Harold Terry may be said to have been produced by the War. His plays are notably chiefly for their topical quality, but they are well done and are not without universal appeal. His first play, written in collaboration with Lechmere Worrall, was entitled *The Man Who Stayed At Home*. It was produced at the Royalty Theatre Dec. 10 1914, when the condition of theatrical enterprise was still sore from the effects of the War's beginning, and it was an immediate success. Terry wrote a second play with a war motive, entitled *General Post*, produced at the Haymarket Theatre March 14 1917. This play, slightly similar in theme to Meredith's *Evan Harrington*, was also a great popular success. In 1921 he produced a play entitled *The Fulfilling of the Law*, in which special appeal was less direct. A young American dramatist, Harold Chapin, who had settled in England, was killed in France while serving in the British Army. He was the author of a number of charming comedies and was expected to take a high place in the English theatre.

The United States

The New York Theatre Guild.—In America, the theatre, after the end of the War, was in a healthier state than in England. This is more true of New York perhaps, than of the rest of the country. Playgoers in that city seem more willing to patronise good things and to support new enterprises than playgoers anywhere else. A remarkable organisation entitled The Theatre Guild of New York has, in three years, raised itself from an obscure, impoverished and unknown position into that of the only first-class theatrical enterprise in the world which is a great financial success. The Theatre Guild grew out of the activities of a small group of enthusiasts who were known as the Provincetown Players and the Washington Square Players. These players gave performances, usually of one-act plays, in small theatres near Washington Square. They were akin to the movement, very widespread in America, known as the Little Theatre or Community Theatre movement—societies of amateurs producing plays primarily for their own entertainment rather than for profit. The Theatre Guild, when established, secured a long lease on an old theatre, the Garrick, in West 35th St., and began operations with the production of *Bonds of Interest*, translated from the Spanish of Jacinto Benavente. This play (*Los Intereses Creados*) has been done in England both under the American title and under that of *The Bias of the World*. It was not a financial success, and the capital of the Guild, about $500, was almost exhausted when the directors decided to produce *John Ferguson*, a four-act tragic Irish play by St. John Ervine. This play was not expected to be financially successful, but it falsified anticipation. It was performed in New York for nine months, and enabled the Guild to establish itself more securely.

Subsequent productions, including Masefield's *The Faithful*, were not quite so profitable, but the season ended with greater hope than it had begun. In the following season Tolstoy's *The Power of Darkness*, St. John Ervine's *Jane Clegg*, Strindberg's *The Dance of Death*, and other plays were performed, of which *Jane Clegg*, which ran for five months, was the most financially successful. The third season included the first production in English of Bernard Shaw's *Heartbreak House*, as well as of A. A. Milne's *Mr. Pim Passes By*. Both these plays made much profit for the Guild, the first-named running for 150 performances.

Eugene O'Neill.—The success of the Theatre Guild and of *John Ferguson* caused an immediate effect on theatrical entertainments in New York, and one interesting result of it was that a young American dramatist of Irish descent, Eugene G. O'Neill, was given an opportunity of producing his plays at a first-class theatre. He had already become known as the author of one-act plays when his six-act tragedy, *Beyond the Horizon*, was produced at the Morosco Theatre in New York. This play, most skilfully acted, had a great success, and those who are desirous of seeing a fine native drama grow up in America felt encouraged to maintain their hope when they contemplated O'Neill's work. In 1920 he produced a strange play in eight scenes, entitled *The Emperor Jones*, which is what may be called a one-part play, dealing with the journey of a negro into a West Indian forest where he lapses into primal terror. This play was produced by the Provincetown Players and the principal part was acted by a remarkable negro actor, Charles Gilpin. O'Neill has now written a great many plays, of which one, *Anna Christie*, was performed with some success in London. A number of his short sea-pieces have been acted in England, in addition to *The Emperor Jones* which was produced, but not with much success, at the Ambassadors in London in 1925. His most sensational play, *Desire Under the Elms*, was forbidden to be performed in England by the censor. It is less lyrical and more animal than the rest of his work. A play, entitled *All God's Chilluns Got Wings*, deals, not very deeply, with miscegenation. A better play, *The Hairy Ape*, showed O'Neill in the environment where he is at his best, among sailors in whom physical powers far exceed those of the spirit. O'Neill, who is almost commonplace when he steps out of this atmosphere, as for example in *Welded* and *The First Man*, has a deep, but unrestrained, lyrical sense which generally redeems the coarseness of his characters. But violence seems to increase in him, rather than to subside, and his development is being watched by his friends with anxiety.

Another American dramatist of quality, Susan Glaspell, suffers as O'Neill does from excess of nerves. She is less lyrical, but more intellectual, than O'Neill. She is also more prolix. One of her plays, *The Verge*, was performed for a special occasion in London by Miss Sybil Thorndike. Another and better one, *Inheritors*, was first acted in England by the Liverpool Repertory Company in 1925. Her work increases in strength, and it is possible that she may exceed O'Neill in quality.

Neither of these dramatists have ever had a play performed by the Theatre Guild, but they may be said to owe their opportunities to the fact that that organisation was so swiftly successful. What that success is may be gauged by the fact that in seven years from the date on which the guild was founded, it had not only established itself as a first-class theatrical body, but had built itself a new and very handsome theatre. It now controls two theatres in New York in which first performances of plays by English authors are often given.

Quality of American Drama.—American dramatists display great technical excellence in their work, together with a tendency towards sentimentalism of a curiously crude character. There is probably more mechanical ability among American dramatists to-day than among any other dramatists in the world, but this ability is seldom related to artistic power and it is frequently used to falsify life. There are signs, however, of discontent with slick sentimentality, and young writers throughout the country are endeavouring to relate technical excellence to plays in which life is truly treated. Dramatic craftsmanship is more closely studied in America than in England, and in many of the colleges and universities students take a course in dramaturgy. The most interesting experiment of this kind is that conducted by Prof. George P. Baker, formerly professor of dramatic literature at Harvard, who, in what is popularly known as "the 47 workshop," instructs his pupils in the writing and production of plays from the point of view of author, producer, actor and critic. Many of his pupils have written competent one-act plays and several of them have successfully produced more ambitious pieces.

One of the ablest of American dramatists and, at the same time, the least prolific, is James Forbes, the author, among other plays, of *The Chorus Lady*, *The Show Shop* and *The Famous Mrs. Fair*. Forbes produces mainly satirical comedies of stage-life, but the last-named piece deals with ordinary life and is a very able bit of work. Other notable dramatists are Edward Sheldon whose *Romance*, with Doris Keane in the principal part, was extraordinarily successful in England; George Broadhurst—whose *Bought and Paid For* was described by Arnold Bennett as one of the best commercial plays he had ever seen; David Belasco; the late Clyde Fitch; Langdon Mitchell, the author of a brilliant comedy, *The New York Idea;* Augustus Thomas, whose *The Witching Hour*, *The Harvest Moon*, *As a Man Thinks* and *The Other Girl* are plays of uncommon quality; the late Charles Klein; Eugene Walter, author of two particularly able realistic plays, *Paid in Full* and *The Easiest Way;* Channing Pollock; A. E. Thomas; Booth Tarkington who, more popularly known, as a novelist achieved remarkable success in 1920 with a light comedy called *Clarence;* Zoë Akins; Sidney Howard, whose play *They Knew What They Wanted* had great success; George S. Kaufman and Marc Connelly, whose very interesting play, *Beggar on Horseback*, singularly failed to repeat in London the success it had in New York; and Maxwell Anderson and Laurence Stallings the authors of *What Price Glory?* The condition of the theatre in America at the end of 1920 was more hopeful than that in England because of the greater general interest in meritable plays and of the noticeable desire, especially in New York, to support original enterprises.

The standard of acting in America, so far as actresses are concerned, is higher than in England, but there is more all-around efficiency among English actors than there is among American actors. The latter excel in character-parts—a very admirable instance of this was the case of Frank Bacon in his own play *Lightnin'*—but are less capable in what are known as "straight" parts. With the exception of John Drew there are few American actors who can interpret characters such as were acted by Sir George Alexander. It is very difficult to discover either actors or actresses in America who can speak verse. These flaws in technique are remediable, however, and are slowly being rectified. One result of the War was to cause a distinct decline in the quality of acting among young players in England, and it is probably true to say that there was less acting ability among the younger members of the English theatrical profession at the end of 1920 than at any other period in the history of the English theatre. In America, on the contrary, there was a marked growth in technical skill among young actors and actresses.

The Drama in France

Conservatism of the French Stage.—In 1910, the theatre in France gave less occasion for satisfaction than the theatre either in England or in Germany. The traditions of decent drama were, of course, maintained at the Comédie Française, the Antoine and the Odéon, but, broadly speaking, plays of quality were few in number and "revues" of a very vulgar character were growing in popularity. That bad state of affairs could not last, and after 1910 until the outbreak of the World War, when the French theatre for obvious reasons completely collapsed, there was a revival of quality in French drama. The French theatre, too, which had not previously offered much hospitality to foreign plays, began to open its doors, not widely, indeed, but slightly to plays written by foreigners. Shakespeare suddenly came into fashion. *Hamlet* was produced at the Comédie Française, *King Lear* at the Antoine, *Julius Caesar* at the Orange Fêtes, and *Romeo and Juliet* at the Odéon. Camille de Saint-Croix organised single performances of many Shakespearean plays which were highly praised. One of Shaw's plays was performed in Paris, but without much favour. English musical comedy, produced on a more extravagant scale than is customary in France, became popular, and George Grossmith set the Parisians to singing "Ip-i-addy-i-ay-i-ay."

The most interesting play produced in Paris during the first five years of the decade was undoubtedly Edmond Rostand's *Chantecler*, which had been anticipated for seven years before it was performed for the first time at the Porte-Saint-Martin in 1910. It had not the great success of *Cyrano de Bergerac*, but it caused much discussion. Lucien Guitry played the part originally intended for the late Constant Coquelin, which part was played in New York by Maude Adams. Rostand, who was born in 1868, died in 1918. Another death of great importance to the French theatre was that of Jules Claretie, who, after controlling the Comédie Française for 28 years, died in 1913. Claretie conducted the difficult affairs of the national theatre with very great skill and diplomacy, and showed clearly that while a national theatre is not a forcing-house for genius, it is certainly a place in which the level of honourable drama is highly maintained. He was succeeded by Albert Carré, who remained in charge of the theatre until he was called up for military service during the War, when he was succeeded by Emile Fabre, a dramatist. Paul Hervieu, the dramatist, died Oct. 25 1915, and Mme. Réjane, the famous actress, June 14 1920.

Much useful, if not particularly significant, work was done by French dramatists from 1910 to 1915, but none of the disintegrating and insurgent influences detectable both in the English and the German theatres appeared to affect the French theatre. Stage *décor*, for example, is singularly poor in France, where, on the other hand, the standard of acting is very high. In addition to Rostand's play, notable pieces were produced by Henry Bataille (*Le Songe d'un Soir d'Amour* and *La Vierge Folle*—the first of which, done at the Comédie Française, was hardly so successful as the second, done at the Gymnase), by Pierre Wolff (*Ruisseau* and *Marionettes*), Henri Bernstein (*L'Assaut* and *Le Secret*), George Duhamel (*La Lumière*), Brieux (*La Femme Seule*, done in England under the title of *Woman on Her Own*), Maurice Donnay (*Les Eclaireuses*), Sacha Guitry (*Le Beau Mariage* and *La Prise de Berg-op-Zoom*), De Flers and de Caillavet (*Habit Vert*) and Tristran Bernard (*Jeanne Dore*—with Bernhardt in the cast).

After the outbreak of War, the French theatre for a considerable period practically ceased to exist. There were only two new plays produced in Paris in 1915—*Les Deux Vestales*, a farce of an old-fashioned broad character, done at the Gymnase and a translation, made by W. B. Perier, of the English play, *The Man Who Stayed at Home* by J. E. Harold Terry and Lechmere Worrall, which was done at the Théâtre des Bouffes Parisiennes under the title of *Kit*, with Max Dearly in the cast. Several war plays, not particularly good, were done in Paris towards the end of the War or immediately after the signing of the Armistice, and Sacha Guitry's play *Deburau* was also produced. A translation of this play, done into rhymed couplets, has been made by H. Granville Barker and was produced in New York in 1921 with great success. Edmond's *Saison d'Amour* was produced in 1919, and Sacha Guitry, rapidly acquiring a high place in France as a dramatist and an actor, was responsible for *Pasteur*, a farce entitled *Le Mari, La Femme et L'Amant* (a title which sufficiently indicates the character of the piece) and a comedy called *Mon Père avait Raison*. The Guitrys, father, son and daughter-in-law, gave a season of their plays in London in 1920 which was exceedingly successful.

Indications of Changing Taste.—But even the French theatre, the most conservative of all, began to feel the need for change as the effects of the War wore off. The theatre in Paris is largely dependent upon the patronage of foreigners. This dependence was increased by the fact that the permanent population of Paris now includes a very high proportion of immigrants from other countries, among whom Italians, Poles, Swiss and Russians predominate. The conventional French play of husband, wife and lover does not attract the foreigner now as it once did, and the French managers suddenly realised that their best customers were abstaining from the theatre altogether. A grave shock was sustained when the Opera House in Paris was let to the producers of a moving picture in 1924. The French mind does not easily adjust itself to change, and the managers, having recovered a little from their first fears, are contentedly waiting for the fruits of other men's labours to drop into their laps. Their audiences, however, continue to decline. The older playwriters, still pulling the same old, worn wires, find that a new generation of playgoers has grown up which is not content with stale repetitions of one dull story, and managers of enterprise are now casting about for new authors and new ideas.

Such managers as Georges Pitoeff, a Russian, and husband of Ludmilla Pitoeff, who played the title part in the French version of Bernard Shaw's *Saint Joan*, Gémier, Lugué-Poe, Jacques Copeau and Dullin have given opportunities for production to young dramatists, in addition to producing the work of foreigners.

The new authors include H. R. Lenormand, Jean Sarment, Jacques Natanson, J. J. Bernard, Jules Romain, Marcel Achard,

Paul Vialar, Paul Raynal, Jacques Deval, Adolphe Orna and Zimmer. Most of these authors found production in small way theatres such as Le Vieux Colombier and L'Atelier, but some of them speedily found their way to more important and better-known theatres. The Comédie Française, slower to move in step with the times than the Boulevard theatres, managed to secure Paul Raynal's war-play *Le Tombeau sous l'Arc de Triomphe*, a piece which sharply divided playgoers into two classes, the younger generation which stoutly approved it, and the older generation which attempted to hiss it off the stage. It contained three characters and made unpleasant references to old men who lived in comfort while young men died in the trenches. Jules Romain, a doctor and a novelist, made reputation for himself with a piece called *Doctor Knock* at the Comédie des Champs-Elysées. This play has been translated into English by Harley Granville Barker, and was produced at the Royalty in April 1926 by Denis Eadie.

Zimmer's play, *Le Veau Gras*, an amusing, but ill-balanced piece, with a first act that has little relevance to the rest of it, was much liked because of its caricatures of provincial French life. Henri Bernstein had great success with his play, *La Galerie des Glaces*, which was produced at the Gymnase in Oct. 1924, and Lenormand, a dramatist of singular quality, wrote a play about Don Juan, entitled *L'Homme et ses Fantômes*, which Gémier produced at the Odéon in June 1924. Lenormand was also responsible for a play entitled *A L'Ombre du Mal*, a morbid play about colonial life, done at the Studio des Champs-Elysées. His striking piece, *Les Ratés* was done, but not with popularity, by the Theatre Guild in New York. French plays seem little to the American taste. Gémier gave performances of Bernard Shaw's *Arms and the Man* and Shakespeare's *The Merchant of Venice*, *A Midsummer Night's Dream* and *The Taming of the Shrew*. An attempt was made to hold a season of English plays at an out-of-the-way theatre, the Albert I., with an English cast. The play chosen to begin the season was A. A. Milne's *The Dover Road*, but it was a failure, and the attempt to perform English plays in English at that theatre collapsed. Success, however, attended the effort made by the Macdona Company to popularise the plays of Bernard Shaw in Paris, although the audience cannot be said to have included many French persons. The French theatre sustained heavy losses towards the end of the period in the deaths of Sarah Bernhardt, de Max (who was a Rumanian) and Lucien Guitry.

The Drama in Germany

Conditions Before the War.—The condition of the drama in Germany in 1910 was very odd—declining in Berlin, flourishing in the provinces. Metropolitan taste was fickle and vulgar; provincial taste was steadfast and of high quality. The result of this odd reversal of customary positions was that the German provinces absorbed almost the whole of the interest of dramatic students. More experiments were made outside Berlin than were made inside it, not only in the quality of the plays performed, but also in the methods of production and in the interior economy of the theatre. Volksbühnen (people's theatres) were organised in many places, at which performances of classical and modern pieces were given at very moderate prices. The two Freien Volksbühnen of Berlin, which were typical in most respects of all the other people's theatres, had between them a membership of 60,000 persons, of whom a considerable number were workingmen. These Freien Volksbühnen contracted with various theatre-managers for the performance of specified plays for their members, and the larger of the two, Die Neue Freie Volksbühne, was spending £25,000 per annum in 1910 on plays produced at 11 different theatres. This society even started a building fund, which in that year had reached £5,000, for the purpose of establishing a theatre of its own, to hold 2,000 persons. The members of this society paid one shilling for each performance witnessed, and seats were allotted by ballot.

A similar society, with a membership of 9,000 persons, existed in Vienna, under the direction of Stefan Grossmann, a dramatist. The Cologne Stadttheater organised performances on lines similar to those of the Volksbühnen, on Sunday afternoons before audiences drawn from workmen's societies which were allowed to nominate the play to be produced. In 1909 the trade unions of Cologne chose Galsworthy's *Strife* for performance, and this play was received with enormous enthusiasm. A Deutsches Volkstheater was in process of erection in 1919. Each subscriber to this society was to be admitted to one performance per week in a season of 40 weeks and to receive a theatrical paper, delivered free of charge, together with free admission to a number of lectures, for an annual subscription of 20 shillings! The number of Stadtbund theatres was increasing remarkably, and certain towns either subsidised or completely owned the local theatre. The following is a record of sums paid by German cities and towns for their own theatres: Cologne, £25,000; Frankfort, £13,000; Barmen, £6,000; Dortmund, £6,000; Essen, £4,000; Elberfeld, £4,000; Aachen, £3,500; Breslau, £3,000; Düsseldorf, £2,500; Magdeburg, £2,500; Kattowitz, £1,000; Thorn, £1,000.

The two great German dramatists, Gerhart Hauptmann and Hermann Sudermann, had reached the apex of their powers in 1910 and were beginning to yield place to new men, of whom the chief were Frank Wedekind, Arthur Schnitzler (an Austrian and, like Somerset Maugham and H. M. Harwood in England, a doctor of medicine) and Hermann Bahr. Problem and "tendency" plays were prolifically produced, and the drama of intellectual concepts rather than the drama of human emotions seemed to predominate. Just before the outbreak of the World War, a number of allegorical plays were being performed, such as *Haus am Meer* by Stefan Zweig and *Mutter* and *Gelebtes Leben* by W. von Molo. But, apart from the extraordinary experimental character of much of German drama and stage production during this time, the general range of theatrical entertainment was very catholic, extending from harshly realistic plays of the soil, such as Sudermann's *Strandkinder*, to purely poetic plays, such as *Medusa*, by a young dramatist of promise, Hans Kyser. In addition to the very diverse quality of native drama, the German theatre produced many foreign plays, equally diverse in character, ranging from Shaw's plays to plays by Jerome K. Jerome. Ibsen, Björnson and Strindberg (who died in 1912) had much popularity in Germany, and so had many French dramatists, but none of them had greater popularity than Shaw, Oscar Wilde and Galsworthy. Other English writers, Maugham, Sir James Barrie, Sutro, Arnold Bennett and Edward Knoblock, Monckton Hoffe, H. H. Davies, Sir Arthur Pinero, W. J. Locke and L. N. Parker, were freely and extensively admitted to the German theatre. Shakespeare, of course, had long been a popular author in Germany and this popularity did not decline during the War.

Hauptmann, who received the Nobel Prize on his 50th birthday in 1912, was fairly prolific during the five years preceding the War. *Griselda*, founded on Boccaccio's legend, was produced in 1909, and was followed in 1911 by *Die Ratten* (*The Rats*). *Gabriel Schillings Flucht* (*The Escape of Gabriel Schilling*) was produced in 1912, and in 1913 came the famous Festival Play commissioned by the city of Breslau to celebrate the war against Napoleon for freedom. This play was produced by Reinhardt in the new rotunda of the Breslau Centenary Exhibition, and its democratic sentiments were so displeasing to the Junkers that it provoked a great uproar. The then Crown Prince threatened to cancel his patronage of the exhibition unless the play were withdrawn—which was done. Another play, entitled *Der Bogenspanner Odysseus* (*Odysseus the Archer*), was written in 1913.

Hermann Sudermann was less prolific than Hauptmann. His *Strandkinder*, a play about people living on the shores of the Baltic Sea, was produced in 1909. This play had considerable affinity with the work of a dramatist who died in 1909, Ernst von Wildenbruch, two of whose plays, *Lieder des Euripides* and *Der Deutsche König*, were performed, after his death, in that year. *Strandkinder* was followed by an historical piece, entitled *Der Blinde von Syracus*, in 1911 and *Der Gute Ruf* in 1913.

Bahr, Wedekind and Schnitzler.—The ascending dramatists, Bahr, Wedekind and Schnitzler, produced many plays in the first half of the decade, as did another well-known, but peculiar and unsuccessful dramatist, Herbert Eulenberg. Bahr, whose gift is

for human comedy, is known abroad by *Das Konzert* (*The Concert*), which was not notably successful in London, but was very popular in America as well as in Germany. Another play, *Kinder*, was produced simultaneously in 20 different German theatres in 1910. It was followed by *Das Prinzip* and *Das Tänzchen* in 1912 and by *Phantom* in 1913. Frank Wedekind, a dramatist of queer, undisciplined genius, was by far the most prolific of all the dramatists in Germany during the period under review and probably of all the dramatists in Europe. He produced nine plays in five years, four of which, indeed, were in one act. The plays were *Die Junge Welt*, *Die Zensur* (one act), *Der Liebestrank*, *Die Büchse der Pandora* and three one-act plays, *In Allen Satteln Gerecht*, *Mit Allen Hunden Gehetzt* and *In Allen Wassern Gewaschen*, which were combined in 1911 under the general title of *Schloss Wetterstein* and issued with the statement that they contained his views "on the inner necessity on which Marriage and the Family rest." These plays were followed by *Der Stein der Weisen* and *Franziska*, the latter, prohibited by the censor in Vienna, being produced in Munich. Arthur Schnitzler, a Viennese, known in England through the *Anatol* plays, translated by Granville Barker, and *Der grüne Kakadu* (*The Green Cockatoo*), had four plays performed in the first five years of the decade, *Komtesse Mizzi*, *Der junge Medardus* (which took five hours to perform), *Das Weite Land* and *Professor Bernhardi*, the latter of which was forbidden in Vienna. Herbert Eulenberg was responsible for six plays, *Der natürliche Vater*, *Anna Wolewska*, *Samson* (his most popular piece), *Alles um Geld*, *Alles um Liebe*, *Belinde* (which won the Volksschiller prize), *Zeitwinde* and a one-act play, *Paul und Paula*. Hans Kyser, in addition to the play already named, produced *Titus und die Jüdin* and *Erziehung zur Liebe*.

The list of meritable German dramatists is a very long one. It includes men such as Paul Ernst, Hans Franck, Otto Harnack, Carl Schönherr, whose Volksstück ("people's play") *Glaube und Heimat* was performed in more than 1,000 theatres in six months, Edward Stucken, Max Halbe, Ludwig Fulda, Ludwig Thoma, Franz Dulberg, Leo Birinski, Reinhard Sorge and Arno Holz. The records of the German theatre during the War indicate that a better standard of play was maintained there than elsewhere.

The Expressionists.—Since the end of the War, a new group of dramatists, known by the generic title of Expressionists, had grown up in Germany, of whom George Kaiser and Ernst Toller are the best known in the English-speaking world. Kaiser's play, *Von Morgens bis Mitternachts* (*From Morn to Midnight*) was acted in London before the Stage Society in 1919, and has been played elsewhere in England since then. His play, *Gas*, was produced by Sir Barry Jackson at the Birmingham Repertory Theatre in 1924. He, like all the Expressionists, experiments with new dramatic forms, but the principal characteristics of his work, which hardly merits the extravagant claims made for it, are violence and neurosis. In addition to the two plays named, he has written others, of which the more meritable are *Die Bürger von Calais* (*The Burghers of Calais*) and *Die Koralle* (*The Coral*). Toller's work, though it, too, has a neurotic note in it, which is not unnatural, considering that some of the plays were actually written in prison where he was confined after the War for his Communistic principles, is of more merit than that of Kaiser. His development is likely to be greater than Kaiser's. Two of his plays have been produced in London by the Stage Society, *Die Maschinenstürmer* (*The Machine-Wreckers*) and *Masse-Mensch* (*The Man and the Masses*), as well as in New York by the Theatre Guild. The latter play was revived at the Regent in London in 1926, but was not successful. Kaiser had considerable success with a play entitled *Nebeneinander* (*Parallel Paths*), but Toller was less fortunate with *Die Wandlung* (*Transformation*) which was a complete failure, and *Hinkemann* (*The Cripple*) which caused a riot in the theatre. Max Mohr, another modernist, wrote *Improvisation im Juni* (*Summer Charades*) which had much success.

A violence of sex interest has been manifested in much of the post-War German drama, and this was most plainly to be detected in Schnitzler's *Reigen* (*The Chain*). The temper of the German theatre, however, is calmer now than it was immediately after the Armistice, and there has been a notable increase in the number of English plays performed. The demand for spectacular pieces has abated in Germany as it has in England, and Herr Reinhardt, who, before the War, produced the *Miracle*, *Oedipus Rex* (with Sir John Martin Harvey and Lillah McCarthy in the principal parts) and *Sumurun* in London, found that his new theatre, Das Grosse Schauspielhaus (The Great Arena Theatre) built in 1919, with seating capacity for 3,000, was a failure.

The Drama in Austria

The theatre in Austria, which had existed in a prosperous, if unimpressive, manner up to the outbreak of the World War, suffered terribly after the Armistice. This was not due to any deficiency in the theatre itself, but to the break-up of the Austrian Empire. The depreciation of credit and currency and the decrease in population instantly brought the Vienna theatres to a state of ruin; and four of the most important of them, the Volksoper, the Carl, the Modernes and the Renaissance Bühne, were obliged to shut their doors and submit to drastic reorganisation. Actors' salaries steadily fell. Authors seemed to lose heart, and hardly any plays by Austrian authors were produced. Those that were done were chiefly of a Biblical character, such as Richard Beer-Hoffman's *Jaakob's Traum* (*Jacob's Dream*) and Anton Wildgans' *Kain* (*Cain*). Arthur Schnitzler wrote one exotic piece, *Komödie der Verführung* (*The Comedy of Seduction*) but Hermann Bahr remained silent.

Most of the plays done in Vienna, after the Armistice, were of foreign origin, German, Russian, English and Hungarian. Franz Molnar, the Hungarian dramatist, achieved remarkable popularity in America with various of his plays, as did another Hungarian dramatist, Ernest Vadja with *Fata Morgana*, though he was not so successful with any other play. *Fata Morgana* was very successfully produced in London. The Czechoslovakian dramatists, the brothers Capek, were also made popular in America by two plays, *R.U.R.* and *The Insect Play*, the first of which was fairly successful in London, the second being a failure. Neither of these plays was of the first importance. A third play by these authors entitled *The Makropulous Affair*, dealing with the elixir of life, was not a success in Vienna. The most popular dramatist in Austria after the War was Bernard Shaw, whose plays were almost perpetually performed.

The Drama in Italy

In Italy, the theatre developed along quite humdrum lines, except that the fastidious indelicacy of Gabriele d'Annunzio yielded place to the dubious metaphysics of Luigi Pirandello. The reformers appeared in Italy, too, but their reforms were chiefly concerned with details of acting. In Italy, the voice of the prompter incessantly is heard hissing throughout the performance. Italian actors, unlike all others, do not memorise their words. They are content to give impressions of them, a habit which reduces them to a state of hopeless dependence upon the prompter who steadily whispers the play, word by word, to them. This habit is said to stimulate the actor's spontaneity, but it also stimulates the anger of the audience in foreign countries when Italian actors play outside Italy, as Duse's company did in France, England and the United States in 1923, and Pirandello's company did in London in 1925. Pirandello's most notable play, *Sei Personaggi in cerco d'Autore* (*Six Characters in Search of an Author*) has been performed in English in London by the Stage Society, but has been forbidden public performance by the censor.

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(St. J. E.)

DREADNOUGHT.—The design of the original Dreadnought proved so satisfactory that from the date of her completion onwards the designs of British capital ships continued on the same lines without any essential departure from the principle of the Dreadnought type, namely, a ship carrying an all-big-gun armament, adequately protected, and of a speed equal to that of contemporary foreign capital ships. The other big naval Powers followed the fashion thus set and so the mixed armament vessel was definitely relegated to the past.

Armament.—The Dreadnought type itself, however, was very soon improved upon, the first break with the 12-in. gun armament being made in 1910 when the British "Orion" class of four vessels was laid down. The guns mounted were of 13·5-in. calibre, all mounted on the centre line in five turrets, the two turrets forward and aft being superposed so that one could fire over the other, giving a broadside fire of 10 guns and a forward and astern fire of four guns. This system, which had already been adopted in the United States capital ships, became the standard for future ships. Although foreign Powers followed the Dreadnought type they did not increase the calibre of their main armament for some little time after the British adoption of the heavier gun.

The foreign contemporaries of the "Orion" class were the "Arkansas," "Courbet," "Conte di Cavour," "Helgoland," "Viribus Unitis," "Settsu" and "Gangut" classes of the United States, French, Italian, German, Austrian, Japanese and Russian navies respectively, all of which carried 12-in. guns. The British ships following the "Orion" class continued to be armed with the 13·5-in. weapon, but in the meantime the United States laid down the "New York" and "Texas," mounting 10 14-in. weapons, and Japan the "Fuso" with 12. The British Navy again took the lead, however, in calibre of guns mounted, the "Queen Elizabeth" class of five vessels with eight 15-in. guns being laid down in 1912, followed the next year by the five vessels of the "Royal Sovereign" class, mounting the same main armament.

France had also gone to a higher calibre weapon for the main armament of the vessels "Bretagne," "Lorraine" and "Provence," but Italy, Germany and Austria remained faithful to the 12-in. weapon, and when the World War had been in progress for about two years, Germany completed the "Baden" class of two vessels, mounting eight 15-in. guns in four turrets, as in the British "Queen Elizabeth." In all the British battleships the main armament was mounted in twin mountings, but the foreign navies in this respect were somewhat less conservative. Triple gun mountings were adopted by France, Italy, Austria, Russia and United States, and the French began the construction of quadruple mountings, but neither these nor the ships for which they were intended were ever completed.

Machinery.—From the Dreadnought to the "Royal Sovereign" class the main machinery fitted was of the turbine type the only essential change made being that from the direct drive turbine to the geared turbine. Geared cruising turbines were first introduced into the British battleships in the "Queen Elizabeth" and the fitting of gearing was continued in all later vessels. The British example in regard to the complete adoption of turbines was not followed at once by other nations. A certain distrust for this new type of machinery seems to have been felt, since Japan and the United States, for example, built sister ships, one having turbine engines and the other having reciprocating engines.

The Japanese ships were the "Aki" and "Satsuma," completed in 1911 and 1910 respectively. The "Aki" had Curtis turbines, and the "Satsuma" triple expansion reciprocating engines, and although differing slightly in dimensions they were really vessels of a class. On trials the "Aki's" machinery developed 28,740 S.H.P., giving a speed of 20¼ knots and the "Satsuma's" developed 18,510 S.H.P., giving a speed of nearly 19 knots. All the later Japanese capital ships were fitted with turbine machinery as a result of experience with these two vessels.

The American vessels with which a similar experiment was conducted were the sister ships "Delaware" and "North Dakota," completed in 1910. The latter was the turbine vessel with machinery of Curtis type but this was afterwards replaced by Parsons type turbines. The next two classes of ships built for the United States, the "Utah" and "Florida" and the "Arkansas" and "Wyoming," completed in 1911 and 1912 respectively, had Parsons turbines, but the American experience with this type of machinery seems to have been inconclusive, for in the following class laid down, "New York" and "Texas," triple expansion reciprocating machinery was reintroduced.

The same cycle of changes commenced with the next class of vessel, the "Oklahoma" and "Nevada," the former having reciprocating machinery and the latter turbines, but ultimately turbines were once again adopted with gearing and a further change made in the "New Mexico," completed in 1918, of substituting electrical for mechanical gearing. This type of electric drive had become the standard for American capital ships.

The other big naval Powers adopted the turbine in turn, Germany completing the battle-cruiser "Von der Tann" in 1910, France the "Danton" class of battleship in 1911, Austria the "Viribus Unitis" class in 1912, Italy the "Dante Alighieri" in 1913, and Russia the "Gangut" class in 1914, all with turbine installation, and these countries continued to install this type of machinery in their later vessels.

Fuel.—The other great departure made in power production concerned the fuel. All the British battleships from the Dreadnought to the "Iron Duke" class had coal-fired boilers with oil as a subsidiary fuel. The oil was sprayed into the furnaces on top of the coal to maintain a burst of speed for a longer period than was possible when firing with coal only.

In the "Queen Elizabeth" class, however, as a result of experience in the light cruisers of the "Arethusa" type, oil was adopted as the fuel, coal being entirely dispensed with. This was a most important step to take in view of the supply of oil being comparatively insecure when compared with that of Welsh coal, but the advantages of oil as a fuel were so great that subsequent to this no British capital ship was built to use coal.

The "Royal Sovereign" class following the "Queen Elizabeths" was originally designed to be coal-fired, owing to a feeling that oil supplies would be insufficient, but during the design stage the advantages of oil fuel became so apparent in other vessels that all oil was ultimately adopted. All the battleships previous to the "Queen Elizabeth" had a speed of approximately 21 knots. This was increased in the "Queen Elizabeth" class to 25 and although the "Royal Sovereigns" were originally designed for 21 knots as coal-fired vessels, the great advantage of oil as fuel was shown by the fact that 23 knots would be obtained with the vessels oil-fired. The British lead in this respect was not followed by any other Power with the exception of the United States who first introduced all oil fuel in the "Nevada" and "Oklahoma" completed in 1916.

Armour and Protection.—The general arrangement of main belt armour, deck protection and underwater protection bulkheads continued on the same plan from the Dreadnought onwards, and the "Orion" class of the 1909–10 programme, completed in 1912, had a main belt varying from 12 in. to 8 in. in thickness, with protective decks varying from 1½ in. to 2 in. and underwater protection to magazines by isolated bulkheads varying from 1½ in. to 2 in. according to their distance from the ship's side.

In the "Royal Sovereign" class of the 1913–4 programme, completed in 1916, the main belt was 13 in. with protective decks varying from 1 in. to 3 in., and a continuous longitudinal bulkhead of 1½ in. in thickness to protect the vessel from underwater attack. This fore and aft protection had undergone various changes in the intermediate vessels, varying from isolated portions near the magazines to a continuous bulkhead, but the increasing power of torpedoes made it necessary finally to adopt the continuous protection. The efficiency of this system of protection was demonstrated at Jutland (torpedoing of "Marlborough"), but it was finally improved upon by the later forms of bulged protection, devised by Sir E. H. T. d'Eyncourt, whilst Director of Naval Construction, and the "Ramillies," the last

vessel of the "Royal Sovereign" class to be completed, was built with a bulge, the other ships of the class being bulged later.

The foreign contemporaries of the "Royal Sovereign" class were very similarly protected except perhaps the German battleships which, with their generally greater beam and a sacrifice of such qualities as habitability and endurance, were able to carry somewhat thicker belt armour. It is a rather striking point that the foreign vessels completed about the time of the "Royal Sovereign" all had from 5 to 10 ft. more beam. The British designers were very seriously handicapped in this respect by the restricted width of the existing graving docks.

Battle Cruisers.—Concomitant with the design and construction of battleships the faster and more lightly protected type of capital ship called the battle-cruiser, was developed for the British Navy, and this lead was followed by Germany, Japan, Russia and America, but only the first three named completed any of these vessels.

Previous to 1910 three vessels of the "Invincible" class were completed for the British Navy, followed by three of the "Indefatigable" class completed in 1911–3, three of the "Lion" class in 1912–3, the "Tiger" in 1914 and the "Repulse" and "Renown" in 1916.

The main armament of the first of these battle-cruisers consisted of eight 12-in. guns, and the speed of the vessels was 25½ knots. The advance in armament followed a similar course to that in the battleships, increasing in calibre to 13½ in. in the "Lion" class and in the "Tiger," the speeds of the vessels being 28 and 30 knots respectively. The number of guns carried was still eight, but in the "Repulse" and "Renown," with a further advance in the calibre of the guns to 15 in. and an increase in speed to 32 knots, the number of guns carried was reduced to six in three twin turrets, two being mounted forward with one firing over the other and the third being mounted aft.

The essential differences between the battleship and the battle-cruiser are clearly shown in the comparison between the battleship of the "Royal Sovereign" class and the battle-cruisers of the "Renown" class and the "Tiger" in Table I.

TABLE I.

	"Royal Sovereign"	"Renown"	"Tiger"
Length extreme	624¼ ft.	794 ft.	704 ft.
Load displacement in tons	25,750	26,500	28,500
Shaft horsepower	40,000	120,000	108,000
Speed at load draft	23 knots	32 knots	30 knots
Main armament	8 15 in.	6 15 in.	8 13·5 in.
Distribution of weights as percentages of load displacement represented by symbols:			
Armament	1·4 a	a	a
Machinery	b	2·2 b	2·1 b
Armour and protection	1·73c	c	1·44c

The foreign battle-cruisers developed on very similar lines, but of those completed only the Japanese "Kongo" class mounted a heavier weapon than the 12-in., these vessels having a main armament of eight 14-in. guns and a speed of 27½ knots. The British battle-cruiser type in action was a great success in the battle of Falkland Is., in which the "Invincible" and "Inflexible," in company with smaller vessels, destroyed Von Spee's fleet, but later the losses of this type in the battle of Jutland brought out their weaknesses when in line of battle against battleships.

The "Hood" Design.—The experience thus gained led to additional horizontal protection being added over the magazines and other vital points of all capital ships and at the same time modified the design of the battle-cruiser "Hood." This vessel was designed by Sir E. H. T. d'Eyncourt early in 1916 and had only just been ordered when the battle of Jutland took place. Additional protection was incorporated without materially altering the essential features of the design, and the resulting vessel was a combination of the characteristic features of both the battleship and the battle-cruiser, since she carried a main armament of eight 15-in. guns, had a main belt of 12-in. armour and had a speed equal to that of any battle-cruiser, namely, 32 knots. Complete bulge protection was fitted in this vessel, and the section of the vessel shown in fig. 1 (*a*) in comparison with a section of the "Royal Sovereign" (*b*) as originally built without a bulge, shows what a great departure she was from the conventional ship form.

The "Hood," completed in 1920, is 860 ft. in length overall, 104 ft. in breadth, displaces at her load draught 41,200 tons and

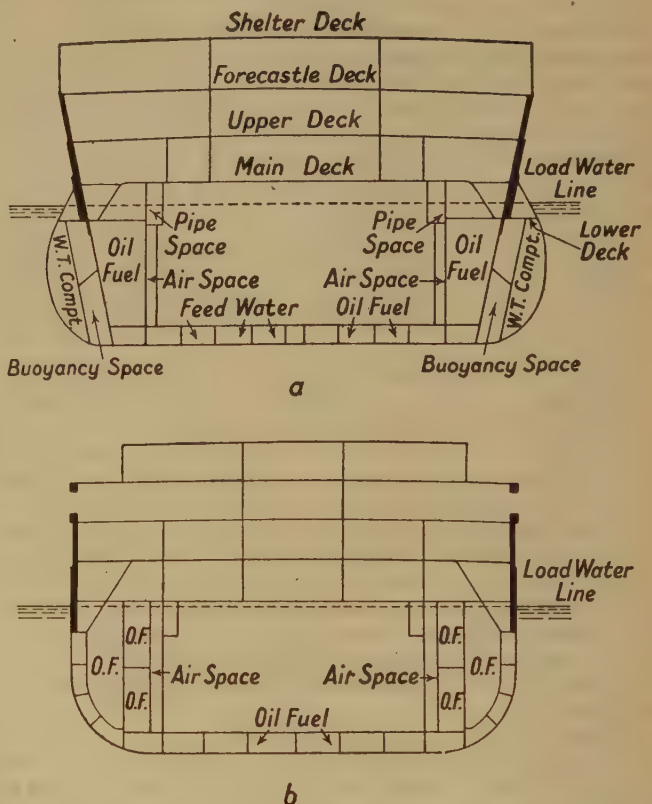

FIG. 1.—*a*. Section of H.M.S. "Hood." *b*. Section of H.M.S. "Royal Sovereign."

with a S.H.P. of 144,000 can be driven at 32 knots. She has the distinction of being the largest and at the same time the fastest capital ship in the world at present, and will probably hold that distinction for many years to come.

At the end of the World War and whilst the construction of the "Hood" was proceeding, warship design practically came to a standstill whilst the lessons of the War were being absorbed. Germany and Austria had practically ceased to exist as naval Powers, Russia was in a similar state, France and Italy had abandoned construction of capital ships some time previous in order to husband their resources and so it was left to the British, American and Japanese designers to continue the study of the design of capital ships.

NAVAL CONSTRUCTION, 1919–22

If we now consider the warship building programmes of these three nations during the year 1919 and up to the signing of the Washington Treaty on Feb. 6 1922, we shall obtain an idea of the trend of capital ship design before it was affected by the treaty.

The vessels built, building and projected, with the salient particulars, are shown in Table II., p. 878.

Once again the calibre of the main armament had increased, this time to 16 in. for both the foreign battleships and battle-cruisers, and the tendency was for both the displacement and speed to increase also. There is no doubt also that the British Admiralty were considering the design of vessels of still greater dimensions than the "Hood," and it was at the commencement of this new era of the building of colossal ships of war that the Washington Conference (*q.v.*) was convened, followed by the signing of the treaty early in the year 1922. Under this

FIG. 1. BRITISH BATTLE CRUISER "HOOD," COMPLETED 1920. FIG. 2. JAPANESE BATTLESHIP "MUTSU," COMPLETED 1920. FIG. 3. U. S. BATTLESHIP "WEST VIRGINIA," COMPLETED 1923.

Fig. 1. Photo. Abrahams, Devonport. Fig. 2. From "Jane's Fighting Ships, 1925." Fig. 3. Courtesy of U. S. Navy Dept.

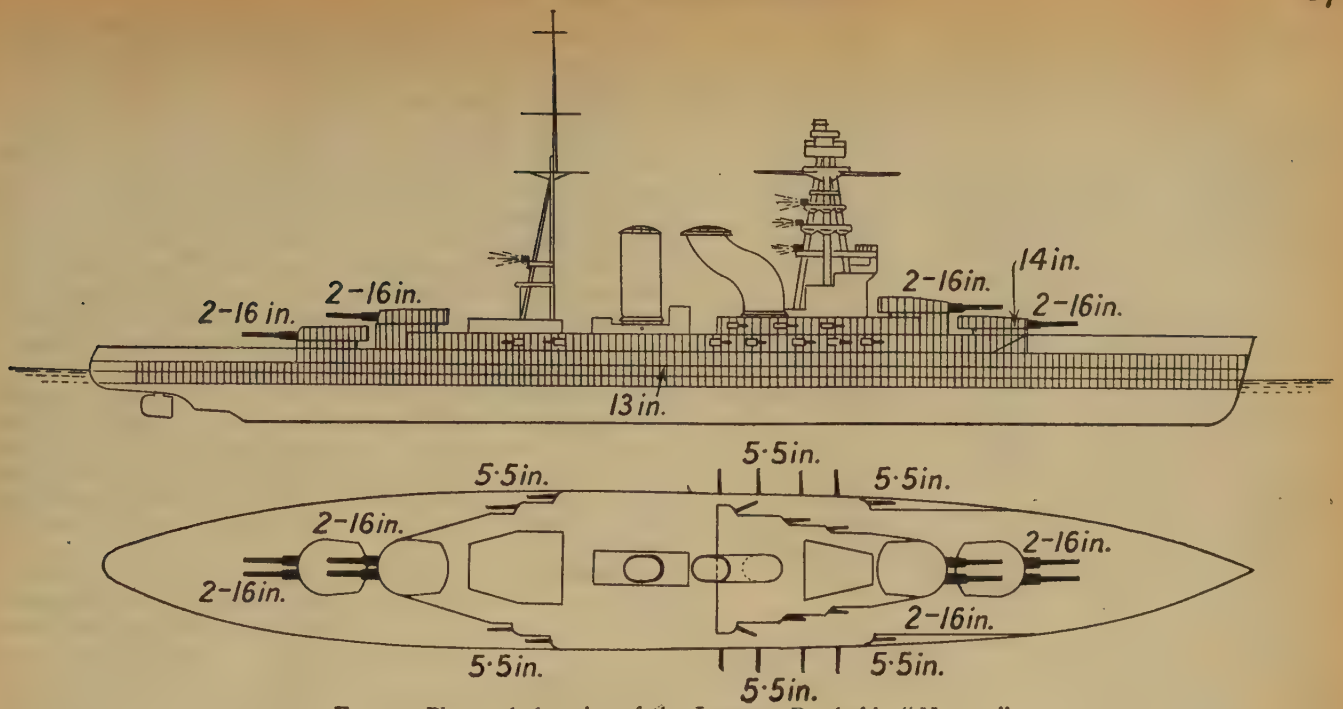

FIG. 2.—Plan and elevation of the Japanese Battleship "Nagato."
Brassey's Naval and Shipping Annual

treaty Japan retained the battleships "Nagato" and "Mutsu," mentioned in the previous table, and was given the power to convert two of the remaining battle-cruisers or battleships then building to aircraft carriers; the rest were scrapped.

United States.—The United States retained the "Colorado," "Maryland" and "West Virginia" and retained also the power to convert two of the battle-cruisers to aircraft carriers. These retained vessels are of special importance, as to a certain extent they set the limits to the design of capital ships which were fixed by the Washington Treaty. They are in the region of 33,000 to 34,000 tons displacement and their main armament consists of 16-in. guns, and the specific terms laid down by the treaty limit the displacement to a maximum of 35,000 tons, the calibre of the main armament to be not greater than 16-inch.

Great Britain.—By the treaty the British Empire was allowed to lay down in 1922, for completion by about the end of 1925, two such capital ships to complete the necessary tonnage allowed and these, the "Nelson" and "Rodney," the first two post-War capital ships to be laid down for the British Navy, were designed by Sir E. H. T. d'Eyncourt previous to his retirement from the Admiralty. These are the only capital ships designed entirely since the Washington Treaty and therefore the only two vessels in which it has been possible to incorporate the lessons learned at Jutland. It is obvious, from a study of the previous table, that as long as the Washington limit prevails, the battle-cruiser type is dead, if it is desired to mount the maximum possible armament of 16-in. calibre and to give adequate armour protection to the vitals. The dimensions of the "Nelson" and "Rodney" have been published and are shown in Table III., p. 878, in comparison with the Japanese "Mutsu" class and the United States "Colorado" type.

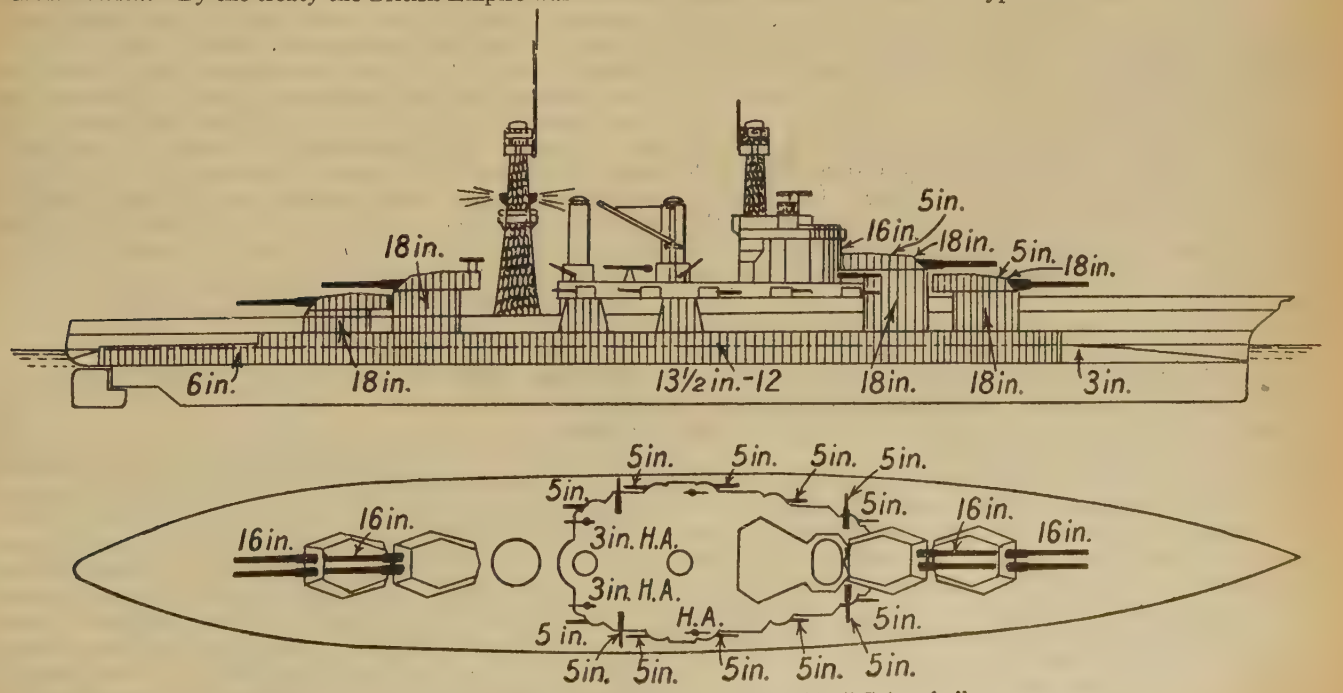

FIG. 3.—Plan and elevation of U.S. Battleship "Colorado."
Brassey's Naval and Shipping Annual

TABLE II.

	Laid Down	Completed	Displ. Tons	Main Armt.	Speed Knots
UNITED STATES					
Battleships:—					
"Colorado"	1919	(1923)	32,600	8 16 in.	21
"Maryland"	1917	(1921)			
"West Virginia"	1919	(1923)			
"Washington"	1919	Scrapped			
"Indiana" class, 6 vessels	Projected	Scrapped	43,200	12 16 in.	23
Battle-cruisers:—					
"Constellation" class, 6 vessels	1919–20	Two being converted to aircraft carriers. Others scrapped	43,500	8 16 in.	33¼
JAPAN					
Battleships:—					
"Mutsu"	1917	1920	33,800	8 16 in.	23
"Nagato"	1918	1921			
"Kaga"	1918	Being converted to aircraft carrier			
"Tosa"	Projected	Scrapped			
Battle-cruisers:—					
"Amagi" class, 4 vessels	1919–20	One being converted to aircraft carrier; others scrapped	40,000	8 16 in.	30
GREAT BRITAIN					
Battle-cruiser:—					
"Hood"	1916	1920	41,200	8 15 in.	32

TABLE III.

	Length on Water-line	Breadth Extr.	Displ. Tons	Main Armt.	Speed Knots
Great Britain					
"Nelson" and "Rodney"	702	106	35,000	9 16 in. reported	..
United States					
"Colorado" class	600	97¼	32,600	8 16 in.	21
Japan					
"Mutsu" class	695 approx.	95	33,800	8 16 in.	23

Other particulars of the "Nelson" and "Rodney" are still withheld by the British Admiralty but they are credited with a main armament of nine 16-in. guns and very heavy armour and complete underwater protection.

Both these vessels were launched towards the end of 1925, the "Nelson" from the works of Messrs. Armstrong Whitworth & Co., Newcastle-on-Tyne, and the "Rodney" from Messrs. Cammell Laird & Co.'s works at Birkenhead. These will be the last two capital ships added to the British Navy for several years to come, as it will be 1931 before two further ships can be laid down for completion in 1934.

United States and Japan.—The same applies in the case of the United States and Japan, which can lay down two and one capital ships respectively also in 1931. Both Italy and France are allowed to lay down capital ship tonnage in 1927, but it seems very improbable at present that such a course will be taken owing to financial considerations.

Political Factors.—Another great factor in addition to the Washington Treaty affecting warship design is the change in the general tactical and strategical situation brought about by the almost complete eclipse of Germany as a naval Power. The centre of gravity as far as the naval situation is concerned has moved from the North Sea, and to a great extent also from the Mediterranean, to a much larger field of operations, namely, the Pacific. This means that British ships will have to traverse much wider areas than heretofore and the design of cruisers with a large endurance, not only to protect the ocean routes, but to operate in the larger oceans, has assumed a relatively greater importance compared with capital ships than has been the case hitherto. (E. T. D'E.)

DREISER, THEODORE (1871–), American author, was born at Terre Haute, Ind., Aug. 27 1871 and received his education in the public schools at Warsaw, Ind., and at Indiana University. From 1892 to 1894 he was engaged in newspaper work in Chicago and St. Louis. In 1895 he became editor of *Every Month*, a literary and musical magazine. In 1905 he was editor of *Smith's Magazine*, becoming managing editor of *Broadway Magazine* in the following year. From 1907 to 1910 he was editor-in-chief of the Butterick publications, including *The Delineator*. He published his first novel *Sister Carrie* in 1900, followed by *Jennie Gerhardt* (1911) and *The Financier* (1912), the last of which established his reputation as a powerful writer of realistic fiction. His other novels include *The Titan* (1914) and *The Genius* (1915). He also wrote *Plays of the Natural and the Supernatural* (1916); *A Hoosier Holiday* (1916) and *The Hand of the Potter*, a tragedy (1918). His latest works were *A Book about Myself* (1922); *The Color of a Great City* (1923) and *An American Tragedy* (1925).

DRESDEN, Germany (*see* 8.574), had in 1919 a population of 587,748. In this figure are included Tolkewitz and Reich, incorporated in 1912, but not 23 suburban communes incorporated in 1921. A later estimate was 613,000. The newer industrial areas of the city lie to the south and southwest. The Diet of Saxony meets in the modern town hall, a Renaissance structure. New buildings include a theatre, a branch of the technical academy, an impressive crematorium and the Haus der Kaufmannschaft. During the World War the loss of foreign visitors and subsequently the dissolution of the court of the King of Saxony bore very hardly on the city. The revolution was followed in Dresden by disturbances and strikes; in 1919 sanguinary street fighting took place.

DRESS: *see* COSTUME.

DRINK TRAFFIC: *see* LIQUOR LAWS.

DRINKWATER, JOHN (1882–), British poet, playwright and critic, was born at Leytonstone, Essex, June 1 1882, and educated at the Oxford High school. After 12 years' work as an insurance clerk, he began to devote himself to theatrical enterprise, and became manager and producer to the Pilgrim Players, who developed into the Birmingham Repertory Theatre Co. His first volume of poems appeared in 1906 and his first play, *Cophetua* (in verse), in 1911. He subsequently published several volumes of verse, critical studies on *William Morris* (1912), *Swinburne* (1913) and others, and several plays, of which *Abraham Lincoln* (1918) was produced with great success both in London and in the United States. Among his later plays were *Oliver Cromwell* (1921), *Mary Stuart* (1922) and *Robert E. Lee* (1923), each of which was performed in London. These plays fall under the category of "chronicle dramas." In 1923 his *Collected Poems* (2 vol.) were published, and in 1925 *The Muse in Council*, a collection of essays, and his *Collected Plays* (2 vol.). In 1925 *The Pilgrim of Eternity: Byron—a Conflict*, his most important prose work, made its appearance.

DRIVER, SAMUEL ROLLES (1846–1914), British scholar (*see* 8.585), died at Oxford Feb. 26 1914.

DRIVING: *see* COACHING.

DROYSEN, GUSTAV (1838–1908), German historian (*see* 8.596), died at Halle Nov. 10 1908.

DRUSES (*see* 8.603).—Drūz or Darazīyah, so-called from the missionary Darazī, who founded the sect in the first quarter of the 11th Christian century. The Drūz community consists of Arabic-speaking mountaineers, estimated to number about 150,000 in the aggregate, who are scattered through different parts of Syria, principally in four districts: (*a*) the Southern Lebanon; (*b*) Hāsbeiyā and Rāsheiyā on the western slopes of Mount Hermon; (*c*) Jebel Haurān, an isolated block of mountains southeast of Damascus on the edge of the Syrian desert; (*d*) the northern part of the Hama district. The settlement in the Jebel Haurān is the most important, owing to the virtual independence which the Druses maintained here against the

Ottoman Govt. and which they sought to assert against the French mandate; but it is also the most recent. The migration of the Druses to the Haurān does not seem to have begun before the 18th century, and took place for the most part during the middle decades of the 19th century.

The autonomous vilayet of the Lebanon was constituted in 1864 under the guarantee of the Powers. In the Lebanon constitution the different religious sects into which the population of the vilayet was divided were represented proportionately in the Government. The system worked well until the constitution was suppressed by the Turks during the World War, and in that period trouble between the Druses and the Maronites in the Lebanon was rare. Meanwhile the Druse community had shifted its centre of gravity to the Haurān, where it was practically out of reach of the Ottoman Govt. and of the Powers. In the peace settlement after the World War the Haurān was included in the French mandated territory of Syria. After the French had conquered the interior of Syria in the campaign of Aug. 1920, they attached additional territory, including the Druse settlements in the Hāsbeiyā and Rāsheiyā districts, to the Lebanon province, and induced the Druses of the Haurān to receive a French resident political officer. Discontent with this territorial change and with the conduct of the French resident in the Haurān led to the Syrian rising of 1925, in which the Druses took the lead. (*See* DAMASCUS; SYRIA.)

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DRY CLEANING.—Dry cleaning is the removal of dirt and stains from materials by means of solvents, and of especially prepared soap. The process is known variously as dry, French and chemical cleaning. It is based on the fact that a considerable amount of the dirt and dust on wearing apparel, draperies, etc., is held in position by greasy substances. When the grease is removed by a suitable solvent, the dirt may be removed mechanically. The process was first employed in France about the middle of the 19th century. At first all the work was done by hand and the operations were very simple. Later machinery was introduced, thus providing the basis for a large industry that requires skill, a thorough knowledge of textiles, leather, etc., and elaborate equipment.

The term dry cleaning is used in contradistinction to cleaning with soap and water. The process involves immersion of articles in liquids other than water, which do not affect the physical properties of the materials treated. In a strict sense, the process is not "dry," but articles immersed in the liquids employed in dry cleaning are not wetted as they would be in water. Water causes textile fibres to become limp, and, in many cases, to alter in shape and size. Petroleum naphtha and other liquids employed in dry cleaning are inert as regards alterations of the fibre. The classes of materials which may best be dry cleaned include many kinds of clothing, millinery and house furnishings. The two cleaning agents used in largest quantities are dry-cleaner's soap and petroleum naphtha. These agents are supplemented by ethyl alcohol, acetone, carbon tetrachloride, acetic acid, etc., which are used in small quantities mostly for removing spots that do not respond to the ordinary treatment described below. Dry-cleaning soap is a superfatted soap, in which about one-half of the fatty acid has been saponified with caustic potash or caustic soda or ammonia. A soap of this nature is soluble in gasolene or naphtha and in similar solvents.

Articles made of strong materials are washed in mechanically driven revolving cylinder-type washers with petroleum naphtha and dry-cleaning soap, followed by rinses in fresh naphtha. The articles are removed from the washer and freed from as much solvent as possible in a centrifugal extractor, and finally transferred to a drying tumbler, where the last traces of the cleaning fluid are removed. The drying tumblers are of metal and are designed along somewhat the same lines as the washer. The drying is hastened by a current of heated air which is blown through the tumbler. The garments when dry go to the spotting table for attention to any spots that may not have been removed in the process just described.

Articles made of delicate materials are cleaned by hand on specially constructed tables, and for some of this cleaning considerable skill is required. The more delicate classes of work cannot be dried in drying tumblers, but must be hung in ventilated, heated, drying rooms. In all cases the used cleaning fluid is drained into reclaiming tanks. After proper renovation it is used over and over again, new solvent being added to make up evaporation and mechanical losses. Most dry-cleaning fluids are inflammable and precautions must be observed to prevent fires when using them. For this reason, dry cleaning can be practised with safety only in plants designed for the purpose.

There are approximately 3,000 power-cleaning establishments in the United States. The total number of persons engaged in the industry exceeds 35,000. Salaries and wages paid annually total approximately $48,000,000. The larger establishments employ from 200 to 600 people. The average number of employees is approximately 12 per plant. European dry-cleaning practice is similar to that of the United States but less machinery is used, particularly for finishing materials cleaned. There are fewer plants per unit of population, but the average size is larger. Some of them have several thousand employees. (Ll. J.)

DUBLIN (*see* 8.617) had in 1923 an estimated population of 431,000. The census figure for 1911 was 304,800. Its finest thoroughfare, Sackville (or O'Connell) Street, witnessed the fiercest fighting of the Easter rising of 1916 and the irregular revolt of 1922. The General Post Office was the revolutionary headquarters in 1916, and in the military operations the greater portion of the southern section of the street from Nelson Pillar to the Liffey was burned to the ground. Over 200 buildings were destroyed, including the General Post Office, of which only the shell remained, the Royal Hibernian Academy, the offices of *The Freeman's Journal*, several leading hotels and a large number of the principal shops and warehouses.

Destruction in 1922.—Rebuilding operations had not been completed when, in June 1922, forces opposed to the treaty with Great Britain seized the block of buildings in the northern section of Sackville Street between Cathedral Street and the Parnell Statue. This position was subjected to an artillery bombardment at close range and, as in the Easter rebellion, the buildings were destroyed by fire. Thus, with the exception of the block between Henry Street and Parnell Street, which suffered only partial damage, the whole of Sackville Street was reduced to rubble. While the southern portion of the thoroughfare has been reconstructed on modern lines, in 1926 little had been done, beyond clearing the sites, to make good the havoc wrought by the 1922 fighting. The heaviest architectural loss sustained was the destruction of the Custom House, and the four Courts. In May 1922 the Custom House, which under British rule was the headquarters of the Inland Revenue and the Local Government Board, was seized and set on fire by armed bands of the Irish Republican Army. Later, clearing operations were undertaken and it is the intention of the Free State Govt. to reconstruct the building.

In the assault of June 1922 on the Four Courts, the guns of the Provisional Govt. battered a breach in the walls, but the destruction of the building was due to the explosion of land mines by the irregular garrison. Rebuilding operations had made good progress in 1926. The pierced dome had been repaired and it is expected that by 1928 the law courts will again be housed in their former home. Meanwhile they are housed in Dublin Castle, which is no longer, as under the British régime, the headquarters of the executive.

Though the castle was handed over after the acceptance of the treaty by Dail Eireann, the Provisional Govt. decided to establish themselves in the College of Science, Merrion Street, which is now known as Government Buildings. This transferred the centre of administrative activity to a new quarter of the city, but the abnormal conditions created by the armed resistance of those opposed to the treaty, which kept ministers practically

prisoners in Government Buildings, made it necessary to select a meeting place for the first Parliament of the Free State with an eye to the exigencies of the military situation. Leinster House, adjoining the College of Science, and the National Museum, which forms a connecting link with the College of Science, were commandeered for the use of the Dail and the Senate.

Little is heard now of the demand that the old Parliament House in College Green should be restored to its former dignity. Though architecturally more imposing than Leinster House, the building could not be converted to the needs of a modern representative assembly save by a heavy outlay for the purchase of adjoining property, while, under present conditions of Free State finance, the cost of providing alternative accommodation for the Bank of Ireland, now in occupation, would be prohibitive.

A few miniature building schemes have been carried out, but nothing has yet been done to deal with Dublin's terrible slum problem. At present in the city 20,000 families are herded into single rooms. The stoppage of building during the War has been relieved in a slight degree for the middle classes by the transformation into flats of the capacious Georgian houses which in former days were occupied by single families. (J. W. Go.)

DUBLIN, UNIVERSITY OF (*see* 8.619).—Trinity College, Dublin, which constitutes the University of Dublin, sent 3,042 members to the World War, of whom 456 were killed or died on active service. Italian, Spanish and Irish form new departments of study. In 1919 arrangements were made for the admission of primary teachers from the Church of Ireland training college. In 1923 arrangements were made with the Royal College of Science to provide teaching leading to the degrees of Sc.B. (Tech.), B.A.I. (Mech.) and B.A.I. (Elec.). In 1925 a school of commerce was founded. A department for the training of secondary teachers in Trinity College has been established. In 1920 the mode of election of fellows by examination was completely altered, and a new system was adopted by which fellows might be elected for proficiency in any branch of learning. Research prizes were instituted for honour graduates. The Lecky professorship of modern history and the professorships of pathology, bacteriology and preventive medicine were founded, as were professorships in general chemistry, plant biology, human anatomy and embryology and physiology.

Benefactions.—The principal benefactions received during the period 1910–26 were as follows: The historical library of W. E. H. Lecky, containing over 6,000 vol., presented by Mrs. Lecky; £3,500 from Sir J. P. Griffith for the extension of Trinity Hall for women students; £2,500 from Lord Iveagh for the equipment of Trinity Hall; £3,000 from Sir J. P. Griffith to help graduates to secure permanent positions; £3,000 from Sir J. P. Griffith to help undergraduates; £10,000 from Lord Iveagh for the school of geology; £20,000 from the same donor for a new bath house in college; landed property bequeathed by Mrs. Lecky to endow the Lecky chair of history; £10,000 from J. M. Purser, M.D., for the schools of physic, natural science and experimental science.

DUBOIS, FRANÇOIS CLÉMENT THÉODORE (1837–1924), French musical composer (*see* 8.623), died in Paris June 11 1924.

DUBOIS, LOUIS ERNEST (1856–), French ecclesiastic, was born at Saint Calais, France, Sept. 1 1856. He was educated at the seminaries of Précigne and Mons, being ordained priest in 1879. In 1885 he became curate of Notre Dame de la Couture at Le Mans, where he spent 10 years and occupied himself with ecclesiastical history. After he became vicar of Saint Benoît in 1895, Mgr. de Bonfils chose him as vicar-general on his appointment to the bishopric of Le Mans. In 1901 he was appointed bishop of Verdun where he was obliged to cope with the delicate situation which arose concerning the separation of Church and State, and accomplished the task with the minimum of friction. In 1909 he was made Archbishop of Bourges, and during the World War was indefatigable in organising charitable associations and relief work. After continuing his admirable work in the diocese of Rouen, to which he was appointed in 1916, he was made Cardinal of Santa Maria in Aquino, Rome, by Pope Benedict XV. in Dec. of the same year. On the death of Cardinal Amette in 1920, Cardinal Dubois was made Cardinal Archbishop of Paris.

DUCHESNE, LOUIS MARIE OLIVIER (1843–1922), French scholar and ecclesiastic (*see* 8.629), died in Rome April 21 1922.

DUCTLESS GLANDS: *see* ENDOCRINOLOGY.

DULUTH, Minn., U.S.A. (*see* 8.653), had a population in 1920 of 98,917, including 30,196 foreign-born, among whom Swedes, Norwegians, Canadians and Finns predominated; and in 1925, according to the census bureau estimate, of 110,502. The area was 62 sq. m. in 1925. The city adopted the commission form of government in 1912, a building code in 1918, a zoning ordinance in 1925, a programme of city planning to be completed in 1927, and enlarged and co-ordinated its fine system of parks, boulevards and playgrounds (over 2,000 ac. by 1925). The Duluth-Superior harbour handled its maximum tonnage in 1923 (59,274,812 short tons, 62% more than in 1910), ranking second among American ports. In 1925 there were 22 coal docks, nine iron ore docks and 27 grain elevators. There were also a cement elevator three shipyards and 43 wharves for general freight.

DUNAJEC-SAN, BATTLES OF THE.—The Dunajec and San rivers, which, rising in the Carpathians, flow northwards across Galicia to join the Vistula on the Polish border, mark the first two stages of the great Austro-German offensive of 1915.

Austro-German Plans.—By the end of March 1915 the Austrian armies in the Carpathians were on the verge of collapse under pressure of the persistent Russian attacks (*see* CARPATHIANS, BATTLES IN THE); and it became obvious to Falkenhayn, who directed German strategy, that the available reserves of Germany must be used in the East to bolster up her principal ally. He had no intention of dispersing these reserves in purely defensive measures, and judged the time opportune to deal Russia a blow which would paralyse her offensive power for many months, if not permanently. The Franco-British attacks during March had given him a gauge by which to measure the defensive strength required in the West. He decided that troops could safely be withdrawn for the Russian front. He had also arrived at a just appreciation of the seriousness of Russia's shortage of reinforcements and of munitions. Not only were all formations much under establishment, but there were no available reserves either of trained men or of rifles; the stock of shells was almost exhausted, the output of the home factories was entirely inadequate and munitions from abroad could only arrive slowly. Russia's situation invited attack.

Having decided on an offensive, Falkenhayn had to choose between enveloping operations from the flanks or a break-through attack. The poor railway communications to the Carpathians and the disorganisation existing in that region as a consequence of the long winter battle excluded an operation from that flank. An enveloping movement from the northern flank—Ludendorff's favourite project—would be too distant to influence immediately the critical situation in the Carpathians. Falkenhayn determined on a break-through attack east of Cracow between the Carpathians and the upper Vistula. This point of attack appears well chosen. No great obstacle would be met till the line of the San was reached; the Vistula would afford some protection to the left flank of the advance; and a success would immediately influence the Carpathian situation. Moreover, the enemy's line on the selected front of attack was weakly held.

Disposition of Forces.—The Russian III. Army, which in Jan. held from the Vistula-Dunajec junction to about Gorlice in the Carpathian foothills only, had extended its front during the Carpathians battle. It now reached to about Mezö Laborcz, southeast of the Dukla pass, a total front of over 100 miles. It comprised a fighting wing and a defensive wing. The left wing, which had been engaged in the last great offensive of the Carpathians battle, consisted of four corps, all somewhat exhausted. The right, the defensive wing, on which the blow was to fall, had been weakened by the withdrawal of one corps to the IX. Army in the Bukowina and by the transfer of another corps to the left, the fighting wing; it now contained two corps only, holding a

front of 50 to 60 miles. The right corps, the IX., held the lower Dunajec, from its junction with the Vistula to south of Tarnów; the other, the X., extended between Tuchów and Gorlice.

These two corps had been sitting inactive opposite the Austrian IV. Army all winter; and the dispositions they had made were calculated for defence against Austrians, not Germans. Consequently there were neither sufficient rear lines nor alternative gun emplacements. The Army had only a single corps in reserve, the III. Caucasian. The Russian army commander was Radko-Dimitriev. He had some ability and was a gallant fighter, but seems to have distinguished himself more as a corps commander than as an army commander.

The German XI. Army, the spear point of the offensive, consisted of eight German divisions from the western Front, two Austrian divisions and a cavalry division. It was assembled with great secrecy behind the right of the Austrian IV. Army, opposite the Russian X. Corps. Its commander was Mackensen, who had led the Łódź offensive at the end of 1914 (*see* Łódź-Cracow) and was to win further fame by his victories in Serbia and Rumania. The Austrian IV. Army was placed under him in addition to his XI. Army. He himself was subordinate to the Austrian High Command.

Mackensen's Attack.—The preliminary bombardment began on May 1 and was continued during the forenoon of the 2nd. It was carried out by 1,500 guns of all calibres, and left the Russians powerless. Mackensen's army swept over the shattered trenches of the X. Corps, meeting with little resistance, and pressed forward in the direction of Rzeszów and Jarosław. The Austrian IV. Army forced the IX. Corps from its line on the lower Dunajec. The Austrian II. and III. Armies in the Carpathians also began a forward move. There followed five days of hard fighting, but the Russians were unable to stem the tide. Radko-Dimitriev's reserve corps attacked gallantly but fruitlessly; his left wing had to yield the Dukla pass and the hard-won gains of the April offensive. An attempt to stand on the line of the Wisłok river and the Łupków pass failed before renewed Austro-German attacks on May 8. Brusilov's VIII. Army was now also involved in the retreat; and a few days later the left wing of the IV. Army north of the Vistula had to retire from the line of the Nida.

The Russians now decided to check their foes on the strong line of the river San, with the fortress of Przemyśl to support their left centre, and the Dniester marshes to protect their left flank. Mackensen's army, however, reached Jarosław on May 14, stormed the bridge-head next day and established itself east of the San. It extended its gains to Sieniawa on the following days and threatened to jeopardise the whole Russian position on the San. But the impetus of the attack had spent itself for the moment and the Russians were given a breathing space. Strong reinforcements were being hurried up to them, but their losses had been enormous, over 170,000 in prisoners alone.

New Russian Line.—The Russian III. Army now held the line of the San (except for the breach made by Mackensen opposite Jarosław) as far south as Radymno; thence the VIII. Army continued the line past Przemyśl to the Dniester marshes near Sambor. The XI. Army was on a line northwest and southeast of Stryj. In the Bukowina the IX. Army had started a counter-offensive, but had made little progress. North of the Vistula on the right of the III. Army, the line of the IV. Army ran from the Pilica river by Radom-Iłża-Opatów.

Further Austro-German Attacks.—The second stage of the fighting began with an attack by Mackensen's forces on May 24, which forced the line of the San at and about Radymno and thrust southeast towards the Przemyśl-Lemberg railway. The Austrians simultaneously attacked Przemyśl from the south, but made little progress. The Russians now made a counter-stroke on Sieniawa, north of Jarosław, with the III. Caucasian Corps. This gallant corps stormed the Austrian positions and caused a temporary set-back to Mackensen's plans. At the same time, heavy attacks were made on the Austrian IV. Army further north.

But the odds against the Russians were too heavy; they had little or no ammunition for their guns and practically no heavy artillery at all; their counter-attacks were made with little or no artillery preparation; even rifle ammunition was not plentiful. Before combined attacks of the German XI. and Austrian II. and III. Armies, Przemyśl fell on June 3; and the line here had to be withdrawn to about Gródek. The line of the lower San, north of Sieniawa, was held till June 11, when Mackensen, who had received reinforcements, attacked again and forced the whole of the San line, the Russians retiring to the last line of defence west of Lemberg. (*See* Lemberg, Battles of.)

Operations in the Southeast.—Meanwhile, during the last week of May and first two weeks of June, battles were being fought further to the east and south, opposite Stryj and along the lines of the Dniester and Prut. At Stryj the Russian XI. Army (Shcherbachev) faced Linsingen's Southern Army; on the Dniester and Prut Lechitski's IX. Army was opposed to Pflanzer-Baltin's group. The result of both battles was the same. In spite of their repeated counter-attacks the Russians had to give ground.

By the middle of June the Russian losses in Galicia since the beginning of Mackensen's offensive included nearly 400,000 prisoners, over 300 guns and much other material. Their losses in killed and wounded had also been exceedingly heavy, for they had counter-attacked repeatedly with little artillery support. The Russians were in fact paying in flesh and blood for their lack of modern equipment. The dominance of his heavy artillery was the chief factor in Mackensen's success; the Russians had none with which to oppose it. The lesson should have been clear enough, yet a year later the Rumanians entered the War to pass through the same bitter experience as the Russians. (*See* Eastern European Front.)

Bibliography.—E. von Falkenhayn, *General Headquarters 1914–16, and its Critical Decisions* (1919); Sir A. Knox, *With the Russian Army 1914–17* (1921). (*See* also World War: Bibliography.)

(A. P. W.)

DUNCAN, ISADORA (1878–), American dancer, was born in San Francisco, Cal., May 27 1878, and was educated there, receiving a special training in music. In 1890, she made her first public appearance as a dancer. In 1895 she went to Chicago, and subsequently joined Augustin Daly's company in New York, taking dancing rôles. In 1899 she went to London, where she was enthusiastically received, and made tours throughout the principal capitals and art centres of Europe. In 1904 she established a school for classical dancing near Berlin, where she commenced the training of the girls who later became known as the Duncan dancers. In 1923 she accepted an invitation of the Soviet Government to establish a school of dancing in Moscow. On her return she took up her residence in Paris (*see* Ballet).

DUNDEE, Scotland (*see* 8.674), with a population of 168,315 in 1921 and estimated at 169,600 in 1923, is the third largest city in Scotland. Broughty Ferry, a considerable town four miles to the east, was added to the borough in 1913. The large factory population, together with the number of high tenement buildings, has given rise to slum conditions with which the municipality was in 1925 endeavouring to cope by means of housing schemes. The area of the borough is 6,548 acres.

Ground containing the ruins of Mains Castle and part of the estate given by Sir James Caird in 1911 were opened as Caird Park in 1923. A Technical College was opened in 1910, and a Training College in 1920; and in 1915 the Central Reading Rooms and Sculpture Galleries in Ward street were finished. A City Hall has been built on the Green Market, a quadrangle containing the old Town House; the latter has been preserved, though the buildings on each side of it have been cleared away. A War Memorial in the shape of an obelisk has been erected on the top of Law Hill.

DUNSANY, EDWARD JOHN MORETON DRAX PLUNKETT, 18th Baron (1878–), Irish dramatist, was born in London on July 24 1878. He was educated at Eton and Sandhurst, and succeeded his father as 18th Baron Dunsany in 1899. Entering the Coldstream Guards, he served in the Boer War, and, in the Royal Inniskilling Fusiliers, in the World War. As a playwright, he first attracted attention with *The Glittering Gate*, produced

in Dublin, 1909; the best of his other plays, which are inspired by an exotic fantasy and expressed in richly coloured language, are *The Gods of the Mountain* (1911), *A Night at an Inn* (1916), *If* (1921) and *Alexander and other Plays* (1925). He has also written numerous tales in similar style, to be found in, among other volumes: *The Gods of Pegana* (1905); *The Sword of Welleran* (1908); *Tales of Wonder* (1916); and the *Chronicles of Rodriguez* (1922); *Evil Kettle* (1926); *Old King's Tale* (1926).

DUPLICATING MACHINE: *see* OFFICE APPLIANCES.

DU PONT, THOMAS COLEMAN (1863–), American manufacturer and politician, was born at Louisville, Ky., Dec. 11 1863. Educated at the Massachusetts Institute of Technology, he entered the Kentucky coal and iron mining industries in 1883, operating on a large scale. In 1900 he removed to Wilmington, Del., being interested in the E. I. du Pont de Nemours Powder Co., of which corporation he was president 1902–15. Having been appointed Senator in July 1921, in place of Josiah O. Wolcott, who had resigned, he failed to secure election on the Republican ticket in 1922, but was successful in 1924. He built a concrete motor highway at a cost of $4,000,000 in the state of Delaware, and made a gift of it to the state.

His cousin, Pierre Samuel du Pont (1870–), having graduated from the Massachusetts Institute of Technology in 1890, engaged in manufacturing at Wilmington, becoming chairman of the board of the E. I. du Pont de Nemours Powder Co., and also chairman of the General Motors Corporation, an organisation consisting of 28 major manufacturing operations, 27 sales organisations and 8 miscellaneous companies, the principal business of which is the manufacture of motor cars, accessories and parts. The E. I. du Pont Co., the business of which was originally confined to the making of explosives, under his guidance, extended its activities to include the manufacture of artificial silk, motion picture films, paints and varnishes.

DUPUY, CHARLES ALEXANDRE (1851–1923), French statesman (*see* 8.690), died at Isle-sur-la-Tête July 23 1923.

DURBAN, Natal, South Africa (*see* 8.696).—In 1921 the population was 146,310, of whom 57,095 were whites and 47,811 Asiatics (nearly all Indians). In 1911 the population was 78,072 (whites 34,882). It is the most compact of South African cities, the borough covering only 12 square miles. Its prosperity depends upon its port (Port Natal); since 1910 it has become a manufacturing centre and a leading holiday resort.

Chief among modern buildings are the Town Hall, opened in 1910, and the Law Courts. The latter face the Victoria Embankment, a fine thoroughfare along Bay Beach, *i.e.*, the Bay of Natal. At the Point, overlooking the eastern entrance to the harbour, an equestrian statue of Dick King, commemorative of his great ride to seek help for the infant settlement, was erected in 1915. A memorial to Durban citizens who fell in the World War was unveiled in the Public Gardens in 1926. From Ocean Beach a semicircular pier, over 900 ft. long, encloses a bathing place free from sharks. Ocean Beach, with its esplanade and park and fine hotels, forms the chief attraction during the Durban winter season (May to Sept.) when the mean maximum temperature is 76° F. For horse-racing fixtures Durban ranks only second to Johannesburg among the cities of South Africa. A wireless station, the first in South Africa, was opened in 1910. In 1925 a site of 50 ac. was selected for a university for Natal.

Vessels are constantly engaged in dredging the bar at the entrance to the harbour; the lowest depth of water at the entrance is 36 ft. the minimum depth at the quayside varies from 23 to 34 feet. There were by 1925 three miles of wharfage and the harbour is equipped with every facility for the rapid loading and unloading of ships. Some 300 ac. of land have been reclaimed at Congella, at the northeast end of the harbour and here on June 4 1925 the Prince of Wales opened a new graving dock, the second largest in the world, being 1,159 ft. long and 138 ft. wide at the entrance.

Shipping.—The bunkering and export of coal, an industry made profitable by the nearness of the Natal coal-fields, made Durban by 1913 the chief cargo-handling port of South Africa. While the amount of coal bunkered, 1,395,000 tons in 1910 and 1,226,000 tons in 1924, tended to decrease, the coal exports rose steadily, being 57,000 tons in 1910 and 1,502,000 tons in 1924. In 1923 the cargo handled at Durban totalled 3,592,000 tons as against 1,907,000 tons for all the other ports of the Union combined. The tonnage of shipping entering Durban, 3,944,000 in 1913 was 3,959,000 in 1923. Owing to the scarcity of shipping there had been a sharp drop to 2,155,000 tons in 1918.

(F. R. C.)

DURHAM, UNIVERSITY OF (*see* 8.709).—By the University of Durham Act, 1908 (8 Edw. VII. c. 20), the university was reconstituted by commissioners appointed under the Act. It now consists of the Durham division and the Newcastle division. The latter is composed of the College of Medicine and Armstrong College, though each of these exists at present as a separate unit, with its own constitution and government. The Durham colleges, University College, Hatfield College, St. Chad's College, St. John's College, St. Mary's College (women) and three residential colleges form also a unit, controlled by the council of the Durham colleges. Certain professors are known as professors of the university, while others are known as professors in the university. Canonries in Durham Cathedral are attached to the professorships of divinity and Greek. The system and life in Durham are broadly similar to those of Oxford and Cambridge. The Newcastle division more closely resembles the modern urban universities. Proctorial administration is carried on by two proctors, one for each division, nominated annually by the senate and appointed by the chancellor.

Since 1908 the University of Durham has made great progress. The numbers of matriculated students has more than doubled. Seven new professorships and six readerships have been established in Durham, five new professorships in the College of Medicine, and seven professorships and four readerships in Armstrong College, while the number of lectureships in all subjects has been very greatly increased. Among other developments may be noted the well-equipped science laboratories, and a department of education in Durham, the bacteriological department in connection with the College of Medicine, and the school of law at Armstrong College. The Durham colleges possess an astronomical laboratory, while Armstrong College has a model farm at Cockle Park, and a marine biological institute at Cullercoats. A new library to contain 200,000 books is being built at Armstrong College. Among recent benefactions may be noted the Union buildings, the sports ground at Newcastle and scholarships.

DUSE, ELEONORA (1859–1924), Italian actress, belonged to a family of actors from Chioggia, near Venice. Her grandfather, Luigi Duse, a celebrated actor of Goldoni plays, created the 18th century Venetian masque of Giacometto, round which a whole dialect repertory turned. Born on a tour in Lombardy, Oct. 3 1859, Eleonora Duse was carried to her christening at Vigevano in a gilt theatrical property-box; some Austrian soldiers presented arms, thinking it was a reliquary. She acted the part of Cosette in *Les Misérables* at the age of four in a booth at Chioggia. At Verona she played Juliet when just 14, and drew public attention by her love of flowers and the use she made of them in her art. The incident is always referred to as "the device of the roses" (*la trovata delle rose*).

About this time her mother, to whom she was passionately attached, died, and thrown on her own resources, often in dire poverty, she passed from one travelling company to another, eventually reaching fame through sheer hard work no less than by genius and the exceptional beauty of her speaking voice. She acted in *Alcibiades* of Felice Cavallotti, in *Orfeo* of Alfieri, and took the part of Shakespeare's Ophelia with success. She gained wider recognition in 1878 when, one night at Naples, she was called upon suddenly to take the leading part in *Les Fourchambault* by Augier. In the following year, after securing a real triumph in the part of Zola's *Thérèse Raquin*, Cesare Rossi engaged her for his famous company as *prima diva* and she added *La Princesse de Bagdad* to her repertory. A memorable year was 1882: she saw Sarah Bernhardt act at Turin in *La Dame aux Camélias* of Dumas fils, and felt inspired to give her own interpretation of Marguerite Gautier—"fille galante, extrêmement distinguée," a character which both actresses idealised. The

Frenchwoman, less realistic and temperamental, possessed a more subtle style; but, in certain scenes, the passionate almost volcanic powers of the Duse admitted of no rival. The greatest triumph, perhaps, in her career was gained in this part, and she was induced to act it in Paris in 1897, when the Parisians were taken by storm, Sarah Bernhardt leading the applause. She also acted in *Frou Frou* and *La Femme de Claude*. Her *Magda*, in the opinion of Sudermann the author, was never surpassed. In the character of Mirandolina (*La Locandièra* of Goldoni) she also showed a remarkable gift for light comedy. She created the character of Santuzza in *La Cavalleria Rusticana*, given for the first time in 1884, and such was her success that Verga said the play belonged as much to her as to him.

Her acting during all this period was characterised by realism devoid of any excess; hers was the highest kind of romantic realism which had passed through the flame of intense feeling. Coquelin the elder said of her: "No one draws from humanity as she does; she is passionately beautiful and great." "O grande amatrice," exclaimed D'Annunzio after witnessing a love scene in *La Dame aux Camélias*. Her own words still further help to explain her vivid and varied personality: "How I have loved life!" she wrote to a friend, and again: "There are a thousand women within me, and each one makes me suffer in turn." Although Duse was noted for her exceptional naturalness, spurning certain mechanical rules of the stage, and showing unerring artistic instinct, she was by no means guided only by impulse. Her spontaneous art was built upon a careful structure, and no actress had a greater capacity for taking pains. She brooded over her characters, which became so much part of herself that she could not act certain plays on two consecutive nights; and, during the run of a season, she withdrew herself entirely from friends and family.

Eleonora Duse was a woman of wide culture; her intellectual life had been greatly influenced early in life through a close friendship with Arrigo Boito, the composer, whose sound criticism proved of considerable value to her art. The books she steeped herself in included the writings of Pascal; Keats; and Thomas à Kempis; *The Letters of St. Catherine of Siena; The Confessions of St. Augustine* and *L'Action* by Maurice Blondel. Essentially religious by nature, she was untouched by organised religion. She travelled a great deal both for her profession and for pleasure: Matilde Serao called her "the impassioned pilgrim." She had no fixed home; the nearest approach to one was her summer house at Asolo. She lived simply but spent large sums on producing plays and in financing her company of actors whom she would sometimes keep idle for long spells on account of health. She made her first appearance in Paris in 1884; went to London and New York in 1893 and to Moscow in 1892 and 1897, and to Egypt. She always particularly liked acting in Vienna.

Her restless, soaring spirit eventually grew weary of Dumas and Augier, finding in *La Dame aux Camélias* alone "a thread of gold to hold together the string of false pearls"; and, towards middle age, the Duse turned definitely to poetry and "les oeuvres de pensée." In 1896 she commissioned Panzacchi to translate *L'Abbesse de Houarre*, which she acted in Rome with so much success that Renan wrote her a letter full of praise and gratitude. At this time she passed under the spell of the later works of Ibsen, to be closely followed by the aestheticism of D'Annunzio. In the Scandinavian dramatist she saw the poet more vividly than the scourger of society. Ellida, *The Lady from the Sea*, with whom she felt some affinity, was her favourite heroine. Ibsen was not altogether satisfied with her interpretation of Hedda Gabler; he is reported to have said as he left the theatre: "She believes Hedda to be a neurotic, but she is absolutely wrong."

Her life-consuming friendship with D'Annunzio began in 1897; they parted in 1902, only to meet 18 years later at a patriotic gathering in Milan. D'Annunzio immortalised their friendship in *Fuoco*, the novel of the lagoons, incorporating many of her letters and sayings. *La Città morta* he had dedicated to Sarah Bernhardt; *La Gioconda* he wrote for "Eleonora Duse of the beautiful hands," and wrote many other plays under her enthusiastic inspiration. She took up the cause of D'Annunzio as a dramatist with almost mystic exaltation, and threw all her energies into trying to found a theatre which was to be a D'Annunzio Bayreuth for the glory of a pure art. A site was offered to her on the shores of Lake Albano, near the Baths of Diana, but to her grief the scheme fell through, chiefly because the public did not recognise the real Duse in the drama of D'Annunzio. *La Gloria* was hissed at Naples in 1898 and no better success attended *Sogno di un mattino di primavera*, but she won some applause for *Francesca di Rimini* in 1902. Undaunted, the Duse insisted upon acting only the plays of D'Annunzio when she went to America in 1902–3 with Ermete Zacconi, and, in spite of financial losses, she refused to revive old favourites. Some people think that D'Annunzio had an enervating effect upon her art, and that her recitation tended towards monotony; while, in the opinion of others, her style lost rough edges and gained in classical grandeur, and her general culture was enriched.

At the height of her fame in 1909, Eleonora Duse definitely left the stage, mainly on account of health. She suffered from asthma and exhaustion. The last performance was given at Berlin in *The Lady from the Sea*, which she described as her swan song. She felt she had been a worthy interpreter of Ibsen that night, adding with characteristic modesty: "but I may be wrong." For twelve years she retired into private life. But, owing to pecuniary losses arising out of the World War, she had to face the necessity of returning to the stage. After much anxious thought she accepted collaboration once more with Ermete Zacconi, appearing at Turin in 1921 in *The Lady from the Sea*. "I only want to act the part of mothers," she said, "women without age, creatures of eternity, like Ellida and so many heroines of the great Ibsen . . . . No wigs, they must accept me with my white hair." They did, and Eleonora Duse found that she had conquered the world a second time. Apart from the question of money difficulties, it is clear from letters and published conversations with friends that a desire to do something for Italy acted as an incentive to work at this time. Animated by a passionate desire to participate in the joys and sorrows of her fellow creatures, she strove to teach "the good and beauty of life" to a world devastated by a spirit of violence, which was abhorrent to her nature. For the purpose of this spiritual crusade, and also for the benefit of young authors, she tried to found an Italian theatre—*Teatro dei Giovani*. She complained that her scheme was not supported by the Government, but her ideas were vague and perhaps, too, time was not ripe for the venture.

This, the last period in her career, was marked rather by a wonderful revival of her youthful genius, rather than by any new creations or change of style. She continued to play Ibsen, D'Annunzio and *La Porta Chiusa* of Marco Praga, and risked popularity, as well as loss of money, by producing a new play, *Così Sià* by Gallarati Scotti. It was killed on its first appearance in Rome in Jan. 1922, so far as Italy was concerned. The play was written round a mother's prayer and vow to the Madonna, a fine fragment which appealed to the Duse, who interpreted it as a symbol of enduring human love and sacrifice. After touring Italy she made her last appearance in London in June 1923 when she acted to far fuller houses than in the heyday of her glory.

She courageously accepted a tour in America the following spring, where she also received a triumphal reception. But her health was broken, and often she had to be revived with oxygen after a performance, though her vitality never gave out during the play. The long journeys and the cold proved too great a strain upon her small reserve of strength; the mild climate of California revived her and she wished to stay longer, but an inexorable theatrical agent urged her forward, and she died from the results of a chill at Pittsburgh on April 21 1924 at the age of 64. She was pitifully anxious not to die far away from Italy, and gave feverous orders, almost with her last breath, to pack up quickly so as to catch the boat home. Italian emigrants knelt on the quay as her coffin was lowered on to the battleship "Duilio" at New York, and national mourning was proclaimed in Italy. Her countrymen desired to see her laid at rest with other illustrious Italians in Santa Croce at Florence, but they respected her wishes to be quietly buried at Asolo.

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DUTCH LITERATURE (*see* 8.719).—The movement towards naturalism, begun in the eighties with the founding of *De Nieuwe Gids*, was succeeded towards the end of the century by a definitely democratic tendency, of which the delicate and consciously simple works of Adama van Scheltema and those of the fiery revolutionary Henriëtte Roland Holst were most representative. Soon, however, the influence of Albert Verwey, with his monthly *De Beweging*, made itself felt. Verwey, originally one of the men of the eighties, gradually developed a more balanced style, resulting at its best in symbolism, and in its less happy phases in extreme intellectualism. This movement gave rise to a number of poets who gave to the period under revision its special character. In the eyes of these younger men Verwey was regarded as the leader. It was more by virtue of his ideas—the exalting of imagination to the rank of the supreme function of the intellect, by whose light one can best learn to understand the soul and the world—than by his poetry, which only too often bears the marks of laborious creation.

Of the elder poets, Boutens, Henriëtte Roland Holst, Karel van de Woestijne and Verwey continued to produce work of merit—Boutens, full of thought and melody; Henriëtte Roland Holst, full of mysticism and ideas of the brotherhood of man—Karel van de Woestijne, the Fleming, voluptuous, sensual, reminiscent of the period of the renaissance. J. H. Leopold (d. 1925) wrote little, but nevertheless exercised a certain influence on the younger generation. Others worthy of mention are Geerten Gossaert, the central idea of whose work *Experimenten* (1919) is the consciousness of the ego, controlled, if not always successfully, by Christian faith; A. Roland Holst, a nephew of Henriëtte, who (with Jan Prins, the inspired poet of the sea and the Orient, and Martien Beversluis) was perhaps the most prominent poet of this time. He has—what is rare in the poems of Verwey's followers—a soft, easy flow of song, a yearning for some hidden beauty existing far away beyond sea horizons, and a deep feeling of mystery underlying the delicate description of some commonplace scene. The works of Jacob Israel de Haan (d. 1924), are, like those of Gossaert, permeated by a strong, sincere religious faith. He is more direct and passionate in his expression than Gossaert, and unlike the latter never lapses into rhetoric, but is terse and concise.

Although not fully appreciated by the leading critics in the *Beweging* circle, Martien Beversluis succeeds by means of an uncommonly delicate and vivid combination of wording and rhyme in giving a surprising and brilliant form to his visions of nature. Of the younger poets, constituting more or less a group, mention may be made of M. Nijhoff, the poet of child dreams robbed of their lustre by the realities of life; Werumeus Buning, whose small volume *In Memoriam* (1924), blooms as a flower of contemplation which has sprung up in a pale, still dawn on the grave of a dead love; van Schagen, who in formless recitatives rejoices in the gloriousness of every aspect of life; Besnard, who in apparently easy-flowing verse makes us feel the emptiness of modern life; Slauerhoff, whose conception of life is similar but more humane, and who therefore can afford to smile now and then. The Flemings, Wies Moens and Urbain van der Voorde, may also be included in this survey of post-War poetry and there are a number of others.

Fiction.—During this period the novel came to flower. The later works of the painter-novelist Jac. van Looy, who belongs to the older school, show a departure from his early plastic manner. In *Jaapje* (1917) and *Jaap*, reminiscences of his childhood, he shows a complete understanding of the mind of a child free from all sophisticated comments. With him may be coupled Ary Prins, who in 1913 completed his *Heilige Tocht;* in its impressionism a typical work of the eighties.

Couperus, up to the time of his death in 1923, wrote novels dealing with aristocratic life, brilliantly coloured stories of olden times, such as *Herakles* (1913), *De Komedianten* (1917) and *Iskander* (1920). In this latter period he also showed himself a master of the short story, frequently told in the first person. Herman Robbers in his later work never surpassed his *Roman van een Gezin*, a study in social psychology. J. De Meester followed up his masterpiece *Geertje* (1921) by many stories full of irony and hatred of respectability. Van Hulzen, after producing a number of striking sketches dealing with people living outside society, wrote various novels on the subject of love and marriage. Realism on the broad lines of Zola probably found its greatest representative in Is. Querido, who, in his romantic cycle *De Jordaan* (1914) drew a brutal picture of life in this typical quarter of Amsterdam, whilst in *De Oude Waereld* (1918) he attempted to resurrect the ancient civilisation of the Orient, and was on the whole successful. In the portrayal of times past, ancient civilisations, and in the modern historical novel (which differs from the romanticism of 1850–70 in that it makes deeper psychological investigations) he was preceded by Ary Prins and Couperus, by Adrian van Oort and Arthur van Schendel. The latter, however, was more individual in his treatment of these subjects. P. H. van Moerkerken also wrote a series of novels dealing especially with the past life of his country.

A great many women contributed towards the romantic literature of the period. In collaboration with her husband, Carel Scharten, Margo Antink, having given independent proof of a talent for vigorous naturalistic work, produced a series of large scale pictures of various phases of society, mostly Italian. The vigorous style of the woman was combined with the man's tendency towards *préciosité*. Mention may also be made of Top Naeff, who began her literary career with a number of books for girls, but later produced works dealing with subtle feminine psychology, including the great novel *Voor de Poort* (1914), a story dealing with the unreturned love of a woman.

Ina Boudier Bakker produced work widely divergent in character—symbolic stories, reminiscent of Norway, plays and a number of excellent sketches of children. Her talent, however, was shown to the best advantage in novels of family life, such as *Armoede* (1917) and *Het Spiegeltje* (1917), which were greatly admired and achieved great popularity. Augusta de Wit wrote admirable novels about the Dutch East Indies. Carry van Bruggen—whose husband, Kees van Bruggen, under her influence, developed into an important novelist of great imaginative power—in her novels is inclined to indulge in one-sided arguments. Her sketches, however, which frequently deal with children, are mostly masterpieces of observation, full of subtle humour. Jo van Ammers-Küller, author of several plays, wrote a number of novels dealing with theatrical life, such as *Het Huis der Vreugden* (1922) and *Jenny Heysten* (1923). Annie Salomons—who also wrote under the *nom-de-plume* of Ada van Gerlo—wrote a number of novels and sketches dealing with the aspirations of the modern woman. Nico van Suchtelen is the chief representative of symbolism in fiction.

Dramatic Literature.—The period is best represented by Heyermans, who in his later plays attempted symbolism, but was really more at home in realism. He wrote one extremely witty play, *De wijze Kater* (1920). Of Emants' later work, *Om de Mensen* is notable as a description of society life at The Hague. One of the best plays of Madame J. A. Simons-Mees is *Levensstroomingen*, which depicts the conflict between parents and children. Both sides are represented with strict impartiality. Jan Fabricius has given us a series of plays dealing with the tropics, but they are very unequal. *Eenzaam* and *De Meteoor* are perhaps the best. Madame Ranucci-Beckman and Dr. P. C. van Rossem wrote a number of witty drawing-room plays. Alph. Laudy's *De Paradijsvloek* was a partly successful attempt at a monumental work. The 20th compared with the 19th century shows a considerable improvement as regards the number of original plays produced, and on the whole interest in the stage has grown, the artistic standard has been raised, and a higher level of performance demanded and exercised. (*See* NETHERLANDS.)

See H. Robbers, *De Nederlandsche Litteratuur na 1880* (1922); Dirk Coster, *Nieuwe Geluiden* (1924). (J. WA.*)

DUVENECK, FRANK (1848–1919), American painter (*see* 8.737), died in Cincinnati, O., Jan. 3 1919. He was awarded a special gold medal at the San Francisco Exposition in 1915, and in the same year he presented to the Cincinnati Museum a large collection of his own works.

DYEING (*see* 8.744).—Profound changes took place between 1910 and 1925, more in the field of industrial politics than in the technical side.

I. THE INDUSTRY IN GREAT BRITAIN

War Problems.—The War produced a period of chaos, and swept the industry into the centre of national politics owing to three main factors—(*A*) the colour users of the world, of whom textile manufacturers were the most important, had become largely dependent on Germany, who, in 1913, supplied three-quarters of the total world demand. Switzerland was the second important source, supplying 7%, Great Britain 6·5%, France 5·4% and the U.S.A. 3·3%. (*B*) On the outbreak of the War the nations of the world suddenly found their supplies cut off, and the important textile industries of Great Britain, France, Italy and the United States were in a most difficult position. (*C*) In addition, colour-chemistry produces a number of chemical experts, whose knowledge enables them to apply chemicals to war purposes in the production of high explosives, such as picric acid and T.N.T., and also in the manufacture of poison gas and the like. It is true to some extent that dye factories can be used for the making of high explosives, but what is more important is that this industry provides a reserve of highly qualified chemists whose services the Government can, if necessary, utilise for war purposes. Thus the nations at war with Germany found their national wellbeing threatened at two points: firstly, a whole group of basic industries, the textile, were jeopardised; while, secondly, the national existence itself was threatened by the superior skill of their opponents in chemical warfare (*q.v.*).

The various nations met the crisis in different ways, according to the national temperaments. In Great Britain, at the outbreak of war, there existed five important British firms making dyes and two German firms with works in Great Britain. The latter were sequestrated by the British Govt., and ultimately disposed of to British firms. The output of the British firms, even when supplemented by supplies from Switzerland, was totally inadequate to meet the requirements of the British textile manufacturers, on whom the demand was abnormally increased by the Government requirements for military and naval uniforms and the like. The average annual British import of dyes from abroad in pre-War years had amounted to nearly 18,000 tons, worth £2,000,000. Many important dyes, such as synthetic indigo, were German trade secrets and had never been made in this country.

British Dyes Ltd.—To meet these difficulties the Government, in close co-operation with the users of dyes, established a company named "British Dyes Ltd.," with a capital of £3,000,000, of which the Government supplied half. The new firm started by taking over one of the old works, that of Messrs. Read, Holliday & Co., at Huddersfield, but began to build new and enlarged works. The building went on during a period of continuously rising prices, and ultimately the huge size and enhanced cost of these buildings became a serious liability to the firm, or rather to its successor.

Meanwhile other works sprang into existence, encouraged by the large profits which for the time being were obtainable. During this period the chief difficulty was that of working out the formulae for the intermediate products, especially for the azo dyes, nearly all of which had previously come from Germany. In addition, British dye manufacturers found themselves faced with a shortage of certain needs, especially "oleum" and oil of vitriol, which necessitated the construction of new chambers and contact plant.

Government Action after the War.—Considerable progress was made, however, and at the conclusion of the War the Government recognised that the dyestuffs industry must be protected and helped to establish itself on a sufficiently firm basis to prevent the recurrence of such a crisis. It therefore recognised the production of dyes as a key industry, and extended to it a strong measure of protection against foreign competition; and secondly, it helped in the establishment of a new firm, which absorbed not only "British Dyes Ltd." but also its chief competitor, Levinstein Ltd., who had previously bought up another important firm, Messrs. Claus & Co.

During and immediately after the War the Government had restricted the importation of German dyes by proclamation; but when peace had been signed this procedure was challenged, and in a test case the courts decided that the proclamation was illegal. In consequence, a special Act of Parliament, the Dyestuffs (Import Regulation) Act 1920, 10 and 11 Geo. V., cap. 77, was passed, which came into force Jan. 15 1921. This Act is intended to protect the dye industry for 10 years, and under it no dyestuff may be imported which can be satisfactorily made in Great Britain, while, where imports are shown to be necessary, a licence must be obtained from a committee appointed by the Board of Trade.

Thus the new firm, "The British Dyestuffs Corporation Ltd.," practically constituted a monopoly, and in order to safeguard national industries in general, and particularly those of dye users, the Government insisted on retaining considerable control in the administration of the business. The shareholders of British Dyes and of Levinstein Ltd. exchanged the holdings they had in these concerns for shares in the new company. The Government, in lieu of the amount it had technically "loaned" to British Dyes, received £1,700,000 worth of shares, and subscriptions were invited for £5,000,000 new capital. These were taken up by the general public, mostly by people not interested in the business as colour users, thus creating an entirely different situation, for the new firm, the British Dyestuffs Corporation Ltd., had now to earn dividends to satisfy these shareholders, whereas "British Dyes" might have been able to satisfy its shareholders, the dye users, if it provided good and cheap dyes, even if its profits were negligible. The British Dyestuffs Corporation had therefore to satisfy its shareholders like any other business, while its hands were, to a considerable extent, tied by the Governmental control to which it had to submit, and the objects of the Government were obviously not precisely the same as those of the people who had subscribed money in the expectation of receiving good dividends.

The clauses in the articles of association which placed the Government in a peculiar position were three in number:—

(*a*) The allotment to Government nominees of a special share carrying special voting rights for the purpose of preventing any alteration in the company's articles of association.

(*b*) Restrictions on the allotment and transfer of shares to foreigners or persons under foreign control, and provisions under which it was necessary to secure the consent of the Board of Trade to any allotment or transfer of shares to such persons.

(*c*) The nomination of two directors by the Government, and the exercise by those directors of certain powers of veto and control over the company's affairs.

The nominal share capital of this new venture was fixed at £10,000,000.

Reconstruction.—It was hoped by these two measures to establish the manufacture of dyes in Great Britain on a firm basis; but by 1925 it had been found that although the licensing system worked fairly smoothly, despite a certain amount of complaint from the colour users, the British Dyestuffs Corporation itself was not a financial success. On Nov. 25 1925 it was reconstructed, the issued share capital of £9,197,112 was reduced to £4,775,000 and the articles amended.

The Government abandoned all claims to control the company and surrendered its shares, which then amounted to £1,700,000, for a cash payment of £600,000. The company agreed to keep in touch with the Board of Trade in all matters of technical information and research, and also undertook that

not more than 25% of its shares should be held by foreigners. The partial failure of the corporation was largely caused by two other factors, firstly the cost of its vast new works at Huddersfield, built at a time of inflated prices; and, secondly, a changed economic situation. All other nations had established dyestuff factories of their own, and in 1925, while the output of the world was four times that of 1913, effective demand had not kept pace with this expansion, and there was not enough business to meet the overhead charges of all. (J. S. M. W.)

II. THE INDUSTRY IN THE UNITED STATES.

The dyeing industry of the United States during the period 1910–26 grew commensurately with the textile industries. An important advance was made in the production of fast colours, especially on cotton goods. This was in keeping with the rapidly extended use of cotton in high-grade wearing apparel and with the increase of steam laundries, displacing household washing. Modern laundry methods or rapidly cleansing and whitening fabrics necessitated the use of strong chemicals, destructive of many of the colours formerly employed in dyeing cotton. The demand for laundry-fast colours was met by the introduction of the so-called "vat" dyes, of which indigo was long the only representative. The extended use of the dye known as sulphur black to take the place of aniline black for cotton hosiery and piece-goods was also worthy of note. The silk industry also grew largely, the United States consuming more raw silk in manufactures than any other country. This led to the great extension of silk-dyeing, chiefly in the industrial centres of South Manchester, Conn., Paterson, N.J., and Lancaster, Pennsylvania. Another branch of the textile industry which has developed to great proportions in the period 1920–6 is that of artificial silk or rayon fibre. This has required a corresponding development in the dyeing industry, as this new fibre requires special methods of dyeing, and in some cases new kinds of dyestuffs. At the present day there is even a larger amount of rayon fibre manufactured than there is of natural silk, and the industry is still growing rapidly.

The World War at first threw the dyeing industry in the United States into confusion, owing to the uncertainty of trade relations with Germany, the more so when the Allied blockade put a complete embargo on Germany's exports. It was then seen how dependent America had been on Germany for dyestuffs, and it was estimated that manufacturing industries with products valued at about $4,000,000,000 might soon be thrown completely out of gear by a lack of dyestuffs. In the confusion which resulted many expedients were adopted in the production of colours, with a consequent reduction in the fastness and quality of dyeing. Dyestuffs became so scarce that exorbitant prices stimulated the erection of many dyestuff factories in various parts of the United States. Large amounts of capital were freely invested in the new industry, and many chemists became engaged in dyestuff research and manufacturing.

Previous to the War the United States had a small dyestuff industry distributed among about five plants. The manufacturing operations, however, were limited chiefly to the assembling of the coal-tar intermediates imported from Germany for the production of the finished dyes, so that the new industry had to be built from the ground up. To the great credit of the American chemist and chemical manufacturer it may be said that in a very short time the more important dyes were successfully made in the United States in such quantity that practically no dye-consuming industry was forced to shut down by reason of a lack of dyes. In 1924 there were 193 firms in the United States engaged in the manufacture of coal-tar chemicals, and of these 78 firms were engaged particularly in the making of dyestuffs, producing 68,679,000 lb. of the various synthetic dyes. Of the dyes sold to consumers the value was $35,012,400, at an average price of 54c per pound. Of the total dyes consumed in the United States about 96% were produced by the domestic industry and only about 4% were imported dyestuffs, the latter coming chiefly from Germany and Switzerland. About 20,000,000 lb. of synthetic indigo were produced in the United States in 1924, about twice the pre-War importation, indicating a great extension in the use of indigo in dyeing. Sulphur black was also produced on a very large scale, as well as all of the required acid dyes for wool and silk, most of the basic dyes, a complete line of direct cotton dyes, and what was still more significant, a rather complete line of vat dyes as well as alizarine and mordant dyes for the fast colours. Associated with the making of dyestuffs there also grew up the many related branches of the coal-tar chemical industry, such as colour-lakes for paints; lithographic and printing inks; coal-tar pharmaceuticals; flavouring and perfume materials; photographic chemicals; and synthetic tannins and resins. The great growth of the industry created a constant demand for increasing quantities of coal-tar distillates, which form the raw materials of the dyestuff industry, and this led to a rapid increase in the number of by-product coke ovens. In 1924 the production of coke in by-product ovens amounted to nearly 78% of the total.

The great production of dyes in the United States during the post-War period led to the building up of a considerable export trade, particularly to South America and the Orient. The total dyes exported from the United States in the year 1924 amounted to 15,713,428 lb., with a value of $5,636,244. The dyes exported, in fact, were about five times the amount and about twice the value of those imported. The dyestuff industry in the United States was wisely protected and fostered by the government by suitable tariff and licensing regulations during the post-War period and has now been established on a firm and permanent basis, and this has greatly aided the stability and prosperity of the dyeing industry.

In the matter of natural dyestuffs America has always occupied a leading position. Many of the principal natural dyes are of American origin. Logwood, fustic, cochineal and the red-woods are all American products, discovered in and still obtained from Mexico, Central America and South America, as well as the West Indies. During the War a product very closely resembling fustic and known as osage orange was developed in the United States and was produced and consumed in large quantities. As the dyer at the present time usually employs the colouring matters of the dyewoods in the form of suitable extracts, there has long been developed in the United States a considerable industry in the manufacture of these extracts, generally produced in connection with the manufacture of tannin extracts. This industry is in no way associated with the coal-tar dyestuff business.

The scarcity of dyes during the early part of the War resulted in a great expansion of the dyewood extract industry, which, however, rapidly declined as the manufacture of synthetic coal-tar dyes increased. In former years natural indigo was extensively used in dyeing, and in early colonial days, large quantities of this dye were cultivated in the southern states. As the growing of cotton increased, that of indigo was neglected, so that most of the indigo used in the United States was imported, chiefly from the Far East. The advent of synthetic indigo, however, soon displaced the natural product, so that but very little of this vegetable dye is now used in America. With the exception of logwood, which is still employed in considerable amounts for the dyeing of silk and leather, the use of the natural dyewoods is fast decreasing. In the dyeing of woollen materials the use of logwood has been displaced by coal-tar dyes that give better and faster colours. Contrary to the belief of many unacquainted with the facts, the natural vegetable dyeing materials can in no wise equal in fastness and in purity of colour many of the recently introduced fast coal-tar dyestuffs comprised among the so-called "vat" dyes for cotton and silk, the alizarine and chrome dyeing colours for wool, and the naphthol coupled colours for cotton dyeing and calico printing. It is now possible to produce coloured fabrics which will stand sun and climatic exposure as well as bleaching and severe laundering in a manner a great deal better than could be obtained with the old-fashioned vegetable dyes. This has led to many innovations in the application of dyestuffs, and many new processes of dyeing have been devised that have greatly enlarged and enriched the art. Another recent development in the dyeing industry in the United States is that of fur dyeing. During the post-War period, owing to the shifting of

the centres of trade, the United States became an important market for the sale and manufacture of furs. This has resulted in the building up of an extensive industry in the dyeing and finishing of furs, which will without doubt become firmly established as an important adjunct to the general dyeing industry of the United States. (J. M. M.*)

III. THE INDUSTRY IN GERMANY AND SWITZERLAND

Germany.—In Germany the industry was firmly established before the War, but it was confined to three main groups which during the War came together under a working agreement and pooling arrangement. In 1925 a financial amalgamation gave the new Farben Industrie Interessen-Gemeinschaft, or "I.G.", as it is known, capital resources of about £40,000,000. The I.G., which is interested not only in actual dyestuff manufacture but in heavy chemical production, and also in making fine chemicals for pharmaceutical, medicinal, photographic, etc., purposes, still holds the premier position in the world's dyestuff trade; but the dominant and almost monopolistic position it held before the War has gone, chiefly through the loss of its former British and American markets and the increase of competition in the principal free dye markets of the world—India and China.

The output of the German factories was influenced considerably during the few years following the Armistice by the fact that they were situated for the most part in the occupied areas, and consequently were under the control of the Allied Army. In 1919 a military commission of inspection representing the different Allied countries visited the factories, and though their report was never published the commission indicated quite clearly that the resources of the German dye industry had been directed almost solely to the prosecution of the War, and had contributed in no mean degree to the extent and duration of the resistance which Germany had been able to offer. Definite connections were established between the dye factories and poison gas manufacture.

During the Peace Treaty negotiations there was a fear that Germany might endeavour to make use of her position in the chemical and dyestuffs industry to secure special terms, or alternatively that, by withholding supplies of such chemical products including dyes as were only available from Germany, attempt to hinder the economic recovery of the Allied countries during the period of reconstruction. Clauses were therefore inserted in the Treaty of Versailles (annex 6 to part VIII.) whereby an option was accorded to the Reparation Commission on one-half of the stocks of dyestuffs and chemical drugs in Germany at the time, and also on 25% of the German output of these products for a period of five years from Jan. 1920. This period was subsequently extended by the London agreement of Aug. 30 1924 to Aug. 28 1928. Under these arrangements large quantities both of dyes and drugs have been delivered by Germany on reparation account and, but for a temporary dislocation during the occupation of the Ruhr by the French, the arrangements laid down by the treaty have worked satisfactorily and smoothly. Some difficulty has, however, been occasioned, particularly to dye manufacturers, because certain countries requisitioned quantities in excess of their domestic requirements and re-exported these excess quantities at uneconomic prices.

France, Italy, Japan, Spain.—In France a national dye factory was started with government assistance, and the pre-War factories in France belonging to the German dye firms were taken over and developed by French concerns. Nevertheless, France is still dependent on foreign sources for the supply of about one-half of her requirements of dyes. The same is the case with Italy; whilst as regards Japan an attempt to create a national dye-making industry with a large measure of government financial assistance has not met with any marked success. In Spain a system of control of imports has been adopted, presumably with the object of protecting the one or two small dye-making factories in that country.

Switzerland.—The four factories which were in existence in Switzerland before the War have made considerable progress since that time. Whilst competition from Germany was suspended owing to the War the Swiss factories made large profits which enabled them to modernise and extend their works and to write off their plants. They made an arrangement with the British Govt. in 1915 whereby in return for supplies of raw materials and intermediates they supplied the British market with a large proportion of their output. As the Swiss factories are situated at Basle, close to the German frontier, and most of the materials supplied to them were of immense importance for war purposes, a system of control by British officials of the Swiss factories was instituted during the war period, but at no time was there any evidence of the misuse by the Swiss of the materials sent to them, they being most anxious to fulfil their arrangement with Great Britain not only to the letter but in the spirit. Since the War one of the Swiss firms—Durand Huguenin, S.A.—has been acquired by the German I.G., whilst the other three have formed a "community of interest," under which they are working together by means of a pooling arrangement for a period of 50 years. These three Swiss firms jointly own a factory in England—the Clayton Aniline Co. Ltd., Manchester—which has made great progress, especially in manufacturing a number of dyes formerly imported from Switzerland. Whether the Clayton factory would continue to be developed to the same extent under a system of free importation into England is open to some doubt.

The capacity for the production of dyestuffs throughout the world has increased enormously since the War, but it is doubtful if there has been any appreciable increase in the rate of consumption during this period. This excess of capacity over demand prevents manufacturers from producing dyes under the most efficient conditions, and in certain cases, as in the U.S.A., this has resulted in price-cutting campaigns. In others, as for example Germany, the efforts of the dye-makers have been directed to other and more remunerative channels, such as the development of products based on synthetic nitrogen and synthetic methyl alcohol. The experience of the war years has shown quite definitely that no country can, without grave risk to its national security and economic prosperity, allow itself to become dependent solely on foreign sources for its supply of dyestuffs and kindred products. (W. Gr.*)

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IV. TECHNICAL ADVANCES SINCE 1910

Important advances in the application of dyes to fabrics from the scientific aspect since 1910 have been mainly concerned with a simplification of the dyeing process, and the production on the fibre of shades of extreme fastness. Experience now enables us to predict with some certainty how a dyestuff of known chemical constitution can be applied to this or that fibre, but, on the other hand, there is still no general agreement as to what happens as the result of the dyeing operation. Thus the artificial dyestuffs are classified for tinctorial purposes, by possessing certain special chemical groupings, rather than by their more exact structure, for these groupings determine their attraction for this or that fibre and as a consequence their method of application thereto.

New dyestuffs of importance have been discovered, and with few exceptions, they require no special dyeing processes. As a result the main principles of this art have remained unaltered. The advent in 1921 of the so-called Celanese silk (partially acetylated cellulose) provided the world with a fibre of distinct properties, for the dyeing of which, however, new methods and colouring matters have in part been found essential.

Sulphide Dyestuffs.—With regard to the employment of these colouring matters for the dyeing of cotton, their chief function,

there is little new to be said. The dyeing process consists essentially in converting the insoluble colouring matter by means of sodium sulphide into the soluble sodium salt of its leuco-compound. This possesses an affinity for the cotton fibre, and by air oxidation passes thereon into the insoluble dyestuff.

The defect, that such dyed material, on keeping, is liable to become tender owing to a development of sulphuric acid, has been carefully studied, and it is now known that the formation of this acid is due not to the presence of sulphur in the free condition, but to an oxidation of a part of the sulphur which is in actual combination with the dye itself (W. Zanker, *Farber Zeitung*, 1914). Trouble due to this character is now rarely experienced. Though the sulphide dyestuffs are largely in use for cotton dyeing, their application to wool in a satisfactory manner was hardly feasible, because sodium sulphide is strongly alkaline, and readily attacks wool. This difficulty can be overcome by the Lodge Evans process (*Jour. Soc. Dyers and Colourists*, p. 252, 1915), based on the fact that sulphide dyestuffs are soluble in sodium sulphite solution. These solutions, however, are devoid of dyeing property because the colouring matter is not present therein as leuco-compound; but on adding sodium hydrosulphite or ammonium sulphide this change occurs and the bath is now ready for use. This process, which is of value for dyeing union material solid shades of black, is not of importance for all wool material, because other fast colours, more easily applied, are available for this purpose.

Insoluble Azo Dyestuffs.—The method for the application of these insoluble colouring matters to cotton consists in the actual formation by chemical means of the dyestuff on the fibre. Thus the material padded with the solution of one of the components of the reaction, generally the sodium salt of beta-naphthol, is dried, and then passed into a bath of the second component, invariably the salt of a diazotised aromatic base.

Reaction occurs almost instantaneously with formation of the azo colouring matter, and by employing the diazo compounds of different aromatic bases varied shades can be obtained by this process. The dyeing of cotton yarn and calico by this method is extensively practised, because these colours have good fastness to soap, and are fairly fast to light.

The diazo compounds of these bases are of an unstable character, and are thus prepared (in solution) shortly before use, (and preferably cooled by ice). It was, however, shown in 1894 that by simple methods these may be converted into stable inactive forms, which are now on the market, and can quickly be rendered ready for use as occasion requires (*Colour Index*, No. 44).

The application of beta-naphthol as sodium salt to cotton, for which it has no affinity, requires extreme care, for in case the dried material is not evenly impregnated therewith, the finished shade will be uneven. In 1912 a substitute for beta-naphthol was placed on the market by the Chemische Fabrik Griesheim Electron, and this, known as Naphthol A.S., is the anilide of beta-hydroxy-naphthoic acid (*Colour Index*, page 333). As sodium salt, it possesses a distinct affinity for the cotton fibre, and the treated material can thus be at once immersed in the diazo solution without previously drying.

The shades thus produced are both brilliant and fast, and, though more costly, it is much superior to beta-naphthol for this purpose. Again, in 1916 a further simplification of the process was announced and products known as " Rapid Fast Dyes " came on to the market. These consist of one or other of the stable diazo compound preparations referred to above, admixed with naphthol A.S. (*Colour Index*, page 364), and by merely padding the cotton in a solution of such a product, drying and steeping in a bath of hot dilute acetic acid, the colour is at once developed. Certain of the insoluble azo dyes (such as *Para Red*, which has been much used as a cheap substitute for Turkey Red), on account of their chemical nature, are capable, when dyed on cotton, of withstanding to some extent a mild bleaching operation, that is to say, a moderate kier boiling of the material with dilute alkali, and subsequent treatment with bleaching powder solution. Thus yarn dyed therewith can be interwoven with unbleached white cotton in the form of stripes and fancy patterns, and the goods subsequently bleached. For this type of process, which is much in vogue, the ordinary insoluble azo colours are markedly inferior to Turkey Red, Indigo, the vat and certain other dyes, but since 1921, faster members of this class have been prepared. These, which can be produced on the fibre according to the methods given above, are obtained by employing on the one hand new derivatives of beta-hydroxy-naphthoic acid anilide, and on the other of diazotised bases generally of a more complex character than those formerly in use. Much which is claimed for these new colours is correct, and the progress of their technical application both in dyeing and calico printing will be awaited with interest.[1]

Artificial Silks.—The so-called " artificial silks " (*q.v.*) which have come into increasing prominence during recent years are all obtained from cotton, wood-pulp or some other form of cellulose (*q.v.*), and until recently all the varieties on the market consisted in their essence of cellulose itself.

The processes applicable for dyeing these materials are generally identical with those available for cotton, though owing to their more fragile nature and a liability for the production of uneven shades, the operation requires special care.

Shortly after the conclusion of the War, a new variety, known as " acetyl silk " or " Celanese silk," came on to the market, which differs in a very interesting manner from other artificial silks in regard to its affinity for dyestuffs. It consists of cotton which has been partially acetylated by means of acetic anhydride, and thus contains acetyl groups which render it more acidic than cotton itself. As a result, it possesses, especially in the presence of certain inorganic salts, a marked attraction for basic dyestuffs, a group of colouring matters to which cotton is practically inert, but on the other hand has little or no affinity for the direct cotton colouring matters. The most important of the methods proposed to overcome this latter difficulty at the time was a conversion of the surface of the fibre into cellulose by the hydrolysing action of alkali (G. F. Briggs, *Jour. Soc. Dyers and Colourists*, p. 287, 1921). When cautiously treated in this manner, the lustre of the silk was not specially impaired but among other difficulties a loss in weight and in strength is liable to occur.

A second method is the use of ammonium thiocyanate (L. G. Lawrie, *ibid.*, vol. II, p. 69, 1924), which renders the Celanese silk capable of dyeing with cotton colouring matters. Much more valuable has been the discovery of dyestuffs and dye preparations especially adapted to the peculiarities of this fibre.

Acetyl silk possesses an attraction for insoluble colouring matters, generally of a basic character, in case these are in a highly dispersed or colloidal condition (G. H. Ellis, *ibid.*, p. 285, 1924) and the so-called Sulpho-Ricinoleic Acid colours are, at least in part, solutions of simple amino-azo compounds in sulpho-ricinoleic acid. The Duranol, Dispersol and Celatene colours again are dye preparations of a similar type (Lawrie, *loc. cit.*). The dyeing of the acetyl silk with these colours merely consists in immersion of the material in the dyebath at a temperature not exceeding 80° C.

The Ionamines of A. G. Green and K. H. Saunders (*Jour. Soc. Dyers and Colourists*, p. 10, 1923; p. 138, 1924), in their essence consist of insoluble basic compounds rendered soluble by a chemical addition of the ($CH_2 \cdot OH \cdot SO_3H$) group. These (omega sulphonic acid) compounds, though comparatively stable in neutral solution, are readily converted (hydrolysed) by acids and alkalis with regeneration of the insoluble colouring matter, a reaction which accounts for their behaviour as dyestuffs. Thus in the dyeing operation, which is carried out at 65–75° C. in the presence of a little formic or sulphuric acid, the soluble ionamine, at first attracted by the acetate silk, is there decomposed, with deposition of the colouring matter on and in the fibre. The dyed colouring matters are basic, that is, contain a free amino group, and by diazotisation and coupling in the usual manner with a phenolic developer, such as beta-naphthol, beta-naphthoic acid anilide (Naphthol A.S.) or resorcin, various shades can be obtained.

[1] For a detailed description of these compounds, the papers of F. M. Rowe and E. Levin (*Jour. Soc. Dyers and Colourists*, p. 204, 1921, and pp. 218, 230, 1924) should be consulted.

Though acetyl silk has little affinity for soluble dyes of the sulphonic acid class, the British Dyestuffs Corporation, Ltd. (British pat. 202,157, 1922), discovered that amino-azo and other insoluble basic dyes, on conversion into carboxylic acids, give soluble products suitable for dyeing acetate silk, and that these again can be converted into a new dye on the fibre by the diazotisation and coupling process.

Excellent shades of indigo blue can be dyed on acetyl silk by employing a vat containing a solution of indigo white, sodium hydrosulphite and ammonia together with a little glue. There is no real difficulty in dyeing mixtures of acetyl silk and cotton, as two distinct colours can be employed in the same bath, each having an affinity for one or other of these fibres. With mixtures of wool and acetyl silk the difficulties are greater, but by first dyeing the latter with a colloidal dye preparation, and subsequently the wool with suitable acid dyestuff, these can be avoided.

The cotton material known as "Immunised Cotton," altered by the action of sulphonic chlorides (Sandoz, Basle) (G. Tagliani, *Jour. Soc. Dyers and Colourists*, p. 165, 1925), resembles acetyl silk in dyeing property, in that it has no attraction for direct cotton colours, though a great affinity for basic dyes. As this "immunisation" of cotton can be carried out locally on either yarn or piece goods, many varied colour contrasts can be obtained by its use both in dyeing and calico printing.

Vat Dyes.—This group contains, in addition to indigo and its derivatives, numerous colours derived from anthraquinone, among which are the fastest dyes known. The use of many of these latter has until recently been mainly confined to cotton, because their usual method of application entails an amount of alkali in the dyebath (vat) which is injurious to wool. Wool, again, according to H. Kammerer (*Jour. Soc. Dyers and Colourists*, p. 68, 1913), shows much less affinity for these colouring matters as leuco-compounds than cotton, and dyeing as a rule with this fibre does not commence below 70° Centigrade. Employment of the minimum of alkali, and the addition also of glue to the vat hinders the injurious action of the alkali on the wool, and satisfactory results are thus possible.

A new method for the application of vat dyes to acetyl silk in admixture with cotton (British Celanese Co.) consists in replacing the harmful alkali of the hydrosulphite vat by sodium phenate (carbolate) and is more specially applicable to those colours which require but small amounts of alkali in the dyeing process. The vat may be set in the usual manner with alkali, and the excess of the latter may be neutralised with phenol (carbolic acid).

Indigo is prepared by the colourmakers in an easily soluble reduced form, and similar preparations of certain other of these vat dyes are on the market. These termed "anthre dyestuffs" are recommended as serviceable for wool dyeing, employing in the vat sodium hydrosulphite, ammonia and glue solution. For protecting wool from the action of the alkali (Actien G. f. Anilinfabrikation) sulphite cellulose liquor, obtained in the manufacture of wood-pulp, is recommended, and a preparation termed "Protectol," probably contains this (A. Edge, *Jour. Soc. Dyers and Colourists*, vol. 38, p. 136, 1922). According to Kollmann (*Jour. Textile Institute*, vol. 13, p. 16, 1922), vat colours can be dyed on wool from a bath containing hydrosulphite of soda and ground chalk or zinc oxide. "Indigosol" (*Colour Index* No. 1178) is a product prepared from indigo, which by acid oxidation is readily reconverted into this colouring matter (Hugenin) (*Jour. Soc. Dyers and Colourists*, p. 340, 1925).

This, which is a sodium compound of the disulphonic ester of indigo white, is readily soluble in water and thus can be used for the dyeing or printing of indigo on cotton, wool or silk. Woollen goods may be immersed in a bath of Indigosol containing sodium sulphate, together with a little acetic and formic acids. After washing, the blue is developed by steeping the material in dilute nitrous acid (sodium nitrite and dilute sulphuric acid) (Durand and Hugenin). Cotton can be dyed by a similar process, employing in the same way a mild oxidising agent, such as ferric chloride, acidified bichromate or nitrous acid.

Another product of a similar type, "Soledon Jade Green," derived from an anthraquinone vat dyestuff (Scottish Dyes, Ltd.), can be applied to fabrics in a similar way to Indigosol. Other anthraquinone dyestuffs of this type have been prepared, and a new process is thus now available for the use of these fast dyes on wool and silk, simple in its application, and avoiding the harmful use of alkali in the dyebath.

Basic Colours.—As these dyes possess little or no affinity for cotton, a tannin antimony, lake or mordant is usually first precipitated on the fibre by steeping the undyed material in a tannin solution and then in a bath of tartar emetic. New so-called mordants for this purpose (Bayer & Co.) consist of phenolic compounds containing sulphur and a preparation of this kind, termed "Katanol O," is on the market (*Colour Index*, 357) (*Jour. Soc. Chem. Ind.* 139A, 1922).

The operation of mordanting cotton with this preparation is much simpler than by the tannin method, and again the shades obtained are purer and of greater fastness to washing. The cotton is merely immersed in an alkaline solution of the Katanol containing common salt, and after rinsing is ready for the dyeing operation (see also R. Fischer, *Textile Berichte*, p. 119, 1924). A second preparation, termed "Katanol W," removes the affinity of the animal fibres for certain of the direct cotton colours. By its use in the case of mixed fabrics the cotton may be dyed a full shade, whereas the animal fibre remains unaffected.

Mordant Dyes yield coloured lakes with metallic oxides. The method of first mordanting the material and dyeing in a separate bath is still in vogue with certain of the phenolic dyestuffs, such as the alizarines, logwood, etc. The more simple procedure of mordanting during the dyeing operation, or at its close, in the same bath, with copper or chromium salts, employing acid mordant dyes largely of the azo class, is now far more generally employed. In addition to the older mordants employed in this one bath method, chromium oxalate or "chromosul" mordant (Sandoz) finds some service. The dyeing operation is again simplified by the use of colouring matters soluble in water and containing copper or chromium in combination, which, in the dyeing or printing operation, are fixed on the fibre as insoluble metallic lakes, such as the Neolan colours (Society of Chemical Industry, Basle) (H. Whitworth, *Jour. Soc. Dyers and Colourists*, vol. 40, p. 256, 1924), which are applied in the presence of sulphuric acid.

The chemical nature of the lakes contained by the combination of dyes with metallic mordants has been investigated from the point of view of the co-ordination theory of valency by G. T. Morgan and his pupils (see *Jour. Soc. Dyers and Colourists*, vol. 37, p. 43, 1921).

Theories of Dyeing.—Numerous theories have been proposed in the past to explain the dyeing operation, namely, the "mechanical," "solid solution," "absorption," "colloidal" and "electrical" theories, the latter being of the most recent date.

In regard to these theories of the dyeing process, it begins to be clear, as W. Ostwald himself indicated (*Outlines of General Chemistry*, p. 295, 1912), that no single theory can account for all dyeing processes. In any case, it seems probable that two stages occur, the first being due, it may be, to either adsorption or electrical attraction. This is then followed by fixation of the dye in or on the fibre by solid solution, colloid aggregation, or by chemical interaction, and these may come into play according to the nature of the fibre, the process and the character of the dyestuff involved.

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DYNAMO-ELECTRIC MACHINES (*see* 8.764).—The term dynamo-electric machine is used broadly to denote a machine for changing mechanical to electric power, or one for changing electric to mechanical power. The former is called an electric generator, the latter an electric motor.

Electric Generators

Steam-Turbine Driven Generators.—In 1910 the largest generating sets were practically never of more than 10,000 kw. capacity.

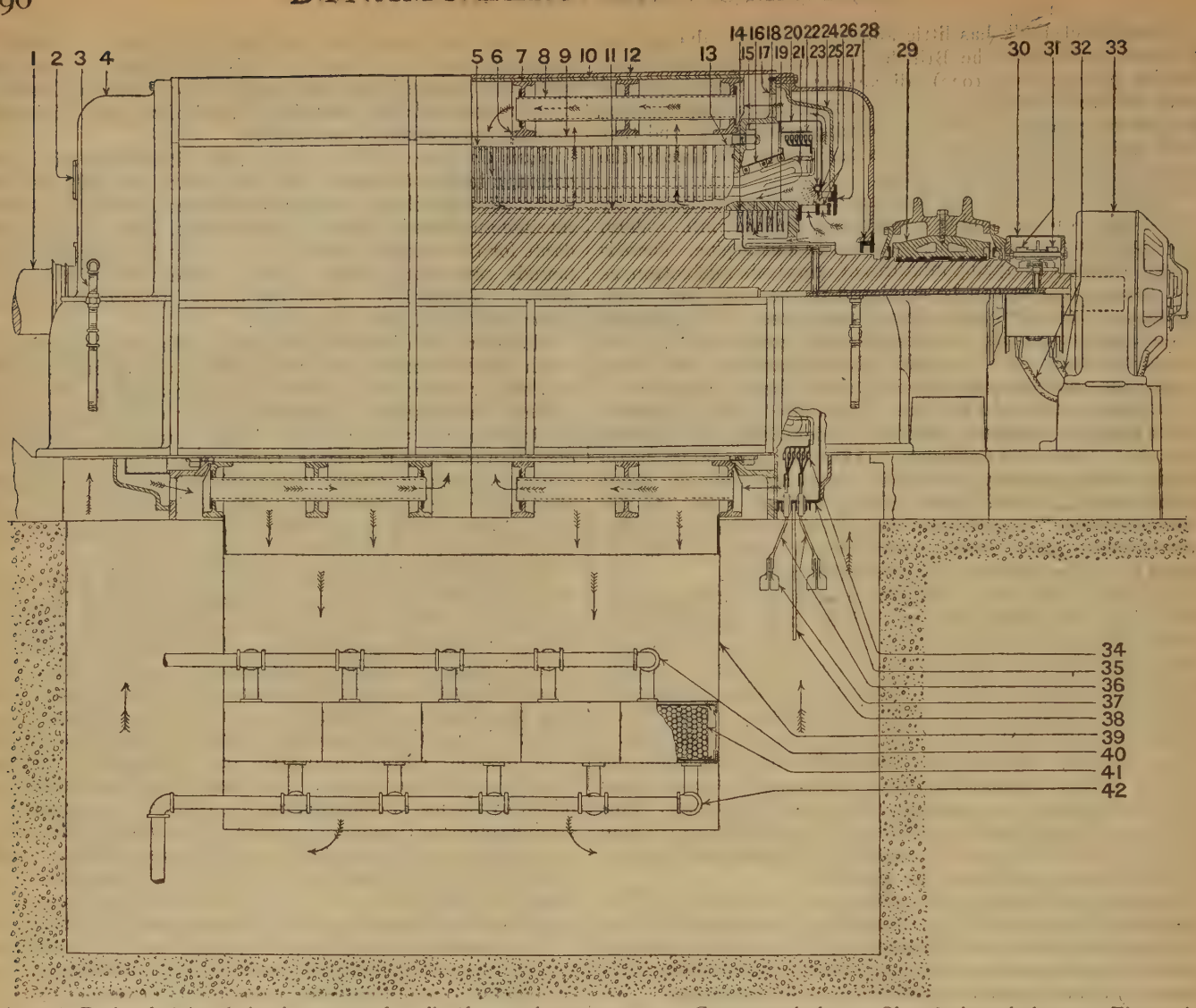


FIG. 1.—Design for closed circuit system of cooling for a turbo generator. 1. Generator shaft. 2. Observation window. 3. Fire extinguisher piping. 4. Outside end shield. 5. Armature punchings. 6. Air deflector. 7. Stator frame I-beam. 8. Air tube. 9. Punching rib. 10. Supporting plate. 11. Rotor. 12. Sheet iron cover plate. 13. Air deflector. 14. Rotor end windings. 15. Rib nut. 16. Binding band support. 17. Armature flange. 18. Binding band. 19. Nickel steel retaining bell. 20. Air deflector plate. 21. Armature coil. 22. End connection support. 23. Fire extinguisher sprinkler. 24. Inside end shield. 25. Air deflector ring. 26. Fans. 27. Air baffle. 28. Oil guard. 29. Bearing. 30. Brush-holder rigging and cover. 31. Collector. 32. Field cables. 33. Exciter. 34. Stator winding connections. 35. Terminal board. 36. Stator winding leads. 37. Stator winding terminal. 38. Barrier. 39. Air discharge duct. 40. Water cooler discharge pipe. 41. Air cooling coils. 42. Water cooler intake pipe.

Reciprocating steam-engines were still the most widely used for large generating sets. At present they are rarely built for driving large generators, whereas 60-cycle steam-turbine driven sets are now built with continuous ratings up to 50,000 kw. for 1,800 r.p.m. and still greater outputs for 1,200 revolutions per minute (*see* TURBINES, STEAM). Such 50,000 kw. single shaft sets are suitable for power factors down to 0·8 at rated load, corresponding to 62,500 kilovolt-amperes. In Europe 3,000 r.p.m. bi-polar 50-cycle turbine generators have been built in sizes up to 20,000 kilowatts. This is about eight times the capacity attained in 1910 for bi-polar 50-cycle generators.

Modern large turbo generators have peripheral speeds (at rated speed) of from 20,000 to 28,000 ft. per min. and are required to stand overspeed tests of 20% in excess of rated speed. In a typical 50,000 kw. (62,500 kv.a.), 1,800 r.p.m. machine, the rotor has a diameter of 49·5 in. (corresponding to a peripheral speed of 23,400 ft. per min.) and is constructed from a solid forging of carbon steel. The rotor slots, which are 8 in. deep, are milled out of the solid forging. The insulation and conductors are retained in position in the slots by steel and alloy wedges. The rotor must withstand the great centrifugal force which, at this peripheral speed, amounts to just over one metric ton for every pound at the periphery. The copper ends beyond the rotor core, and the insulation, are held very solidly against the slightest movement by retaining bells of nickel steel and by separators consisting of aluminium castings designed to provide passages for the cooling air. The heat generated in such a machine by the internal losses is removed by circulating through the machine some 110,000 cu. ft. of air (four metric tons) per minute. At present the most approved practice is to employ a completely closed circulating system for the cooling air which, after passing through the generator, is cooled by flowing over pipes through which water is circulated. To avoid carrying moisture into the generator it is necessary that in some one section of the cooling system the air speed be not over 600 ft. per minute. Consequently, such a circulating system for a 62,500 kv.a. generator must have a maximum cross section of 183 sq. feet. At other parts the cross section may be much less and the air speed higher. The air makes the complete circuit in a few seconds, thus being heated and cooled many times per minute. This is coming to be believed to constitute the most satisfactory way in which large generators can be kept clean and cool. As a generator costs over $500,000 the justification for such precautions is evident. Fig. 1 illustrates a design for a closed circuit system of cooling for a turbo-generator.

Friction Loss in Turbo-Generators.—The use of such high peripheral speeds as 20,000 to 28,000 ft. per min. and the circulation of such large quantities of cooling air as over 1,000 cu. ft. per sec. occasions very large friction losses. An 1,800 r.p.m., 62,500 kv.a. (50,000 kw.) machine will have at its rated load an efficiency of about 97·0%. The loss in the machine is thus 1,500 kilowatts. About 40% of this loss is due to friction. Experimental machines have been built running in hydrogen instead of in air. Because of the low density of hydrogen, the friction loss, if atmospheric pressure is used, is reduced to one-tenth. In the above example the total loss would be reduced from 1,500 kw. to about 960 kw. and the efficiency would be increased to about 98·1%. Moreover hydrogen has higher thermal conductivity and higher forced heat convection. The use of hydrogen also decreases the extent to which the insulation is deteriorated by corona.

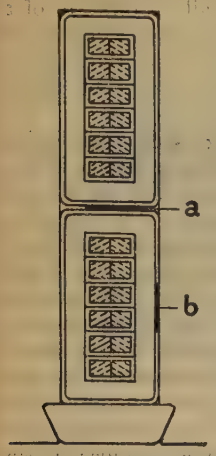


FIG. 2.—Cross section through stator slot showing embedded temperature detectors located at *a* and *b*.

An important feature in the design of the stator windings is the use of transposed conductors to eliminate wasteful circulating currents. The importance of such transposition in the construction of conductors had been pointed out prior to 1910 by A. B. Field, but the advent of these large modern generators has made their use imperative. The extremely great core length of the largest turbo-generators brings into prominence the matter of expansion and contraction as a cause of insulation deterioration and unbalancing. It is thus desirable to design such machines for the lowest practicable temperature rise.

Water-wheel Driven Generators (*see* DAMS; HYDROELECTRICAL ENGINEERING).—In the large scale generation of electricity, the importance of the water-wheel driven generator is (at any rate, in waterpower countries, such as Scandinavia, France, Italy, Switzerland and America) commensurate with that of the steam-turbine driven generator. While in 1910 the largest water-wheel driven generators in operation or being constructed had a rated output of only 15,000 kw., there are now some in operation with ratings of over 50,000 kilowatts. As the speeds of hydraulic turbines are low in comparison with those of steam turbines, such generators have more poles, larger diameter and relatively small core length and present a completely different appearance. In fig. 3 on plate is shown a vertical-shaft 72-pole, 60-cycle machine with a rated output of 20,000 kv.a. and a speed of 100 revolutions per minute. The design of these lower-speed machines presents less complex problems than that of steam-turbine driven generators. However, the mechanical design must be adequate for a runaway speed of approximately twice normal speed. This imposes a serious limitation on the peripheral speed at the rated shaft speed.

Stability of Generators.—Stable operation of large generators on the occurrence of sudden overloads is a matter to which much attention must be given. American designers observe as a conservative limitation a much larger ratio of field to armature magneto-motive forces than European designers think necessary.

Wave Form.—With high peripheral speeds and few poles as in steam-turbine generators, it is comparatively easy to obtain a good potential wave, since there are many slots per pole. But by the use of fractional pitch windings, suitably shaped gap contours, proper gap depths and slot opening dimensions and other means, an almost perfect potential wave may be obtained even where there are very few slots per pole and per phase. It is not sufficient that the resultant wave shall be within a specified percentage of sine form, but it is important that certain particular harmonics which adversely affect telephone systems shall be kept down to very small amplitudes at all loads.

Induction Generators.—In 1910 it was anticipated that induction generators were about to be employed on a considerable scale on systems employing sufficient synchronous machines or their equivalent, to supply the required magnetising current. Steam-turbine driven induction generators of 7,500 kw. rating at 750 r.p.m. were indeed placed in service in 1911 and quite a number of smaller induction generators are in use. But the synchronous type continues to be practically always employed. However, some induction motors are operated under conditions where they serve temporarily from time to time as induction generators, as, for example, in certain types of electric locomotives, where the axles are driven by induction motors; in Scherbius sets and in certain varieties of frequency converters.

Direct-Current Generators.—The rapid growth of the practice of providing electricity in the form of polyphase currents from large generating stations has nearly eliminated the direct-current generator driven by a prime mover as an original source of electricity, except relatively unimportant isolated installations.

Careful study, however, continues to be given to the possibilities of high-voltage transmission by direct current (*see* ELECTRICITY, TRANSMISSION OF). So far as relates to the transmission of large amounts of power over distances of hundreds of miles the cost of the transmission system decreases considerably with decrease in the periodicity employed. It is possible that the use of as low as five cycles for the periodicity during the transmission stage will be better than going to direct current (zero periodicity). If, however, direct current is employed, the present state of the art will not require the use of machines with commutators. Polyphase machines can be employed of whatever periodicity is consistent with economical design, the polyphase currents being converted into direct current in mercury arc or vacuum rectifiers, of which any required number may be placed in series to supply the high-voltage direct-current transmission line. Such outfits can be built in any desired large capacity and for steam-turbine or water-wheel speeds according to need.

A direct-current generator on the same shaft as the polyphase motor by which it is driven, constitutes, together with its driving motor, a motor generator set. These sets are extensively employed in substations in which high-voltage polyphase alternating current is received from a distant generating station. Where the conditions cannot be met by synchronous converters, such motor generator sets are widely used for supplying electric railways and also for supplying individual customers whose requirements are best met by direct current. It is probable that within a very few years the mercury arc rectifier will be widely employed in cases of this sort where motor generators and synchronous converters are at present being used. The mercury arc rectifier takes the place of the entire motor generator set or synchronous converter and has higher efficiency and other advantages.

Direct-Current Generators for Ward-Leonard Systems.—For special applications where a direct-current generator is used for the exclusive supply of a single motor or group of motors, the conditions of supply to the motor are controlled by adjustments of the excitation of the direct-current generator. This is the Ward-Leonard system of control and is used for applications where the load is constantly changing by large amounts. When such considerable fly-wheel capacity is provided on the generator shaft as to occasion a fairly constant input from the supply system with rapidly and widely varying output from the generator, the combination is known as an Ilgner system. Ilgner sets are widely employed for hoists and reversing rolls.

Electric Generators for Electrically Propelled Ships.—During the period from 1910 up to the present there have been installed on naval and merchant vessels a total of considerably over 500,000 kw. of electric generators supplying motors which drive the propellers. While most of these generators are of the steam-turbine driven polyphase type and often of many thousand kilowatts rated capacity each, the smaller ships are often driven by direct-current from generators directly connected to Diesel engines (*see* MARINE ENGINEERING).

Exciters.—There is a large production of small direct current generators employed to provide the excitation to alternating-current generators and synchronous motors. Such machines may also ultimately be rendered obsolete by the use of mercury arc or vacuum rectifiers for the purpose.

High-Frequency Generators.—Since 1918 a good many high-frequency generators have been built for radio work. The Alexanderson generator is of the inductor type and over 20 have been built in the 200 kw. size. The speed is generally about 2,500 r.p.m., the corresponding periodicity being of the order of 20,000 cycles per second. Other high-frequency machines which have been considerably used for radio work are the Goldschmidt alternator and the Latour alternator.

For induction furnace work increasing use is being made of generators supplying current at a frequency of about 500 cycles per sec., and higher frequencies up to 2,000 cycles per sec. are sometimes used. The rotor of a 480-cycle machine is shown in fig. 2, on plate.

Temperature Detectors in Large Generators.—In America there has developed since 1910 a general practice of equipping large electric generators with embedded temperature detectors, several located at various parts of the stator windings being provided. The knowledge thereby obtained of the amount and distribution of the temperature inside the machine has been of great value in improving designs. In America, where the usual design of stator winding provides two coil sides per slot, the highest observable temperature has generally been believed to be that disclosed by a detector located midway between the top and bottom coil sides as shown diagrammatically at *a* in fig. 2 and midway between the core ends. The temperature of the hottest places in the copper windings may be some five or more degrees greater. The original object of providing these temperature detectors was for the purposes of acceptance tests. They have, however, often proved very useful as a permanent feature to permit of guiding the operating staff in loading the generators, the internal temperatures being made at all times available from the readings of switchboard instruments. In a considerable number of large generators the highest temperature affecting the insulation, instead of being between the coil sides, will be on the core side of the slot insulation near the ends of the core. Consequently, detectors ought also to be located at these places, which are indicated by *b* in fig. 2.

Electric Motors

Most of the modern varieties of electric motors were already in use (or at any rate their principles were known) in 1910. All types have, however, undergone considerable modification and improvement. By standardisation and by mass production the cost has been notably decreased. The 1923 U.S. census of manufactures gives the production of electric motors for that year as just over 5,000,000 H.P., and gives the total number of motors built in the United States in 1923 as 2·4 million, of which 2,000,000 were fractional horse-power motors. These latter are used largely in homes to drive phonographs, hairdryers, egg-beaters, vibrators, coffee grinders, washing machines, ironing machines, sewing machines, dish washers, ventilating fans, vacuum-cleaners, floor-polishers, pumps, etc. (*see* Household Appliances). Aside from domestic uses may be mentioned small motors for automobile starters, automobile tire pumps, gasolene pumps, portable drills, lathes, bottle labellers, cream separators, etc. A considerable proportion of these small motors are of a class designated Universal Motors, the distinguishing feature of which is that, for a given circuit voltage and load, they run at substantially the same speed whether the supply be direct current or alternating current.

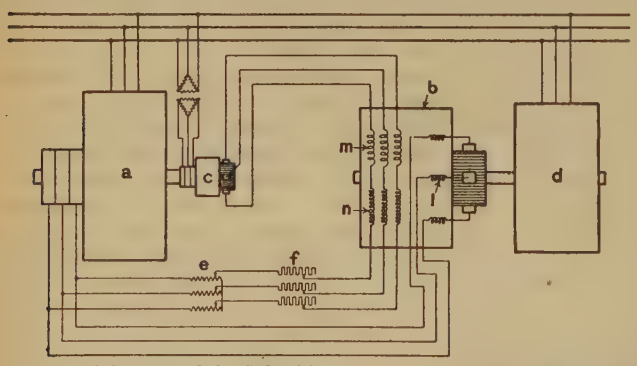


Fig. 3.—Diagram of the Scherbius system of speed control of induction motors. *a.* Main induction motor. *b.* Polyphase commutator motor. *c.* Ohmic drop exciter. *d.* Squirrel cage induction machine. *e.* Auto transformer for speed regulation. *f.* Variable resistor for speed regulation. *l.* Neutralizing winding of polyphase commutator machine. *m.* Main field winding of polyphase commutator machine. *n.* Interpole field winding of polyphase commutator machine.

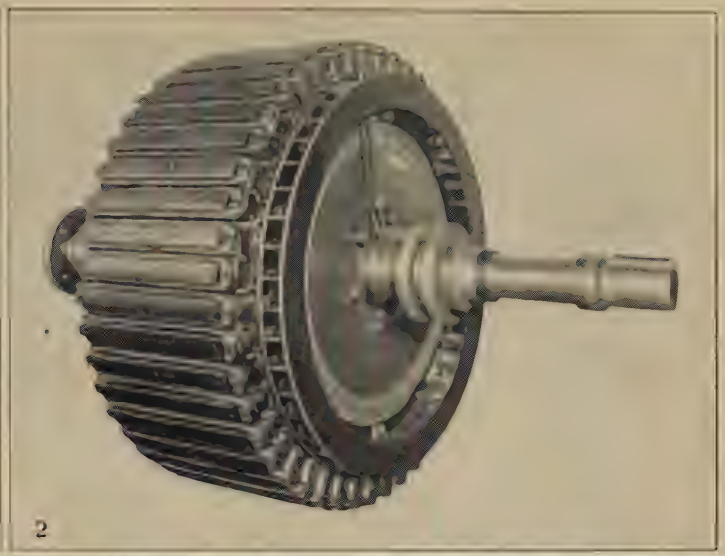
From 1 H.P. upwards, there has, since 1910, been a continuing rapid trend toward the use of the polyphase squirrel cage induction motor. The direct-current motor is relatively of far less importance now than in 1910. Where speed control is necessary, the direct-current motor is usually more suitable, but polyphase commutator motors which provide for speed control by brush shifting are available, although their cost is high. The notable tendency in 1926 is toward the much wider use of synchronous motors of all sizes in order to improve the system power factor. Static condensers are also being installed with induction motors for the same purpose. Synchronous motors are generally fitted with some auxiliary feature such as a squirrel cage winding to provide adequate starting torque. But it is sometimes arranged for the load to be applied through a clutch after the motor has acquired synchronous speed. Fig. 1 on plate shows a type of so-called super-synchronous motor in which the stator is permitted to revolve during the period of acceleration from rest up to synchronous speed and is then brought to rest with a band brake while the rotor runs up to synchronous speed.

There have since 1910 been developments consisting in so designing transposed conductors as to increase the eddy current losses at starting. The squirrel cage system of an induction motor will provide more starting torque per ampere input to the motor, the greater the loss in the squirrel cage. Full periodicity occurs in the squirrel cage at starting, thus intensifying eddy current losses, while the periodicity at full speed is very low indeed. There are many ways of attaining the desired object. Some of these are modifications of Boucherot's proposals. Others, such as the Kierstead principle described in U.S. Patent No. 1188182 of 1916, are novel. The simple expedient of using radially deep squirrel cage conductors is also effective.

The multiplicity of devices and types of construction of all sorts at present widely used to endow electric motors with desirable characteristics as regards high starting, accelerating and stalling torque, speed control and other features, as also constructional characteristics such as being acid-resisting, dust-proof, gas-tight, moisture-resisting, splash-proof, submersible (*see* Salvaging), weather-proof, drip-proof and explosion-proof, is too great for enumeration in this article.

Electric Railway Motors.—These are more effectively ventilated than the 1910 motors and are for this reason and owing to improved design features and materials much lighter per horse-power. Since 1910 hundreds of single-commutator direct-current railway motors have been built for 1,500 v., two in series being used in pairs on electric locomotives for 3,000 v. service. Several European countries have, since 1910, adopted as standard the high-voltage direct-current system of railway electrification. In Germany and Switzerland, where the standard periodicity for single-phase railway motors is 16⅔ cycles per sec., fairly satisfactory and not excessively heavy single-phase railway motors have been developed in large sizes, which are mounted above the trucks where the necessary space is available, the axles usually being driven through rather elaborate mechanical transmission systems. (*See* Railways.)

Electric Drive of Rolling Mills.—All new steel mills are invariably equipped with the electric drive, and the replacement of the steam drive in old mills is proceeding rapidly. During 1925 there were installed in America for driving the rolls 150 motors with an aggregate capacity of 275,000 horse-power. The total aggregate capacity of all motors at present installed in steel mills in America is 4,000,000 horse-power. Of this total there are 1,200 motors driving rolls, and their aggregate capacity is 1·5 million horse-power. Electrification has led to great increases



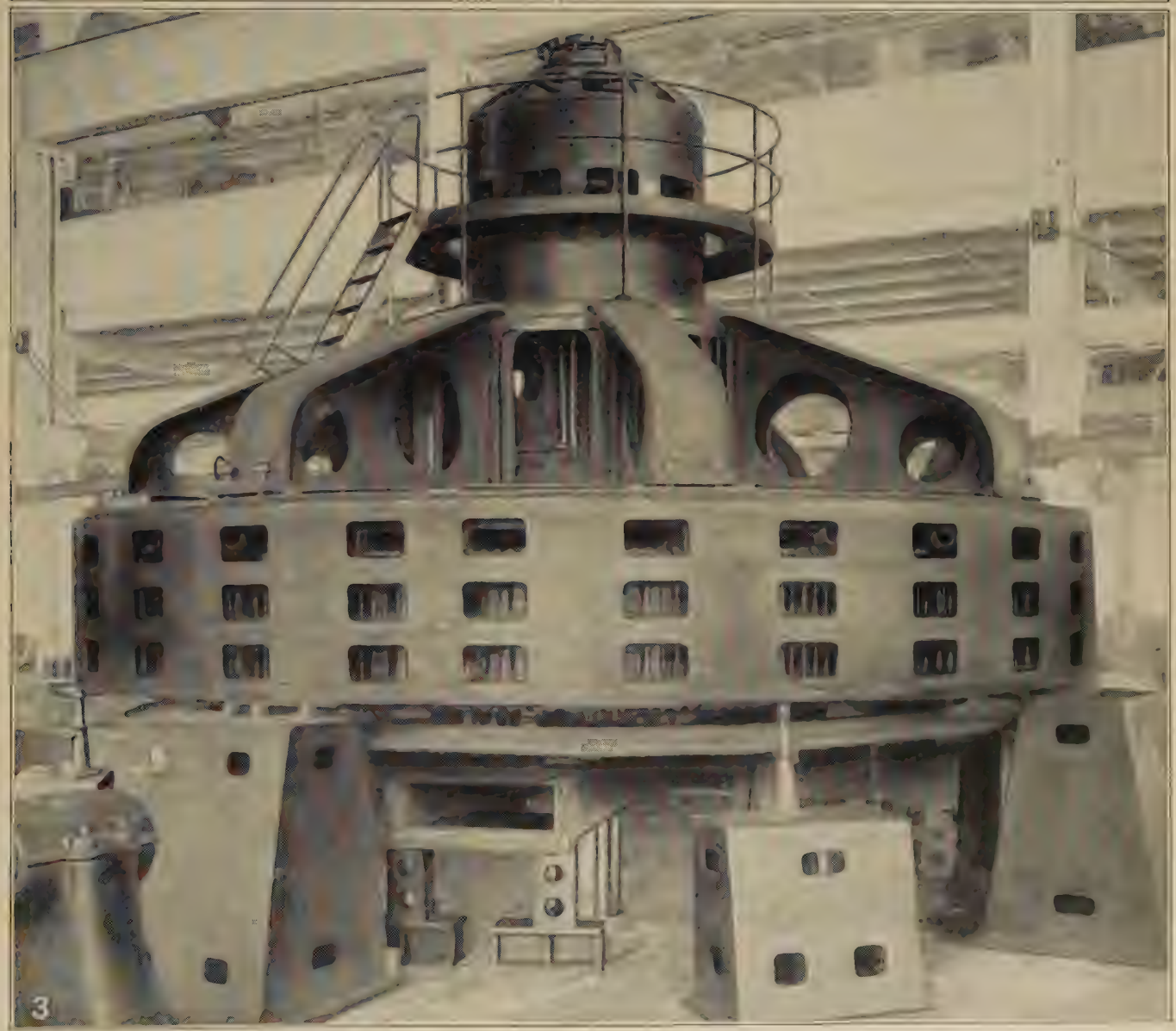


FIG. 1. 8 pole, 100 H.P., 900 r.p.m., 220 volt super synchronous motor. FIG. 2. 480 cycle rotor of a 48 pole 600 k.v.a., 1,200 r.p.m., 1,875 volt generator for induction furnace work. FIG. 3. 72 pole, 20,000 k.v.a., 100 r.p.m., 6,600 volt, vertical shaft water wheel driven generator.

in the output of steel mills through speeding up the rolls, has improved the product through the much greater exactness of control and has decreased the manufacturing cost.

For reversing mills the Ilgner system with liquid slip regulator is almost always used and the d.c. motor which drives the reversing rolls is sometimes of very large capacity, such, for example, as a continuous capacity of 8,000 H.P., and a capacity for momentary loads up to 22,000 horsepower. Reversing from full speed in one direction to full speed in the other direction is accomplished in from three to four seconds. For non-reversing constant-speed mills induction motors are nearly always used. However, a recent installation comprised a 9,000 H.P., 107 r.p.m., 60-cycle synchronous motor. For non-reversing mills requiring adjustable speed, there are often employed induction motors with the Scherbius or the Krämer[1] direct current system of speed control, although when close speed regulation is required d.c. motors are employed.

Scherbius System of Speed Control of Induction Motors.—The Scherbius system is one of the systems developed and extensively used since 1910, providing for the economical control of the speed of induction motors. It is shown diagrammatically in fig. 3, in which *a* represents the induction motor whose speed is to be controlled, *b* is a commutator regulating motor whose main and interpole stator windings are connected (1) to the slip rings of *a*, through a resistor *f* and an auto-transformer *e*, and (2) to the commutator brushes of a small frequency converter *c*, which is mounted on the shaft of *a*, and whose slip rings are connected to the supply circuit through a small transformer. On the same shaft as *b* is a squirrel cage induction machine *d*, whose stator windings are connected to the supply circuit.

For speeds of *a* below synchronism, *d* is an induction generator returning energy to the supply circuit, while for speeds of *a* above synchronism it is an induction motor driving *b*, which then is a generator. *c* is called an "ohmic drop exciter" and serves to supply the resistance drop of the excitation circuit at the proper frequency to *b* and so supplies the whole excitation when *a* is at or very close to synchronous speed. The speed control of *a* is obtained by manipulation of the transformer *e* and the resistor *f*.

Reversing Drives.—Excavators (shovels), cranes, hoists, reversing planers and slotters, elevators (*see* ELEVATORS), conveyers, etc., constitute examples of motor applications requiring repeated rapid acceleration and reversal. Often the reverse drive is at a speed several times greater than the load drive. The choice between direct-current and alternating-current motors for these applications depends upon many circumstances. Often good systems are available with each type of motor.

Mining Applications.—Electric motors are very extensively used in both the coal and metal mining industries, there now being approximately 2,750,000 H.P. installed in these fields in the United States. Many steam drives have been converted to electric power with remarkable savings in cost of operation, and electric motors are used for practically all new undertakings.

At the mines proper (*see* MINING) electric motors are used for the following purposes: (1) hoisting, (2) pumping, (3) ventilation and (4) haulage. For the driving of mine hoists there are used both geared reversible polyphase induction motors and direct-current motors (usually without gears) operating on the Ward-Leonard or Ilgner systems. Many hundreds of hoist induction motors have been installed, ranging in capacity from 100 H.P. to 1,800 H.P., and direct-current hoist installations have been made in capacities up to 5,000 horsepower. A notable example of a large automatic electric hoist is that at the Inspiration Copper Co. mine in Arizona, consisting of dual 580 H.P. direct-current equipments which have a combined maximum daily capacity of 22,000 tons of ore from a depth of 750 feet.

Wood and Metal Working Machinery.— It is often desirable for wood-working machinery, that the driving motor should have extra high speed. Thousands of small squirrel cage induction motors with speeds up to 25,000 r.p.m. have been developed in America for this class of machinery and are usually mounted directly on the shaft or spindle of the machine to be driven. They are of bipolar design and are operated from the high-frequency generators of motor generator sets or from the high-frequency circuits of frequency converters. At 420 cycles per second the speed of a small induction motor will usually be well above 20,000 revolutions per minute. These motors are also used for such purposes as (1) grinding small bearings and ball races (2) driving oil separators (3) driving wood shapers and wood-carving machinery. A type of motor which is built by a European firm for driving wood-working machinery and which avoids the need

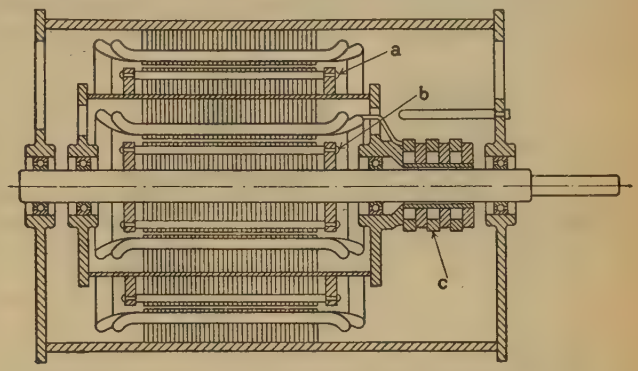


FIG. 4.—Cross section of a German high speed polyphase motor with two concentric rotors. *a*. Outer squirrel cage. *b*. Inner squirrel cage. *c*. Slip ring.

for a frequency converter is shown in fig. 4. The motor has two concentric rotors. If the windings are bipolar and if the stator and the outer rotor are each supplied with 50 cycles, the inner rotor will run at 6,000 r.p.m., or twice the speed associated with a single rotor 50-cycle bipolar motor. The driving of air compressors may be mentioned as a very important instance of requiring motors of large capacity and very high speed.

Extra-Low-Periodicity Motors.—Careful study has been given by the author to the design of extra-low-periodicity motors, such as 6 to 10 cycles per second. For low-speed applications such designs have characteristics as regards lower cost, higher efficiency and power factor, and capacity for carrying large overloads, which are much superior to 60-cycle and even to 25-cycle designs.

CONVERTERS

Synchronous Converters.—Reference has already been made to motor generator sets for transforming alternating current received in a motor into direct current delivered from a generator driven by the motor. While in 1910 synchronous converters which accomplish this purpose in a single machine and at higher efficiency than with motor generators had been widely used for years, they were of relatively low speed and consequently large and expensive. The synchronous converter of 1926 has, for a given capacity, voltage and periodicity, from 50% to 100% higher speed. Furthermore for 60-cycle circuits much larger capacities are now obtained in a single machine. In 1910 the 25-cycle converter was developed for quite large sizes up to 750 v. at the commutator, but the 60-cycle converter was limited to much smaller sizes and voltages. The improvements have been accomplished through more suitable interpole design, higher peripheral speeds of commutator, thinner commutator segments, improved brush-holder design, the use of flash barriers and other related devices, equaliser connections, amortisseur windings and other features. Improvements in very high speed circuit breakers have also contributed. The largest number of collector rings used in 1910 was six. At present 12-ring synchronous converters are being built. Fig. 5, an example of this, is a 12-phase, 4,200-kw., 285-v., 25-cycle, 16-pole synchronous converter, with its airblast transformers located integrally with the converter. This saves all the floor space formerly occupied by the transformer and also the long heavy-cross-section secondary cables from the transformers to the collector rings and the losses therein. For electric railway substations the modern synchronous converter is usually specified to carry 150% rated load for two hours and twice

[1] For a description of the Krämer system, see p. 576 of the 5th edition of the *Standard Handbook for Electrical Engineers.*

rated load momentarily. However, 300% rated load for five minutes is sometimes required and provided.

In America the practice followed in starting synchronous converters continues to be the use of low voltage transformer taps with the field circuit disconnected into sections and with the brushes raised from the commutator. In England the usual method consists in employing a small squirrel cage motor on the shaft and connecting its stator windings in series with the synchronous converter. When the converter has been brought up to speed, the stator windings of the starting motor are short-circuited.

Motor Converters.—In Great Britain motor converters are supplied by several manufacturers as an alternative to synchronous converters on the basis of there being an economic field for each. Motor converters are not used in America.

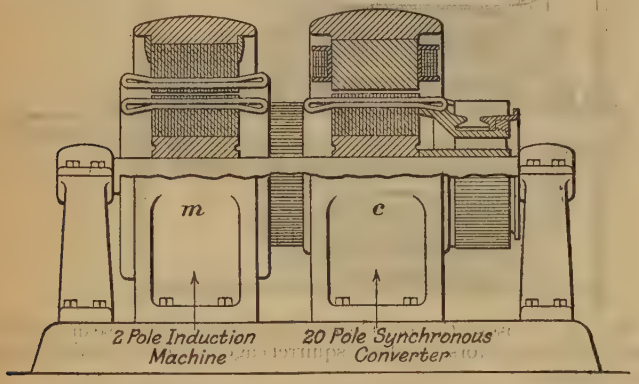


FIG. 5.—Synchronous converter system with transformer on shaft.

Transformer on Shaft of Synchronous Converter.—As an alternative, in saving floor space, an attractive proposition consists in mounting on the shaft of the synchronous converter the transformer, which steps down the voltage and multiplies the phases. Such an arrangement substitutes three small-current high-voltage slip rings for the six or 12 heavy-current slip rings otherwise required. It is still more attractive to have only the secondary half of the transformer on the shaft, the primary being on a stator. Then no slip rings are needed and the shaft is relieved of more than half of the weight of the transformer.

This ideal is nearly realised by the arrangement illustrated in fig. 5. The left-hand member is structurally a 2-pole induction machine, the right-hand member being, in the example, a 20-pole, 400 r.p.m. synchronous converter. A three-phase high-voltage 60-cycle source supplies the windings on the left-hand stator and establishes in the stator a magnetic field with a speed of 3,600 r.p.m. in a direction opposite to the shaft speed of 400 revolutions per minute. Consequently current of 66·7 cycles is induced in the windings of the left-hand rotor and delivered, at 12 or more phases, to the rotor windings of the synchronous converter. An analysis shows that the left-hand machine is nine-tenths transformer and one-tenth induction generator.

Frequency Converters.—These are now far more widely used and are built in sizes many times greater than in 1910. This increase in size has become necessary for interconnecting extensive transmission and distribution systems. A synchronous frequency converter for interconnecting 25-cycle and 60-cycle systems has been built with a speed of 300 r.p.m. and with a rated capacity of 35,000 kilowatts. It has an efficiency of 96·1%, or just over 98·0% for each machine. In the largest frequency converter yet built, one of the machines is of the induction type, so far as relates to its mechanical construction. This converter has a capacity of 40,000 kw. for the transfer of energy from a 60-cycle to a 25-cycle system and for 38,000 kw. when the energy is transferred in the opposite direction. The speed of the set is 300 revolutions per minute. The synchronous type member has 10 poles and the induction type member 14 poles. The necessity for having an exact relation between the frequencies of the two systems may be avoided by adding a Scherbius speed-regulating set to the induction type machine. This plan has been employed in several recent frequency converters.

Synchronous Condensers.—With the growth in size and voltage of transmission lines, the problems of voltage regulation and power factor correction have become very important and have led to the wide use of synchronous condensers located at suitable points in the system. As an important instance may be mentioned a synchronous condenser for 60 cycles, 11,000 v. and 25,000 kv.a. running at 600 revolutions per minute. For some other purposes where it is desired to control the power factor, use is made of other kinds of machines, which have come to be known as phase advancers. Amongst these may be mentioned those devised by Leblanc, Scherbius and Kapp. Descriptions of these are given at pp. 578 to 585 of the 5th ed. of the *Standard Handbook for Electrical Engineers*. No considerable need for such machines had developed in 1910.

Automatic and Supervisory Control.—Particularly with reference to converters, condensers and other apparatus in substations, but also as applying to generators in hydraulic stations, mention should be made of the wide use which is now made of automatic switching and supervisory control. Such operation was non-existent in 1910. But in America alone at the end of 1925 a total of 5,000,000 kw. was thus controlled. Much quicker operation is secured and there is a complete avoidance of the mistakes made in manual operation. The first cost is greater, but this is offset by operation savings and improved service.

Generators and Motors Wound for High Voltage.—While a few machines have been wound for voltages of nearly 30,000 by using considerable thicknesses of the best of slot insulation, it is still usual to employ transformers for any voltage higher than 16,000. There are grounds for believing that stators of generators and motors could in many cases economically be wound for much higher voltages by enclosing the stator windings in a space containing oil. A system of pipes through which cooling water is circulated could be located in the oil. Instead of oil the enclosure could contain air or suitable gas at high pressure. Such constructions would also decrease the deterioration of the insulation through corona action.

Various constructions have been proposed to permit of accomplishing these purposes. A sound basis when air is used would be to make the enclosure only reasonably airtight and have a small compressor supply of make-up air to maintain—say —two or three times atmospheric pressure. Not only will the high-pressure air be a better insulator but it will conduce to a much lower temperature rise just as there is a higher temperature rise when an air-cooled machine is operated at a high altitude. By means of a suitable fan the high-pressure air can be drawn from the stator enclosure through a closed-circuit cooling system (such as that illustrated in fig. 1) and back to the stator enclosure.

Standard Specifications for Dynamo Electric Machines.—In the interval between 1910 and 1926 a vast amount of standardisation work for dynamo-electric machinery has been accomplished in various countries. Some of the leading specifications employed in Great Britain, America and internationally are those adopted by the American Institute of Electrical Engineers, the British Engineering Standards Association and the International Electrotechnical Commission. (H. M. H.*)

DYSENTERY (*see* 8.785).—The term now designates a clinical syndrome in man characterised by the passage of blood and mucus, the bloody flux of former times, consequent upon the pathogenic activities, primarily upon the large bowel, and leading to superficial or deep ulceration, of certain microbic forms of life, protozoal or bacterial. Though this character is pathognomonic of the disease it is but one sign or symptom thereof and is not in itself a pathological entity. The syndrome arises from the habitual localisation of the micro-organism in the mucous membrane of the lower bowel; and as dysentery may be due to diverse micro-organisms, the causal one or its family or generic name is employed to specify the type of infection, thus—amoebic, bacillary, spirochaetic, ciliar and helminthic dysentery, the first two being the most prevalent and of world-wide incidence.

Pseudo-dysentery.—The term pseudo-dysentery has been given to the passage of blood and mucus arising when there is ulcera-

tion of the lower bowel in other diseases in which the site of activity of the causal micro-organism is not a specifically selective one and confined to the lower bowel, but may occur in other parts of the body, as in tubercle, syphilis or in typhoid or paratyphoid. Again this passage of blood and mucus may be found associated with a pathological state of the kidney, heart or liver or with carcinoma of the bowel, the impaction of a foreign body or mechanical irritation.

Clinical Dysentery.—The term clinical dysentery is applied to a group of cases of a mild form of dysentery of short duration, seen especially in natives in the tropics, the aetiology of which is not yet known. In all forms of dysentery there is frequently associated abdominal pain and tenesmus, or one only of these symptoms; or, again, both may be absent, for they depend on the site or extent of the ulceration.

Causal Organisms.—The causal micro-organisms have been grouped. Protozoa and bacteria found in the intestine of man have been classified into pathogenic and non-pathogenic, and the varieties of form certain protozoal organisms undergo in their life histories in the intestines, or when, as some helminths do, they pass through a phase of existence in an invertebrate host, have been studied and made known.

The findings of Walker and Sellards in Manilla from experiments on condemned prisoners show that of the five amoebae found in man only one, *Entamœba histolytica*, is pathogenic to him. Later Darling, James and others at Panama differentiated it from the non-pathogenic E-coli, an entamoeba commonly found in the large bowel of man. Recently Cutler, Boeck and Dr. Bohlar have cultivated the *E. histolytica* in artificial media. In the Philippine Islands Vedder studied the specific action on amoebae of emetine, an alkaloid from ipecacuanha, and its application with such beneficial results to man was first made by Sir Leonard Rogers in India. A new species of bacillus dysenteriae, *B. dys. Schmitz*, was first found in Rumania in 1916.

Improvements in Technique.—Mechanical aids have been improved to obtain more precise clinical knowledge. The sigmoidoscope, by which one can see 20 cm. up the bowel, is now employed to look for any ulceration and its character in this region and, if present, specimens for laboratory examination can be taken direct therefrom, so that this instrument renders a double and very valuable service. Skiagrams taken after a barium mixture, given by mouth or injected per anum, have been very serviceably employed to determine the movements and the nature of the bowel condition, and presence of any ulceration, filling defects, strictures or diverticula in its wall in subacute or chronic cases (*see* RÖNTGEN RAYS).

In England and France the existence of bacteriophage has been determined. Regarding dysentery d'Hérelle found that if a few drops of the filtrate from a broth culture of the faeces of a convalescent case of *B. dys. Shiga* be placed in a broth culture of this bacillus, the micro-organisms are dissolved. The action is considered due to the development of an ultra-microscopic virus or to a ferment or lytic property which destroys the bacillus organisms and this virus or property has been developed to extend to other bacillary dysentery (*see* BACTERIOLOGY).

AMOEBIC DYSENTERY

This is also called amoebiasis, loeschiasis or tropical dysentery, the latter because of its early endemicity and greater incidence in the tropical areas.

The causal organism *E. histolytica* (Loesch 1871), a species of the genus Entamoeba, affects man alone in nature, though the dog and cat, and recently the guinea-pig and rat, have been infected experimentally. The *E. histolytica* in its life-cycle in man passes through three stages—a large vegetative stage when living within the tissues, giving rise to ulceration and passage of blood and mucus; a pre-cystic or minuta stage found in convalescents and in carriers, when the amoebae are much smaller and live on the mucous membrane within the bowel, from which they may pass into the membrane and assume the larger vegetative form, and a cystic stage. The amoebae increase in numbers by division of the parent into two. In the pre-cystic, or minuta, stage they contract into a smaller, rounded or ovoid form, develop a firm outer wall and become transformed into cysts with the characteristic one to four nuclei, and containing chromatoid rods which possibly act as food stores. It is by swallowing these cysts that man is infected. These cysts do not resist drying, but retain their vitality for two weeks if kept moist in the faeces or in water. They can therefore be transmitted by direct contamination with faeces, through handling soiled linen, by flies carrying them on to food, by soil or by drinking contaminated water; and prophylaxis must be directed accordingly.

Symptoms.—Clinically the disease is characterised by its chronicity with tendency to recrudescence of symptoms. The onset is insidious, the sufferer first noticing a feeling of debility and lassitude with an increase of stools soft in character, and with blood and mucus for several days. These may clear up and be the only signs noticed, or they may recur months later. Most often the initial stage is followed on by an acute exacerbation of symptoms, dependent in their degree upon the extent of the ulceration in the large bowel, the most markedly affected sites being the entire colon, the caecum, flexures and appendix, sigmoid and rectum. Stools become still more frequent, even up to 40 or 50 in 24 hours, and the ulceration gives rise to abdominal pain and, if at the rectum, to severe tenesmus. The patient takes to his bed exhausted. In uncomplicated cases there is but slight rise of temperature or other symptoms of toxaemia as the entamoeba produces no toxin.

The entamoebic cysts in cystic form pass through the stomach unchanged, and in the small intestines they germinate, and young amoebulae are set free. These increase in size, multiply by a process of division, and, by their lytic power, penetrate through the mucus membrane lining the large bowel, into the submucous layer, where they continue to proliferate and destroy the tissue, including the small blood-vessels, thus leading to the haemorrhage that accompanies the mucus produced by the irritation of the membrane, and impeding the circulation of blood and lymph at the site. A typical flask-shaped ulcer is formed, with roughened undermined edges at the orifice, and when situated approximately they are frequently joined by submucous tunnels.

Occasionally super-added infection with other bowel organisms supervenes, and gangrene may follow, or the amoebae may penetrate through the outer muscular walls of the large bowel, giving rise to perforation and accompanying peritonitis, or, by penetrating a blood-vessel, they may be carried off in the blood stream and give rise to an abscess in the liver, to which the blood first takes them, or, most exceptionally, an abscess in the brain or lung or elsewhere. Healing is brought about by the development of fibrous tissue at the sites of the ulcers.

Diagnosis.—Diagnosis is quickly made by examination of the stools. In the acute condition they may consist entirely of blood and mucus, or contain also a little faecal matter. The mucus is stained a brownish colour by degenerated blood cells and the blood is usually in the form of clots, not evenly mixed through it. Microscopically the *E. histolytica* is readily found and is distinguished by its rapid movement, ill-defined nucleus and greenish tinted ectoplasm and ingested red cells. White cells are not seen in great numbers, and they tend to break down and disintegrate as distinguished from the many pus cells which are present in bacillary dysentery, and which tend to become swollen and structureless. Charcot-Leyden crystals, seen in dysentery of the amoebic type, may be found.

Treatment.—The acute symptoms readily subside under appropriate treatment. The patient should be put to bed. The specific treatment is ipecacuanha, or an alkaloid extracted from it, emetine. Combined hypodermic injections of emetine hydrochloride with oral administration of ipecacuanha (Brazilian), or of bismuth subnitrate in large doses, to attack the amoebae from within and without, have given striking results. The toxic action of emetine on the heart must be watched. Added to the specific treatment in acute cases there is the general and symptomatic, which may include an early free flushing of the bowel by a dose of castor oil with tinct. opii. added; later followed by magnesium (or sodium) sulphate in hourly or two-hourly half or drachm doses for 12 or 24 hours. Morphia may be necessary to relieve the abdominal pain and straining. The diet must be light and easily assimilated, and raw food should be withheld.

The symptoms subside in one to three weeks, the patient regains his general health after suitable convalescence and no further trouble may follow. However, not infrequently the fibrous healing leads to the thickening of the bowel wall, partial loss of peristalsis or to constriction producing chronic constipation,

or, what is rare, stenosis and blockage; or again the entamoeba may persist in the lumen of the bowel, ever ready to enter its wall and renew symptoms when conditions so favour. The usual medical and dietetic measures are taken when constipation supervenes, and liquid paraffin has proved a useful adjunct.

Therapy Notes.—Treatment to eliminate the entamoeba in its pre-cystic form from within the lumen of the bowel of the carrier is not yet on an equally satisfactory basis. Emetine hydrochloride injections, so effective in killing the entamoeba when in body tissues, have no effect upon it. An important measure to avoid recrudescence is to maintain the general health and avoid indiscretions in diet. There are several medicaments given to kill off the entamoeba and it may be necessary to vary or repeat courses of them; these are ipecacuanha, emetine alone or combined in an encapsuled pill, bismuth subnitrate, Ravaut's paste, Stovarsol, etc. Intravenous injections and colonic lavage with neosalvarsan have been much used to supplement oral treatment, by the French. Colonic lavage through an appendicostomy wound or by enemata has not given the good results anticipated. Amoebic hepatitis and small abscess of the liver respond well to injections of emetine hydrochloride, but a large abscess needs surgical intervention. A carrier should, if possible, live in the temperate zone.

Bacillary Dysentery

While sharing with the amoebic the clinical dysenteric syndrome above described, it differs therefrom in the shortness of the incubation period, generally 24 to 72 hours, by its sudden acute onset with elevation of temperature which may persist several days or more, and other symptoms of toxaemia; extreme contagiousness; seasonal prevalence (midsummer and autumn); epidemic character and incidence in temperate regions, where the amoebic type is practically limited to sporadic cases; higher death-rate and in the complications that may follow infection more especially with *Bacillus dys. Shiga*, namely: arthritis, fibrositis, conjunctivitis, muscular paralysis and myocarditis. Clinically it may assume forms varying in symptomatology from mild to severe, and occasionally be hypertoxic, typhoidal or ulcero-gangrenous in character. Outbreaks of dysentery in asylums, prisons, concentration camps and ships are generally bacillary in type.

The bacillary dysentery group comprises:—

1. The *B. dys. Shiga* (Chantmesse and Widal 1888, Shiga 1898, Kruse 1900), a well-defined homogeneous species, known as the true dysentery bacillus, since it alone contains endotoxins which are pathogenic to man and experimental animals.
2. *B. dys. Schmitz* (Schmitz 1916, Andrewes 1918, Broughton-Alcock 1918), another homogeneous species and a bacillus which contains endotoxins acting severely on rabbits but much less pathogenic to man. Its incidence is rare.
3. *B. dys. Flexner-Hiss* (Flexner 1900, Hiss and Russell 1903), a mildly toxic heterogeneous group of bacilli characterised by their power to ferment mannite, produce indol from peptone and containing many species recently distinguished by the agglutination and absorption reactions.
4. A further group which embraces bacilli rarely found and characterised by specific agglutination and absorption properties and power to ferment certain sugars, *e.g.*, *Bacillus of Strong, Castellani, Gay, d'Herelle* and others, each capable of producing a mild, clinically dysenteric syndrome in man.

Symptoms.—Clinical symptoms vary, as do the degree of the intestinal lesions and the toxicity of the causal bacillus. Infections with *B. dys. Shiga* are characteristically the most severe. The ulcerative lesions are not confined to the large bowel but extend one to two feet up into the small intestine. The bacilli pass through the stomach, multiply in the small intestine and produce at least two toxins which are absorbed into the blood, one acting on the nervous system and the other excreted into the large bowel, causing inflammation with coagulation of lymph, thrombosis of vessels and necrosis of the submucous layer and superimposed mucous membrane. The bacilli proliferate on the bowel wall, an exudative fibrinous diphtheritic-like membrane forms and separates off, leaving superficial ulcers with raised, red, oedematous edges. These may deepen by continued microbic action and even penetrate through into the peritoneum, leading to peritonitis, or gangrene may set up in the damaged necrosed tissue, and in either case death follows unless surgical intervention is early. Repair proceeds along the same lines as in amoebic cases, but, the ulcers being generally more superficial, the permanent damage is not so great.

The stools have a characteristic microscopic appearance, as numerous pus and epithelial cells and large, macrophage cells are present in the mucus. Microscopically the stool most often consists of mucus, like cloudy-grey jelly streaked or stained by bright red blood, or the mucus may be bile-stained in a diarrhoea-like stool, or, in very severe cases, there are shreds of necrosed mucosa.

Causation.—The causal bacillus is readily isolated by culture within the first days, but afterwards it becomes difficult as the microbic life in the necrotic tissue becomes a flora of proliferating organisms. The life of dysentery bacilli is prolonged by mixing the faeces with 30% glycerine in 0·6% sterile sodium chloride (Teague and Durman's solution), and the method is very useful when specimens are to be sent by post or transport to a laboratory. The *Bacillus dys. Shiga*, the only species isolated from the blood stream, has been found therein in only four or five cases. The bacilli dysenteriae pass to the mesenteric glands along the lymphatics, but are arrested there.

After the cessation of the symptoms the percentage of cases retaining the causal organism in the bowel is very small. If the patient becomes a carrier of *B. dys. Shiga* the stools will continue to be in part muco-purulent, even up to three or more years. The property of agglutinating the causal organism and other strains of the same race is present in the blood after the first week and may last for only eight or ten days in mild cases, but when the infection is prolonged this property of agglutination persists for a longer period. *B. dys. Shiga* infected cases generally agglutinate, also the *B. dys. Flexner-Hiss* in a lesser degree, but the converse does not hold. *B. dys. Flexner-Hiss* cases agglutinate several species of the group, rarely only the strain isolated from them. *B. dys. Schmitz* cases do not appear to develop agglutinins even for their own organism.

Treatment.—In bacillary dysentery the patient, especially if infected with *B. dys. Shiga*, is much more ill than in amoebic, and attention is given to neutralising the toxins which act strongly on the heart and other vital organs, besides general and symptomatic treatment and elimination of the microorganism from the intestines. Infections with *B. dys. Shiga* are outstandingly the most severe, and it is the anti-Shiga serum prepared by inoculating the bacilli with their endotoxin into the horse which is the most efficacious. It has also been used in severe cases due to *B. dys. Flexner-Hiss* with some success. A polyvalent horse serum prepared by inoculating strains of both these groups of microorganisms has been extensively given in cases of either infection, but the best results are gained from anti-Shiga serum in *B. dys. Shiga* infections where this specific line of treatment is most required. The injections should be given as early in the disease as possible and in large doses, dependent upon the severity of the case, *e.g.*, 60 c.c., 40 c.c., 20 c.c., on successive days in a severe case; saline aperients until the stools become faecal should be given frequently. Heart stimulants may be needed. Diet as above. Thereby amelioration is rapid, sequelae rare, the bacillus early eliminated and convalescent carriers much more rare than after amoebic dysentery, and the bowel wall is not so often permanently damaged. After an attack it is well to take care in building up the general health and adhere to a diet.

Prophylaxis.—The general prophylactic measures to be taken are comparable with those against infections with *E. histolytica*, but it should be remembered that bacilli are lower vegetable organisms and can proliferate in a suitable environment outside the body. Dependent on several factors, bacillary is more contagious than amoebic dysentery. Encouraged by successful results following inoculations of typhoid and paratyphoid vaccines, some series of inoculations with a vaccine of *B. dys. Shiga* were made in epidemic areas during the War, as this was the bacillary organism so prevalent and so toxic in epidemics during war conditions. Its contained toxins give rise to acute local reactions unless modified prior to inoculation by special methods, as by treating the heat-killed bacilli with normal serum (serum treated) or with specific horse anti-serum (sensitised), or

by inoculating both specific anti-serum and bacillary emulsions on approximating days, or by giving an absorbed specific anti-serum and bacillary emulsion simultaneously, or by emulsifying the bacilli in oil. These series of inoculations made by various workers gave encouraging results. Vaccine-therapy employed to rid the convalescent carrier of *B. dys. Shiga* has not been successful. In striking contrast with *B. dys. Shiga* the killed and untreated emulsions of the *B. dys. Flexner-Hiss* group give rise to no reaction, even in high doses.

Spirochaetic Dysentery.—This is due to *Spirochaeta eurygyrata* (Le Dantec 1900, Werner 1910). To a considerable extent evidence is increasing that this spirochaeta is capable of giving rise to an acute condition with passage of blood and mucus or of what is more frequent, maintaining a chronic or intermittent mild form of dysentery, or it may give rise to no symptoms. It is never found free in faecal matter but only in mucous shreds excreted, in the detached crypts and occasionally within the lining epithelial cells of the mucous membrane. Many observers consider that it proliferates and gains a footing on a bowel damaged by the entamoeba. It is a rare form of dysentery but has a wide endemic distribution in tropical and subtropical countries. Treatment of the very rare acute condition is by frequent saline aperients. In its chronic form best results have followed enemata containing oil of eucalyptus, or by calomel at night followed by a saline aperient next morning or by Slovarsol.

Helminthic Dysentery.—The chief helminths which give rise to dysentery are the bilharzia worms, *Schistosoma mansoni*, in Africa, South America, West Indies and *Schistosoma japonicum* in the Far East. Another trematode which may cause dysenteric symptoms is *Fasciolopsis buski*, found in China, Assam and India. Thymol or beta-naphthol are used in treatment of this latter.

Infections with hookworm (*see* HOOKWORM), *Ankylostoma duodenale*, are widely distributed in tropical lands and extend to subtropical regions. In such infections blood and mucus are sometimes passed in large quantities and these cases may be mistaken for true dysentery.

Ciliar dysentery due to *Balantidium coli* is a form of dysentery that has been found in Europe, Japan and the Philippine Is., but rarely elsewhere. An investigation of a number of habitants of Utuado, Porto Rico, led to the detection of many carriers without symptoms. The ciliar form of dysentery is rarely seen outside endemic regions and the causal organism is transported therefrom in sporadic cases that may arise elsewhere.

Carriers.—A certain number of cases of dysentery become convalescent carriers, harbouring the parasite in the intestine with or without obvious activities on the host. The contact or healthy carrier may have no signs past or present. Neither type of carrier is very common in the bacillary form, and there are more of *B. dys. Flexner-Hiss*, but both types are not very uncommon in amoebic dysentery.

The causal organism, bacillus or amoeba, can live in some humans, to all appearance as a harmless commensal within its host. The first sign of the presence of the entamoeba may be an abscess in the body, generally in the right lobe of the liver, very rarely in the brain or the lung, though its transference from the bowel by the blood stream is a rare sequela outside tropical regions. Only by laboratory investigation of the stools, and finding of the amoeba or its cyst, can the contact or healthy carriers be detected. Lowering of resistance by debilitating illness, indiscretions of diet, poor feeding, crowding together, etc., may lead to activity of the organisms on the bowel wall, giving rise to symptoms. Carriers of dysenteric organisms should always be looked for and treated and should not be employed on the preparation or distribution of foodstuffs which may become infected and spread infection to others. Helminthic and ciliar dysentery carriers are practically limited to endemic regions and to those arising from infections therein. Of 9,431 returned troops claiming State aid for disabilities following War dysenteries, 942 harboured the *E. histolytica* and four of these acquired a liver abscess in England; 10 carried *B. dys. Shiga*, 7 *B. dys. Flexner-Hiss*, 1 *B. dys. Shiga* and *E. histolytica*, 12 *Spirochaeta eurygyrata*, 10 *E. histolytica* and *S. eurygyrata*. Approximately half of those who were not completely freed of *E. histolytica* during early treatments after arrival in England have remained carriers, despite many forms of treatment since. The vast majority do not suffer from acute symptoms. A few persist in passing blood and mucus, others a catarrhal exudate with active amoeba.

Examinations of the faeces of groups of people who have never been in tropical lands, some leading normal lives, others in camps, prisons, asylums, etc., by various workers in temperate regions, including England, Europe, the United States, Northern China, have shewn a percentage of carriers of the amoeba of dysentery in a varying but definite percentage amongst apparently normal people living normal lives, as well as in subjects under conditions of confinement. The findings of the bacilli of dysentery were less frequent. When we consider that the spread of the disease is from the faeces of infected subjects, and that a distinct carrier rate is found under conditions of hygiene and sanitation, it will be appreciated that the very frequent lack of any such conditions amongst natives increases the risk of infection in tropical lands. Again the less healthy conditions of life in these parts tend to favour a lower resistance of the body and a higher number of cases with symptoms. Whenever people are confined or crowded together, as has happened formerly in asylums, prisons, etc., the risk of a spread of infection is great and an outbreak of dysentery not uncommon when rigid sanitary measures are not applied.

General Conclusion

Epidemiology.—Dysentery is markedly more frequent in hotter countries and tends to arise in subjects of lowered body resistance. This disease appears in its most devastating epidemic form in armies, fugitives, refugees and pioneers and vanishes before the comfort and prosperity of a well-fed and settled people, especially when living under favoured climatic and sanitary conditions. During the World War, its invaliding rôle was considerable in all armies, especially those fighting in tropical countries where the conditions favoured it, and in parts of eastern Europe where sanitary control was not scrupulously exercised. On the Gallipoli Peninsula, nearly every soldier who landed on the peninsula suffered from dysentery or diarrhoea, and few escaped the former disease. Severity of the climatic conditions, difficulties of obtaining adequate food and sterilised water, fly pests, fatigue, hastily improvised resting places and sanitary arrangements, prolonged periods in trenches, were the important factors conducive to infection. The comparatively small death roll was due to the knowledge that dysentery may be due to diverse organisms, each having a specific line of treatment. Most deaths were due to *B. dys. Shiga* infections.

Incidence.—In most temperate zones the incidence of dysentery is practically limited to occasional small outbreaks of the bacillary form, to sporadic cases of this or of the amoebic form due to infection from a patient or from a carrier of the organism, and to cases that have been infected in tropical or subtropical lands or under War and such like conditions of life; but in hot climates these forms of dysentery constitute one of the most prevalent diseases and claim a very high incidence and death rate, approximating that of malaria.

As a sequel to the inflowing of the white races and the development of agriculture, mining and other industries in tropical lands, there has been an appreciation of the economic value as well as of the maintenance of better health and social conditions that followed the investigations into tropical diseases, the care in health and disease of the native and application of fitting hygienic and sanitary measures on a large scale. To cite but two extensive beneficial issues in areas heavily infected with dysentery, the once so prevalent amoebic dysentery in the Panama Canal Zone is now uncommon there, while in the Malay States, where bacillary dysentery is the more frequent form, there has been an increasing fall in the number of cases and death rate during the last decade.

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DYSON, SIR FRANK WATSON (1868–), British astronomer, was born at Ashby-de-la-Zouch, Leicestershire, on Jan. 8 1868, and was educated at Bradford Grammar School and Trinity College, Cambridge, where he was second wrangler and Smith's Prizeman. In 1894 he became chief assistant at the Royal Observatory, Greenwich, and in 1905 was made astronomer royal of Scotland, a position which he held until his return to Greenwich in 1910 as astronomer royal of England. From 1899 to 1905 he was secretary of the Royal Astronomical

Society. He was elected F.R.S. in 1901, subsequently serving on the council, and was in 1921 awarded the royal medal for his numerous contributions to astronomy, and especially for his important investigations of the distribution and movements of stars and the bearing of these upon the structure of the stellar universe. He was conspicuously successful, too, in obtaining records of the spectrum of the corona and chromosphere during eclipses of the sun. He was knighted in 1915. His publications include papers on mathematical and astronomical subjects in *The Quarterly Journal of Mathematics*, and other periodicals.

DZERZHINSKY, FELIX EDMUNDOVICH (1877–), Russian politician of Polish descent, was born at Vilna. He joined the Social Democratic party of Lithuania in 1895, and two years later was arrested and banished to Siberia for political agitation. In 1899 he escaped, was rearrested in the following year and in 1902 again escaped. After he had taken part in the revolution of 1905 there followed further years of banishment until 1912, when he returned to Warsaw, was arrested again and sentenced to nine years hard labour. After the revolution of March 1917 he was released and became a member of the military revolutionary committee which organised the Bolshevik revolution. In Dec. 1917 he organised and became chairman of the Cheka, or secret police which fought the revolution. By his ruthless methods in this capacity Dzerzhinsky became one of the most feared men in Russia. He was appointed commissar of the home department in 1919. The organisation of the cheka was found to be so complete that it was possible to dispense with Dzerzhinsky's supervision and in 1921 he was transferred to the commissariat of transport, where he carried out an exhaustive reform of the railways. Under his rule bridges were rebuilt, lines and rolling-stock put in order, punctuality restored and pilfering and banditry stopped. In 1924, after the party dispute on policy at the time of Lenin's death, Dzerzhinsky was placed at the head of the supreme economic council.

EAKINS, THOMAS (1844–1916), American painter (*see* 8.791), died at Philadelphia June 25 1916.

EAR, NOSE AND THROAT, DISEASES OF THE (*see* 8.794, 20.79).—This article gives a short survey of the main development of these branches of scientific medicine during the years since 1910.

I. DISEASES OF THE EAR

The researches of Arthur Cheatle into the anatomy of the temporal bone have shown that in 80% of cases the mastoid process is of the "pneumatic" or cellular type, *i.e.*, the process is composed very largely of air cells. In the remaining 20% it is of the "infantile" type in which the bone is dense or acellular. The same investigator also demonstrated that mastoid cells may develop in regions other than the mastoid process, *e.g.*, the floor of the tympanic cavity, the root of the zygomatic process, in the upper and posterior wall of the bony meatus, around the posterior vertical, semicircular canal, the wall of the sigmoid sinus and in the apex of the petrous portion of the temporal bone. He has shown that persistence or excessive development of certain small veins in the inner wall of the mastoid antrum may favour the spread of infection leading to intracranial complications.

These anatomical features may be the chief factors in establishing the nature of clinical symptoms and the line of treatment to be adopted when disease attacks the temporal bone, particularly in inflammatory lesions brought about by invasion of the middle ear by pathogenic organisms. During this period the attention of otologists has been more than ever concentrated on the anatomy, physiology and pathology of the labyrinth, and particularly on its vestibular component.

This activity followed on the publication in 1907 by R. Bárány (Vienna) of his classical treatise *The Physiology and Pathology of the Semicircular Canal Apparatus in Man* and later the brilliant work of R. Magnus and his assistants of the Utrecht University which may be regarded as parallel or supplementary to that of Sir Charles Sherrington at Oxford. Albert Gray (Glasgow) has added to our knowledge of the comparative anatomy of the labyrinth and John S. Fraser (Edinburgh) to the microscopic anatomy of pathological lesions affecting it.

The internal ear or labyrinth comprises two essential structures, the cochlea which is to the ear what the retina is to the eye; the vestibular apparatus which subserves two important functions: (*a*) static (saccule and utricle) which has to do with the maintenance of equilibrium (*b*) kinetic (saccule, utricle and semicircular canals) for the recognition and analysis of motion.

In conditions of health certain tests are employed which give definite results indicating a normal condition of the vestibular apparatus, *e.g.*, the pointing tests, nystagmic movements of the eyes after rotation of the patient and the employment of the caloric and electrical tests. These reactions will be modified or absent when the vestibule is diseased so that it is often possible to determine the situation of the lesion.

With such information at his command the aural surgeon can now explore the labyrinth and its immediate neighbourhood with a success hitherto undreamt of. Consequently, certain types of vertigo intractable to treatment by constitutional measures, acute and chronic suppuration of the labyrinth with threatening symptoms of meningitis, and tumours of the auditory nerve, are often amenable to surgical intervention.

While little advance can be registered in the treatment of the well-known types of insidious and slowly progressive forms of chronic deafness, it is more than probable that in future generations there will be fewer suffering from deafness than at the present time. This will be due to prevention rather than cure, because it is recognised that the so-called "chronic middle-ear deafness" is primarily due to infection passing from the naso-pharynx by way of the Eustachian tubes into the middle-ear cleft and its adnexa.

From this point of view, no wiser social legislation has been instituted than that which provided for the establishment of school clinics, child welfare centres, etc., in which skilled examination and treatment of the ears, throats and teeth of children are carried out. Prophylactic measures of this kind will go far, not only toward the preservation of hearing, but also in the prevention of those serious and often fatal complications which are apt to result from neglected acute and chronic suppuration of the middle-ear cleft, *e.g.*, meningitis, abscess of the brain and certain types of septicaemia. In the diagnosis and treatment of such serious conditions mention must be made of the valuable assistance to be derived from an examination of the cerebro-spinal fluid drawn from the lower end of the spinal canal by "lumbar puncture."

Lumbar Puncture.—A hollow needle is passed successively through the tissues between the arches of the 3rd and 4th lumbar vertebrae until it pierces the dura-arachnoid sheath of the spinal theca. The fluid then issues from the needle and about 5 to 10 c.c. is collected for examination. Normally this is a clear alkaline fluid with a trace of proteids, a slight amount of sugar and free from cell elements. These characteristics may be strikingly altered when infection spreads from the ear into the adjacent regions of the cranial cavity, *e.g.*, the fluid may be increased in amount, it may be turbid, its chemical constitution modified and leucocytes, lymphocytes and endothelial cells may be present together with one or more types of infective organisms.

Finally and in regard to treatment, A. R. Friel has demonstrated the value of zinc ionisation for certain cases of chronic suppuration in which the sepsis is confined to the tympanum and does not involve the "attic" nor the antrum, and where the perforation in the tympanic membrane is large enough to admit of the middle ear being filled with the ionising fluid. Suppurations intractable to other non-surgical measures, which had existed for many months, or even for years have been cured by one or two applications of this treatment.

II. DISEASES OF THE NOSE

During the decade 1915–25 the nasal cavities have received more attention from the general medical profession than formerly and for the following reasons:—

(*a*) Within these cavities or in the air cells or sinuses connected with them, foci of infection may exist which may give rise not only to local symptoms but to others in distant regions, such as the lungs, heart, gastro-intestinal tract, kidneys, muscles, joints, the central nervous system, the peripheral nerves and the special organs of the senses, especially those of the eye and the ear.

(*b*) Nasal symptoms are frequently a local manifestation of hypersensitiveness or anaphylaxis of the individual to certain proteids.

In regard to infection no organ or tissue of the body appears to be exempt from possible sub-infection by the organisms or their toxins if and when these are located in the antral, ethmoidal, frontal or sphenoidal sinuses. They gain entry into the system by inhalation into the lower air passages and thus bring about pulmonary symptoms or they may be swallowed and cause affections of the gastro-intestinal tract.

In other instances the organisms or the poisons produced by their growth find their way into the lymphatics or blood-vessels and are thereby disseminated to such distant regions as have already been indicated. It is therefore obvious that in the presence of symptoms which suggest absorption from a focus of chronic sepsis, the rôle played by the nasal sinuses should not be overlooked. This important subject has recently been emphasised and fully dealt with in the "Semon Lecture," University of London (1925), by Dr. Watson-Williams.

Treatment.—The most noticeable change in the surgical treatment of these infective foci has been in relation to the technique employed when chronic suppuration involves the frontal sinus. Hitherto an external operation was performed which involved some weeks of after-treatment, the infliction of a more or less noticeable

scar in the region of the eyebrow and a radical procedure not free from considerable risk to life. To-day the sinus is approached through the corresponding nasal cavity and an attempt made to secure free and permanent drainage of the septic focus. The results are generally satisfactory, the patient is rarely confined to bed for more than a week, no deformity is produced and in skilled hands the risks of complications are small. It only remains to be said that the higher nasal sinuses are difficult of access and important structures lie in their immediate vicinity, *e.g.*, the eye and the intracranial structures. Consequently only those who have ample opportunities for acquiring the necessary manipulative skill should undertake operations in these regions.

One of the most intractable diseases of the nose is Foetid Atrophic Rhinitis (Ozaena). It is characterised by gradual wasting of the nasal mucous membranes and the bony structures which they cover. These atrophic changes are accompanied by the formation of foul-smelling crusts and not infrequently with a sinking in of the bony framework of the nose. Its cause has not been fully ascertained, and it is possible that constitutional and local factors may play their part in establishing the disease. Hitherto surgeons have depended chiefly on local antiseptic applications to affected areas and the daily use of cleansing washes.

More recently better results have been obtained by surgical measures which aim at narrowing the nasal cavities by forcing inwards the inner walls of the antral sinuses and maintaining them in that position. The literature on the subject records many cases which appear to have been cured or greatly benefited. Lupus of the nasal mucous membrane has proved to be amenable to radium therapy.

Hypersensitiveness or Anaphylaxis.—This term connotes an abnormal sensitiveness in certain individuals to protein substances, shown by the occurrence of phenomena mainly connected with the action of certain groups of involuntary muscles. These substances may gain access to the body from the atmosphere by microbial infection, by the ingestion of foodstuffs or be produced within the body by aberrant metabolism. Hay fever and asthma may be produced by the action of pollens and the hairs or dandruff of animals, such as horses, cats or dogs upon the conjunctiva or the mucous membrane of the nose. Vasomotor rhinitis and angio-neurotic oedema are also manifestations of this condition of hypersensitivity.

Research has shown that it is possible to identify these substances in any particular case by applying extracts of the suspected agents to minute abrasions of the skin, or to the conjunctiva in the case of air-borne pollens, and observing the local reaction to such extracts. Treatment must be directed toward putting the patient's tissues into what is known technically as a " refractory state " in which the organism no longer reacts abnormally to these protein substances and the method adopted must vary with the factors present in each individual case. By draining surgically a septic focus, such as an infected paranasal sinus, the absorption of microbial toxins is lessened, or by stimulating the production of antibodies in infections where surgical drainage is not applicable, we lessen the sensitivity of the organism to that infection and to other factors, such as foodstuffs or pollens, though these may have to be dealt with separately. Where neither of these methods applies we can treat the condition by the elimination from the diet of the foodstuffs shown by the skin tests to produce the abnormal state. Where the only feasible explanation is an error of metabolism the cause must be investigated by means of chemical and bacteriological examinations of the blood, the contents of the gastro-intestinal tract and the urinary excretion.

III. DISEASES OF THE THROAT

The Tonsils.—This term is popularly applied to compact masses of glandular or lymphatic tissue which are situated between the anterior and posterior faucial pillars which form the isthmus between the mouth and the pharynx. They are more correctly spoken of as the faucial or palatal tonsils, because similar collections of lymphoid tissue are present in the nasopharynx and in the base of the tongue. The complete circle of glandular tissue is known as Waldeyer's Ring. It is present in all children and while it tends to undergo a natural involution or atrophy about the age of puberty, this change not infrequently fails to take place.

Adenoids.—The term adenoids implies an overgrowth of the lymphoid mass in the nasopharynx which is sufficient in degree to produce symptoms. In conditions of health the collections of lymphoid tissue comprising Waldeyer's Ring are supposed to possess a protective function in the earlier years of life, *e.g.*, in the acute specific fevers of childhood they often bear the first brunt of the attack by infective organisms, and may thus be regarded as barriers to a generalised infection of more distant and important organs.

But when, as frequently happens, any or all of the components of the lymphoid ring become the seat of a chronic infection, or act as foci of sepsis, then their potency for evil is equal to or even greater than that of the paranasal sinuses already referred to. The faucial tonsils are peculiarly liable to act as centres of local and general infection because they are exposed to contaminated atmosphere, food and to the organisms associated with diseased conditions of the gums and teeth.

No facts in medicine have been more clearly established than that the ring of tonsillar tissue in the upper air passages forms an easy and open portal for infection by the micro-organisms of disease. It is only necessary to mention the initial inflammation of the tonsils and their immediate regions which herald an attack of scarlet fever, measles, diphtheria, influenza (frequently) and acute rheumatic fever. The symptoms which chronic septic conditions of the tonsils may cause are far-reaching and important and their cure or relief by enucleation of the tonsils is a matter of frequent experience. As the influence of chronic sepsis on the higher brain has hitherto received little notice it may be as well to give an illustration of the toll of diseased tonsils in this connection.

Chronic infective foci, by lessening the general resistance of the body and producing degenerative changes in the nervous and endocrine systems, dispose to and even determine mental disturbance. Without infection the chance of psychosis developing is very slight. At the New Jersey State Hospital (Trenton) the number of discharged patients increased from 37 to 85 % after removal of oral and tonsillar infections (H. A. Cotton, 1923). It is often forgotten that a small septic tonsil—especially in adults—frequently causes more definite symptoms in distant organs or tissues than large and prominent tonsils which are often only a cause of local discomfort. The modern practice of " enucleation " or complete rather than partial removal of the tonsils is based on the facts which are briefly outlined above.

Malignant Disease.—Two types are commonly met with, viz., sarcomata and carcinomata. If left untreated they prove fatal, but if recognised and dealt with in their earlier stages they may be cured or afforded long periods of immunity from recurrence. During the period under review experience has shown that radiotherapy alone or in conjunction with cutting operations of less radical nature than formerly, has produced equally good if not better results than extensive surgical procedures by themselves.

As a rule sarcomata respond more quickly to radium than is the case with carcinomata. Radium bromide, sulphate or emanations from the pure element are employed and carefully measured amounts are enclosed in suitably screened containers. These are inserted into the growth for a definite period of time while the neighbouring regions are at the same time submitted to radiation. The primary carcinomatous growths are treated in the same way, but usually after a " block dissection " of the glands in the neck has been made.

Diathermy.—When a high frequency current is led into the body by a narrow metal rod or needle, an intense heat is developed in the tissues around its point of entry, so that they are coagulated and can be removed easily. (*See* ELECTROTHERAPY.) The operation is practically bloodless, the patient suffers no shock, the scarring is slight and healing rapid. The coagulation by heat prevents dissemination of the cancer cells into the surrounding tissues which ordinary surgical manipulations may not

be able to avoid. A dissection of the glands in the neck can be made before or after destruction of the primary growth.

Treatment by diathermy can only be carried out successfully when the growth is situated in readily accessible regions such as the mouth, soft palate, tonsillar regions, posterior wall of the pharynx and the epiglottis of the larynx. It will be contra-indicated in the immediate neighbourhood of large blood-vessels, bone and cartilage. Whatever may be the value of "deep" X-ray therapy for malignant disease in other regions of the body, no results yet observed would recommend it for similar conditions in the throat or larynx.

Diseases of the Larynx.—Tuberculosis of the larynx is practically always secondary to a primary infection of the lungs, and its treatment has improved *pari passu* with that of the pulmonary lesion. Frequent inspection of the larynx, and the recognition of the earliest signs and symptoms of tuberculous laryngitis, followed by prolonged functional rest of the voice, have cured many patients whose general health and resistance have been maintained or improved by the régime of sanatorium treatment. In these circumstances and if prolonged functional rest of the vocal cords fails to cure small or limited tuberculous lesions in the larynx, the application to them of the galvano-cautery will often produce rapid healing. Severe surgical measures for the removal of infected laryngeal tissues are rarely called for. The value of tuberculin in the treatment of laryngeal tuberculosis is still a matter of opinion. It would be safe to state that its employment may be a useful accessory to general treatment in carefully selected cases. For fuller information on this subject see "the Mitchell Lecture" by Sir St. Clair Thomson (*Brit. Med. Journ.*, Nov. 8 1924).

Malignant Disease.—Here again the essential for successful treatment is early diagnosis. Any adult suffering from an alteration of the normal speaking voice of more than a few weeks' duration should be examined by an expert laryngologist. The treatment of the disease in its early stages is surgical and aims at its complete removal. The records of cure or many years of freedom from recurrence are probably better than those in any other region of the body.

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EARTHQUAKES (*see* 8.817).—Seismology originally meant that department of knowledge which deals with earthquakes. Up to about the end of the 19th century the meaning was almost unambiguous; the earthquake dealt with was the disturbance or quaking of the solid earth which could be felt and, when sufficiently severe, might cause damage or destruction. Toward the end of the century it was found that certain very severe earthquakes were accompanied by disturbances which could be registered, with suitable instruments, far beyond the region where the shock could be recognised without instrumental aid, and not infrequently these records could be obtained at great distances, even up to the antipodes of the origin.

It is, however, only a very small proportion of the shocks which can be felt, not more than one in 100, which give instrumental records at long distances from the origin; and it is probable, though not yet proved, that some of these long-distance records represent disturbances which nowhere were of a nature and severity that could be recognised except by delicate instruments.

From the study of these long-distance records of unfelt disturbances, a new department of knowledge arose, which, being new and giving rise to some remarkable and surprising results, has rapidly grown in importance till, at the present day, it has almost usurped the title to the name seismology, though a large part of it does not concern the earthquake, as that word was originally understood. Where the existence of the two branches is recognised, they have generally been distinguished as the old and the new seismology, but the new seismology is already an old and established subject of study and it seems better to distinguish them, when distinction is necessary, as *teleseismology* (τῆλε, distant) and *engysseismology* (ἐγγύς, near), the former being the study of the long-distance records, the latter the study of the shock which can be felt near by the place of origin. The two branches are, and must remain in practice, almost distinct sciences, for the method and character of observation are very different in each case.

Duplex Origin of Earthquakes.—The connecting link between these two branches of seismology is to be found in the recognition of the duplex origin of certain great and destructive earthquakes, in which the destructive surface shock is of shallow origin and a secondary effect of a more deep-seated disturbance, which gives rise to the distant records. These have been named bathyseism and episeism, the former being applied to the deep-seated origin and the latter to the secondary shock originated near the surface. Roughly, and with all the inaccuracy inevitable in a simile, they may be likened to the effect of the firing of a big gun; the explosion in the gun gives rise to a loud report which may be heard at long distances away, and may be taken to represent the bathyseism and long-distance records, while the explosion of the shell which falls some distance away from the gun and causes the destruction desired, is the analogue of the episeism, or destructive shock. Thus Prof. H. F. Reid, from a study of the destructive shock of the Californian earthquake of April 18 1906, concluded that it originated at a depth of about 20 km., and Dr. L. Pilgrim, of Stuttgart, studying the long-distance records, concluded that they originated at a depth of about 140 kilometres. These two very divergent estimates, obtained from different sets of data, by methods in each case sound and trustworthy, are easily reconcilable if the latter is regarded as referring to the bathyseism and the former to the episeism.

Depth of Origin.—The depth of origin of the long-distance records has been the subject of several studies, and depths of 50 km. to 1,300 km. have been deduced. Prof. H. H. Turner concludes that the bulk of them originate at about 200 km. below the surface, that a small number start from greater depths down to about 600 km., mainly grouped round a depth of 500 km., while a still smaller number originate at lesser depths up to 50 km., and these are mainly grouped round a depth of about 100 kilometres. On the other hand, from the record of earthquakes which occurred in Italy over a period of 14 years Mr. R. D. Oldham finds that out of a total number of 5,605 shocks, more than 90% originated at depths of less than 10 km., and only 1% at depths of over 30 kilometres.

Cause of the Episeism.—This strong contrast in depth is symptomatic of a difference in character of origin; the surface shocks which can be felt, or episeisms, are in some cases clearly due to the shock consequent on fracture of the rock composing the outer crust of the earth, and this is probably the usual cause of origin; but it is doubtful whether anything analogous to fracture, as we understand it, can take place under the great pressures and other conditions which must prevail at the depths where the bathyseism originates.

Cause of the Bathyseism.—The real nature of the bathyseism is still unknown, but in some cases, at any rate, and possibly, if not probably, in all, it is accompanied by a change of bulk, by which strains are set up resulting in distortion and fracture of the overlying rock near the surface. A possible cause is a regrouping of the chemical elements of a mass of deep-seated material, to form a new mixture of compounds, occupying a different volume from that which the original grouping required. Chemistry knows of many instances where an inert mixture of compounds may by change of temperature or pressure, or by some other external cause, change to a mixture of a new set of compounds, occupying a different volume. The most familiar instances of this are those known as explosives, in which the alteration of volume is very large and the change very rapid, but in other cases the action takes place more slowly, or the change of bulk may be much smaller. It is by no means impossible that similar changes take place in the interior of the earth, some slow and gradual, giving rise to elevation or subsidence of the land, others sufficiently abrupt to set up disturbances which are propagated as elastic waves, and may give rise either to earthquakes

which can be felt, or to those which can only be registered by suitable instruments.

Interior of the Earth.—The study of the distant records has led to some interesting conclusions regarding the material of which our earth is composed. Any disturbance of the nature of a shock will set up two sorts of elastic waves which can be transmitted in a solid, one condensational and the other distortional, and these two forms of wave motion are distinctly recorded on all seismograms up to a distance of about 100° from the origin, beyond which the second phase of distortional waves can no longer be recognised. From the times at which the arrival of these waves are recorded at the stations now scattered over the globe, it is possible to calculate the paths followed through the substance of the earth; this problem has been attacked by different workers by different methods, and their conclusions, though differing in detail, are concordant in main features.

Successive Layers of Differing Material.—The outermost layer of the earth is composed of material which transmits the condensational wave at about 5½ km. per sec.; this extends downwards to a depth of some 50 to 60 km., and at that depth there is a rapid and great change to material of a very different character, in which the rate of transmission jumps to about 7½ km. per sec., increasing steadily and continuously as the wave path penetrates toward the centre of the earth, till a depth of about two-tenths to a quarter of the radius is reached. Here the steady increase is checked, indicating a change in the character of the material traversed, but the increase in rate of propagation is again resumed, at a slower rate, till a depth of a little over three-tenths of the radius is reached and the rate of propagation has risen to 13 km. per second. From this depth the rate of propagation does not vary much at first, but beyond about a half of the radius from the surface, the rate of propagation decreases with increase of depth and at the same time the material traversed ceases to be able to transmit the distortional waves.

Other Investigations.—These conclusions have an important bearing on, and receive confirmation from, the results of other lines of investigation. The depth of 50 km. corresponds very closely with the depth at which the lower limit of the outer shell of cooled and solid rock, known generally as the crust, has been placed by geologists on physical and petrological grounds; the depth of about a fifth to a quarter of the radius, is that which would separate the metallic, mainly iron, central core from the outer shell of stony matter; the innermost nucleus, consisting of matter which is unable to transmit the distortional wave, had not been suspected before it was revealed by study of the distant seismograms, but is in accordance with the conclusion which has been reached by Dr. H. Jeffreys, from a study of the tidal retardation of the earth's rotation, that the central part of the earth is devoid of rigidity.

Earthquake of Sept. 1 1923.—The Japanese earthquake of Sept. 1 1923 ranks as the most destructive on record. The roll of killed and injured is officially stated as 99,331 dead, 103,733 wounded and 43,476 missing; but an appreciable proportion of these casualties is attributable to the conflagration which followed on the earthquake, and was the cause of more than 95% of the destruction of property, estimated as representing a loss of not far from £1,000,000,000. From the point of view of the maximum intensity of shock, or of the area affected by the earthquake, it ranks as a great, but by no means among the greatest on record; it is, however, of great scientific interest on account of the extent of the displacements of surface level which took place and the completeness with which these have been recorded.

Changes of Level.—The principal centre of the Tokyo earthquake was under Sagami bay to the south of Tokyo, and soundings taken some months after the earthquake showed that the sea bed had been raised over large areas and depressed over others; the uplift gave soundings ranging to 135 fathoms less than had been recorded at the previous survey, and in the depressed area the depths had increased by as much as 259 fathoms at one place. The bulk of the depression amounted to 50 cu. km. (12 cu. m.) and that of the elevated tracts 20 cu. km. (4.8 cu. m.). As the size of the sea waves, which accompanied the principal shock, was not very great, it is certain that only a small part of these changes took place at the time of the earthquake, the greater part being probably due to the more gradual change taking place during the period of great instability, accompanied by very numerous after-shocks, which followed on the great earthquake.

Along the shores of the bay the changes of level were much less; except along a short length of coast line, the level of the land rose at the time of the earthquake, but the initial rise was not permanent and, within a month, gradually sank till the remaining uplift was less than half of the original. The most detailed observations were from Misaki, where the original uplift reached the maximum recorded figure of 25 ft., and a small island off the shore became part of the mainland; no change took place for the first four days, and then the land began to sink, at first by more than 2 in. a day but afterwards more and more slowly, till on Sept. 26 the remaining uplift was only 4 ft. 7 inches. Changes of a similar character had been recorded in the cases of the Cutch earthquake of June 16 1819, and the Chilean of Feb. 20 1835, but the records lacked detail and completeness, and have not been universally accepted.

Periodicity of Earthquakes.—The periodicity of earthquakes has long been a subject of study. In general, the attempt has been to find some connection between the frequency of occurrence and some natural period such as the day, the year or the lunar month. With regard to the first two, the examination of the record from any region usually shows a distinct periodicity, the frequency of shocks reaching a maximum at some particular time of the day or year, and a minimum frequency at about half-way between the maxima, but when one district comes to be compared with another, and even when records separated by an interval of many years come to be compared with each other, no agreement can be found in the times of maximum and minimum frequency. Some of the most recent work on this subject suggests that the true periods are not the day or year, but differ slightly from them, so that, in the course of a few hundreds of years, the time of maximum frequency gradually works round the clock or calendar. If this suggestion should be borne out by further work, it would prove that the earthquake is a purely terrestrial phenomenon and is uninfluenced as to time of occurrence by any cause exterior to the earth.

Against this must be set one consideration which indicates that the gravitational attraction of the sun and moon, though in no way a cause of the occurrence of the earthquake, may, to a small extent, have an influence in determining the exact time of occurrence. If any record is examined, which contains a sufficient number of shocks to give a trustworthy average, it is found that the day shocks are slightly more frequent in summer, as compared with the general average for the year, and slightly less frequent in winter, while the reverse is the case with the shocks occurring during the night. As this is just what would be expected if the gravitational, tide-producing, stresses had some influence, and as the same relative disproportion has been found to be repeated, and to become more conspicuous, in those cases where the record has been discussed in terms of lunar hours and declination, it seems likely that the effect is in reality due to this cause. The smallness of the variation from average frequency, amounting to not more than 5% in general, is a measure of the slightness of the effect of these extra terrestrial influences.

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EAST, SIR ALFRED (1849–1913), British painter (*see* 8.827), was knighted in 1910, and died in London Sept. 28 1913.

EAST AFRICA: *see* KENYA COLONY; TANGANYIKA TERRITORY.

EAST AFRICA, OPERATIONS IN.—When the World War broke out in 1914 the garrison of British East Africa, the territory immediately north of German East Africa, was scattered and engaged on punitive expeditions remote from the enemy frontier. In the case of each Protectorate the troops were native with

European officers. The German forces, some 5,000 strong, including 260 Europeans, lay ready to the hand of their commander, Von Lettow-Vorbeck, a capable and determined soldier well able to employ them to full advantage. If it is remembered how keenly sensitive the native soldier is to any shortcoming in his superior and that Von Lettow had only been with his command for six months when hostilities began and kept that command efficient and formidable through four years of steadily declining fortune, some idea may be formed of the resolute nature and soldierly qualities of the German commander-in-chief. His operations consistently bore the clear imprint of his skill and personality, and there were advantages, other than his professional capacity and steady courage, upon which he could rely.

I. EARLY OPERATIONS

The country—nearly double the size of Germany in 1914—which was the scene of operations, is for the most part covered by bush, dense as a rule, but occasionally thinning out to something like park land. High mountain ranges, thick with vegetation, rear themselves from bush and jungle which are fever stricken and liable to wholesale inundation during the rainy season. Rivers abound and malaria and dysentery of a malignant type, with other tropical diseases, combined to swell the casualty list of a European or Anglo-Indian force. Practically every animal imported into East Africa for the use of the British forces succumbed to the tsetse fly. The route of every British advance was marked by casualties due to diseases from which the rank and file of the enemy—askaris recruited from local tribes—were immune. Surprise by the attacker was as difficult as it was simple by the defender, who waited concealed and warned by the laborious approach of his adversary cutting roads and bridging rivers.

Supply and transport presented appalling difficulties to an advance through hundreds of miles of naturally impenetrable bush, while the defending force slowly fell back upon the magazines posted in its rear. Only an overwhelming preponderance in numbers made any advance possible, but a force starting with a strength adequate for an offensive enterprise constantly found itself reduced at best to an equality of strength on contact with the enemy. Many good cards were thus in the hand of the German commander; and he rarely failed to play them with full effect.

Naval Operations and German Advance.—On Aug. 8 1914 two British cruisers, "Astraea" and "Pegasus," arrived opposite Dar es Salaam from Zanzibar, and, being unable to leave a garrison, the naval commander covenanted with the German governor that the latter should forbear from any hostile action in Dar es Salaam itself. Parallel to the southern frontier of British East Africa and about 50 m. distant from it ran the Uganda railway from Mombasa to Lake Victoria. This tempting and exposed objective, for the protection of which the British troops at the outset were hopelessly inadequate, at once appealed to Von Lettow, who on Aug. 15 seized Taveta, which lay in British territory at the eastern end of the gap between the southern slopes of Mount Kilimanjaro and the northern end of the Pare mountains in the German Protectorate. An enemy force here was a standing menace to the British capital at Nairobi, and, constantly raiding the railway line, seriously hampered the British initiative.

In September the enemy cruiser "Königsberg" returned to Dar es Salaam and on Sept. 20 surprised and destroyed the "Pegasus" while undergoing repair in the Zanzibar roadstead. A combined enemy operation against Mombasa, for the execution of which the "Königsberg" was to attack the port in conjunction with a land force moving north along the coast, failed, as the "Königsberg" was driven by the ships of the Cape Squadron into the Rufiji delta, where she was run aground. The land force began its march along the coast on Sept. 20, was repulsed at Gazi, 25 m. from Mombasa, on Sept. 23, and retired to the frontier on Oct. 8. The crew of the "Königsberg," which was blown up in July 1915, after being set on fire by the monitors "Severn" and "Mersey," joined the enemy land forces, together with its armament of ten 4·1 guns.

German raids along the coast, on the Uganda Railway, and into the frontier districts of Uganda, Belgian Congo, Rhodesia and Nyasaland were constant in the opening months of the campaign. These small enterprises were much simplified by the central position of the enemy and the excellent lateral communication afforded by the central railway from Dar es Salaam to Kigoma, on Lake Tanganyika. This lake was under German control until Dec. 1915, when by the operations of motor boats specially brought from Capetown the enemy was deprived of the one lake which had not been in British hands since the earliest days of the campaign.

Reinforcements from India.—It soon became apparent that, unaided, the British Protectorate forces could not hold their own, and the Government of India consented to send an expedition. On Aug. 25 its leading unit reached Mombasa with Brig.-Gen. Stewart, who assumed command. The rest of the expeditionary force was directed on Tanga, the northernmost German port, at the southern extremity of the Usambara mountains, healthy highlands where the bulk of the German settlers resided. Coincident with an attack on Tanga an advance against Moshi by the north of Kilimanjaro was to be made by Stewart. The expeditionary force under Brig.-Gen. A. E. Aitken was about 7,000 strong and (except for the 2nd Loyal North Lancs.) composed of Indian troops.

Failure of British Offensive.—The transports reached Tanga on Nov. 2, when the local commissioner represented the place as an open and undefended port and bombardment was deferred. Meanwhile, Von Lettow, advised of the plan by captured Indian mails, was hurrying reinforcements to the coast. When one and a half British battalions landed two miles east of the town on the evening of the arrival, they met with strong opposition and fell back. Von Lettow arrived on the evening of the following day, when British reinforcements had been landed and fighting resumed, and on Nov. 4 heavily defeated his opponent, whose casualties were 795. On the same day Stewart, checked at Longido, was compelled to retire. The British force at Tanga reembarked and reached Mombasa on Nov. 5. The first British offensive had thus failed completely. Von Lettow's success at Tanga put an end for the time being to any general offensive against him, and it was not until 1916 that the next British advance was set in train.

The intervening period was occupied in raiding by both forces, with occasional engagements of a more ambitious nature. A British force was compelled to surrender on Jan. 17 1915 at Jasin, in enemy territory, to a superior force, after 48 hours' fighting, which exhausted their ammunition and water. German losses, especially in officers, were serious, as was the shrinkage of ammunition. Maj.-Gen. M. I. Tighe assumed chief command in April 1915 and in June, Bukoba, on Lake Victoria, was successfully attacked.

Reinforcements Arrive.—Aid was now sought from a different quarter, for, with the conquest of German South West Africa by Gen. Louis Botha in July 1915, the resources of the Union of South Africa became disposable to an extent which was impossible till the disappearance of the enemy from her own border. During the latter half of 1915 there was continuous preparation in South Africa of troops, depôts, supplies, medical stores, transport, animals and material of all kinds for use in East Africa. By Feb. 1916 one mounted brigade, two infantry brigades and one field artillery brigade, complete with all their auxiliary units, had arrived from South Africa to join Tighe. A second mounted brigade followed, together with a battalion of the Cape Corps (coloured men from the Cape Province). Tighe also had the following European units: the Calcutta Volunteer Battery, the 2nd Loyal North Lancs., 25th Royal Fusiliers, 2nd Rhodesians and two local settlers' corps; India sent him from her native army 10 infantry regiments, one squadron of cavalry and two mountain batteries. The battalions of King's African Rifles were the original native Protectorate force. At the same time, Von Lettow's force had reached the highest limit which it attained in the campaign and was probably over 20,000. The exact combatant strength is difficult to estimate, for there were many carriers of whom a percentage were armed and many trained as askaris. The askari in his own country is a soldier of high value. Such a

force, with a strong leaven of Europeans trained to arms, under a skilful and determined commander, was a formidable adversary in tropical bush country.

German Ammunition Supplies.—In April 1915 the mind of Von Lettow, which had been sorely exercised by his shortage of ammunition, was relieved in the following remarkable manner: A British ship, the " Rubens," seized at Hamburg, left that port loaded with arms and ammunition and appeared off Tanga on April 4, being sighted by H.M.S. " Hyacinth." Entering Manza Bay on fire and abandoned, she was boarded by bluejackets, who found her timbered up and battened down. After firing more rounds the " Hyacinth " steamed away on the assumption that her quarry would burn herself out. The Germans returned and salved almost the entire cargo, and a largely increased volume of enemy fire from the Mauser pattern 1898 rifles which the " Rubens " had brought was the result. A repetition of this operation a year later will be referred to.

II. OPERATIONS UNDER GENERAL SMUTS

The chief command in East Africa was assumed by Gen. Smuts in Feb. 1916. He had previously declined the post, but when Gen. Smith-Dorrien was compelled to relinquish the command in consequence of illness he accepted it. He reached Mombasa on Feb. 19 and found the railway completed from Voi to Serengeti, 5 m. from Salaita Hill, the German advanced position from Taveta. A week earlier an attack on Salaita had failed. The rainy season was at hand and movement would then become impossible, and Smuts telegraphed to Lord Kitchener that he was ready to carry out the occupation of the Kilimanjaro area at once. The proposal was agreed to and Smuts proceeded to initiate his first advance.

British Advance on Taveta.—An attack, designed primarily to hold the enemy, was to be delivered on Salaita by a force under Gen. Malleson, while Stewart was to repeat his attempt of 1914 to reach Moshi by the north of Kilimanjaro and thence to intercept any enemy retirement in his direction. Gen. van Deventer with a mounted brigade, moving by Malleson's right, was to cross the Lumi river, and by way of the foothills of Kilimanjaro cut the enemy line of retreat between Taveta and Moshi. The execution of this movement unobserved was the only chance of surprising the enemy, for it was apparent to Von Lettow, who had made all preparations for retirement, that Taveta was Smuts' objective. In the event it may be accepted that this surprise was effected. Van Deventer moved on March 8 and on the following day his troops were astride the Moshi-Taveta road. On the same day the Germans evacuated Salaita and took up new positions on two hills, Latema and Reata, covering the gap between the Pare mountains and Kilimanjaro. The main enemy force was posted at Himo, 5 m. from the gap, whence it could move in any direction to attack or retire. The progress of Stewart's force was so slow that his movement was without effect.

The new enemy position was attacked on March 11 and, after severe fighting all day and the succeeding night, was occupied on the morning of the 12th by a general advance in support of detachments which had won their way to the two crests during the night and caused a retirement by the enemy.

German Withdrawal.—Von Lettow now withdrew his entire force to a position (Kahe-Ruvu) which stretched south of the Taveta-Moshi road from Kahe railway station eastward along the northern end of the Pare mountains. He was followed up and attacked on March 18 from Latema Nek by Brig.-Gen. Sheppard, and on March 20 van Deventer was sent from Moshi to turn the enemy at Kahe. He seized Kahe on March 21 and on the following night, after a very severe action with Sheppard, the enemy withdrew to Lembeni, 20 m. south of Kahe. Von Lettow abandoned one 4·1 gun, and had expended ammunition to an extent which he could ill afford, but his force was intact and the timely arrival of the second blockade runner at this juncture with four 4·1 field howitzers, gun and small-arm ammunition, machine-guns, stores, provisions and clothing was an inestimable stroke of good fortune. Here the operations which Smuts had undertaken before the rainy season were successfully concluded and the British forces took up positions covering Taveta and Moshi and facing the enemy at Lembeni.

During the ensuing rains Smuts reorganised his force and prepared to resume the offensive at the earliest possible date. He could rely for assistance in his main operations upon the Belgians in the northwest and the British force under Maj.-Gen. Northey, operating from Nyasaland, to the southwest. For reasons fully recorded in his dispatches, Smuts decided at once to send van Deventer with a mounted force rapidly by Arusha to Kondoa Irangi and thence to the central railway and east along that line to Morogoro. His own force was to move south by the Pangani, and make for the same ultimate objective, Morogoro. It was hoped that Von Lettow would there be brought to bay by the two converging forces.

New British Offensive.—Van Deventer moved on April 3 and occupied Kondoa Irangi on April 19, capturing the enemy garrison at Lol Kisale en route. He reached Kondoa Irangi after heavy casualties in men and animals from disease and was there cut off and reduced to immobility as a consequence of his losses and the advent of the rainy season. Von Lettow concentrated a force against van Deventer and fighting ensued, but the German attacks, with one exception, lacked vigour and were all repulsed. Van Deventer's position was eased by the end of May, when Smuts began his advance down the Pangani and the Belgians moved on Tabora. Maj. Kraut was in command of the German force opposite Smuts when the latter set his troops in motion southwards from Moshi on May 18, Von Lettow having assumed direction of his concentration against van Deventer.

Systematically outflanked by his opponent, whose main advance along the Pangani was supplemented by flank movements by the Pare and Usambara ranges, Kraut found himself compelled to leave the Tanga railway and retire upon Handeni. This place was seized by Smuts on June 19, Korogwe having been occupied four days earlier. On June 24 the Germans were attacked simultaneously on three sides, but, after determined fighting, withdrew into the Nguru Hills. Smuts was now compelled to halt his force on the Msiha river. In a month 250 m. had been covered, but malaria had reduced the strength of all units, combatant and non-combatant, in some instances to 30% of their original numbers. The troops were on half rations, and the transport, which included a variety of types of motor vehicles, was much damaged. The coast region was now dealt with, and with the aid of the Navy, Tanga, Pangani, Sadani and Bagamoyo were successively occupied between July 17 and Aug. 15. The removal of the British base to Tanga saved 200 m. of rail transport. Dar es Salaam was occupied on Sept. 4, but three months elapsed from its capture before it could be used as the base.

German Retreat.—Von Lettow now moved the bulk of his force once more opposite Smuts, and on June 24 van Deventer resumed his advance and at the end of July held the central railway from Kilimatinde to Kikombo, about 100 miles. On Aug. 9 he was ready to move on Morogoro. The Belgians were at the same time advancing on Tabora against the German force under Maj.-Gen. Wahle, who was left to do his best unaided, though some reinforcements were sent southwest against Northey. Smuts moved again on Aug. 5, opposed by a detachment of the enemy whose main force was withdrawn to Kilosa, whence it proceeded south towards Mahenge, the eventual direction of the enemy retirement on all fronts. Von Lettow directed the remainder of his forces by a route through the Uluguru mountains, thus foiling the attempt to intercept him at Morogoro. Heavy fighting ensued in these mountains but Kisaki fell into British hands on Sept. 15 and Von Lettow retired to Mgeta river and there entrenched himself. On this front during the three last months of 1916, activity was confined to such minor affairs as are usual between opposite entrenched forces. Civil administration was instituted in the occupied area behind the British forces.

Belgian Operations.—The Belgian force (also native), under Maj.-Gen. Tombeur with European officers, was divided into two brigades, the Northern (Col. Molitor) and the Southern

(Lt.-Col. Olsen) and operated in the northwest of German territory, opposed by Wahle, who was instructed to avoid a decisive action. The Belgian operations, well planned and successfully executed, were of prime importance to the general campaign. Broadly described, they were as follows. Molitor invaded Ruanda by the north of Lake Kivu while Olsen co-operated south of him by the north of Tanganyika. The movements started on April 4, and by the end of May the Belgians were in possession of Ruanda. Molitor then sent columns southwest to join hands with Olsen and other columns southwest to Lake Victoria, which was reached on June 27.

In the middle of July, on a front between Tanganyika and Victoria, Molitor and Olsen moved south on the respective objectives of Tabora and Kigoma, the terminus of the central railway on Tanganyika. Olsen occupied Kigoma on July 28 and Ujiji on Aug. 2, and then moved east on Tabora. Co-operating with Molitor was a British column under Brig.-Gen. Sir C. P. Crewe, who captured Mwanza on the southern shore of Lake Victoria on July 14. On Sept. 19 Molitor occupied Tabora which Wahle had evacuated the previous day, leaving behind his sick with civilians and prisoners of war. Crewe reached the central railway a week later.

British Advance from Rhodesia.—By this time Northey had succeeded in interposing some of his forces, which were in three columns under Lt.-Cols. Hawthorn, Murray and Rodgers (the last a South African unit), between Tabora and Mahenge. His advance was on an original front between Lakes Nyasa and Tanganyika. Murray occupied Kasanga (Bismarckburg) at the south end of Tanganyika on June 8. The Germans were defeated at Malangali on July 24, and on Aug. 29 Iringa was occupied, Lupembe having been seized 10 days earlier. Northey, ordered with van Deventer, now at Kilosa, to deal with the enemy in the Mahenge district, was much outnumbered by forces already in touch with him and Wahle's columns approaching from the north, and on the night of Oct. 21 most of Wahle's troops broke through him. On the same day Kraut was heavily defeated at Mkapira. Hawthorn secured the surrender of an enemy column at Ilembule. On Dec. 24 van Deventer and Northey attacked the Mahenge force. An enemy column surrendered to Northey, but the force engaged with van Deventer escaped him after fighting from Dec. 25 to 28.

Position at End of 1916.—By the beginning of 1917 Smuts had evacuated 12,000 to 15,000 white troops (South Africans), mostly victims to malaria, and they had been replaced by the Nigerian Brigade (Brig.-Gen. Cunliffe) and fresh battalions of the King's African Rifles. Kilwa and Lindi, south of Dar es Salaam, had been seized by the navy and a force under Maj.-Gen. Hoskins had been concentrated at Kilwa. On Jan. 1 1917 an advance was made on the Mgeta position, but after heavy fighting the enemy retired across the Rufiji at Kibambawe. Smuts now went to England and Hoskins assumed the chief command. The rains ensued, and to clear the north bank of the Rufiji was all that could be barely accomplished before operations ceased perforce. Hoskins completely reorganised his command, but before operations were resumed he was ordered to Palestine. His successor in East Africa was General van Deventer, who assumed command of the forces there at the end of May 1917.

III. VAN DEVENTER'S OPERATIONS

The enemy forces were disposed as follows: Von Lettow near Kilwa, Wahle in the Lindi area, Tafel at Mahenge, detachments between Kilwa and Lindi, and near the Ruvuma. Northey lay south and west of Tafel with another British force at Iringa, northwest of the enemy. The rest of van Deventer's troops were to act against Von Lettow. In pursuance of this decision an advance was made by the Kilwa force under Brig.-Gen. Beves on July 5 towards Liwale. The enemy fell back to Narungombe, where a severe engagement took place on July 19. The enemy retired south, but the Kilwa force was unable to move again until mid-September. In Aug. the enemy was driven from the Lukuledi estuary to allow of an advance inland from Lindi. The Kilwa force (Hannyngton) was to move south and that at Lindi (Beves) west. These operations were marked by the hardest fighting of the whole campaign. Von Lettow fell back, under pressure by Hannyngton, towards Nyangao, 40 m. southwest of Lindi, Wahle doing the same before Beves. On Oct. 15 a four days' battle began between Beves' force and the enemy under Von Lettow joined by Wahle. The latter retained their position and it was 10 days before Beves' force under the command of Cunliffe could resume the offensive.

On Oct. 8 Tafel, pressed by Northey with Belgian co-operation from the north, had retired from Mahenge, and, breaking through two weak detachments on Nov. 16, moved southeast towards Von Lettow, whom he was debarred from joining by the Kilwa force. Vainly endeavouring to join the main body, Tafel reached the Ruvuma, but, unable to procure food, surrendered with his entire force on Nov. 28.

Germans Retire to Portuguese Territory.—On the night of Nov. 25–26 Von Lettow, having shed all weaklings, crossed the Ruvuma into Portuguese territory and thenceforward moved as the circumstances of his position, without bases and short of ammunition, dictated. Early successes in the new sphere of action, especially at Ngomano, gave the Germans food, ammunition, arms and clothing, and when the rainy season set in in Jan. 1918, they were able to rest for a short time.

The operations during 1918 were carried out almost entirely by natives, the King's African Rifles, and Von Lettow fell back upon guerilla tactics. Against him in Portuguese territory were sent columns from the east and south shores of Nyasa; and another (Brig.-Gen. Edwards) advanced west from Porto Amelia midway between the Ruvuma and Mozambique. After various engagements Von Lettow marched in May south to the Lurio river, 200 m. from German territory, captured Ille, and in June reached the coastal region near Quelimane. On July 1 he captured Nyamakura, 25 m. from Quelimane, and in the middle of Aug. at Chalana, eluded envelopment by converging columns. Turning northwest, he was engaged by Hawthorn (who had succeeded Northey) at Lioma, east of Lake Shirwa. After several encounters, the German force reached the Ruvuma again on Sept. 28 and, after resting at Ubena, where Wahle was left, set out for Rhodesia. On Nov. 1 Von Lettow made an unsuccessful attack on Fife and, turning southwest, took Kasama on Nov. 9. Advised on Nov. 13 of the Armistice, he accepted it the following day, and on Nov. 23 formally surrendered to Gen. Edwards at Abercorn. With him were Dr. Schnee, the Governor, and Maj. Kraut, together with a force of 30 officers and 125 other Europeans, 1,165 askaris and 2,891 other natives (including 819 women), 1 small field gun, 24 machine-guns and 14 Lewis guns.

Troops Engaged, Casualties, Etc.—The troops employed by the Allies in East Africa included 52,339 sent from India (5,403 British) and 43,477 South African whites. East African and Nyasaland settlers, Rhodesian volunteers and the 25th Fusiliers numbered about 3,000; African troops (King's African Rifles, Nigerians, Gold Coast Regiment, Gambia Company, Cape Corps) and West Indians about 15,000; an approximate total of 114,000 not reckoning Belgian native troops (about 12,000 in all), Portuguese and the naval force engaged. The greatest number in the field at any one time, May to Sept. 1916, was about 55,000; the lowest, in 1918, some 10,000, all African, save administrative services.

British and Indian casualties were returned at 17,823; of these 2,762 were in the South African Forces. These figures are exclusive of casualties among carriers and of deaths and invaliding through sickness, which among the South Africans alone exceeded 12,000. The cost of the campaign to Great Britain, inclusive of Indian and South African expenditure and that of the local protectorates to March 1919, was officially estimated at £72,000,000.

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(J. J. C.)

EASTER, FIXED (*see* 8.828).—The question of the date of Easter has vexed the Church for many centuries, and the difficulties which had arisen in determining the Easter date led directly to the introduction of the Gregorian Calendar. The ecclesiastical astronomers of the Middle Ages exercised their ingenuity upon it for centuries, and made many elaborate tables.

It is not proposed in this article to go into these very complicated matters, but to give a short summary of the more important considerations, and to present some account of the subject in its more modern aspects. The celebration of the great spring festival is consecrated by the Church to the commemoration of the central fact of the death and resurrection of our Lord. This occurred at the time of the Jewish Passover. The Jews celebrated their deliverance from Egypt by the Feast of the Passover. This was held on the 14th day of the first month of the Jewish ecclesiastical year, which commenced with the vernal equinox, at the time of the full moon. The Gospels record that our Lord celebrated the Passover on the Thursday, while Caiaphas and the Priesthood apparently celebrated it on the Friday, the day of the Crucifixion. As the Jewish day is counted from sunset to sunset there may be some explanation of the difference in this fact, but when the festival of Easter was established by the Church, there was a sharp controversy between those who celebrated the event on the 14th day and those who celebrated it on the 15th, the Quartadecimans, and the Quintadecimans, which led to much bloodshed.

The Council of Nicaea, held in A.D. 325, decided that Easter should be celebrated on a Sunday, but it was not till A.D. 716 that the English clergy submitted themselves to the Papal rule, and that feeling ran high at the time may be judged from the fact that Ethelfrith, King of Northumbria, massacred 1,200 monks at Bangor, who adhered to the heresy of the 14th day.

These acute religious controversies have long since died down, but the fact remains that we are left with a method of fixing the date of Easter by which it can vary from year to year by no less than 35 days, between March 22 and April 25 (*see* 4.997). The date is fixed in accordance with the tables prepared by Clavius for Pope Gregory XIII., when he reformed the calendar on Feb. 24 1582, and is an attempt to reconcile the solar with the lunar year, on the Metonic system, with all the complications of the week, the month, the epact and an inexact calendar. The tables occasionally produce strange results. In 1923 the full moon of the heavens fell on the Sunday given by the tables for the celebration of Easter; and the Resurrection, going by the real moon, was being celebrated before the Crucifixion.

Proposals for Fixing Easter.—The inconveniences of an oscillating Easter are felt by all sections of the community, as school terms, university terms, law terms and the great holidays of Easter and Whitsuntide are all affected by a moving Easter. Chambers of Commerce, national and international, have since 1900 year by year passed resolutions in favour of a fixed date for Easter. At the International Congress of Chambers of Commerce held in Rome in 1923 such a resolution was re-affirmed and addressed to the Holy See. Not long afterwards the matter was referred to the League of Nations, and a conference was summoned at which the Roman, the Eastern Orthodox and the Anglican churches were represented, and it was agreed that there was no insuperable objection, on dogmatic lines to the fixing of Easter, and it was abundantly proved that there was a practically unanimous wish among the nations concerned that Easter should be fixed.

The Movement in Great Britain.—On April 27 1921 Lord Desborough introduced a Fixed Easter bill in the House of Lords. Under this, Easter was always to be kept and observed on the second Sunday in April, which was the date in 1925. The three main arguments in favour of the date were: (1) That it is the nearest Sunday to the generally accepted date of the event which it commemorates; (2) that as the mean date of Easter for 100 years has been April 8·3, such a Sunday complies to the full with the requisition that any date selected should fall within the present limits of deviation, and (3) it divides the Christian year equally, and is a convenient date for the people.

As regards No. 1 it may be stated that, though the matter cannot be absolutely decided, the balance of opinion seems to be that the Crucifixion took place on Friday, April 7 A.D. 30, so calculating by Sundays, and in order to secure a date which can be very easily remembered, the second Sunday in April would appear to be an appropriate one, but it would be still more accurate to make Easter Sunday on April 9, if that day were a Sunday, or on the Sunday following April 9. Certain ecclesiastical difficulties would then be avoided and there would always be 24 Sundays after Trinity, and the whole ecclesiastical calendar would be admirably fixed. The Archbishop of Canterbury stated in the course of the debate in the House of Lords that as far as the Anglican Church was concerned it would be entirely acceptable to them that Easter Sunday should be a fixed Sunday and not a variable one, provided that, among other things, the Western Churches were agreed. This evidently points to the Holy See, which has admitted that no question of dogma is concerned. Indeed the Roman Catholic Bishop of Salford has pointed out in a letter published in *The Tablet*, that the dogmatic dangers and difficulties of the early centuries involved in a change of the Paschal calculation are no longer existent, and there can be no objection from the theological point of view. He also stated that it is a reform which has long been due, and that for the Catholic Church the Holy See could make the change with a stroke of the pen.

The supporters of the reform point out that the celebration of the Birth of our Lord was fixed in the 4th century by enactment for Dec. 25, thus consecrating the old Saturnalia of Rome to the new religion, and that, this having been done, there is no good reason why the celebration of the Death and Resurrection should vary 35 days in accordance with a fictitious moon. The date of the celebration of Easter is primarily a matter for the churches, and should be settled by them, but the inconveniences of a widely oscillating Easter are felt in so many departments of civil life that it is to be hoped that the matter may be taken in hand without further delay. The possible alternative of fixing the Easter and Whitsuntide holidays independently of the Church has been often mooted, but its use would be generally deplored. (D.)

EASTERN EUROPEAN FRONT CAMPAIGNS.—This heading covers the story of the operations on the main Russian front during the World War. It includes the campaigns in Rumania, but not the Serbian or Salonika campaigns nor the Russian campaigns in the Caucasus against Turkey. As the article is of such a general nature, its division into sections has been based on chronological sequence. The headings employed are therefore I. The Campaign of 1914; II. The Austro-German Advance into Russia, 1915; III. Rumania's Effort, 1916; and IV. The Russian Revolution, 1917.

I. THE CAMPAIGN OF 1914

Theatre of War.—The theatre of operations after Rumania had joined in the War, extended from the Baltic to the Black Sea, a distance of some 800 m. in a direct line, or more than twice that distance if measured along the frontier lines between the opposing States. In Aug. 1914 the actual length of the frontier line along which the Russian and Austro-German hosts faced each other was over 1,000 m. from the Baltic to the northern frontier of Rumania, which was at this time neutral. This great length was due to the projection of Russian Poland as a huge salient between German East Prussia and Austrian Galicia. The shape of the frontier, the great distances, and the physical features and communications, combined to divide the Russian theatre into three "sub-theatres" until the Russian retreat out of Poland in 1915. Thus the operations in East Prussia, in the Polish salient and in Galicia, though they formed part of a combined whole, had each their own special characteristics.

The greater part of the huge area of operations was plain or gently undulating uplands. The only heights sufficient to constitute a serious military obstacle were the Carpathians, which extended in a semicircle from the south-west corner of the

Polish salient to the Iron Gate on the Danube, forming a protective barrier for the Hungarian plains on the north and east. Opposite Russia, they ran roughly parallel to the frontier and at 50 to 100 m. distant from it; opposite Rumania they actually marked the frontier. It was a constant aim of the Russians throughout the operations, and the objective of Rumania's single abortive offensive, to pierce this barrier and reach the plains below.

Though there is only this one mountain barrier, the water barriers in the theatre are numerous and formidable. The most serious from the strategical point of view is presented by the marshes of the Pripet (sometimes called the Pinsk Marshes or Polyesie), an area stretching east from near Brest-Litovsk, some 200 m. long by 100 m. broad, where communications are few and military movements on a large scale extremely difficult in consequence. Other water lines which had a considerable effect on operations are: in East Prussia, the line of the Masurian lakes; in the Polish salient, the rivers Vistula, Narew, Bobr, Niemen and Bug; in Galicia, the Dunajec, Wisłok, San and Dniester; in the Rumanian theatre, the Danube itself, the Oltu (Aluta) and the Siret (Sereth). Besides the rivers enumerated above, there were a number of lesser streams which influenced the course and direction of the operations. Strategy in this theatre was in fact largely determined by rivers. Rivers retard the movement of an advancing army but are seldom a permanent bar to its progress; though many of the principal river crossings had been fortified in peace, these fortifications had little influence on the course of operations, except, indeed, at Przemyśl. In East Prussia and in Poland were extensive stretches of forest, which had certain tactical consequences. The Carpathians also were thickly wooded.

The real key to the strategical moves on this Eastern European front lay, as ever, in the communications. In this respect the contrast between Russia and her western neighbours was striking. In both railway and road communication Russia was extremely backward, in spite of all her efforts in the years preceding the war to develop her strategical railways. The Russian general staff had of set purpose prevented road or railway construction in the north and in the south-east of the Polish salient in order to provide protection to a defensive position in the centre of the salient. This short-sighted policy seriously hampered Russian strategy when an offensive campaign from Poland was undertaken. Nor could Russia make much use of her great rivers as lines of supply owing to lack of previous development. Thus superior communications gave to her adversaries the inestimable advantage of greater mobility.

Characteristics of the Armies.—Of the Germans little need be said; their army of 1914 was probably the most powerful instrument of war yet forged. The raw material of the Russian army was in many ways excellent. The Russian peasant in physique and powers of endurance surpassed the rank and file of other Continental armies; he was easily disciplined and stoically brave. But his lack of individuality and want of education unfitted him for the strain of a long and unsuccessful war, and made him unduly dependent on good leading. This was not forthcoming once the original cadre of regular officers and N.C.O.s had fallen, since the Russian system did not produce an efficient type of reserve officer.

In organisation, the Russian army was very weak on the technical side; the proportion of guns to rifles was smaller than in other armies; there were large masses of cavalry, provision for which threw a great strain on the communications, but which accomplished little. In no way except by weight of numbers could a Russian army hope to gain the advantage over a German force. The Austrian army, only slightly, if at all, superior to the Russian on the technical side, was inferior to it in fighting quality. This was due to the heterogeneous nature of the Austrian personnel, many of whom fought unwillingly and surrendered freely. A Russian force was almost always the master of an Austrian force of similar size, but required a great numerical preponderance to meet a force of Germans with any hope of success.

The Plans of Campaign.—The German plan of 1914 was a development of that drawn up by Schlieffen many years previously. It provided for an offensive against France designed to obtain a rapid and decisive victory, and a defensive in the East against Russia until the decision had been obtained in the West. The choice of France for the initial offensive was actuated chiefly by the relative slowness of Russian mobilisation and by the impossibility of gaining a rapid decision against Russia owing to the great distances. The choice once made, Germany's problem in the East was to determine the minimum strength to be left for defensive purposes. This was eventually fixed at nine divisions, active and reserve, with one cavalry division, for the protection of East Prussia; and certain second line troops for the defence of the Eastern fortresses (such as Posen, Torún [Thorn], Danzig, Königsberg) and to watch the Polish frontier. The troops in East Prussia, organised into four corps, formed the VIII. Army under Prittwitz.

The chief of the Austrian General Staff, Conrad von Hötzendorf, of some ability and of sanguine temperament, had planned an offensive into south-east Poland between the Vistula and Bug rivers, directed on the line Chełm (Kholm)-Lublin. This was to be carried out by the I. and IV. Armies (Dankl and Auffenberg). To protect their right flank and rear, the II. and III. Armies (Kövess and von Brudermann) deployed east of Halicz and Lemberg. This offensive of Conrad's was originally designed as part of a combined Austro-German offensive, in which German forces from East Prussia were simultaneously to attack on the Narew line. Germans and Austrians were to meet about Siedlce and thus cut off the whole Polish salient. Conrad had repeatedly urged this plan on Moltke, but had failed to induce him to provide sufficient troops to take the offensive from East Prussia, before France had been disposed of.

In the absence of German co-operation, it is difficult to see what permanent success Conrad could have hoped for from his Chełm-Lublin offensive, since, as already pointed out, the Russians had neglected the communications in that area expressly to embarrass the operation he had chosen. From the German point of view, however, this Austrian offensive fitted in admirably with their strategic plan, since, whatever its outcome, it would keep the Russians fully engaged and thus safeguard the vital industrial areas of Silesia, till the campaign against France had been won.

The Russians had gauged accurately the intentions of both their adversaries. Their original plan was to take the offensive against the Austrian armies in Galicia and to act defensively in the Polish salient and against the Germans in East Prussia. They were, however, pledged to their French allies to assume the offensive against Germany at the earliest possible date. Six armies were initially deployed in front line. The I. Army (Rennenkampf) assembled on the east frontier of East Prussia, and the II. Army (Samsonov) at Warsaw. These two armies formed the North-Western front, under Jilinski. They were intended for action against the German forces in East Prussia. The South-Western front, under Ivanov, consisted of four armies, of which the IV. (Salza) and V. (Plehve) were to deploy on the Lublin-Chełm railway to meet the expected Austrian offensive; the III. Army (Ruzski) and VIII. Army (Brusilov) were to take the offensive at once from the eastern frontier of Galicia in the direction of Lemberg. It will be seen that the Austrian and Russian plans were almost the exact counterpart of each other. The Grand Duke Nicholas assumed chief command of the whole Russian armies. Though no great strategist, he was shrewd and had a strong personality. His chief of staff, Yanushkevich, was a man of no great ability or character. The Russian strategy is attributed mainly to Danilov, head of the operations branch of the General Staff.

In addition to the front line armies, the VI. Army was assembled at Petrograd for the protection of the capital and as a general reserve, the VII. Army at Odessa to watch the Black Sea coast, and an army in the Caucasus to watch Turkey. At the last moment, after mobilisation, a momentous change in the Russian dispositions was made. The I. and II. Armies were

ordered to invade East Prussia at once, without waiting to complete their concentration. This change was made solely to assist Russia's allies in the West.

East Prussia: August–September 1914.—Rennenkampf's I. Army comprised 11 divisions and five cavalry divisions and Samsonov's II. Army nine divisions and three cavalry divisions. They had thus in combination an overwhelming superiority over Prittwitz's VIII. Army, which was defending East Prussia. Combination between them was, however, completely lacking and led to their defeat in detail. Jilinski, who was responsible for combining the action of the two armies, was a man of some administrative capacity but little aptitude for command. Samsonov's army had to move before its concentration was completed, and was deficient in transport. The arrangements for obtaining and recording intelligence were indifferent in spite of the large masses of cavalry available; and so defective were the means of intercommunication that the Russians were frequently forced to issue orders by wireless in clear, with the result that the Germans often had complete information of their enemy's moves and intentions.

The course of events was briefly as follows: Rennenkampf crossed the frontier on Aug. 17 driving back a German force at Stallupönen; and on the 19th and 20th, after a hard battle at Gumbinnen, defeated Prittwitz, who had concentrated against him the bulk of his army, leaving only one corps to observe the southern frontier. Meanwhile Samsonov, stumbling slowly forward by Mlawa, crossed into East Prussia on the 21st, causing Prittwitz in momentary panic to announce his intention of withdrawing behind the Vistula. He was promptly superseded by Hindenburg, with Ludendorff as chief of staff. Within a week the new commander had completely defeated the II. Army at the battle of Tannenberg, surrounding and capturing the greater portion of it. Receiving a reinforcement of two corps which had been hastily recalled from France, he then turned on Rennenkampf, who had remained inactive during the disaster to the II. Army, though faced by a small German detachment only. Between Sept. 7 and 13 he was attacked and driven out of East Prussia with very heavy casualties (*see* MASURIAN LAKES).

In these operations the Russians had suffered a total loss of some 250,000 men, a crippling loss in spite of Russia's immense reserves. Much war material had also been lost and this could not easily be replaced. On the other hand this invasion of East Prussia, by causing the recall of two corps from the West at the crisis of France's fate, had made possible the victory of the Marne.

Operations in Galicia, August–September 1914.—Meanwhile the Austrians in Galicia had suffered heavy defeat at the hands of Ivanov's south-western group of armies. The offensive of their I. and IV. Armies towards Lublin and Chełm at first made satisfactory progress, battles at Krasnik and Komarów ending in their favour. But their flank guard of the II. and III. Armies was unable to withstand the onslaught of the Russian III. and VIII. Armies. On Sept. 2 Lemberg was lost and the advance of the victorious left wing was consequently stayed. Two corps from the Russian IX. Army (which had been formed at Warsaw as a central reserve) now reinforced Ivanov's right wing, and the whole Austrian line was gradually pressed back. On Sept. 11 a retirement to the San was ordered by the Austrians; by the end of the month they had withdrawn to within 50 m. of Cracow, leaving their fortress of Przemyśl to stand siege.

First and Second Invasions of Poland.—The Austrian defeat compelled the German Supreme Command to send direct assistance to her ally. This was done by the transfer of five and a half corps, formed into the IX. Army, from East Prussia to the front Cracow–Częstochowa, whence it advanced on Warsaw in the last days of Sept. in conjunction with a simultaneous advance along the whole Austrian front up to the Carpathians. The Russians had halted on the San after their defeat of the Austrians, and were in the process of transferring troops north to form a new front south of Warsaw. This re-grouping was carried out in safety behind the Vistula, only cavalry being left to oppose the German advance west of the river. By the middle of Oct. the German IX. Army was near Warsaw, but the Austrian advance had been held up on the San. The Russians now counter-attacked all along the line. In the south they drove the Austrians back to the Dunajec, in the centre they compelled the German IX. Army to fall back, and in the north the newly-constituted X. Army crossed the frontiers of East Prussia.

The intention of the Russian Commander-in-Chief was now to invade Silesia with his V., IV. and IX. Armies, in that order from the north. His right flank was to be protected by the X. Army in the east of East Prussia and by the I. and II. Armies north and west of Warsaw, his left flank by the advance of the III. and VIII. Armies in Galicia. But the Germans had thoroughly broken up communications in south-west Poland during their retreat, and the Russian advance was slow and halting.

Their more nimble opponents once again used the superior mobility given them by their highly developed network of railways to launch a telling counterstroke. A German Eastern Front Command was constituted under Hindenburg and Ludendorff, and the IX. Army, now under Mackensen, was withdrawn from south-west Poland and concentrated between Posen and Torún. It advanced on Nov. 11, with its left flank on the Vistula, against the right flank and rear of the Russian main armies. The Russian I. and II. Armies were severely mauled, and the latter was by Nov. 17 in a critical situation, almost completely surrounded at Łódź. It was saved by a skilful counterstroke of Plehve's V. Army; and the Germans in their turn were in danger of envelopment and disaster. Thanks to Rennenkampf's failure to act with energy they extricated themselves with credit. Four corps from the Western Front released by the conclusion of the Ypres battle now joined Mackensen, and enabled him again to advance and to capture Lowicz and Łódź by Dec. 12. In the south heavy fighting had taken place east of Cracow with no decisive result (*see* ŁÓDŹ-CRACOW).

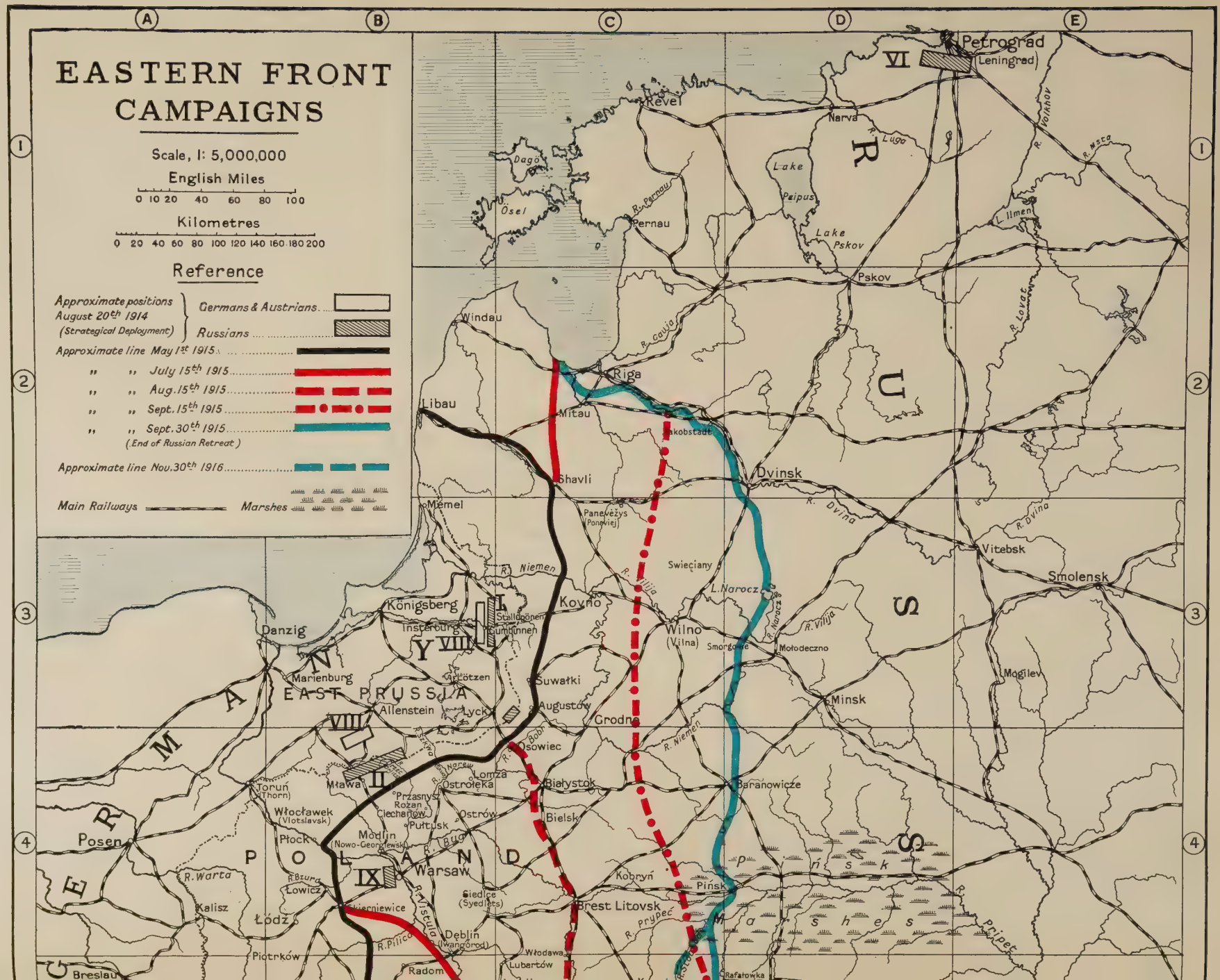
II. THE AUSTRO-GERMAN ADVANCE INTO RUSSIA

January–April.—The 1914 campaign had ended in stalemate both in East and West. The German plan of a swift overthrow of France, to be followed by an unhurried reckoning with Russia, had miscarried. And her Austrian allies were already perilously near to breaking under the strain. From now onwards German formations had to be interwoven into the Austrian battle line to stiffen its uncertain fabric. On the other side, the weaknesses already evident in the Russian army were increased by the deficiencies in munitions, especially rifles and shell, which now began to be seriously felt.

Even the severity of winter gave little check to the fighting. In the centre the front remained stable but furious battles on either flank marked the opening months of 1915. On the Russian side, the Grand Duke had realised that he must secure his flanks solidly before any further attempt to advance in the salient. The problem was on which flank to make the main effort; on this point Russian strategists were divided. The majority were for making an end of Austria; others urged, very reasonably, that the occupation of East Prussia would do more than anything else to solve Russia's strategical problem. In the end both were attempted and neither aim was accomplished.

Conflicting German Plans.—On the German side, there now became evident a fundamental difference of opinion between Falkenhayn at supreme command and Ludendorff, the guiding brain of the campaign on the Eastern front. The latter aimed at nothing less than decisive manoeuvre on the largest scale against the Russian armies, and now urged that all available resources should be put into a great effort from both flanks, which was to finish the Eastern campaign once for all. Falkenhayn judged the distance too great and the communications too sparse for manoeuvre on such a scale. He would admit only the limited offensive which sought tactical success; he hoped by a series of such successes to wear out the resisting powers of the Russian army.

On the southern flank, battle raged all along the Carpathians from Jan. to mid-April. The Russians sought to secure the crest of the mountains and to debouch on to the plains below.


EASTERN FRONT CAMPAIGNS
Scale, 1: 5,000,000
English Miles
0 10 20 40 60 80 100
Kilometres
0 20 40 60 80 100 120 140 160 180 200
Reference
Approximate positions August 20th 1914 (Strategical Deployment)
Germans & Austrians
Russians
Approximate line May 1st 1915
" " July 15th 1915
" " Aug. 15th 1915
" " Sept. 15th 1915
" " Sept. 30th 1915
(End of Russian Retreat)
Approximate line Nov. 30th 1916
Main Railways
Marshes
A
B
C
D
E
1
2
3
4
Petrograd (Leningrad)
VI
Revel
Narva
R. Luga
R. Volkhov
R. Msta
Lake Peipus
Lake Pskov
L. Ilmen
Dago
Osel
R. Pernau
Pernau
Pskov
R. Lovat
Windau
R. Courland
Riga
Libau
Mitau
Jakobstadt
Dvinsk
R. Dvina
Shavli
Memel
Panevezys (Ponewiej)
Swieciany
Vitebsk
Smolensk
R. Niemen
R. Vilija
L. Narocz
Wilno (Vilna)
Smorgonie
Molodeczno
Mogilev
Minsk
Konigsberg
Kovno
Danzig
Insterburg
Gumbinnen
Stallupönen
VIII
Marienburg
Soldau
Suwałki
Augustów
Grodno
EAST PRUSSIA
Allenstein
Lyck
Osowiec
R. Bobr
R. Narew
Lomza
Ostrołeka
Białystok
Baranowicze
Mława
II
Toruń (Thorn)
Włocławek (Wlotslavsk)
Przasnysz
Rozan
Ostrów
Bielsk
Posen
Płock
Modlin (Nowo-Georgiewsk)
Putlusk
R. Bug
R. Warta
R. Bzura
Lowicz
Warsaw
IX
Kalisz
Łódz
Skierniewice
Siedlce (Syedlets)
Kobryn
Pinsk
Brest Litovsk
R. Prypec
Marshes
R. Pripet
R. Vistula
R. Pilica
Deblin (Iwangorod)
Piotrków
Włodawa
Lubartów
Radom
Breslau
Rafałowka

SILESIA
Oppeln
Częstochowa (Chenstokhov)
Noworodomsk
Kielce
Opatów
Sandomierz (Sandomir)
Beuthen
Katowice (Katowitz)
Ratibor
AUSTRIA
Cracow
Tarnow
Jarosław
Jasło
Gorlice
Przemyśl
Lemberg
Rawa Ruska
Grabowiec
Komarów
Sokal
Włodzimierz Wolynski
Łuck
Równe
Dubno
Brody
Złoczów
Tarnopol
Brzezany
Sambor
Stryj
Halicz
Stanislau
Nadwórna
Kamenets Podolsk
Proskurov
Kiev
R. Dniepr
Brno (Brünn)
Vienna
Budapest
Mukačevo (Munkács)
Uzsok
Czernowitz
BUKOVINA
BESSARABIA
R. Prut (Pruth)
R. Dniester
Jassy
Odessa
HUNGARY
R. Tisza (Theiss)
R. Danube
R. Maros
TRANSYLVANIA
Sibiu (Nagyszeben) (Hermannstadt)
Brasov (Kronstadt)
Petrosani
Vulcan Pass
Rothenthurm Pass
Campul Lung
Mărăşesti
Focşani
R. Siret (Seretch)
Braila
Ploesti
Pitesti
R. Arges
Bucharest
Craiova
R. Oltu
Cernavoda
Constanţa
Silistra
Turtucaia
Rákhovo
Ruschuk
Sistova
Varna
BLACK SEA
DOBRUDJA
CROATIA-SLAVONIA
Belgrade
Orsova
Iron Gates
BOSNIA
Sarajevo
SERBIA
BULGARIA
MONTENEGRO
I
II
III
IV
V
VII
1
2
3
4
5
6
7
8
A
B
C
D
E

The Austrians, stiffened by Linsingen's German Southern Army, strove to drive them back and to relieve Przemyśl. The result was indecisive; the Russians captured Przemyśl, which fell on March 22, and gained some ground in the Carpathians, but only at the price of terrible losses.

In the north, the Grand Duke had intended to strike his main blow with the recently constituted XII. Army in much the same direction as Samsonov's ill-starred offensive. But Hindenburg and Ludendorff forestalled him. Falkenhayn had, with some reluctance, consented to reinforce the Eastern front with four newly-constituted corps. A X. Army was formed in East Prussia. With this, and with the VIII. Army, Hindenburg took the offensive against the Russian X. Army, which was stretched out over a wide front just inside the Eastern frontier of East Prussia. In a battle which lasted from Feb. 8 to 22, the Russians were completely surprised and heavily defeated, with the loss of 110,000 prisoners, four divisions being surrounded in the forests of Augustówo. The attack of the Russian XII. Army in the latter part of Feb. and the beginning of March was easily repulsed.

German Offensive: May–Sept.—During the latter half of March and in April, except in the Carpathians, there was a breathing space in the operations. Falkenhayn now decided on an offensive in the East on a large scale; his aim was to hammer the Russians into powerlessness so that he could then concentrate the main German forces in the West without fear for the collapse of Austria. The French and British offensives of March had enabled him to judge the extent to which he could safely weaken his Western front to provide the necessary forces. He determined on a break-through on the Dunajec between the Carpathians and the Vistula, and entrusted the operation to Mackensen with the newly-formed XI. Army, which contained eight divisions from the Western front. The concentration was carried out with great secrecy; and the attack, which fell on the Russian III. Army (Radko-Dimitriev) was preceded by artillery fire on a scale hitherto unknown on the Eastern front. Operations commenced on May 2 and had a great and immediate success. The Russians were driven back with heavy losses to the line of the San.

Meanwhile, the Franco-British attempts at relief offensives had shown Falkenhayn that the defence in the West could stand the strain; and he withdrew more divisions for a continuance of Mackensen's offensive. Italy had declared war on May 24; and Falkenhayn had some difficulty in dissuading the Austrian command from weakening their Galician forces. Mackensen forced the San, recaptured Przemyśl on June 3 and Lemberg on June 22. Large numbers of prisoners were captured and the whole Russian organisation was much shaken. Incidentaliy, the Turks, hard pressed in Gallipoli, were relieved from the menace of a Russian corps which had been training at Odessa for an attack on Constantinople. This and all other available Russian reinforcements were thrown pell-mell into Galicia. But the Russian powers of resistance were by no means broken, and they still counter-attacked vigorously.

Falkenhayn decided to continue the offensive, but now with an eye on the clock, for the Allies in the West were obviously preparing fresh attacks, which would probably develop not later than September. There was once again a sharp conflict of opinion between him and Ludendorff as to the plan on which the offensive should be continued. Ludendorff urged a decisive attack on Kovno and towards Wilno (Vilna) and Minsk, with the object of cutting the main communications of the Russian forces. A German force had, at the end of April, crossed the north part of the East Prussian frontier and established itself at Libau and Spavli. It was thus well placed to facilitate Ludendorff's proposed operations by turning the line of the Niemen, provided it were made sufficiently strong to overcome the Russian forces which had been sent north to oppose it and protect Riga. But Falkenhayn would have nothing of this bold plan, which he feared would commit him too deeply into the interior of Russia. He ordered instead a continuation of Mackensen's offensive northward between the Bug and Vistula towards Brest-Litovsk. Hindenburg was to co-operate by an attack through Przasnysz on the Narew line.

The Russian Retreat.—These July offensives were successful, but only after heavy fighting. Thus the Grand Duke was enabled to withdraw his forces from Warsaw and the salient while his line of retreat was still open. This embittered the controversy between Falkenhayn and the Eastern command (Hindenburg and Ludendorff). The former accused Hindenburg of not prosecuting the attack on the Narew with the full strength at his disposal—he had, in fact, kept certain formations in hand for his Kovno-Wilno scheme—and thus allowing the Russian forces to escape; while the latter retorted that his advance on Wilno, if permitted, would have cut off the whole Russian forces and ended the War in the East.

It was now the middle of August. Falkenhayn was compelled to return troops to the West to meet the impending French offensive in Champagne; he therefore ceased any further attempts on a large scale in the East. He had already accomplished his object; in prisoners alone the Russian losses amounted to 750,000, and the Russian armies would obviously be incapable of any offensive for many months. He left Hindenburg to continue the campaign, and withdrew the ban on the Wilno advance, should Ludendorff still judge it feasible. Mackensen was taken to hammer out a fresh victory in Serbia.

During the latter half of Aug. and all Sept. the Russian retreat continued, pressed by constant German and Austrian attacks. Ludendorff tried his Wilno manoeuvre; but, though Kovno, Grodno and Wilno fell, the Russians, by hard fighting, kept open their lines of retirement. At the end of Sept. the retreat was finally stayed on the general line Riga–Dvinsk–Baranovicze–Pinsk–Dubno–River Siret–Czernowitz. Early in Sept. the Tsar had taken over the chief command from the Grand Duke Nicholas. His chief of staff and the virtual commander-in-chief was Alexeyev (*q.v.*), a man of parts, but lacking in firmness of decision. The strength of the Russian armies at the front had by this time sunk to 650,000. Over 8,000,000 men had already been mobilised, but the losses had been enormous. The Russian morale was also low, and there was a feeling that their Allies in the West, by sitting inactive during Russia's trial, had ill repaid the sacrifices which Russia had made for them in 1914.

III. RUMANIA'S EFFORT

On the Eastern front, in the spring of 1916, the forces were organised as follows: on the German front, from Riga to the marshes of the Pripet, which formed the dividing line between the German and Austrian sectors, lay 42 German and 2 Austrian divisions; south of the Pripet were 38 Austrians and 4 German divisions. The Russian line was divided into three fronts, the Northern from Riga to Dvinsk, the Western from Dvinsk to the Pripet marshes, and the South-Western thence to the Rumanian frontier. The number of divisions allotted to these fronts was approximately 35, 60 and 35 respectively, and the total rifle strength was over 1,500,000.

Russian Offensive.—The battle of Verdun began in February. On March 18 the Russians started a relief offensive on their Western front. The point of attack chosen was on either side of Lake Naroch, east of Wilno. After a preliminary success the Russians persisted in attacks although a thaw had rendered the ground practically impassable. By the end of March they had lost 150,000 men and had little to show for their losses. They then commenced to prepare an offensive at Motodeczno, a little south of Lake Naroch, to take place in July, in combination with the Franco-British offensive in the West. Brusilov, who had succeeded Ivanov in command of the South-Western front, had been ordered to prepare such offensives as he could stage with his own resources, to serve as distractions to the enemy from the main Russian effort.

In the middle of May the Austrians—contrary to the wishes of the German Supreme Command—made an attack on Italy, which at first met with considerable success. Italy made an appeal to Russia to prevent the Austrian formations on her front

from crossing over to Italy. Brusilov's offensive, loosed on June 4 in answer to this appeal, met with a sudden and surprising success. The Austrian front, from which the best troops had been withdrawn for the Italian attack, crumbled into collapse. But the Russians proved unable to take full advantage of their opportunity. The reserves were all in the north, and could not be moved down as fast as the Germans could produce divisions to fill the gaps.

During June, July and Aug. Brusilov's offensive continued with considerable success, but by the end of Aug. it had lost its impetus. The Bukovina and a large portion of Eastern Galicia had been occupied and nearly 400,000 prisoners taken (*see* LUCK). But the Russian losses had been enormous; by the end of the autumn they amounted to something over 1,000,000 on Brusilov's front alone. Holding offensives made on the Russian Western front at Baranovicze had also cost the Russians heavy losses with no gain. Outside Russia, Brusilov's success had two important results—the entry of Rumania into the War on Aug. 27, and Falkenhayn's replacement at Supreme Command by Hindenburg and Ludendorff.

Rumanian Campaign: Aug.–Dec. 1916.—Rumania had for some time been awaiting a favourable opportunity to throw in her lot with the Allies. In Aug. 1916 this seemed to have come. The Russian conquest of the Bukovina safeguarded the right flank of her intended advance into Transylvania; the German reserves seemed fully occupied in stemming Brusilov's attacks and the Franco-British offensive on the Somme; the Bulgarians were, it was hoped, well held by Sarrail's Salonika army, an attack by which was promised. Encouraged by France and Great Britain, Rumania took the plunge.

The prompt and united effort of the Central Powers against Rumania was in contrast to the lack of unity between the Allies, particularly between Russia and Rumania. Consequently Rumania's adherence to the Allied cause was to prove an embarrassment, rather than an addition of strength. The Rumanian strategical problem was not an easy one; the long narrow salient of Western Wallachia, projecting between Hungary and Bulgaria; the location of the capital within 30 m. of hostile territory; the exposed position of the Dobruja with no good natural defences; the great length of frontier line in proportion to the depth of the country; and the lack of lateral railways, were all obvious defensive weaknesses.

Only on the supposition that her enemies were too fully occupied to stage an offensive of any great weight against her, could Rumania have anticipated, as she undoubtedly did, an easy victory. The invasion of Transylvania as her main operation was clearly indicated. It would give her possession of the territory she claimed by right of common nationality; and it would open to the Russians the Carpathian passes. Moreover, the occupation of a line about the Maros valley, across the chord of the great re-entrant bend of the Carpathians, would shorten her front by over 100 miles. A further advance westward would, however, have far to go before threatening any area vital to the Central Powers.

The Rumanians advanced in three columns, each about four divisions strong. The IV. Northern Army seized the passes south of the Bukovina and was to act in co-operation with the Russian left; the II. Army in the centre moved on Braşov (Kronstadt), and the I. Army by the Rothenthurm and Vulcan passes on Sibiu (Hermannstadt) and Petroşani. A detachment of a division at Orsova on the Danube defended the left flank and rear. Three divisions were left in the Dobruja to face the Bulgarians; by a provision of the Convention under which Rumania entered the War, they were to be supported by a Russian force of two infantry divisions and one of cavalry. Other Rumanian detachments amounting to about three divisions held the line of the Danube. The whole southern front was under the III. Army command.

The plan of the Central Powers provided for a concentration in Transylvania behind the defensive line of the river Maros. This group was to make a counter-offensive against the Rumanian I. and II. Armies as soon as the concentration was complete. Meanwhile a Bulgarian army, assisted by a German detachment and Austrian bridging train, the whole under the command of Mackensen, was to carry out an immediate invasion of Rumania's "back door," the Dobruja.

Rumanian Offensive Stopped.—The Rumanian advance was slow, and the Austro-German concentration on the Maros was completed without interference. Meanwhile Mackensen's operations had been attended with success of far-reaching importance. He stormed the strongly fortified bridgehead of Turtucaia on Sept. 5, capturing almost the whole of two Rumanian divisions, while a third Rumanian division was defeated and driven northwards. Silistria fell on Sept. 9. The Russian forces which now came up succeeded in saving, for the time being, the Constantsa-Cernavoda railway. A counter-attack in the Dobruja and an attempt to cross the Danube at Rakhovo in Mackensen's rear were badly combined and executed, and failed completely. Operations in the Dobruja came to a temporary standstill early in October. Mackensen's intervention had had the desired effect of halting the main Rumanian offensive and of drawing the available reserves southward. The counter-offensive in Transylvania was now launched. The Rumanian I. Army was beaten at the battle of Sibiu between Sept. 26 and 28 and their II. Army at Braşov, 10 days later. The Rumanians were driven out of Transylvania and thrown on the defensive all along their frontier. Relations between the Russians and Rumanians, already strained, were not improved by Mackensen's defeat on Oct. 19 of the Russo-Rumanian Dobruja Army and occupation of the Rumanian port of Constantsa and the railway to Cernavoda.

Fall of Bucharest.—The Rumanians repulsed the enemy's attempts to cross the passes on the heels of their retreat from Transylvania and compelled him to pause and await fresh reinforcements. They also defeated the first attempt of Falkenhayn, who commanded the principal Austro-German army, to force the Vulcan and Surduc passes. But a second attack with fresh troops, made at the same spot from Nov. 10 to 17, broke their resistance. They fell back to the line of the river Oltu (Aluta). Falkenhayn had won his race against winter only by a few days, as snow would soon have made large-scale operations in the high passes almost impracticable.

As soon as Falkenhayn's army was across the mountains and within reach, Mackensen made the next move in the carefully concerted plan. Leaving a force to hold the narrowest part of the Dobruja north of the Constantsa railway, he had withdrawn the bulk of his forces to Sistova, where was his bridging train. On Nov. 23 he crossed the Danube, thus turning the line of the Oltu, which had already been crossed by German cavalry. Both armies now advanced on Bucharest, which fell on Dec. 6, after a hard-fought battle on the Arges river. This reflected great credit on Gen. Presan, who had now become Chief of the Rumanian General Staff. Tardy Russian attacks in the Carpathians and Dobruja had no effect, and Russians and Rumanians now withdrew to the Siret–Danube–Black Sea line.

Sarrail's offensive on the Salonika front had been made with little apparent determination and had brought no relief. The campaign had given the Central Powers control of the oil and wheat of Wallachia and had added 300 m. to the already overlong Russian front. On the Allied side, it had been a badly mismanaged affair. The plan of the Central Powers was boldly conceived and executed. The careful co-ordination of the moves by Mackensen and the Transylvanian group are worthy of study.

IV. THE RUSSIAN REVOLUTION

In the early spring of 1917 the initiative was definitely with the Allies, and a simultaneous offensive by all the Allies was planned, with the intention of preventing the Germans from transferring reserves from one front to another. This plan was ruined by the snapping of the weakest link in the Allied chain, Russia.

Collapse of the Army.—Though the Russian Army was now better armed, better equipped and probably better directed than ever before, the losses of the previous two and a half years

had worn out the endurance of the rank and file, who were weary for peace. Still the army would have held but for the internal collapse. The Russian revolution broke out in the middle of March. The effect on the army was immediate. The Provisional Government, by its weakness, allowed the situation to pass out of its control into the hands of the subversive element. The notorious "Order No. 1" of the Workmen's and Soldiers' Soviet was the first and fatal step in the destruction of discipline. The poison spread rapidly throughout the uneducated, war-weary mass of the Russian soldiers; and the corps of officers, which had sadly deteriorated during the War, was powerless to check the evil.

Even as early as April, an Austro-German attack on the Stochód bridgehead found the Russians little inclined for fight; a few months later the bulk of the army was a harmless, demoralised mob. By great efforts a part was blandished into undertaking the attacks in Galicia known as "Kerensky's offensive" at the beginning of July. Thanks to the unwonted abundance of guns and shells, these at first met with some measure of success, especially in the region of Stanislau, and showed what might have been achieved had the army remained sound. But they speedily collapsed so soon as real resistance was met; and when the Germans on July 19 commenced a counter-offensive east of Lemberg, the front crumbled at once. By early Aug. the Russians had been driven out of Galicia and the Bukovina, and it was only policy which halted the Austro-German armies at the frontiers of Russia itself.

Armistice with the Central Powers.—The Central Powers had resolved early in Aug. to complete the occupation of Rumania and improve the defensive position by driving the Russo-Rumanian army behind the Prut. This intention was foiled by the fine fighting of the re-constituted Rumanian army, which fully held its own at the battle of Marasesti. At the beginning of Sept. the Germans captured Riga, meeting with little resistance. A month later the Bolshevists seized power, and at once began overtures for an armistice. This was concluded early in Dec., the Rumanians being forced to follow suit.

The Russian debacle gave the Central Powers a last chance to win the war in 1918, and for long rendered the Allied victory doubtful. But up to the final collapse of the nation, under the internal strain of its own disorganisation rather than under external pressure by its foes, Russian strategy towards her Western allies had been chivalrous in the extreme. Despite their deficiencies in equipment and consequent enormous losses, they never hesitated to attack when the pressure in the West was severe. This must always be remembered to Russia's credit in judging of her efforts in the World War.

For more detailed accounts of the individual battles fought in the Eastern European theatre, reference should be made to the following articles: Brest-Litovsk, Battles of; Dunajec-San, Battles of the; Lemberg, Battles of; Łódź-Cracow, Battles of; Luck (Lutsk), Battles of; Masurian Lakes, Battles of the; Narew, Battles of the; Narocz Lake, Battle of; Przemyśl, Sieges of; Tannenberg, Battle of; Vistula-San, Battles of.

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EAST INDIES, NETHERLANDS (*see* 17.467).—Asiatic possessions of the Netherlands. Their area is 733,667 sq. m. and the population 49,350,834.

Political Development.—The economic and technical progress of the islands after 1900 did not at first affect the general organisation of the Government, but in the long run the extension of the European-conducted agriculture, mining and industry created a demand for skilled labour and accelerated the process of differentiation in the mass of the native population. This development, coupled with the tendencies commonly described as the awakening of the East, resulted in more or less popular movements of political character. The Chinese revolution of 1911 led some sections of the Chinese community to assume an overbearing attitude towards the natives, who retaliated by founding a society of politico-religious character, the *Sarekat Islam*, aiming in the first instance at breaking the Chinese ascendancy in inland trade, but soon developing into a numerous and influential political party.

Other associations of a distinctly political character appeared about the same time, such as *Budi Utomo* (1909), whose members belong to the native professional and intellectual class, and an Indian party under Eurasian leadership and with the avowed object of separation from Holland. The latter disappeared after some years of very lively agitation, the Eurasians (who are legally and socially treated as Europeans) having realised that their community would be the first to suffer by separation. The *Sarekat Islam* split into a communist or "red" wing and a relatively moderate reform party. Labour unions of the continental socialistic type have been formed among the industrial working class; after the Russian revolution many came under communistic influence. By an Act of 1916 a central representative body, called the *Volksraad* (national council), had been created at Batavia, one-half elected, the other nominated. Although its functions were advisory only, its powers of criticism and advice in matters of budget, legislation and administration were large enough to secure for it at once an influential position.

In 1922 the revision of the Dutch constitution was made the occasion for the further reform of colonial institutions in order to place the task of legislation and administration as much as possible in the hands of authorities and bodies resident in the colony, and ensure to the resident population as large a share in those bodies as would be found practicable. Under the new colonial constitution, which was worked out by an Act of 1925, the *Volksraad* becomes, in conjunction with the Governor-General, the regular legislature for all matters of internal policy, except in so far as the Imperial Parliament deems proper to legislate by Act or to empower the Crown to regulate on specified subjects by order in council. The reorganised *Volksraad* consists of a president, appointed by the Crown and 60 members, of whom 25 are to be natives (20 elected by native members of local councils and 5 nominated), at least 30 Netherlanders (15 elected) and three to five others (three elected). Officials may serve on the *Volksraad* as elected or nominated members, and in both cases are as free to speak and vote as non-officials.

Population.—The table following gives the population according to the census of Nov. 1920, with the figures of the census of Dec. 1905 in brackets.

	Java and Madura	Other islands	Total
Europeans (including half-castes, Americans and Japanese)	135,288 (65,535)	34,420 (15,375)	169,708 (80,910)[1]
Natives	34,433,476 (29,715,908)	13,871,144 (7,304,552)	48,304,620 (37,020,460)
Chinese	384,218 (295,193)	425,429 (268,256)	809,647 (563,449)
Arabs	27,806 (19,148)	17,115 (10,440)	44,921 (29,588)
Other foreign Orientals	3,383 (2,842)	18,555 (20,128)	21,983 (22,970)
Total	34,984,171 (30,098,626)	14,366,663 (7,618,751)	49,350,834 (37,717,377)

[1] The figures for 1905 do not include the Europeans serving in the army and navy, totalling 15,866.

The density for the colony as a whole is 67 per sq. m.; for Java (including Madura), 689; some districts of Java are seriously overpopulated. The Government has tried, with some measure of success, to create a current of emigration to South Sumatra, and the plantations in the east coast district of Sumatra, the Straits Settlements, the Federated Malay States and Surinam employ Javanese

as indentured labourers, but only part of them settle down in their new home. The average mortality is 21 per 1,000. In the crowded native and Chinese quarters of the old seaports it is much higher; among the coolies on modern plantations it has been brought down to 12 per 1,000.

Education.—The principal aims at which the educational policy of the period 1910–25 were directed were: (1) increase the number of vernacular schools for the mass of the people; (2) develop a type of school with Dutch as the medium for the higher classes (Dutch-Native and Dutch-Chinese schools); (3) create secondary schools adapted to the special requirements of the country (suitable for all races alike) in addition to the older secondary schools copied on the Holland model and (4) develop higher general, scientific, technical and professional education.

In 1920 a college for civil engineers was opened at Bandung. Batavia has a college for lawyers, opened in 1924, and medical schools exist at Batavia and Surabaya. A board of education was instituted in 1918.

Exports and Imports.—Notwithstanding the disturbance caused by the War, the history of the Netherlands East Indies (N. I.) in the first quarter of the 20th century was one of almost constant progress. Order was firmly established by 1900, and native and European production increased. Total imports and exports doubled in value between 1900 and 1911; in 1913 they were valued at 1,177 million guilders. Capital was attracted, not only from the Netherlands as before but also from other European countries, large sums being invested in rubber. Food crops were not extended at the same rate, and importation of rice became increasingly necessary; in Java, where little arable land was available for extension of food crops, the yearly rice imports in 1913 amounted to 258,000 metric tons.

Just before the War progress seemed to have come to a standstill owing to a general fall in prices of tropical products, and the outbreak of war paralysed all foreign trade for a while. But soon another tendency set in, and during some years colonial products were in great demand. Intercourse with Holland being hampered by war measures, the export trade had to seek other markets in Japan, China, British India, Australia, the United States, Chile and South Africa. Regular shipping lines to these countries were established, and for some time a good number of the imports that formerly came from Europe were supplied by them. The years 1917–8 were years of growing difficulties. The seagoing tonnage was diminished by the German submarine war and the seizure of many Dutch ships in American ports on a plea of angary; large quantities of produce could not be disposed of, and the importation of rice for consumption decreased. The Government had to step in and organise the collection and distribution of rice to prevent starvation in many districts. With the Armistice this crisis came to an end, and prices went up to fantastic heights (sugar rose from 5 guilders per picul in 1918 to 45 in 1919 and 72 in 1920), with the inevitable results of over-production, overtrading and speculation.

Finance.—The general rise of prices and wages and the pressing needs of increased transport and harbour accommodation made great demands on the public finances, and a period of deficits set in which reached a climax in 1921, when the revenue amounted to 756,000,000 guilders and expenditure to 1,060 million. The funded public debt rose from 83,000,000 guilders in 1913 to 1,176 million in 1923. Reaction set in by the middle of 1921, but the profits of the favourable years enabled most of the older firms to stand the strain. Public finances were set in order by a strong policy of retrenchment and the fiscal year 1924 showed a surplus, with revenue at 707,000,000 guilders and expenditure at 662,000,000. The monetary system had been maintained in sound condition, so that by April 1925 Netherlands India was able to return to the gold standard.

Production and Trade.—Native agriculture in 1925 was still mainly concerned with food crops; on Java and Madura the area of irrigated rice fields in 1924 was 7,800,000 ac., other crops (non-irrigated rice, maize, cassave, peanuts, etc.) covering 10,900,000 acres. As a result of the Government policy of education the natives are taking more and more to growing export products, in Java especially copra, tea, tobacco, kapok; in the other islands rubber, pepper and coffee. Still, the bulk of the exported products is grown on European-managed estates. The principal articles of export are given in the table in the preceding column, with quantities (when not otherwise indicated, in tons of 1,000 kilos) and values (in million guilders) for 1923.

	1910 (quantity)	1923 (quantity)	1923 (value)
Sugar	1,179,576	1,827,518	499
Rubber	2,768	143,661	171
Kerosene, gasolene (1,000 litres)	801,434	889,518	118
Other petroleum products (value)	5·6	..	61
Tobacco	62,856	52,246	86
Copra	248,148	320,362	85
Tin and tin ore	5,713	30,277	60
Tea	15,338	48,114	76
Fibres (kapok, sisal-hemp, etc.)	19,718	44,422	31
Coffee	14,730	38,608	30
Cassava products	11,719	111,451	20
Quinine	119	251	11
Cinchona bark	7,235	7,058	7
Pepper	26,189	28,618	11

In 1924 the total value of exports and imports, including coin, was 2,286 million guilders.

Rubber.—Rubber, which was first planted in 1876, increased in importance. The industry suffered heavily from the crisis of 1920–1, and the Government was asked to join in the working of the Stevenson scheme (*see* RUBBER). Dutch planters and Government alike refused to adopt this compulsory restriction policy, but the British owners of rubber plantations in Sumatra, many of them also owning estates in Malaya, for the greater part voluntarily adopted the restriction policy. The rubber boom that followed the rise in prices stimulated not only the European-conducted planting industry but also the native production, which in 1923 already supplied more than one-third of the total exports from Netherlands India. For 1924 the production of native rubber was estimated at 53,000 tons (of 1,000 kilos) as against 90,292 tons of plantation rubber; native production was still fast increasing. The capital invested in the rubber estates is supplied largely by non-Dutch countries; in 1924 31·9% of the area under rubber in Netherlands India, 34·9% of the estates in production and 30·9% of the production were British.

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EAST LONDON, South Africa (*see* 8.836), had population (1921), including suburbs, of 34,673, of whom 20,374 were whites. East London, which ranks as the fourth port of the Union, has grown in importance as the entrepôt for an extensive agricultural district and it exports a large proportion of the wool produced in the province. Alterations at the harbour designed to secure a large enclosed space at the mouth of the Buffalo river were in progress in 1925. The tonnage of ships entering the port was 1,906,000 in 1913 and, after falling to 325,000 in 1919, had reached 2,043,000 in 1923. The average value of imports in 1910–4 was £4,261,000; in 1923 the value was £5,142,000. The average value of exports was £2,067,000 in 1910–4; in 1923 exports were valued at £5,517,000. Though eclipsed as a holiday resort by Cape Town, East London attracts many visitors, as does also the neighbouring municipality of Cambridge, whose population (4,890) is included in that of East London.

EASTMAN, GEORGE (1854–), American inventor (*see* 23.431), manufacturer and philanthropist, was born at Waterville, N.Y., July 12 1854. He was educated at Rochester and became interested in photography. In 1880 he began to manufacture dry plates, and four years later produced the first practicable roll film. In 1888 he invented the "kodak." He devoted the greater part of his fortune to the advancement of education, and had given by 1925 a total of over $58,000,000 for such purposes. Of this sum the University of Rochester received over $25,000,000 including upward of $5,500,000 for the medical school and $6,500,000 for the foundation and endowment of the Eastman school of music. He gave also $15,500,000 to the Massachusetts Institute of Technology and about $2,000,000 to the Hampton and Tuskegee Institutes (*See* PHOTOGRAPHY).

EBERT, FRIEDRICH (1870–1925), German politician, was born in Heidelberg Nov. 4 1870, the son of an impecunious tailor. He was an early recruit to the Socialist movement, becoming a fluent speaker and a first-class trade union organiser, suffering persecution and boycott for the cause. He moved to Hanover, and later on to Bremen where he joined the staff of the local paper of the party, and, having dropped his trade as a saddler, became labour secretary for Bremen. From 1905 Ebert played an important part in the direction of the Socialist party. He entered the Reichstag in 1912. A year later he became chairman of the party, which at that time was torn between the Orthodox and Revisionists; his common sense was considered a guarantee for keeping the party together.

At the outbreak of the World War, Ebert, deeply impressed by the danger of a Russian victory, voted, with his party, for the War credits. His common sense revolted against the optimistic pacificism of Haase and his followers, who later became the Independent Socialist party. He continued to strive, however, at home and abroad, especially at the Stockholm conference in June 1917, for a just peace. He became leader of the Majority Socialists in 1916 and chairman of the budget commission of the Reichstag in 1918. Though disapproving of the peace of Brest-Litovsk, he opposed strikes to bring about peace. In Feb. 1918 he tried hard and fairly successfully to put an end to the Berlin strike, which threatened to become a national calamity. For the part he played at that time he was attacked later on by the Independents as well as by the representatives of the old order.

After Ludendorff's collapse in Sept. 1918 Prince Max of Baden formed the first parliamentary Cabinet. Ebert induced his party to join at a time when Ludendorff's insistence on an immediate demand for an armistice was already known. The negotiations about the armistice continued over a month. The suffering working classes began to be restless. When the plans to force a great naval battle became known, a mutiny took place at Kiel. Acting on Ebert's advice, Prince Max sent Noske to Kiel who succeeded in re-establishing order.

Ebert, knowing the historical attachment of the German people to monarchy, wanted a parliamentary democratic government, on English lines, but no republic. When the organised working men began to follow the Independents inspired by the Russian example, Scheidemann intimated to Prince Max (Nov. 7) that the Socialists must withdraw from the Cabinet, and that if the Emperor did not abdicate by the 9th one of his sons, not the Crown Prince, should take his place. The Emperor vacillated. By the 9th the masses had got out of hand. The monarchy collapsed, but the knowledge of the abdication had not the desired effect. Scheidemann proclaimed the German republic, and Prince Max offered the chancellorship to Ebert, which he accepted. He formed a provisional government consisting of three Independents and two Majority Socialists besides himself.

From Nov. 1918 to Feb. 1919 it was touch and go whether Germany would be a democratic country or a soviet republic. The small group of German Bolshevists, the Spartacus Union, led by Karl Liebknecht and Rosa Luxemburg, insisted on following Russia's example, whilst the Independents did lip service to democracy, but wanted to postpone the elections. Ebert insisted on an early election for a Constituent assembly, to give Germany a democratic constitution. For nearly two months the Government had no power. The Spartacists had armed their adherents and repeatedly tried to imprison Ebert and his colleagues. Ebert called Noske to Berlin, who succeeded in quelling the Dec. and the Jan. risings by means of quickly organised volunteers. When the struggle was over, the elections to the National Assembly took place quite quietly. Democracy had won the day, thanks to Ebert and the Moderate Socialists. It was but fitting that the Assembly elected him the first provisional president of the German Republic. Ebert stuck to his post when the Treaty of Versailles had to be signed and later when, as early as 1920, a military rising, the Kapp Putsch, took place. He left Berlin with his Government to return when the general strike, had forced the leaders to surrender.

As President.—Ebert's term as president was provisional. He wanted to withdraw from office at the appointed time (1922) and to subject himself to a proper election. He bowed, probably unwisely from his point of view, to the wishes of the majority of the Reichstag, including the People's party, who asked him to accept office for a second term from their hands until 1925. When that term drew near its end, reactionary and radical forces had gained strength in Germany. This was shown by the result of the general election of May 1924. But by 1925, after stabilisation had done its work, the situation had improved considerably; there appeared to be quite a fair chance that Ebert, if he chose to stand, might be re-elected.

By that time Ebert had become a statesman; he had dropped the party leadership. He remained on friendly terms with his party, but he considered himself the representative of the German people as a whole. He wielded the great but rather veiled power of the German President with consummate tact. His attitude when forming cabinets, and when reaching decisions was correct, constitutional and wise. He had gained the confidence of all persons with whom he came in contact. He had made the office of the president influential, though not conspicuous. This artisan who had not had the academic training so greatly valued in Germany succeeded in getting a firm grasp on foreign affairs. He saw a point quickly and he knew how to deal with men. Singularly modest and unassuming, his was the dominant influence, nevertheless, in the many crises the German Republic had to pass through in the year that followed the peace.

But the fact that a plain man of the people was the head of the state did not commend itself to the reactionary elements of German society. A campaign of calumny was organised against him, accusing him of having fermented sedition and broken the back of the German Army. He was forced to bring an action for libel against Herr Rothard, who had published in the *Mitteldeutsche Zeitung* a letter and footnote accusing Ebert of treasonable conduct in connection with the munition workers' strike in Jan. 1918. Rothard was found technically guilty, but the judge's finding was unfavourable to Ebert. As the judge's political bias was scarcely denied, the public, including the Cabinet sided with Ebert. The Central Government and many state governments passed votes of confidence; the public assured him of their sympathy, but the strain practically killed Ebert, who had been suffering from repeated attacks of appendicitis. He did not wish to be operated upon before the case was over, and then it was too late. He died Feb. 28 1925 at Charlottenburg.

Ebert was a very fortunate combination of the light-hearted spirituality and sober shrewdness of the South German. He had faith in ideas and ideals, but he believed in action and in organisation as well. There was passion in him, but there was common sense; there was strength in him, and there was suavity. He was by no means a genius towering head and shoulders above his fellow men. He was rather one of them, sharing their feelings and their qualities, so that they could trust him completely, being just far enough ahead of them to make them follow him, the true leader for an incipient democracy.

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EBNER-ESCHENBACH, MARIE, FREIFRAU VON (1830–1916), Austrian novelist (*see* 8.843), died March 12 1916.

ECHEGARAY, JOSÉ (1833–1916), Spanish author and playwright (*see* 8.870), died at Madrid Sept. 16 1916.

ECOLOGY.—The period 1910–26 has witnessed extensive research along many lines. Descriptive ecology, which considers the vegetation of the earth as composed of static units and deals chiefly with the spatial relations of plant communities, their composition and construction, is a necessary preliminary to the more intensive studies by which alone the existing flora and fauna can be correlated with the conditions of the habitat.

Attempts to give greater precision to descriptive ecology led Raunkiaer[1] to elaborate a classification of growth forms mainly based on their adaptation to periods of adverse conditions. By comparison of the percentages of the different types of growth

[1] The figures throughout the text refer to notes at the end of the article.

form (*e.g.*, trees, herbs, etc.) in any given region, numerical expression can be given to the biological differences of different areas, which are often very pronounced. Thus, whereas the flora of Spitzbergen contains only 2% of annual species that of the Libyan Desert contains 42%; similarly the proportion of annuals decreases with increasing altitude. Equally valuable is the distinction emphasised by Braun(2), between those species which are almost invariable constituents of a particular type of plant community (constants) and those which, even if rare, are more or less restricted to it (characteristic).

The Upsala School has attempted to define the plant community in statistical terms based upon the constancy of species in minimal areas chosen empirically(3). These methods, if still somewhat subjective have led to greater accuracy in description and the recognition of the distinction between the abundance of a species and the frequency of its occurrence.

Study of Climate.—It has been long recognised that temperature conditions chiefly determine the character of vegetation zones more or less parallel to the equator, whilst within each of these the interplay of temperature, precipitation, humidity, wind and sunshine, as they affect the water supply of the plant, determine the incidence of forest, natural grassland and desert. But though climatic conditions are largely responsible for the changes in the character of the vegetation as we proceed from the equator to the poles or, in the vertical direction, up a mountain slope, yet these climatic factors are profoundly modified by differences in soil and topography as when the altitudinal tree-limit rises on a dry calcareous soil or is depressed on smaller, as compared with larger mountain masses. The correlation of the broader vegetational and climatic features is well exemplified by the recent account of the plant communities of the United States by Livingstone and Shreve(4) who show that the plant communities of that region follow closely the changes in the ratio of precipitation to evaporation.

As an example of modern descriptive ecology applied to aquatic communities the account of Esthwaite Water may be cited. If, as the ecologist conceives, the plant community is but the "resultant" of the combined action of all the habitat conditions, it is apparent that its conception as a purely static assemblage disregards the importance of the historic factor and the sequence of changes through which the community passes. This change with time led Clements(5) to the assumption of a climatic climax community to which all the other plant communities of the same climatic area were related as stages in a succession, arrested, it may be, by natural or artificial causes. In temperate climates the succession in certain communities has been shown to follow a sequence of soil changes, due directly or indirectly to leaching and the accumulation of plant residues, and these soil changes may be the fundamental initiating factors of the plant succession, disturbing an equilibrium which might otherwise have remained relatively stable(6).

Habitat Factors.—In no direction has progress been more pronounced than in the study of the habitat factors. Of these, soil acidity plays an important rôle, due both to the direct effect of the hydrogen and hydroxyl ions and to the influence of the concentration of these on the solubility of toxic salts such as those of aluminium and iron. Not only do various species exhibit a definite range with respect to this factor but for each species there is an optimal reaction or reactions at which the maximum frequency and vigour is attained(7, 8). This applies not merely to the phanerogamic vegetation but also to such important micro-organisms as the nitrogen-fixing bacteria of the soil(9).

Soil Problems.—Research on soil problems has been chiefly carried out on agricultural soils(10) which differ in their disturbed character from the natural soils with which the ecologist is more concerned. These latter possess a definite structure with marked changes in the vertical direction(6), and with this structure can, to some extent, be correlated the depth and form of root systems. The underground organs of the plant have been investigated for prairie species by Weaver(11) who has moreover developed a nomenclature of root form.

Water Supply.—The early concept of available and non-available water has been given greater significance by the work of Briggs and Shantz on the percentage of water present in natural soils when permanent wilting sets in. This equilibrium represents the point at which the supplying power of the soil balances the demands of the plant and hence varies with the water content of the soil and the atmospheric conditions. This non-available water probably consists of combined water and some of the capillary-absorbed water and, though not constant in amount, varies only within narrow limits for a given species and soil type(12).

Methods have been devised for obtaining samples of the actual soil solution which show that its osmotic pressure varies both with the nature of the soil and its water-content, moreover the latter appears to influence the proportions in which the various soluble substances are present. The osmotic pressure of the plant is intimately related to that of the habitat both in space and time, and freezing-point-depression methods show that plants of similar habitat and growth-form tend to possess similar osmotic pressures and hence similar capacities for withdrawal of water from their immediate environment.

Light Factor.—With respect to the investigation of the light factor, one of the most important advances is the recognition of the relation between optimal illumination and habitat. Thus whilst the woodsorrel (*Oxalis acetosella*) attains its maximum rate of assimilation at about one-tenth the full intensity of sunlight, a sun-plant such as *Amaranthus* can utilise an intensity of over one-third(13).

The chief problem of ecology is to explain why plants grow where they do. Does a particular species inhabit a woodland or a mangrove swamp because the conditions here are most favourable to its physiological processes or because elsewhere it is suppressed by more vigorous competitors? The one view demands a general fitness for the special environment, the other a greater tolerance. Much of the recent work on individual species has emphasised their adaptation and there seems reason to believe that the habitat has effected a selection of the most favourable mutants(14).

Historical Ecology.—Historical ecology and palaeo-ecology have received comparatively little attention but the admirable summaries of Laurent and Seward(15,16) of what is known respecting the floras of the past, the work of Mrs. Clement Reid on the pre-glacial floras of Britain(17) and of Erdtman on the vertical distribution of pollen in peat(18), have done much to shed light on the plant migrations of the past, of which a knowledge is essential to a correct appreciation of the distribution of the present.

Detailed Ecology.—Of the detailed ecology of individual species (autecology) little is known, except for a few habitats (19), although the experimental study of the characteristic species of the major plant communities is almost a pre-requisite for comprehending the causes of their occurrence. Similarly the relation of plants to one another and to the animals of the same environment is as yet an almost untouched field of research.

Economic Applications.—Economic applications of ecology have been mainly directed toward the control and utilisation of natural successions, as in the work of Cockayne on the grasslands of New Zealand and of Smith on mountain pasture(20, 21). The use of ecological methods in the control of erosion and accretion of maritime habitats developed by Oliver is especially noteworthy(22).

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ECONOMICS (*see* 8.899).—As the second half of the 19th century was marked in economic thought by the emergence of the historical sense, so the early decades of the 20th century have been marked by the impulse toward exact quantitative measurement. Abstract reasoning, proceeding by deduction from the assumption of self-interest, has by no means lost its value, as assisting, and sometimes greatly assisting, in the explanation of observed phenomena; even though there is a growing feeling that the classifications which it devises depend for their practical significance on the ascertained magnitude of the concrete facts which fall within them.

The historical study of economic conditions, which may be said to have completed its first stage in 1900–4 with the generalisations of Schmoller's masterly survey, continues to progress. Of late it has been turning its attention to one after another of the great industries of western Europe. In England a series of monographs on particular trades has illuminated the past and given added significance to the present. In France, the renaissance of historical studies in the universities is lifting the *ancien régime* and the economic effects of the Revolution out of the realm of controversy. American scholars are bringing fresh and unbiased minds to the examination of the society of the Old World.

It is evident, however, that it is in neither of these two directions, abstract reasoning or historical investigation, that the main tide of economic interest is now turning, but rather in the direction of statistics and accounting. And this is not for their own sake, nor even for their immediate value as tools in the hands of administrators; it is rather for ascertaining the magnitude of economic phenomena, for measuring the potency of economic forces, for indicating the requirements and limiting circumstances of national economic policy.

Modern Tendencies.—This was clear even before the World War. It arose from the organisation of business on the one side and from the enlarged functions of government on the other. For instance, the rapid conquest of the larger part of the field of modern business by the limited liability company, or corporation, necessitated in every country some procedure in the way of registration and annual returns or balance-sheets. At the end of the 19th century it occurred to Körösy, the statistician of Budapest, that it would be possible, on the basis of this material, to arrive at conclusions concerning the profitableness (or rentability) of joint-stock enterprise. The discussion his work provoked led to a whole series of attempts, especially by German statisticians, to measure the gainfulness of particular industries, and in 1909 the German Imperial Govt. undertook the task with its first annual report on "the business results of German joint-stock companies." Here, then, was a development arising out of existing official material, but forcing to the front important and difficult questions as to the meaning to be assigned both to capital and to profit.

A more general movement, arising out of the internal necessities of business undertakings themselves, was the extension and elaboration of cost accounts. With the multiplication and diversification of the products of manufacturing concerns, it was no longer sufficient to have the figures for total cost and total sales; it became necessary to ascertain the cost of each class of goods or components and to find how it was composed. It became requisite to distinguish between direct, or prime, cost and indirect, or general, cost. In a surprisingly few years the term overhead charges has displaced in business circles the various other terms by which the idea had been expressed, and it has now become part of the speech of the educated world. It is realised that overheads must largely determine price policy and employment policy; and since they are bound up with the scale and continuity of production and these with the size and character of the market, they must have a bearing on national tariff policy and the like. Closely parallel with the cost-account movement was the independent movement toward greater efficiency of labour, known for a time as scientific management (*q.v.*). The movement had several unfortunate defects, especially in its earlier phases; but it did at any rate increase the demand for an exact measurement of output in relation to remuneration and time.

Influences of the War.—The resort to statistics and accounting was vastly stimulated by the World War. Conscription, modern means of transport and blockade destroyed the distinction between enemy forces and non-combatant citizens. Governments, belligerent and neutral alike, were constrained to take control of all the economic activities of their peoples. For this purpose they found it necessary to acquire as exact information as was obtainable. Figures of food supply and cost of living from being the curiosities of science became instruments of government. With hundreds of factories owned or controlled by the State, with the political dangers of profiteering and with the financial requirements of Govt., not only had figures to be collected, but working definitions had to be arrived at of capital and profit. In order to do what was quite unavoidable with respect to primary commodities, viz., to fix prices, the public authorities had to feel their way to an assessment of "fairness" in profits and wages. Within the factories themselves the relation of output to working time and all the problems which came to be associated with the word fatigue had to be faced, not from a welfare point of view, nor from a profit-making point of view, but from a munition-producing point of view.

Commercial Education.—In the period since the War, the interest in the quantitative measurement of economic conditions has been greatly furthered by the remarkable extension of higher commercial education. This has been most marked in the United States and in Germany. In the United States there were already in existence, in certain of the universities, schools or departments of commerce or of business administration, most of an undergraduate, but one or two of a graduate, character. In Germany there were already a number of commercial high schools of university status (Handelshochschulen). Most of these were now turned into universities, while at the same time the economic departments of the older universities, under the pressure of incoming throngs of students, took on much of the character of commercial high schools. Even in England the University of London followed the example of Birmingham and Manchester, and established a faculty of commerce. Economics in all these countries, instead of being regarded as a study appropriate only to a future lawyer or official or journalist or professor or as a subsidiary element in a general education, now came to be regarded as professional education for an active business career. That being so, business economics or private economics, *i.e.*, the study of economic conditions from the point of view of the business interests of those in charge of particular undertakings, naturally came to claim a large share of the attention of the student, side by side with the political or national economy which interested the philosopher or statesman.

In the centre of economic study, viewed as professional preparation for a business career, necessarily appeared business administration or *Betriebslehre*. Considering the diversity in local needs and in the qualities of available teachers, it is not surprising that terms like these have been given very differing content in differing places. But almost everywhere the new purpose has led to increased attention to measurement by statistical and accounting methods. It has made use of the internal statistics which modern big business is driven to collect for its own guidance, and in return it has stimulated and criticised them. Nor has this been all; in several universities in the United States the teachers in the schools of commerce have organised bureaux of business research, obtaining both financial support and statistical material from business organisations in their several areas. Expenses, profits and losses in particular lines of business, distribution charges, wholesale and retail, the turnover of

stock, the element of rent and allied problems have been subjected to scrutiny, with the help of the latest refinements of accounting practice and mathematical statistics. The results arrived at have not only been of direct value in actual business practice, but also throw light on the validity of some of the conceptions of current economic theory, such as those of the marginal producer or the representative firm.

Trade Forecasts.—Meanwhile some universities, not as a rule officially, but in effect through the activities of members of their staffs, have become interested in the wide-spread hope or longing in the business world which is associated with what is known as forecasting. This development, though not now limited to the United States, has taken place there on a larger scale. For some years before the War a number of independent agencies had made a business of furnishing clients with forecasts as to the future movement of trade. Whether the forecasts rested on an assumed equality of action and reaction, of prosperity and depression, or upon an assumed sequence of trade movements, they called for the collection and grouping, by approved statistical methods, of the masses of figures now regularly turned out by governments and trade organisations. Since the War this field of work has been entered upon by bodies of academically trained experts, associated with particular universities, though not formally authorised by them. The best known is the Harvard Economic Service, which has been followed by a London and a Cambridge Service.

Whatever may be the value of the services thus offered to the business world, there can be no doubt that the labours they involve have led to a more searching and continuous scrutiny of certain large classes of economic statistics than they have ever before received. During the same period, and under the stress of the abnormal currency and price fluctuation of the post-War years, the method of measuring the level of prices by index numbers has become widely familiar; and instead of the single *Economist* index, an almost perplexingly large choice of index numbers is now pressed upon the world's attention.

Agricultural Statistics.—The new interest in numerical measurement since the War has passed over from finance and merchanting and manufacture to the most conservative branch of economic activity, agriculture. Ever since the introduction of artificial manures and the creation of experimental stations, like that at Rothamsted, a stream of statistical calculations has been poured forth as to the effect of the application of varying doses of particular fertilisers and feeding stuffs on crops and cattle. On the chemico-biological side there has been abundant material for illustrating and confirming the principle implied by the law of decreasing returns. But until recently there have been far less adequate means of measuring the facts on the economic side, and of ascertaining exactly the ultimate return to the farmer under varying conditions of cost and sale.

Among the pioneers in agricultural book-keeping and in the effort to obtain results of general significance by the statistical grouping of the book-keeping results were the peasant farmers of Denmark. In Great Britain and America, in recent years, Institutes of Agricultural Economics, such as those attached in the one country to the universities of Oxford and Leeds, and in the other country to Northwestern University, have begun to deal seriously with the difficult problems of valuation and distribution of expenses and to stimulate the farming community to co-operate with them and to imitate. Here, as in some other of the directions in which more exact measurement is being aimed at, the general theory worked out by an earlier generation proves its usefulness in the preliminary analysis of the situation; it is sufficient to refer to the proposition that "rent does not enter into the cost of production." Moreover, there is an element of truth in the assertion that the new methods of measurement are, after all, simply ways of estimating the strength of the tendencies or, putting it the other way, the strength of the friction which economic theory has long been in the habit of affirming. But while this is so, it is also true that abstract reasoning tends to fall from a primary and antecedent position, where it asserted conclusions and then looked round for confirmatory examples, to a secondary and subsequent position in economic enquiry; *i.e.*, to be resorted to only after history and statistics have ascertained what are the facts to be explained (*see* FARM ORGANISATION).

Conclusions.—The number of persons professionally engaged in economic teaching or investigation in academic institutions had been growing in England and America before the War; it has been greatly enlarged since. The output of statistics by government offices is steadily growing, and the scientific standard, notably with respect to labour statistics, has been rising. Economists and statisticians are being engaged by the great banks and business concerns, especially in America and Germany. The accounting profession is gaining in professional status. Works management is being differentiated from engineering, and is calling for ampler and exacter records. It may be anticipated, therefore, that for some time to come the quantitative measurement of economic phenomena will secure increasing attention. The present accidental distinction between accounting and statistics will probably largely pass away in the higher work of measurement; for accounting is but the necessary means for arriving at the data which statistical science has to handle. And, with the present trend toward business consolidation, and the transference of particular branches of business to state (central or local) management or control, the need for measurement will make itself felt with growing force.

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(WM. A.)

ECUADOR (*see* 8.910), a republic of South America. Its area is 250,000 square miles. No systematic census has been taken, but the population in 1925 was estimated at 2,000,000. The capital, Quito, had 80,000 inhabitants, and the chief port, Guayaquil, 100,000; towns next in importance were Cuenca with 40,000 inhabitants, Azogues with 35,000 and Ambato with 25,000.

I. POLITICAL HISTORY

The Government candidate for the presidency, Dr. Emilio Estrada, was elected by a large majority in 1910 over Señor Alfredo Baquerizo Moreno to succeed Gen. Eloy Alfaro, whose term of office expired on Aug. 31 1911. On Dec. 21 1911 Estrada died, an event which was followed in a few days by Gen. Pedro Montero proclaiming himself supreme chief of the republic. The Government organised an army to remove him from this position, and early in Jan. 1912 the constitutional forces met the revolutionaries at Huigra, and later at Yaguachi when Montero's supporters were finally defeated. A formal convention was signed on Jan. 20 by Gen. Plaza for the Government, and by

Montero; but on the same day the people of Guayaquil rose and disarmed the revolutionaries, many of whom, including Montero, were arrested. Soon afterwards Montero was assassinated.

Meanwhile Dr. Carlos Freile, President of the Senate, had assumed the executive authority, and arrangements were made for the holding of presidential elections in the last four days of March. When the elections were held the Conservative party abstained from voting and the Liberal candidate, Gen. Leonidas Plaza, received a majority; but Dr. Francisco Andrade Marín, President of the Deputies, had already assumed office on March 6, which he held until Aug 10, to be succeeded temporarily by Dr. Alfredo Baquerizo Moreno. Gen. Plaza, the constitutionally elected candidate, took office on Aug. 31 for the four years ending Aug. 31 1916. The stamping out of yellow fever and bubonic plague was attempted early in Plaza's presidency, and the efforts met with success; in later years these two maladies were practically non-existent as a result of the policy then decided upon.

The War Period.—In his message to Congress in 1914 the President raised the question of constitutional reform, and again in 1915, when he proposed the introduction of the parliamentary system by amending the fundamental law of the republic; on both occasions his proposals were rejected. Meanwhile, after the outbreak of the World War, the Government announced by decree that it would observe strict neutrality, would abide by the Hague Convention of 1907, and by the general principles of international law. As a result of the presidential elections held in Jan. 1916 Alfredo Baquerizo Moreno, the Liberal candidate, was elected and assumed office on Aug. 31, at a period when the economic strain caused by the World War overshadowed political events.

After the severance of diplomatic relations with Germany by Peru, the German ex-minister at Lima wished in Oct. 1917 to proceed to Ecuador, to which country he was also accredited; he was informed by the Ecuadorian Minister at Lima that his reception by Ecuador would be incompatible with American solidarity. On Dec. 8 following, Ecuador severed relations with Germany. The whole of Moreno's term of office was largely occupied with the economic problem and the less important fiscal problems that had long awaited a solution. Notwithstanding all his efforts to that end—relieved by the introduction in 1917 of laws regulating cabinet procedure and duties, and a decree in 1919 to transfer the administration of the province of Oriente and the Galapagos Is. to the Foreign Ministry—the situation did not improve.

Post-War Problems.—Dr. José L. Tamayo was inaugurated as President on Aug. 31 1920, for the term ending Sept. 1924. In his opening address to Congress he outlined the grave economic and financial problems facing the country, caused in the first instance by the World War and then by the delays in the sale of cocoa; and also because foreign capital was not coming in as formerly. During his administration laws and decrees were promulgated to regulate the exploitation of petroleum lands, to reserve for the country 6% of the total output of oil wells, to raise funds for aviation and for military education in higher schools, academies and universities. The year 1922 was uneventful but for the continued economic difficulties and for the centenary celebrations in May of the battle of Pichincha (*see* 8.919).

In 1923 a contract was signed by the President with a London syndicate for a loan of $18,000,000 gold, to be guaranteed by customs receipts: the proceeds were to be used for the liquidation of debts to Ecuadorian banks, the purchase of shares in the Guayaquil and Quito Railway and the payment of interest on the bonds of this line and public works. In the same year three severe earthquakes caused serious damage, the first in Machachi, the second in Quito, the third and most severe on Dec. 15 at Tulcán in the province of Carchi.

Señor Gonzalo S. Córdova, an experienced diplomat and presidential candidate of the Liberal Association, received in 1923 an overwhelming majority over Senator Intriago and Colonel Lasso for the term 1924–8. Two revolutionary movements followed this election; the first in Jan. 1924, organised by Lasso, the defeated Democratic candidate, and the second in Sept. 1924, organised by Señor Jacinto Jijón Caamaño in the centre and north of the country, shortly after the inauguration of the new President. Both movements failed, but during the remainder of the year much unrest prevailed in the capital and provinces.

Negotiations between Ecuador and Peru for an adjustment of their boundary dispute came to an end with the signature at Quito on June 21 1924 of a protocol agreeing to a "formula mixta" for a settlement; this dispute had existed to disturb the peace of both countries since 1830. Criticism was levied against the clause in the protocol which makes arbitration by the President of the United States dependent upon a prior settlement of the Tacna-Arica question; but notwithstanding this it was generally agreed that a step in the right direction had been taken. In Oct. the Government relinquished the control which, resulting from conditions caused by the World War, it had exercised over international exchange.

The political unrest which was manifested in 1924 again showed itself in 1925 when on July 9 a revolutionary movement unaccompanied by violence removed the President from office and caused him, with ex-President Plaza, to leave the republic. A military *junta* led by Gen. Gómez de la Torre took over the executive power and formed a Government with Señor Modesto Larrea Jojón as head of the Cabinet and Gen. de la Torre as Minister of War. With this *de facto* Government the United States maintained relations, but refused to recognise the new régime as a Government *de jure*. (*See* TACNA-ARICA.)

Defence.—Military service is compulsory between the ages of 18 and 50, but it is not enforced. In time of peace, the army, navy, air force and lighthouses are in the charge of the Ministry of War. In May 1922 a military mission from Italy arrived in Ecuador to reorganise the national army. In 1925 the standing army consisted of 558 officers, 1,300 non-commissioned officers and 3,108 men.

Education.—Primary education is compulsory and free. The control of public education is in the hands of a superior council over which the Minister of Public Instruction presides. In 1924 there were in Ecuador 1,488 primary schools, with an enrolment of 112,219 pupils. In 19 *colégios*, or academies, there were 2,218 students; in three normal institutes there were in attendance 431 students. At the Central University of Quito 638 students were enrolled. In addition to these educational institutions, there were agricultural, industrial and commercial schools and schools of arts and trades.

II. ECONOMIC HISTORY

Finance.—In Ecuador's budget for 1924 the receipts amounted to 30,473,236 sucres, while the expenditures aggregated 36,531,625 sucres, leaving a deficit of 6,058,389 sucres. The main items in the national revenues for 1924 were as follows, in sucres: import duties, 8,738,382; export duties, 2,824,214; internal revenue, 9,497,486; decentralised revenues for railways and public instruction, 5,831,094; and revenue derived from laws not considered in the budget, 3,217,609. The expenditures were distributed thus, in sucres: legislative and executive departments, 451,402; interior, 4,051,067; foreign relations, 1,350,899; public instruction, 5,299,331; war and navy, 6,709,679; treasury, 3,037,554; and public debt service, 9,174,951. The budget for 1925, promulgated on Oct. 16 1924, was estimated at 35,833,080 sucres. As Congress was not summoned during 1925, no budget for 1926 was promulgated.

Production and Industry.—The principal product of Ecuador is cocoa. The production in 1924, which was approximately 62,345,600 lb. showed a decrease over previous years, occasioned by the "witch broom" disease. The crop of cocoa for the first six months of 1925 at approximately 49,688,200 lb. showed an increase over that of the same period in 1924, which was 43,583,000 pounds. During 1924 67,470,900 lb. of cocoa were exported from the port of Guayaquil, of which 26,257,000 lb. were taken by the United States and 3,045,000 by the United Kingdom. Coffee is also produced, the production for 1924 being valued at 9,316,880 sucres. Ecuador produces about 80% of the total world production of *tagua* (ivory nuts), the crop for 1924 ranking after that in coffee in value at 8,544,460 sucres. Rubber plantations with more than a million trees showed a

decline in production in 1924. Cotton production has increased, the crop for 1924 being valued at 2,374,680 sucres as against 2,292,919 sucres for 1923.

Under a decree of Congress 1921 oil deposits are declared state property. Operations of importance are carried out in the Santa Elena oil-fields. The estimated annual production of petroleum in the republic is 40,000 barrels. The principal manufacture of Ecuador is Panama hats, of which the estimated monthly production is 700 dozen. Exports of hats in 1923 were valued at 2,797,526 sucres, and in 1924 at 2,241,380 sucres. Eight textile factories were working in 1924, one of which produces cotton prints, an industry that has made rapid progress and has produced cotton and woollen cloths for export.

Foreign Commerce.—The total foreign trade of Ecuador in 1923 amounted to 85,159,563 sucres (1 sucre = $0.487). The imports amounted to 39,460,778 sucres, while the exports aggregated 45,698,785 sucres. The countries taking the largest amounts of exports were, in order: the United States, France, Great Britain, Germany, Spain and Chile; while the countries furnishing the largest amounts of the imports were the United States, Great Britain, Germany, France, Belgium, Peru and Spain. In 1923 the chief exports were cacao, ivory nuts, coffee, hides, rubber and cotton.

Communications.—During the post-War period steps were taken by the Government for the improvement of roads, most of which were merely trails or bridlepaths. Some internal traffic is carried on the rivers, especially on the Guayas river and the tributaries of the Amazon. In 1924 the railways of Ecuador aggregated about 420 miles. Besides extensions of the most important line in Ecuador, the Guayaquil and Quito railroad, a number of other short lines were under construction in 1925. The most important of these was the line from Esmeraldas to Quito, which, when completed, will furnish the shortest line from the seacoast to the capital. Contracts had been approved for a line from Manta to Santa Ana, passing through Montecresti and Portoviejo; for a line from Quito to Ibarra; from Huigra to Cuenca; for an electric line from Babahoyo to Balzapampa; a line from Ambato, on the Guayaquil and Quito railroad, to the Rio Arajuno in the east. In 1914 a radio station was officially opened at Quito, and wireless communication was established with a small station in Guayaquil.

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ECZEMA: *see* SKIN DISEASES.

EDDINGTON, ARTHUR STANLEY (1882–), British astronomer, was born at Kendal, England, Dec. 28 1882. He was educated at Owen's College, Manchester, and Trinity College, Cambridge, where he was Senior Wrangler in 1904 and Smith's Prizeman in 1907. In the latter year he was elected Fellow of his college. From 1906 to 1913 he held the post of chief assistant at the Royal Observatory at Greenwich; and in 1913 he became Plumian Professor of Astronomy at Cambridge. In 1914 he was made director of the observatory at Cambridge, and in the same year was elected Fellow of the Royal Society. His principal researches, in recognition of which he was made a member of many British and foreign scientific societies, were on the motions of the stars, stellar evolution, relativity and gravitation. He was president of the Royal Astronomical Society from 1921 to 1923. His published works include *Stellar Movement and the Structure of the Universe* (1914), *Report on the Relativity of Gravitation* (1918), *Space, Time, and Gravitation* (1920), *The Mathematical Theory of Relativity* (1923). (*See* ASTRONOMY.)

EDDY, MARY BAKER (1821–1910), the discoverer, founder and leader of Christian Science, was born July 16 1821, at Bow, near Concord, New Hampshire, U.S.A. She was the youngest of the six children of Mark Baker and Abigail Ambrose Baker. Her father was a man of local prominence, first at Bow and later at Tilton, New Hampshire; a farmer, a Justice of the Peace, a member of the committee having charge of the public schools and a deacon of the Congregational Church. Her mother was the daughter of Deacon Nathanial Ambrose, of Pembroke, New Hampshire, who also represented the same type of citizenship. All of Mrs. Eddy's American ancestors were New England people of sturdy character and of English and Scotch descent.

Considering that educational facilities for women were limited when Mrs. Eddy was young, the education she obtained was exceptionally liberal. She graduated from the Academy at Tilton, besides which she had extensive training from two excellent tutors, her brother, Albert Baker, and her pastor at Tilton.

When Mary Baker was 22 years old (Dec. 1843) she married George W. Glover, a native of Concord, New Hampshire, who had established himself in business as a contractor and builder at Charleston, South Carolina. Six months later he died, a victim of yellow fever, at Wilmington, N.C., whither they had gone temporarily, pursuant to his business. Her only child (also named George W. Glover) was born in the following Sept. after she had returned to her father's home in Tilton. Thereafter, for nine years, Mrs. Glover lived at Tilton with her father or with her sister, Mrs. Abigail Tilton, and occupied herself to the extent allowed by delicate health in caring for her child and in teaching. For a time she conducted a private school for young children; at other times she was a substitute teacher in the New Hampshire Conference Seminary.

After Mrs. Glover had been a widow for nine years (in 1853) she married Dr. Daniel Patterson, a dentist, of Franklin, New Hampshire. She was reluctant to marry him, but consented largely because she wanted a home of her own in which her child would be welcome. When she had gone to live with her sister, the child had been put in the care of a nurse who had worked for the Baker family. Dr. Patterson, however, disappointed her expectation, for he was not willing that the boy should be in their home permanently. He even participated in a plot by which the boy was taken to a frontier state, so that she did not see him again for many years. Her marriage to Dr. Patterson proved to be extremely unfortunate. After a decade or more of alternate care and neglect, he finally deserted her at Lynn, Mass., whither they had removed from New Hampshire. Long afterward (in 1873) she obtained a divorce from him for desertion resulting from adultery. In 1877 Mrs. Glover (Mrs. Patterson having resumed this name) married Asa Gilbert Eddy, of Lynn, Mass., an ardent Christian Scientist and the first of her followers to engage in the public practice of Christian Science. This union was most happy, but he passed away at Lynn in 1882, at a time when she felt that his encouragement and support were of inestimable value to the great religious work in which she was then engaged.

Mrs. Eddy's religious history began by contact with her mother, Mrs. Baker being devout and spiritually minded as well as distinguished for her culture and intellectual power. Mrs. Eddy herself had the courage and independence to dispute a point in theology when she applied, at the age of 12, for membership in the Congregational Church at Bow. Afterward she became a member of the Congregational Church at Tilton, and continued her affiliation with this denomination until she became the founder of another. As a girl and young woman, she devoted more thought to religious subjects than was usual, even among the devout people of her class in the New England of her time. She was also driven by persistent ill health to ponder the cases of healing of disease related in the Bible.

In 1862, at the instance of her husband, Dr. Patterson, Mrs. Eddy went for treatment to Phineas P. Quimby, of Portland, Me., a magnetic healer. He was not religious; in fact, he was fond of arguing against religion to any and all who would listen. Nevertheless, Mrs. Eddy was disposed, by her previous course of thinking, to attribute to spiritual power the apparent benefits which resulted to many of his patients, including herself, from what she afterward recognised as a form of personal magnetism or mesmerism. The relief thus obtained by Mrs. Eddy did not last, but she continued until her discovery of Christian Science to regard him as a gifted man, whose practice could be explained in religious terms.

Mrs. Eddy regarded her discovery of Christian Science (*q.v.*) as a religious and scientific experience—an unfoldment of spiritual

ideas—which continued and developed through many years. (See pages 24–9 of her autobiography entitled *Retrospection and Introspection.*) In particular she identified her discovery with her almost instantaneous recovery from a severe accident, a fall on an icy street at Lynn in Feb. 1866. As was related in the Lynn *Reporter* at the time, she was picked up in an insensible condition and carried to a nearby residence, where she was cared for during the night. A physician "found her injuries to be internal and of a severe nature." The next day she was removed to her home "although in a very critical condition." Mrs. Eddy has related the sequel as follows: "On the third day thereafter I called for my Bible, and opened it at Matthew ix. 2. As I read, the healing Truth dawned upon my sense; and the result was that I rose, dressed myself, and ever after was in better health than I had before enjoyed. That short experience included a glimpse of the great fact that I have since tried to make plain to others, namely, Life in and of Spirit; this Life being the sole reality of existence." (*Miscellaneous Writings*, p. 24.)

Speaking of her ensuing experience, Mrs. Eddy has said, "I knew the Principle of all harmonious Mind-action to be God, and that cures were produced in primitive Christian healing by holy, uplifting faith; but I must know the Science of this healing, and I won my way to absolute conclusions through divine revelation, reason and demonstration. The revelation of Truth in the understanding came to me gradually and apparently through divine power." (*Science and Health with Key to the Scriptures*, p. 109.)

From her girlhood, Mrs Eddy had been an accomplished writer of both poetry and prose. She had contributed extensively to newspapers and periodicals and had acquired a considerable reputation as an author. Thus, she had been offered a position, with a salary large for that time, as assistant editor of a magazine. As soon as Mrs. Eddy felt that she comprehended what she regarded as the restoration of primitive Christianity with its healing power, her ability as an author became particularly useful for the purpose to which she thenceforth devoted her life. She wrote and herself published (at Boston in 1875) the first edition of the Christian Science text-book, then called *Science and Health* but later entitled *Science and Health with Key to the Scriptures*. Beginning slowly, the demand for this book increased steadily, and still continues to increase. Aided at first only by a copyist and a printer, Mrs. Eddy was aided for subsequent revisions by critics (both friendly and hostile) and especially by the development of her own thought, but, as she has said, in the final edition, "I have revised *Science and Health* only to give a clearer and fuller expression of its original meaning." Other published works by Mrs. Eddy include *The People's Idea of God* (1886), *Christian Healing* (1886), *Unity of Good* (1891), *Rudimental Divine Science* (1891), *No and Yes* (1891), *Church Manual* (1895–1910), *Miscellaneous Writings* (1896), *Christ and Christmas* (1897), *Christian Science versus Pantheism* (1898), *Pulpit and Press* (1898), *Messages to the Mother Church* (1900; 1901; 1902), *The First Church of Christ, Scientist and Miscellany* (1913).

Naturally, Mrs. Eddy was the first Christian Science practitioner. Numerous and wonderful cases of healing resulted from her practice, until work which could not be left to others required all of her time. Likewise she taught Christian Science to pupils in classes, thus teaching about 4,000, until she was obliged to leave this work to those of her followers whom she authorised as teachers. In 1883 Mrs. Eddy founded *The Christian Science Journal*, a monthly periodical, which she edited for 11 years and again later for nearly a year. In 1898 she founded *The Christian Science Sentinel*, a weekly, and in 1908 she established *The Christian Science Monitor*, an international daily newspaper. Even after she left the office of editor, she continued to write for these publications, and maintained a close supervision of their contents. This she relaxed, as editors acquired qualifications, but did not discontinue until she passed away.

Mrs. Eddy began to organise the Christian Science movement by forming the Christian Science Assn. at Boston in 1876. At first it consisted of herself and six of her students. Three years later, also in Boston, she and a selected number of her students organised the Church of Christ, Scientist, into which the earlier association was merged. Again, in 1892, she and a selected number of her students organised the First Church of Christ, Scientist, in Boston, Mass., which succeeded the earlier church and is the present institution. In one aspect, it is a local congregation of Christian Scientists; in another aspect, it is The Mother Church of the Christian Science denomination. From 1881 to 1895 Mrs. Eddy was the pastor of her church. Then she introduced reading from the Bible and from the Christian Science text-book instead of personal preaching in the services of her denomination.

Next to what she did as the discoverer and founder of Christian Science, Mrs. Eddy's greatest work was as the leader of the Christian Science movement. Though living in a rather secluded manner (at Lynn until 1882; in Boston from then till 1889; at Pleasant View, near Concord, N.H., from then until 1908; and afterward at Chestnut Hill, a suburb of Boston), she initiated every important step by which her religion attained the position it held when she passed away on Dec. 3 1910; thus she laid the foundation for its later development and future progress. As has been remarked by intelligent observers, Mrs. Eddy's faith in God, her dependence on prayer, her obedience to Christ, her patience in adversity or opposition, and her combination of practical and spiritual wisdom were exceptional in the most extraordinary degree. Beyond cavil or question, her life was an illustration and a demonstration of her proposition that "prayer, watching and working, combined with self-immolation, are God's gracious means for accomplishing whatever has been successfully done for the Christianisation and health of mankind." (*Science and Health*, p. 1.) See *The Life of Mary Baker Eddy*, by Sibyl Wilbur, Boston (Christian Science Publishing Society, 1923). (C.P.S.)

EDINBURGH (*see* 8.937).—By the passage of the Edinburgh Boundaries Extension Act of 1920 Edinburgh became, as regards area, the second largest city in Great Britain. This was through an amalgamation with Leith, and the absorption of the suburban districts of Liberton, Colinton, Corstorphine and Cramond. The municipal area was increased from 10,597 to 32,402 ac., and the population in 1921 was 420,264. The number of municipal wards was increased from 16 to 23, and the number of members of the city council from 50 to 71, made up of three representatives of each ward in addition to the two *ex-officio* members, the dean of guild and the convener of the trades. The four Leith wards form the parliamentary division of Leith, and the four suburban wards are in the northern division of Midlothian and Peebles.

In 1917 the corporation agreed to purchase the plant of the Edinburgh Tramway Co. for £50,000, and the transfer took place in July 1919, at the expiry of the company's lease. The work of replacing the system of cable cars was begun in 1910. A tramway extension to South Queensferry and Port Edgar was sanctioned by the council in 1917. The most important addition to the public parks was the establishment, by the Zoological Society of Scotland, in conjunction with the town council, of a zoological park at Corstorphine Hill, opened in July 1913. The site, which extends to 74 ac., was purchased by the town council and leased to the Society. Large corporation markets and slaughter houses were opened in 1910, and in March 1914 the Usher Hall, bequeathed to the city in 1898 by Mr. Andrew Usher, was completed and opened.

Additions to the public memorials in the city include the Black Watch Memorial (1910); a statue of Dr. Guthrie (1910); a life-size statue of Thomas Carlyle, presented to the National Gallery by Lord Rosebery in 1916; the Gladstone Memorial (1917); and the Edward VII. Memorial in front of Holyrood Palace. In 1913 Lord Rosebery presented to the city the historic house in the Lawnmarket, known as Lady Stair's House; and in 1920 the birthplace of Robert Louis Stevenson, 8, Howard Place, was purchased as a memorial by the R. L. Stevenson Club. In 1911 the King and Queen dedicated the new chapel of the Order

of the Thistle, in St. Giles' Cathedral. The new Freemasons' Hall was opened in the same year. The western spires of St. Mary's Cathedral, carrying out the original plan of Sir Gilbert Scott, were completed and dedicated in 1915 and 1917. The National Museum of Antiquities, which was used by the timber control during the World War, and the national portrait gallery have been reconstructed. A Scottish War Memorial will be erected at the castle. In 1924 a new wing of the university buildings was opened. A scheme for a new dock at Leith, to the north of the Edinburgh dock was prepared at the end of 1924, and a quay, 1,000 ft. long, was built in the outer harbour. Since the residence of the King and Queen at Holyrood in 1923 many decorative and domestic improvements have been made there.

During the World War the proximity of Edinburgh to Queensferry and Port Edgar and the great battle cruiser and destroyer base in the Firth of Forth gave it strategic importance in the naval operations, and its position as the headquarters of the Scottish command made it a centre of military organisation. Preparations for defence against an invasion by sea were made in its vicinity as in other coastal districts, but no serious anti-aircraft protection was given until after a Zeppelin raid, on April 2 1916, in which 10 people were killed and 11 seriously injured, and damage was done to warehouses, private houses and public buildings. (O. J. R. H.)

EDINBURGH, UNIVERSITY OF (*see* 8.941).—New chairs have been established since 1910 in bacteriology, clinical medicine, tuberculosis, French, chemistry in relation to medicine, German, therapeutics, psychiatry, forestry, zoology (second chair), accounting and business method, natural philosophy (second chair), mining and organisation of industry and commerce.

Lectureships have been founded in Italian, Spanish, Arabic, actuarial science, Indian and colonial history, technical chemistry, English law, physiology of the nervous system, genetics, venereal diseases, radiology, neuropathology, psychiatry. Diplomas have been instituted in social study, psychiatry, forestry, technical chemistry, public health, actuarial mathematics, geography. New degrees are granted in veterinary science, education, commerce, philosophy (doctor), mining and technical chemistry.

Women were admitted to classes in the faculty of medicine in 1916; before this date they attended special extramural classes which were recognised by the university. In 1922 an Act was passed—Universities (Scotland) Act 1922—granting powers to the universities to make ordinances: (1) to fix an age limit for principals and professors; (2) to institute a system of pensions or superannuation allowances for principals and professors, and (3) providing for the admission of lecturers or readers as members of the Senatus Academicus. The University of Edinburgh has exercised the powers granted under the Act. The age limit in the case of principals has been fixed at 75 and in the case of professors at 70.

In 1919 the university acquired 115 acres of land at Liberton, a suburb to the south of the city, and in July 1920 the King laid the foundation stone of new chemical laboratories. In Dec. 1924 this building was formally opened by the Prince of Wales, who thereafter received the honorary degree of doctor of laws. It is intended to erect additional buildings on the site for the use of other science departments. An ordinance of the University Court, No. 33, was passed enabling the university to appoint readers, a certain proportion of whom may be appointed to membership of the faculties.

In 1916 three hostels were built for the accommodation of women students attending the university or the provincial college for the training of teachers. A closer relationship has been established between the university and the Edinburgh provincial college for the training of teachers by a single appointment to the offices of the professorship of education in the university and the director of studies of the training college. Since 1913 the university has granted the use of rooms to the Workers' Educational Association for evening classes. The list of subjects taught has included, among others, English literature, economics, history, psychology, science and music, and the majority of the teachers are drawn from the university staff. The number of matriculated students was as follows:—

1910–4 (average)	3,420
1915–9 (average)	2,400
1920–4 (average)	4,533
1925	3,964

In 1924–5 the number of women students was 1,228.

EDISON, THOMAS ALVA (1847–), American inventor (*see* 8.946), after 1910 perfected a battery of large storage capacity for propelling vehicles. This proved of great service, for example, in moving baggage trucks at railway stations. He hoped to produce, with Henry Ford, an automobile so propelled. He was specially interested in the cinema, and early in 1913 displayed the first talking pictures, produced by synchronising the motion picture and the phonograph. Although as yet unperfected, the inventor believed that such pictures were destined largely to replace text-books in the schools. When in 1915, it appeared probable that the United States might be drawn into the World War, Secretary Daniels formed, Oct. 7, the United States Naval Consulting Board, of which Edison was made chairman. In Jan. 1917, placing his business affairs in charge of his officers, Edison devoted himself exclusively to naval problems. Among the previous matters with which he successfully dealt were the detection of submarines by sound from moving vessels, the quick turning of ships by means of sea-anchors, and the devising of a type of projectile which would enter water direct without ricochet. He also designed and took charge of plants for the manufacture of chemicals used in warfare which had previously been produced exclusively in Germany. In 1916 he announced a portable searchlight fed by a storage battery and more powerful than the acetylene lamp.

EDMONTON, Canada (*see* 8.946), the capital of the province of Alberta, had a population in 1921 of 58,821. Edmonton is one of the chief western points on the Canadian National Railways, and is the terminus of the Calgary and Edmonton branch of the Canadian Pacific Railway. The Parliament Building of the province of Alberta stands high above the north bank of the Saskatchewan river. Edmonton is the chief educational centre of the province, and here in addition to the University of Alberta, with beautiful buildings on the south side of the river, are Alberta and Robertson colleges, Westminster Ladies' College and a Presbyterian college. Edmonton has extensive live-stock, dairy, milling and packing industries, and many manufacturing establishments; it is the centre of a prosperous farming district, and the growing regions of the Peace and Mackenzie rivers bring it further importance as a distributing point. There are 30 coal-mines in and about the city; and gold, silver and oil are also found in the neighbourhood.

EDMUNDS, GEORGE FRANKLIN (1828–1919), American lawyer and political leader (*see* 8.949), died in Pasadena, Cal., Feb. 27 1919.

EDUCATION (*see* 8.951).—The recognised importance of education in the modern world justifies, indeed demands, an article dealing with it from various points of view. The following contribution, therefore, is divided into several sections, each from the pen of a recognised authority. These main sections are: I. General Introduction. II. Education in Western Europe. III. Education in the United States. IV. Educational Experiments. V. The Architecture of School Buildings. Section II. is followed by a carefully written bibliography of the literature of education, also from the pen of an expert.

I. GENERAL INTRODUCTION

Each year it is becoming more and more difficult to frame a satisfactory definition of education. The reason for this is twofold. The subject is, in the first place, an always developing one. If we speak of it in the way people did a generation ago, as the training of the mind of youth, we are brought up by the fact that the duty of educating is recognised to-day as extending to the minds of those who have passed beyond adolescence. Not only in the university, but in that growing system under which training of a university type is being extended extramurally to the working classes in industrial and other centres,

we find education extending its scope to the adult. Even when the university has provided all the higher training it can for the student, it has only prepared him to develop his faculties by his own initiative in another fashion. He can, when fully trained, study books which were formerly sealed to him, and the library takes him further in that process of self-development for which the professor has prepared him. Education to-day therefore knows no limit but the grave.

Education and Biology.—But this is only one aspect of the larger significance which the word is receiving. There is a second illustration. In recent years biological science has made it impossible to draw any sharp line of demarcation between the individual as merely alive, with initiative and energy as such, and the individual as also intelligent. Life and mind unite in the formation of habitual activities which enable the individual to get rid of hindrances to freedom caused by his environment. Inherited qualities of life and its predispositions have to be taken into account if the development of mind is to be rendered intelligible and then guided. This is especially the case with young children who have not reached the stage of generalising their experience in any definite fashion.

The result is that biology and psychology are entering increasingly into the study of education, especially in its early stages, and are affecting its practice. The field of the teacher is thereby being extended, particularly as regards the study and fashioning of the lives of children. Education is therefore getting an extended significance at this end also, and the study of psychology, which enters into it throughout its field, is now playing an increasing part in it. But the part which it plays is not the main feature in education. It must never be forgotten that its chief concern is with the development of personality, and that this depends on intelligence and on a moral and religious training for which the limited growth of the mind of the young child affords no more than a preliminary preparation.

Continuity of Education.—Another modern principle which is adding to-day to the complication of the meaning of education is that it is being more fully recognised that the system must be treated as a whole, of which the earlier stages are indeed preparatory, but lead into those that come later. The individual continues identical through the growth of his personality. But in childhood he can take in only what is appropriate to the infantile stage and falls within his capacity at that stage, as in the nursery school. Later on, there comes to the child grown older what is stimulated further by something that we call primary education. This process prepares for secondary training, but there is no sharp line of demarcation between these later stages. The subjects of the earlier conduct to the subjects of those that come later, but the system is an entirety and has to be recognised as such. What any division implies is, in reality, that brain and personality can only absorb gradually, and by stages, but that what is absorbed belongs to a system which is not itself divisible into separate parts, but expands as its meaning and effect, by degrees, enter into and are absorbed by a developing mind. The subjects of instruction appropriate to the differing stages thus involve each other. Bearing these things in mind, the first object must be to give some view of what the educational system stands for to-day.

An examination of the records of 1925 shows that there has been a marked change in the directions just indicated. It will be convenient to take an actual instance, and the most obvious instance to select as supplying material for judgment is that of England. Scotland also affords evidence of a striking development of new tendencies in some respects of a different kind. Some reference must also be made to Germany, France and Italy, for in these countries the same sort of impelling force, arising from the effects of the War, is illustrated.

II. EDUCATION IN WESTERN EUROPE

Developments in Great Britain

The system of national education in England has advanced its scope since 1911 (*see* 8.971). Then the system was that established under the Education Act of 1902, which abolished parochial school boards and made the county councils the local authorities for all forms of education short of the university type. Secondary and primary education were no longer technically separated, so far as concerned powers to administer them, and a definite step had been taken towards unifying the national educational system. The voluntary public elementary schools, mostly Church schools, were brought, by the Act of 1902, under the local education authorities, and were assisted, so far as secular instruction was concerned, by contributions from rates, which were added to the public grants they already enjoyed. These schools were continued with most of the control, except as regards secular teaching, exercised before by managers established by the founders.

The new local authorities were given power to provide other schools, for technical and secondary education, and to levy rates for this purpose. But even under these powers, while elementary education went on developing, secondary education increased but slowly. The access to it from the elementary schools was hampered by the small provision of secondary school buildings. The task of providing these by the local authorities had begun, but progress was very slow. Even to-day the greater number of pupils passing from public elementary into secondary schools unfortunately leave the latter when still under 16 years of age. For all excepting a very small proportion of school children secondary education ends in practice two years before it should. There are over 5,000,000 children in the public elementary schools of England, and the number leaving these schools is probably about 600,000 in each year. But the provision for their further education is still wholly inadequate. England is in this respect behind Scotland, where the tradition has been different, in a very material degree.

Religious Controversy.—The religious controversy over the schools in England must not be passed over. The Act of 1902 had to be made a compromise on this question if the House of Lords were to pass it. Accordingly, that Act provided for the maintenance of the schools not provided by the local education authorities, *i.e.*, the voluntary schools, mostly of Church foundation. These were to be maintained by the authorities out of the rates. They were each to have, under the Act of 1902, six managers, of whom four were to be denominational foundation managers, and two were to be appointed by local authorities. The foundation managers were to be such that they would have regard to the ownership of the school building, and to the principles on which education had been given in the schools as managed in the past. These schools were to be maintained and kept efficient under the direction of the local education authorities, and, as regards secular instruction, their directions were to be carried out as regards the number and educational qualifications of the teachers, but the consent of these authorities to the action of the managers was not to be withheld except on educational grounds, and such consent was required for the dismissal of a teacher, unless the dismissal was on grounds connected with the giving of religious instruction. The managers were required to provide the school free of charge. The relation of the local educational authorities to these managers was defined in a judgment given by the House of Lords in 1912 (Gillow v. County Council of Durham, 1913, Appeal Cases 54).

The tendency has, not unnaturally, been for these non-provided, or voluntary, schools to diminish in number. One reason has been that in the areas, mostly rural, where there was only a single school, this school was denominational. But there has been at least as great a diminution in the urban areas. In 1903 there were 5,975 provided schools as against 14,238 non-provided. In 1924 there were 8,967 provided schools as against 11,776 non-provided. The difference in accommodation is still more striking: in 1903, there were places for 3,065,169 scholars in provided, as against 3,722,317 in non-provided; in 1924, there were places for 4,428,096 scholars in provided, as against 2,661,618 in non-provided schools.

Education in Scotland.—In Scotland the Scottish Education Act of 1918 made a clean sweep on this subject; all the schools, provided and non-provided, were brought under the control of

the new education authorities as regards the rate aid and substantially as regards state aid and the authority had to be satisfied as to the qualifications of the teachers before the denominational authorities were allowed to appoint them. The novel spectacle was seen of nuns studying in the universities in order to secure the necessary qualifications for the higher appointments in schools controlled by the state.

Education Acts, 1918 and 1921.—The Education Act of 1918, which was carried through by Mr. H. A. L. Fisher, and which is now re-enacted, along with most of the earlier Acts, in consolidated form by the Education Act of 1921, made a determined attempt to improve the state of things in England and Wales. This new Act did not attempt to re-open the controversy over the Church schools. But it aimed at the establishment of "a national system of public education available for all persons capable of profiting thereby," and the local authorities were called on to prepare schemes setting out the provision which they had made and proposed to make to this end. The Act effects important changes in respect of elementary education (*see* ELEMENTARY EDUCATION) including the power to establish nursery schools for children between two and five years of age. It raises the compulsory school age for education from 12 to 14 with power to the local authority by by-law to extend that age to 15. It abolishes part-time attendance; it makes provision for central schools for the older and more intelligent children in the elementary schools, and it lays emphasis on physical training and the social side of education. The local authorities are to co-operate in providing for the preparation of children for further education in schools other than elementary, and for their transference at suitable ages to schools which give such further education. The Act also deals with the supply and training of teachers, and extends the duties and powers of the local authorities with reference to medical inspection and treatment to secondary and continuation schools. It removes the limit imposed on rating powers for education other than elementary.

Continuation Schools.—But perhaps the most novel feature of the statute was that which instituted a compulsory system of part-time continuation education after the close of the elementary school period. "Young persons" between the ages of 14 and 18 were required to attend a continuation school for 320 hours in the year, unless able to claim exemption under the Act. Unfortunately financial difficulties have prevented the nation from making this new system a general or efficient one. What has, however, emerged is not only a growth in the recognition of the necessity of secondary schools, but an increasing disposition in pupils, who are leaving the elementary schools, to attend technical and special schools, and also, when older, classes of a purely university tutorial character and those organised on an increasing scale by such bodies as the Workers' Educational Association. (*See* WORKERS' EDUCATION.)

Secondary Education.—Looking back over the history of education in England, we find that the backbone of secondary education used to be the local endowed grammar schools. These were often of great antiquity and owed their existence to the munificence of private founders, often ecclesiastical in character. It happened frequently that these grammar schools bore no relation to the needs which had sprung up amid a changed population. They might exist in remote and small towns, while the populous industrial centres were without them. Successive commissions did something to secure the due application of their revenues, but there was no general scheme of reform which was carried into effect.

Sometimes these endowed schools reached a high level of efficiency and prosperity, but at other times they merely languished on, often with inadequate resources. There were indeed higher grade schools, founded to promote the teaching of science and art, but the local authorities, school boards after the passing of the Education Act of 1870, were restrained by the state of the law from developing this side so as to make it follow on primary education. The famous Cockerton judgment gave the quietus to every such attempt. However, the Technical Instruction Act of 1889 enabled committees to be set up to develop technical instruction with the aid of certain moneys granted by Parliament out of the revenue from excise, and known as the "whisky" money. The teaching was mostly in the evening, but some of the ordinary schools were subsidised for this kind of teaching. Presently the subjects were so extended as to include English and modern languages.

These influences stimulated the desire for systematic secondary education, and this led to the recognition of the want of some method of training the teachers required for these and for the elementary schools. Pupil teacher centres had begun, with the commencement of the century, to come into existence. What was needed was a general system, with control both by the Board of Education and the local authorities. In 1904 the former body took a fresh step. It sent out regulations which defined a secondary school as one which could offer to the scholars up to and beyond the age of 16 a four years' course of general education of a wider scope and more advanced degree than that in the elementary school. English, geography, history, at least one language other than English, mathematics, science and drawing, manual work, physical exercises and, for girls, housewifery, were among the subjects included. Grants-in-aid were made, and the Education Dept. in Whitehall, although still hampered by the insufficiency of the money put at its disposal, was no longer interfered with by the independent organisation of the Science and Art Dept. which was now merged into it. Some good work was accomplished by this and subsequent efforts of the Education Dept., and a scholarship system for the benefit of children in elementary schools, who desired to proceed to secondary education, did much to render the new movement popular. (*See* SECONDARY SCHOOLS.)

The Report of a Royal Commission under the presidency of Lord Bryce appointed in 1894 had done a good deal to give definite shape to the movement. As the result of the report of that commission, the Board of Education Act of 1899 was passed. Under this Act the department of science and art had been incorporated into the department of education in a newly-organised Board of Education, with a president and a parliamentary secretary, and the powers of the Charity Commissioners in relation to educational endowments were also transferred to the new board. A consultative committee to advise the board was likewise set up, and, after the passing of the Education Act of 1902, the administrative work was divided, in accordance with the functions of the board, under the heads of elementary, secondary and technological.

University Development.—The machinery at Whitehall was now adequate to the task. Assistance was added from another source. The early part of the 20th century witnessed a great development in the provision for university education in England. London University had already, as the result of the London University Act of 1898, been developed, though very imperfectly, into a kind of teaching university, instead of being left as a university whose functions were confined to giving degrees on a mere external examination basis. Dissensions among those interested prevented the work from being completed, and it is even to-day far from completion. But the university colleges and schools in London received a great stimulus, and they have not only developed into an aggregate of powerful university colleges, but have increased in number.

The movement brought into being a desire on the part of the university colleges elsewhere than in London for the grant of full university status. As the result of an enquiry held by a special committee of the Privy Council on the application of the colleges at Liverpool and Manchester for charters, a committee, over which the late Duke of Devonshire presided, and on which Lord Rosebery and the late Lord Balfour of Burleigh sat, the request was found to be justified. There was a hearing of witnesses which lasted for several days in Dec. 1902. After deliberation the committee reported, and an order in council, of Feb. 10 1903, gave effect to the report.

The charters petitioned for were to be granted, but it was added that this step involved issues of great moment which must be kept in view, and for the solution of which due preparation

should be made, especially in regard to those points on which, having regard to the importance of the matter and the effects of any changes upon the future of higher education in the north of England, co-operation was expedient between universities of a common type and with cognate aims. The date of this order in council is too little remembered, but it is a memorable one. It gave state recognition to a fresh development in higher education. The principle laid down was that the number of the English universities might usefully be increased, and that they were to include civic universities, with their headquarters in great cities, large enough and keen enough to ensure that the requisite local resources should be forthcoming for the maintenance and development of the new universities. It was considered, and as the event proved, rightly, that the civic university would make an appeal to the citizens greater than the old type of local university college had been able to do.

The movement thus started grew. Not only Liverpool and Manchester, but Birmingham, Leeds, Sheffield and Bristol founded universities. Durham was expanded and developed so as to take in Newcastle-upon-Tyne. With the inclusion of London, no fewer than eight teaching universities were thus added in the early part of the 20th century to the list in England. To these the most recent, Reading, must be now added. Besides this, two new universities were added in Ireland. These fresh influences on higher education came into action very rapidly. Their activities found a parallel in new activities of Oxford and Cambridge and there came into operation a new force, permeating from the top the whole educational system in England. Many of the teachers in the schools almost at once sought to qualify themselves by taking the degrees, based partly on record of work in the university, which the new provision made possible. There were other opportunities for further colleges of a university type, some of which seem to be on the road to the attainment of university status.

The result has been a substantial increase in the number of teachers passing through these new institutions and so gaining a university training, and also of special training colleges available to teachers. The Board of Education now assists teachers to follow approved full-time courses of advanced study at the universities. There are now also short courses at Oxford, Cambridge and elsewhere provided for teachers in secondary schools. (*See* TEACHING.)

Board of Education.—The Board of Education is concerned with the universities only indirectly. The grants to them are made under the advice of a wholly distinct body, the university grants committee of the Treasury, a body which contains individuals of high experience in university affairs. From the report of this committee for 1923–4, it appears that, in spite of financial pressure in the classes from which the university students are mainly drawn, and in spite of the rise in fees and in personal expenses, there are now 56·9% more full-time students of both sexes at the British universities and colleges than before the War. The committee estimate that a further increase is probable. They also point out that the basis of the university curriculum is being broadened in response to new requirements. It records with satisfaction that the Chancellor of the Exchequer has agreed to place on the estimates for 1925–6 an increased grant-in-aid for the universities of £1,550,000, in substitution for the £1,242,570 which was included in the vote for 1924–5.

Adult Education.—In yet another fashion the universities have undertaken a national duty. About 1875 Oxford began to interest itself in adult education (*see* ADULT EDUCATION) of an extramural type and Cambridge appointed a syndicate for local lectures, and so took the first official step in the movement for university extension (*see* UNIVERSITY EXTENSION). But the system of isolated local lectures has had to be supplemented. This is being increasingly done by tutorial classes, mainly organised by joint committees of the universities and the Workers' Educational Asssociation (*see* WORKERS' EDUCATION). Dr. Albert Mansbridge has taken a prominent part in the movement. The new tutorial class system already receives some financial aid from the Board of Education, given through the local education authorities.

Under this system courses of lectures are held wherever practicable by university tutors, who establish themselves in the industrial locality where the teaching is given. The lectures form a consecutive course, running to 12 or even 24 lectures. When practicable there are courses extending over successive years; where possible, three. The hours are in the evening, for the students are mainly of the classes that are engaged in manual labour in the mine, the factory or the field or are busied in clerical work in the counting-house during the day. So far they have been popular and have brought labour into a further relation with education. For the students are adults and the standard of teaching and the qualifications of the teacher are those of the university, and appropriate to adults with experience of life. Summer meetings and schools for the same kind of student are now organised by some of the universities, including Oxford and Cambridge (*see* SUMMER SCHOOLS). These are well attended and are popular with the working classes. Another body, the British Institute of Adult Education, is actively co-operating in developing the movement.

In this kind of extramural university education the most sought-after subjects for the moment appear to be those of economics and industrial history. But literature and languages, philosophy, including psychology, sociology, history, natural science and music are also being increasingly chosen. The system is spreading over England, and the new universities and the university colleges are active in extending it. But it is much dependent on access to libraries. The work of most of the counties in establishing libraries and the intervention, on an already considerable scale, of the Carnegie United Kingdom Trust, by providing central libraries from which those that are local can draw books, are helping to get over this difficulty (*see* LIBRARIES). A further question of growing importance is that of extending the availability to localities of the national museums. (*See* MUSEUMS.)

Altogether the adult education movement may be said to have opened up a new way in which higher education of the university type can be reached by the democracy, and it may well travel much further along that road, particularly if the state assists it financially in a larger measure than at present. The universities are thus becoming more of national institutions than they were before they took up the movement. The latest feature in the movement is that the trade unions have determined to take it up, and desire to have an active part in its direction. The question of the expediency of this may give rise to discussion, but it appears to be an advantage that the Trade Union Congress should now be interesting itself directly in the higher education of the working classes, in connection with the activities both of universities and local authorities and the Workers' Educational Assn., and of the labour colleges which have been established in various centres.

Special Organisations.—The system of education as it exists to-day in England has now been described. It has been shown how it extends in principle from the nursery school, through primary and secondary stages, to the higher education, given either within the universities or by them extramurally. There are other agencies, not organised in any way by the state, which co-operate in the work. For example, the Boy Scouts movement (*see* BOY SCOUTS), the industrial settlements, the Sunday-school organisations and the Women's Institutes, along with others, are contributing a good deal that is of special ethical value. The description given here has not been extended to them, partly for reasons of space, and partly because they are less directly connected with education in the strict sense than the recognised organisations already described.

The Board of Education is now not only assisting adult education and the tutorial class system by grants made to the local authorities for the purpose, but it has appointed special committees which have made valuable reports on the subject. One of these reported in 1924. The inspectors of the board now visit and report to it upon the university tutorial classes. What remains

is to take the system of national education, look at it as a whole, and ascertain the nature of the mental treatment which characterises each stage in that whole.

The Psychology of Education

The earliest stage is concerned with the conduct of very young children. The conduct of the lower animals is largely guided by what is called instinct, and, in the case of the higher animals also, including man, instinct plays a great part. Waking and sleeping, much of what we reveal in our actions is due not to consciously formed purposes but to habits which are ours as members of our species, and which yet enter into the making up of our personalities (*see* Psychology). These habits are in many cases instinctive, the result of inheritance, and often, even when they have been originally formed by choice, they come to seem instinctive. In social, as well as individual, action much of what is done is not the outcome of conscious purpose. Mother and child, for example, are alike ruled by the unconscious promptings of the species.

But the fact that, especially in young children, instinctive habit plays a large part does not alter the necessity of regarding the child as a person by guiding its mind. The law extends to the child protection and even rights. In its behaviour there are premonitions of the higher rights of adolescence. Still, consciously formed purpose is only one among the aspects of nascent personality. The other aspects, those more nearly of the higher animal, have to be studied by methods which extend to phases with which the teacher in the primary school has to concern himself less.

In the nursery school the personality has to be developed by different means. (*See* Montessori Method.) Here the insight of the modern psychologist becomes of most obvious value. He refuses to limit individuality to the mind. The biologically regarded organism enters into the constitution of personality, and, if the purpose of education be to develop the best forms of individuality, the body and what is bodily must not be ignored. Our organs are in large measure self-directing. We do not, for example, perform the function of digestion consciously, nor do we consciously control our steps when walking. Yet the life of the organism is a whole and if that life fails these processes cease. For physiologists and psychologists alike this is so. This whole life controls the parts and functions, sometimes unconsciously, sometimes consciously. Our conscious efforts as persons are what is called conative. They are guided and made possible by inherited instincts which do not always come into consciousness. When they do, and when action is consciously based on past experience, we have one form of memory.

Development of the Child.—As the physical individuality of the child develops into consciousness his conative and memoric capacity develops with it. Freedom of choice gives him new activities. These activities are the outcome of his self-directing energies and they have values which vary. What education has to do is to bring into his consciousness ever-increasing interests and values. The child has to be guided in the fashioning of his experience and to the most valuable forms of activity in fashioning it. His tendencies in conation are thus set in higher directions and his experience is enriched by the new memories which influence his choices. The ideas that often seemed most attractive are thus to be refashioned in the earliest form of school. The meanings of the things around are expanded and connected together. The original attitudes towards events are modified and further experience creates new dispositions. Here the teacher has his opportunities.

It is obvious that in this region there is much work for the psychologist, and much has been done by writers, such as the German biologist, Richard Semon, in providing theories and detailed explanations. At the stage of infancy in the development of the child the application of these is often of value. But there are other fields in which psychologists have been working which are concerned with young and old alike. One of these is the investigation made by physiological psychologists into the dependence of the mind on the nervous system. (*See* Psychiatry.) So wide a subject only admits of mention; it is enough to say that it is to-day recognised as being an important one in the study of education and must not be neglected.

Another field is that of psycho-analysis. (*See* Psycho-analysis.) Freud and Jung have in different ways developed the view that there is in the self a region of which we are not conscious, but in which are buried "complexes" which are striving to break through and influence conscious action in ways which become intelligible only if we study the region of their genesis. This point of view has many adherents, and it is now entering into the studies by teachers of the minds of their pupils. The field which is thus opened up is, however, a somewhat controversial one.

It is obvious that psychology, in forms such as those alluded to, is an important subject in the theory of education. But it can never be relied on as containing the whole of the truth. Teaching, which is directed to the development in the best direction of individuality, must be primarily concerned with personality, that is with intelligence that is conscious of itself as such. Psychology has the value for education that physics and chemistry have for biology. But just as it is at least doubtful whether the former sciences, concerned as they are with mere order in externality, can furnish conceptions which adequately express the character of life, so it is doubtful whether psychological methods can really reach to developed personality. Direct study of the individual minds of his pupils is always necessary for the teacher. He may derive much subsidiary help from scientific observation, such as that afforded by "fatigue psychology," or in quite another form from the method of Dr. Maria Montessori, which is to throw on the child as much as possible the responsibility for its own education, and to reduce external interference with self-development to a minimum.

Still the teacher must influence the environment, and so direct development under its influence. The influence of his own personality counts for much, even in the infant school, and the example he sets, mental and moral, counts for certainly not less in the subsequent stages of education. The old psychological notions were insufficient in so far as they treated knowledge as a merely passive interpretation of external experience. We have learned that knowledge is an activity which changes even that experience for him who possesses it, and therefore requires adequate stimulus from within and direction from without. The giving of these is the work of the teacher throughout his whole career, and it depends primarily on his developed personality as well as on the individuality of his pupil. The school is the environment in which he works and the influence which he directs. Enough has been said to show the new scope and importance in the teaching of to-day of psychological ideas.

Science in Education.—The desire on the part of those concerned with education to apply scientific conceptions in the organisation of their work is to-day increasing. The stimulus to apply general science seems to have come to them from the searching methods forced on their notice by the World War. It is indeed since the War that in England much of the growth now described has taken place. The study of childhood and primary training has become more thorough; secondary education still remains the weak point, but its shortcomings are being closely scrutinised, and it is slowly being developed. The idea of the university type of education is laying hold of the people with greatly increased power. The advance in England has been accompanied by an advance in Scotland in kind, probably not relatively speaking as great, for there was less unbroken ground to be covered.

Germany, France and Italy

In the other countries of Europe analogous, though not wholly similar, advances have been made with not less zeal. In Germany there is a striking example of this. She had before the War a remarkable educational system, in advance in most respects of that of any other country, but it was a system which had been shaped unduly in the interests of the well-to-do classes, and did not fit the new constitution of the democratic republic. With the advent of a democratic form of government all this is

being changed. Germany is struggling to establish a principle of unity (*Einheit*), under which the children of rich and poor shall be educated together, and she is also doing her best to develop the system of continuation schools which existed in her country before the War, and which she is now trying to make not only everywhere compulsory, but extended in scope.

In studying the voluminous literature which her new educational leaders are pouring out about the ideals of her new system, it is impossible not to realise that the old keenness about education still pervades the German people and makes it ready for sacrifices in order to preserve what has been one of her great advantages. The German universities do not appear to have thrown themselves into the work of spreading their influence extramurally to the people in the way the universities of England are doing. But this side of the work of levelling up the popular mind is not being overlooked. The teachers in the higher schools in the industrial centres, men who have been university trained, are giving a new sort of adult education to those round them. Altogether the effect of the War in imparting fresh stimulation to the growing demand for equality in education (the national poverty notwithstanding) appears to be not less striking than it is in England.

Education in France.—In France an analogous desire for equality in education is apparent. Like Germany she had before the War a splendid system of secondary schools. But the provision for those children in her elementary schools who could not hope to go there was deficient. An effort is being made to concentrate on improving primary education. The highly centralised system of state control renders the accomplishment of this task more difficult in the absence of local initiative. But French statesmen appear to be quite aware of its importance; a lesson which the War has driven home. They are still faced with difficulties caused by the highly centralised educational system established under Napoleon, and hardly less by the insistence of the Church on a religious character for the schools.

But, on the other hand, France has inherited a splendid tradition in her establishments for secondary education of lycées and colleges, in which ability to speak well and write well is developed in the scholars as it is almost nowhere else. Recent reforms, while leaving undiminished the classical tradition recommended as indispensable for this purpose, are introducing science also into these institutions. The recommendations of the Ribot Commission in 1899 about secondary education have been followed up by the proposals for widening the basis of the system made by M. Bérard in 1921. The purpose was to provide an *élite*, nurtured in the traditional culture of the French nation, but so extended as to reach poor and rich alike.

Under this scheme scholarships were to be given to enable the best pupils in the elementary schools to proceed to the reformed secondary schools. The Chamber of Deputies and the President of the Republic approved the plan, but it remains to be seen how the national financial necessities will permit of its being carried fully into effect. The position in France of her secondary schools is a great one. They have influenced the development there of primary education and appear likely to influence it still more. The War has stimulated the desire of the French for a much improved system of national education in which rich and poor shall both share.

Education in Italy.—Another and last example of the influence of the War, apparent also in many countries other than those here referred to, is the development of the national system of education in Italy. In that country education has always been a state monopoly. The schools were almost entirely state schools, and the educational machinery was by tradition highly centralised. The system was, however, good in many respects, although it was bureaucratic and lacked elasticity. The teachers were too tightly bound. The subjects prescribed were too numerous, and yet fine art and music and games were not taught. Primary education was compulsory, but the weak spot was the difficulty of enforcing the compulsion. This was partly due to the small interest taken by the nation in its system of education, notwithstanding that the schools were open to everyone.

The Spirit of Education.—It was plain that education had to be made more interesting, and, among others, Prof. Giovanni Gentile, the Minister of Education in 1923, set himself to accomplish this. He considered that his first task was to reform the spirit of the teachers. These must learn that education is no mere matter of empirical rules, or even of organisation, but is a spiritual activity, involving the continuous self-recreation of the individual teacher. The plan is to entrust him with a large amount of liberty in working out the purpose prescribed to him. This is accompanied by greater freedom given to the local education authorities, with which they can adapt the schools to the varying requirements of their neighbourhood. It is a new experience to read in an official decree such words as those with which the minister introduced the new scheme in 1923:—

> The schemes for study which are described here are intended more than anything as a guide. The teacher is informed of the result which the state expects from his work in each school year, leaving him free to use what he individually considers the most suitable ways for arriving at it. These, for several reasons, are always various and elastic; according to how the teacher is situated with regard to his scholastic surroundings, and according to his individual personal culture, and the particular character which he has succeeded in giving to the spirit of his teaching, by means of observation and personal experience. The following schemes are designed in such a way as to oblige the teacher continually to renew his personal culture; not only by means of the superficial little manuals in which he can gather the crumbs of knowledge, but from the living fountains of national culture. . . . These schemes forbid the commonplace platitudes which have so long dulled children's education, and demand pure genuine poetry, sincere searching for truth, energetic investigation of the popular spirit, restless and never satisfied, asking always the reason why; the rapture of contemplating pictures resplendent with art and life, the communion with great souls which speak through the mouth of the teacher.

Noble words these of the minister-philosopher in whose hands the cause of education in Italy was placed in 1923. It will be of interest to observe how far the new spirit is realised.

Some Conclusions

Reviewing the state of education in England and in the other civilised countries referred to, it may be said to be this. The War brought about a remarkable advance, primarily through the fresh interest in education which has been awakened in the people. This interest has resulted in a desire for equality of educational opportunity, which is having its effect on the policy of governments. Democracy is coming to its own in the attainment of fresh chances for its hitherto less fortunate members. The spirit of scientific organisation is also becoming everywhere operative. Much remains to be accomplished, but a beginning has been made, and the process of development now initiated does not seem likely to stop. If wealth again accumulates, a good deal is likely to be asked for in order to give the people better chances than those hitherto attainable.

It is not only in the schools and universities that the new desire is making its influence felt. The chiefs of industry and commerce are asking for higher standards of knowledge in those whom they employ. They are recognising, too, the value in their undertakings of pure science, and in England the Govt. is co-operating, through the medium of committees under the President of the Council, in giving what is wanted. It is a new function of the President of the Council to organise and to stimulate industrial and scientific research. Public funds have been placed at his disposal. In the year 1925–6 some £380,000 was applied for these purposes. In 1925 the Govt. also added to its machinery a committee under the Cabinet analogous to the Committee of Imperial Defence, but devoted to problems of civil enquiry. This new committee, which has hardly as yet had time to get into its work, opens up new possibilities in the way of furnishing the Cabinet with exact knowledge for the disposal of civilian problems of every kind, at home and in relation to the Empire.

These changes bear closely on the growing demand for education, and especially for higher education. The strides made in organisation are great, and the spread of knowledge is more rapid as well as wider than was the case before the War. But the

advances actually so far made are in outlook and organisation mainly, and until the financial stress of the time passes and the freer provision of public funds becomes practicable, the full advantages of what has been recently accomplished can hardly be reaped. Notwithstanding this, it is no exaggeration to say that the convulsion which shook the world in 1914 has produced a new stimulus to education of all kinds. (H.*)

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(A. E. T.*)

III. EDUCATION IN THE UNITED STATES

Each state has its own system of education, which includes elementary and secondary schools and institutions of higher learning. All the states have enacted compulsory school laws, but in standards and enforcement of them the states vary widely. School attendance is generally required of children between the ages of 8 and 14 (or 16) during from 6 to 8 months of the year, and many states further require attendance at part-time or evening classes by those who have not acquired a prescribed minimum of education or who cannot adequately speak, read and write the English language.

The national Govt., through Congress in 1916, notably reenforced the compulsory school laws of the states by an enactment prohibiting the shipment, in interstate commerce, of any articles in the manufacture of which children under 14 have been employed. In place of a nearly uniform curriculum and the almost universal requirement of 8 years in the elementary school, there is manifest a tendency to group together as a "junior high school" the seventh, eighth and ninth grades, which otherwise would constitute the last two years of the elementary school and the first year of the secondary school. The purpose of the rearrangement is to facilitate departmental teaching, to free the child from the rigid grade system of promotion (by which a failure in one subject necessitates the repetition of the whole year's work), and to permit earlier a choice of courses and thereby prepare the pupil for greater accomplishment in his chosen field during the later high-school years. The public secondary schools have grown rapidly in numbers and resources. Their enrolment doubled in the 10 years, 1908–18; from 1,564,152 in 1918 the enrolment rose to 2,160,861 in 1922. They are no longer essentially stepping stones to college; they represent the continuation of the common schools, and their function is to complete the formal education of that vast majority which will never enter institutions of higher learning.

Colleges and Universities

Throughout the country, but especially in the West and Middle West, so-called junior colleges are becoming numerous. Some of these institutions are derived from small colleges without support from taxation; some of these colleges, finding themselves financially unable to continue satisfactorily the full four-year course, limit themselves to two years; others, more significantly, form the upward extension of the vigorous public high schools. This type not only brings the opportunity for higher education within the reach of many who could not leave the immediate vicinity of their homes, but also reacts favourably on the pupils and teachers of the secondary schools. The college remains the most characteristic feature of education in the United States. In 1922 there were enrolled 414,806 collegiate students as compared with 341,082 in 1920 and 174,213 in 1910. While competition is displacing registration, the entrance requirements are, perhaps, less rigid. Even the conservative Association of New England Colleges recommends "a system of tests for admission, in which a certificate shall be taken for the quantity, and examination shall be held in a limited number of subjects for the quality, of school work."

The curriculum covers a very wide range of subjects, but experience has shown that it is unwise to permit the student to exercise untrammelled freedom in the choice of his studies, and most colleges now limit the selection of courses in such manner as to prevent too great concentration and too great dispersion as well. The universities, though not more numerous, have in recent years grown stronger. Their graduate departments, better manned, attract more students. In this respect the development of the state-supported institutions has been remarkable. A few years ago only three had achieved distinction on this field; by 1924, 13 had qualified for membership in the Association of American Universities, and constituted one-half of its members. The enrolment of graduate students in all universities in 1916 was 11,215; in 1920 it was 15,612; and in 1922, 22,061. So great has become the demand among women for higher education that the colleges exclusively for women are no longer able to provide for the rapidly increasing number of applicants for admission. Bryn Mawr, Vassar, Wellesley, Smith and Mount Holyoke have been forced to establish waiting lists. The doors of the universities for the most part stand open to women upon an equal footing with men. By 1922, 35% of the students, graduate and undergraduate, enrolled in the universities, colleges and technological schools were women, and it may confidently be predicted that women will soon outnumber men. The general admission of women to courses in medicine removes practically the last barrier discriminating between the sexes. (*See* Co-education.)

Professional Education

Schools for professional training have grown rapidly. Whereas early in the 19th century professional education comprised little more than preparation for the ministry, it now includes theology, medicine, law, the profession of engineering and two offshoots of medicine—dentistry and veterinary medicine. Pharmacy and nursing are sometimes regarded as professions because a specialised education is prescribed for those who would practise them.

Theology.—The colleges first founded in what is now the United States—Harvard, William and Mary, and Yale—were established to train men for the Christian ministry. As the colleges have developed into universities the original aim has been merged into the broader purpose of providing liberal education for all, while influential schools of theology have grown up, for the most part, as strictly denominational institutions independent of the universities. Methods of teaching and the content of the curriculum have been revised. Formal theology is emphasised less, a first-hand knowledge of human relationships more; Hebrew is not always obligatory, while the results of literary and historical criticism are fully discussed. Freedom of thought in some institutions has completely liberalised the training and greatly modified the traditional theology. During the years 1870–95 the number of theological students increased more rapidly than the general population. For the next 25 years the figures showed marked fluctuations, but for the period as a whole neither student enrolment nor the number of graduates kept pace with the increase in population.

Medicine.—The medical schools of the United States were slow to adjust themselves to the new conditions brought about by the growth of medical science. They followed the model of continental Europe rather than that of Great Britain, in that the teaching was almost exclusively by lectures and imposed no definite requirement as to the preliminary education. There was lacking also, for the most part, stimulating contact with colleges or universities of high academic ideals; and therefore there developed an organisation which lent itself readily to commercialism. Later, however, medical teaching has been revolutionised, and it now exemplifies the highest standards of professional education. The rapid development of physiology and physiological chemistry, bacteriology, pathology and hygiene necessitated the enlargement of the curriculum to include these subjects. Laboratory methods of teaching have been introduced, at very great cost for buildings and equipment. Teachers qualified by training and experience have superseded practising physicians as instructors in the fundamental sciences; in the clinical branches also pedagogical standards have been raised, and in many schools full-time clinical instructors are in charge. Satisfactory preliminary education is regarded as essential, and all recognised medical schools in 1926 require of candidates for admission the completion of the four-year secondary school course and at least two years of college work, including physics, chemistry and biology.

Cornell, Western Reserve and Leland Stanford require three years of college for entrance; Harvard a degree from, or two years of high rank in, a college or scientific school; Johns Hopkins and Chicago a Bachelor's degree or its equivalent. Most significant of all, the student is again brought into intimate contact with the patient; hospitals and dispensaries are used as laboratories where the prospective physician may acquire skill in examining patients and familiarity with the manifestations of disease. The degree of Doctor of Medicine is conferred on completion of the medical course, which in nearly all schools is four years in length. A few institutions require also, before granting the degree, a fifth year, spent as an *interne* in a hospital. Advancing educational requirements, the consequently greater cost of medical training, and the increasing knowledge and interest of the public in matters of public health combined to reduce the number of medical schools from its maximum of 162 in 1906 to 80 in 1925; of medical students from 28,142 in 1904 to 18,200 in 1925; of medical graduates from 5,747 in 1904 to 3,974 in 1925.

Engineering.—The beginnings of American technological training were made, not in the long-established colleges, but in a group of special schools, independently founded, such as the Massachusetts Institute of Technology in Boston and Stevens Institute in Hoboken, New Jersey. Later the universities eagerly took up education in engineering, developed elaborate departments and offered the greatest variety of courses. Another type of technical school is the state college of "Agriculture and Mechanic Arts," supported by land grants from the Federal Government. Engineering schools require of applicants for admission the completion of the four-year secondary school course. Instruction is largely by means of laboratory courses. The University of Cincinnati went a step further, and perfected an arrangement by which students spend half their time outside the college, actually employed in some form of engineering work; periods of two weeks of study alternate with like periods of practice in a shop. The degree of Bachelor of Science, with or without specification of the branch studied, is commonly conferred after four years of college work. The degrees of Civil Engineer, Mining Engineer and so forth are awarded for undergraduate work by some schools in place of the B.Sc., by others reserved for more advanced study.

Dentistry.—Since 1900 there has been increasing uniformity among dental schools until, in 1921, all recognised schools required for admission at least the completion of a four-year secondary school course, and many of them demanded an additional collegiate year of preliminary training, followed by four full years of professional training. The increasing recognition of the relation of dental pathology to health and disease in the body as a whole tends to make dentistry a branch of the study of medicine, and a leading group of dental schools decided to demand in 1927 the same two years of collegiate preliminary training now required of medical students, followed by four years of dental training. The growing appreciation of the value of dentistry is indicated by the increase in the ratio of the number of dentists to the total population. In 1850 this ratio was 12 for 100,000; in 1910 it was 43; in 1920, 56; in 1925, 68.

Veterinary Medicine.—In this, as in other professions, there has come a realisation of the necessity for a solid foundation of general education on which to base special training. The accepted standard in 1921 was the completion of a four-year secondary school course and three years in a college of veterinary medicine. In 1900, 13 schools enrolled 362 students and graduated 100 veterinarians. In 1916 the numbers had increased to 22 schools, 3,064 students and 759 graduates; but in 1921 the number of veterinary schools declined to 14 and the student enrolment to 849.

University Extension Work

Under this head are grouped all those activities of institutions of higher learning which are carried on for the benefit of people unable, through lack of time or training, to matriculate in the regular college or university courses, but who still desire some form of higher education, and this extension of facilities is designed to include in its scope persons many years older than the ordinary undergraduate. Originally no more than a series of public lectures on topics of literary, historical or scientific interest, this extramural teaching has extended its range, diversified its method and multiplied its activities, until it has become, in some instances at least, an important function of the university.

The spirit of service to the community which it embodies was expressed by the late President Van Hise in these words: "So far as the University of Wisconsin is concerned, we propose to take up any line of education work within the state for which the university is the best fitted instrument"; and again: "It is my ideal of a state university that it should be a beneficent influence to every citizen of the state." In such a programme the whole realm of human knowledge is included, from sewing to Sanskrit and from plumbing to philosophy. Summer sessions, of from six to eight weeks' duration, provide valuable opportunities for those, chiefly teachers and students, whose work allows a long vacation. Varying standards prevail in the summer schools: in not a few the amount and quality of the work render it acceptable as part of the requirement for a degree. The University of Chicago has made its summer session the full equivalent of one of the winter terms, and operates on a four-quarter schedule. Teaching by mail is another method employed by some universities to widen their spheres of influence. Extension teaching is also carried on by local boards of education, especially in large cities. Much of it takes the form of part-time classes for children who have left school prematurely and for immigrants who lack command of the English language.

Private enterprise outside of academic circles has contributed to extension teaching along two distinct lines. The Chautauqua Assembly is the prototype of the summer school (*q.v.*), and has exerted a very wide influence through the thousands who each year attend its courses. Quite different in scope, but not less valuable, is the kind of work done by other institutions which provide opportunities and incentives for continuous and serious study as well as lecture courses and concerts having a wider appeal. Perhaps the most valuable extension teaching is that which reaches into the home, bringing to the mother such information as will aid her in solving her manifold and peculiar problems. The U.S. Govt. prepares and distributes upon request a comprehensive series of pamphlets containing instruction regarding the selection and preparation of food, infant feeding, child hygiene and many other subjects. Whenever possible, nurses and women trained in the household arts visit the homes and, by personal directions and demonstration, often succeed in promoting the welfare of the family where print alone would fail. Intellectual development is stimulated by courses of home reading. The recognition of the importance of home influences as factors in the child's success at school led to the formation of "parent-teacher associations," from which the teachers gain a knowledge of the home environment of their pupils and the parents learn how best to co-operate in the work of educating their children.

Vocational Training.—This term denotes training of less than college grade, designed to fit the individual to earn a livelihood. Its beginning in the form of manual training may be traced back as far as 1880, but except for a few isolated experiments it is a development of the 20th century. Phases in the progress toward an understanding of the problem have been: (1) attention was focused on "misfits"; the problem was stated in terms of what might be called a "niche" theory of society as that of finding the particular place or station in life that exists somewhere for each individual; (2) it was held to be the duty of society to regard with earnest concern and in some way to aid those that are defective; (3) then came the idea that the schools might prevent individual and perhaps unusual types from being spoiled in the making; (4) next came a shift in emphasis to the necessity for vocational training; and (5) finally came a recognition of the necessity for an educational survey of the community in order to determine what opportunities are already available and what its industrial needs really are.

The so-called Smith-Hughes Act passed by Congress in 1917 authorised appropriations aggregating $7,000,000 a year for promoting, in co-operation with the states, special training in schools designed to meet the needs of those preparing to enter agriculture or industry; provision being also made for training teachers for this work by industrial or commercial corporations. The teaching of domestic science was begun in the schools of Framingham, Mass., in 1898. The desirability of such training for every young girl has led to the inclusion of one or more courses in home economics in the curriculum of every girls' high school, and also in the upper grades of the better organised elementary schools.

Agricultural Education.—Training for agricultural pursuits more than any other branch of education has been fostered by the Federal Government. Its development manifests several stages, each characterised by a different method. The land grants of 1862 led to the establishment of state colleges of "Agriculture and Mechanic Arts," which, however, for a generation at least were predominantly schools of engineering. In 1887 Congress authorised subsidies to agricultural experiment stations under state control, a policy the wisdom of which was quickly demonstrated. In a few years these stations accumulated a wealth of exact knowledge relating to farm problems which would have been of inestimable value if it could have been applied. Then came the development of agricultural extension education, employing agencies such as lectures, bulletins, correspondence courses, reading courses, farmers' institutes, short courses in agricultural schools, travelling libraries, educational trains, demonstration farms, education exhibits at fairs and moving pictures. This phase culminated in the Smith-Lever Act of 1914, which appropriated more than $4,000,000 annually to be apportioned among the states for agricultural extension work. Such activity, creating a great demand for teachers and farm demonstrators, reacted beneficially upon the agricultural colleges. Meanwhile, another tendency was becoming manifest. The science of farming was being taught in the secondary schools. This plan possessed so many obvious advantages and showed such satisfactory results that in the decade following 1910 it was widely adopted. In 1922, 2,175 public secondary schools, with an enrolment of 59,276 pupils, provided vocational instruction in agriculture. In most schools the boy or girl is required to carry out, under supervision, some definite enterprise such as the cultivation of a small plot, the raising of pigs or poultry, or the conduct of a miniature dairy. A detailed record of the undertaking, including a financial statement, is required and forms a basis for grading the pupil's work.

Certain private corporations, not directly engaged in teaching, have influenced education in the United States. The General Education Board, for example, incorporated in 1903, employed the funds at its disposal in assisting institutions of higher learning throughout the country, and in the southern states it also promoted the development of the secondary schools and the teaching of agriculture. Later it entered the field of medical education. The Carnegie Foundation for the Advancement of Teaching, incorporated in 1906, starting with a programme of pensions for retiring college professors, has been led into the field of investigations and surveys. The published reports of its findings have contributed in large measure to educational progress. The Russell Sage Foundation performs similar service.

Statistics.—The magnitude of work in education may be indicated by figures from *The Statistical Survey of Education* for the school year 1921–2, published in 1925 by the United States Bureau of Education. The total enrolment in all schools (public and private, from kindergarten to university) was reported as 26,458,655; the total number of teachers, 871,131 (men 180,362, women 690,769); the total cost (including outlays) for the school year, $2,053,250,492; the value of all school property, $4,369,163,043. For the public schools of elementary and secondary grade the Bureau reported the following figures:—

Pupils enrolled	23,239,227
Average number of days schools were in session	164
Average number of days attended by each pupil enrolled	130·6
Number of teachers (men 118,085; women 604,891)	722,976
Percentage of men teachers (Percentage in 1879–80, 42·8)	16·3
Average annual salary of teachers	$1,166
Number of schoolhouses	270,574
Value of all school property	$3,008,563,033
Receipts	$1,444,241,920
From income of permanent funds and lands	$23,767,933
From county and local taxes and appropriations	$1,106,331,287
From state taxes and appropriations	210,707,514
From all other sources	103,435,186
Expenditures	$1,580,671,296
For sites, buildings and equipment	$305,940,965
For salaries of superintendents, supervisors, principals and teachers	$885,475,100
For all other purposes	$389,255,231
Total expenditure *per capita* of population	$14.47
Total expenditure per pupil in average attendance	$85.76
Average total expenditure per day for each pupil	$0.523

(A. S. D.; N. M. B.)

BIBLIOGRAPHY.—The United States Govt. publishes a *Biennial Survey of Education.* The Education Bureau has issued a *Report* annually from 1871, and a number of *Bulletins* covering the subjects of Agricultural Colleges and Education, Citizenship and Civics, City Schools, Colleges and Universities, Commercial Education, Health and Hygiene, High Schools, Home Economics, Industrial Education, Kindergarten, Rural Schools, Secondary Education, Teachers and Vocational Education. Valuable information is also

contained in the annual *Reports* of the Depts. of Education of the various states, *e.g.*, Massachusetts, Pennsylvania and New York.

The following works deal with higher education: David Starr Jordan, *The Care and Culture of Men* (1910); H. M. Bennett, *Women and Work* (1917); H. W. Stuart, *Liberal and Vocational Studies in the College* (1918); Thorstein Veblen, *The Higher Learning in America* (1918); Le Baron Russell Briggs, *Men, Women, and Colleges* (1925).

On education in general the following are some of the more important books: A. T. Hadley, *The Education of the American Citizen* (1902); C. F. Thwing, *A History of Education in the United States since the Civil War* (1910); *Education in the United States*, a series of monographs, ed. Nicholas Murray Butler (1910); E. L. Thorndike, *Education: a First Book* (1912); F. P. Graves, *A Student's History of Education*, (1915); *New Possibilities in Education*, ed. A. L. Sahrie, The American Academy of Political and Social Science (1916); J. Dewey, *Democracy and Education* (1916); G. R. Twiss, *The Principles of Science Teaching* (1917); E. P. Cubberley, *Public Education in the United States* (1919); J. A. H. Keith and W. C. Bagley, *The Nation and the Schools* (1920); Ross L. Finney, *The American Public School* (1921); E. H. Reisner, *Nationalism and Education since 1789* (1922); J. L. Horn, *The American Elementary School: a Study in Fundamental Principles* (1923); H. C. Link, *Education and Industry* (1923); D. H. Smith, *The Bureau of Education: its History, Activities and Organisation* (1923); A. Gesell, *Mental Growth of the Pre-School Child* (1924); W. Goodsell, *The History of the Family as a Social and Educational Institution* (1925); W. H. Kilpatrick, *Foundations of Method* (1925); *Cyclopedia of Education*, ed. P. Monroe (1925); C. H. Judd, *Psychology of Social Institutions* (1926); Thomas Jesse Jones, *Four Essentials of Education*, pref. by F. H. Giddings (1926).

IV. EDUCATIONAL EXPERIMENTS

Educational experiments in England and Wales are usually suggested by the needs of the moment and not by a desire to test by experience a hypothesis formed beforehand. The persons who conduct them do so to overcome a recognised difficulty or to achieve a better way of teaching. In one department, that of intelligence testing, research experiments are tried and it is here that, in the strict sense of the term, experiment takes place. The importance of this subject led to its being referred to the Consultative Committee of the Board of Education which issued a report on it in 1924. Their findings are not conclusive, but in general recognise the importance of these tests while cautious as to the probable usefulness of the results.

Central Schools.—Of experiment in a wider sense there is a great deal. The Board of Education itself is encouraging an experiment on a very large scale in urging local education authorities and school managers to set up central schools, to which boys and girls in elementary schools are transferred at or about the age of 11 for a course of study specially designed to cover the years up to 14 or 15, selection being either by age alone, or through examination. Thus some central schools include all children from the schools which feed them, above 11 years of age, dull and clever alike; others, such as the London central schools, consist of picked scholars. This movement is dictated by various considerations, such as the growing demand for advanced instruction beyond the primary stage, consciousness that the ordinary elementary school, small or large, does not usually do full justice to its older scholars, and a desire for economy, since the concentration of specially qualified teachers in central schools is more economical of energy as well as of money than to spread them over ordinary schools with children from 7 to 14.

Many hold that the primary age ends or should end at 11, with a fair equipment in the tools of learning; and that all teaching beyond that age should be post-primary if not secondary in character. Where central schools are established, this principle holds the field, with the proviso that the best type of co-ordinated instruction beyond 11 is not necessarily that of the normal secondary school. Some central schools have an industrial bias and devote much attention to practical work; others have a commercial bias. This important experiment alters essentially the English conception of an elementary school, which, if the central schools become universal, will no longer be an "omnibus" school for children from babies up to 14. The change toward industrial and commercial studies in the central schools encounters the objection that it tends to lessen, rather than increase, the adaptability of pupils, to restrict them to fixed stations in life instead of broadening their opportunities as the older, less specialised, schooling was believed to do. The movement grows, however, if slowly; one obstacle prevents a general acceptance, the very large number of schools under voluntary, and usually denominational, management. Some Church of England schools are acquiescing in it; in other cases, Church central schools are set up; in some the Church schools refuse to participate. The Roman Catholic schools will not "decapitate" their own schools to send their children to non-Catholic central schools; here and there they found Catholic central schools. An effect, not unforeseen, of the change is that infant schools may tend to become absorbed in the new junior primary school and no longer be a separate entity.

Experiments in Infant Schools.—Apart from organisation, one of the most striking waves of experiment has taken place in infants' schools and classes. Where formerly the three R's in a dull form were the staple of instruction, modified by some artificial exercises denominated "Kindergarten," the school now tries to cultivate speech besides reading and leading "up to reading," activity instead of immobility, self-help instead of formal instruction. This new orientation in fact preceded the spread of Montessori doctrines, but it was strongly reinforced by them (*see* MONTESSORI SYSTEM), even where they were not accepted in full. The infants' school and class become now more of a social agency and a centre of education than a centre merely of instruction.

School Experiments.—Another movement has grown quietly without the support of a great name, but spreading by its own reasonableness. This is the "ruralising" of many schools, not only in the country but also in many towns. When this goes no further than nature study, it is a recognition that school lessons should be related to the child's surroundings. But gardening is very popular and a school often includes bee-keeping and even poultry-keeping. The Welsh Dept. of the Board of Education have stimulated the extension of the idea of suggesting that rural lore, including history, antiquities, architecture, folk-song and speech, should be cultivated in country schools. Connected with this trend is the tendency to localise the geography teaching on the one hand, by studying closely the geography of the town, village or region, and on the other to supplement the local study by school journeys. School journeys are not for all, since their management requires very special organising and personal care. In small numbers they preceded the Boy Scout movement (*see* BOY SCOUTS), but the proved practicability of school journeys reinforced the camping idea of the Scouts and camps grew in popularity. One annual camp under the patronage and the personal attention of the Duke of York, combining boys from the public schools and boys brought up in elementary schools, is a noteworthy example of an attempt to create a sympathy between classes brought up very differently. Both secondary and primary schools have even organised school journeys and school camps in other countries.

Handicraft Work.—The progress of instruction in handicrafts is on the whole slow, for this form of instruction is apt to be expensive. But the idea that handicraft for girls, as well as for boys, is an essential element in education undoubtedly grows and the stage is now reached where impatience is expressed at the lack of proper progress where formerly a missionary kind of advocacy was required to make the idea acceptable at all. Handicraft for boys means usually work in wood and metal; and for girls besides needlework and cookery, long established, laundry work, housecraft and the simpler beginnings of crafts like weaving, basketry, embroidery, lace making and pottery.

Cinema, Gramophone and Broadcasting.—These are perhaps past the stage of experiment. The schools are considering and trying experiments in new fields with results which are not yet firmly established, experiments with the gramophone, broadcasting and the cinema. The gramophone has practically won its way to a position of limited but decided usefulness. It becomes more and more used for music, and the introduction by its means of a wide variety of good music into the schools means an increase of music and the appreciation of it as a liberal factor in education. It is also used in the teaching of foreign languages. Broadcasting

is on its trial (*see* BROADCASTING); every day at fixed hours in the afternoon lectures and talks are broadcast from the various studios and schools, and the teachers are asked to co-operate by giving the children who listen appropriate revision and appropriate exercises, talks on literature, history, simple science, especially natural history which in this way may regain the place in children's education it used to have and deserves to have, and, of course, music. The value of the cinema is more doubtful at present. It appears to be of use (where it can be used) chiefly as recreative, or as giving a pictorial summary of teaching, the mass of which has been communicated by word of mouth or acquired by reading.

The Dalton Plan.—Mention must also be made of experiments in teaching such as the well-known Dalton plan. In a few schools this is followed very thoroughly: in more, adaptations of it are made (in the usual English way), in part of a school, or in some subjects only. The experiments so far have hardly been crucial enough for a final verdict to be passed. The plan was started originally in secondary schools, but it has also been adopted experimentally in a few elementary schools. The direct method of teaching foreign languages is another example of a movement which has passed the stage of experimentation in one sense. Its principle is fairly well accepted; but it is carried out not always in its purist form but modified to suit the circumstances of the pupils. Dr. Rouse of the Perse School, Cambridge, continues to use it for Latin and Greek, though he has no great following (*see* CLASSICAL EDUCATION). The question of the training of teachers is being canvassed and the ultimate scope of the training, as well as the forms it will take, are too uncertain to admit of description. One result may be noted, that the idea of training for teachers in secondary schools gains ground. (H. WA.)

EXPERIMENTS IN THE UNITED STATES

In America experimentation has become a normal function not only of individual schools and colleges but of whole systems of education. The experimental movement has coincided with the rapid quantitative expansion of educational facilities which has marked the first quarter of the 20th century. It has spread with the growth of schools; especially has it accompanied the introduction of new types of schools. The movement owes its impetus primarily to the university schools devoted to the scientific study of education which prepare for professional service an ever-increasing number of school administrators. More recently normal schools and teachers' colleges, philanthropic foundations and special research bureaux maintained in connection with state and city systems have likewise made important contributions to the movement. Not only have these latter agencies extended the range and variety of experiments, but they have also done much to inoculate the whole teaching profession with the experimental point of view.

The most significant educational experiments may be classified for convenience as (1) experiments based on psychological investigations, (2) experiments dealing with the reconstruction of the curriculum and (3) experiments bearing on the reorganisation of the educational system. There is naturally some overlapping of these categories.

Experiments Based on Psychological Investigations.—Educational psychologists have been concerned with developing two kinds of measures: measures of native capacity and measures of intellectual achievement. The measures of native capacity, the so-called intelligence tests, appeared only sporadically in the schools before the World War, although a number of American psychologists, building on the work of Binet, had been endeavouring to adapt them to educational purposes. In 1917 and 1918 the opportunity presented itself to use intelligence tests on a large scale in classifying and assigning the personnel of the American draft army. The results obtained through subjecting 1,750,000 men to certain simple forms of these tests demonstrated their fundamental validity and attracted the attention of both educators and laymen. Since the War, intelligence tests have come into general use in schools of all grades. They have been steadily refined and improved, but are still regarded as in the experimental stage. In the classification of pupils and their selection for special treatment, in comparing the progress of different groups of children, and in a wide variety of studies of the educational process, the tests find constant application. They have been adopted by many colleges as part of the matriculation machinery.

The effort to invent objective measures of achievement in school subjects has produced a series of new devices called scales or standard tests. These are designed to estimate the results of the work done in the schools more reliably than is possible by means of the conventional examination. By the correlation of the scales and standard tests with the age of the pupils, tentative norms of achievement at different stages of school life are being established. Scales or standard tests and intelligence tests are now being used in conjunction, with a view to determining the respective rates of progress of children of different mental endowments. Scales and tests of proved reliability are already available in most of the school subjects. Those designed to measure achievement in handwriting, spelling and arithmetic have been longest in existence and have had widest application.

The whole testing movement has led teachers and administrators to appreciate more fully the essential importance of adapting school procedures to individual differences. Thus in spite of the great growth in the school population, devices for individualising instruction are becoming more numerous and more effective. The defective or sub-normal child was the first to receive special attention. In the last few years, however, the realisation has grown that the gifted child suffers quite as much from subjection to an inflexible régime designed for the mediocre and that society suffers still more from a training process that hampers the full development of the superior individual. Hence a variety of experiments are now in progress throughout the United States which have as their object the identification and the appropriate education of the gifted pupil. In these experiments colleges and universities are beginning to participate through the establishment of so-called honours courses and through devices for segregating and stimulating the superior student.

Experiments in the Reconstruction of the Curriculum.—For some years the conviction has been gathering momentum that the curricula of schools at all levels are not only out of harmony with the requirements of modern life, but that they are also at variance with the laws of mental growth and of learning which the psychologists have been discovering. Modern living conditions have transferred to the schools a multiplicity of tasks previously performed by other agencies. The social aims of education have also become more prominent at the same time that the necessity of recognising the idiosyncrasies of the individual has been revealed. The problem of reconstructing the curriculum is now the central problem of American education. It is being attacked in hundreds of schools. Certain experiments have seemed promising enough to be widely imitated, with some local modification. One of these is the Dalton plan and another is the platoon or work-study-play plan. Under this plan, conspicuously in operation in public-school systems of Gary, Detroit and certain other cities, half the children are in classrooms while the other half are at work or at play in school shops, laboratories, studios, on the playground or in the auditorium. Decreased classroom space and greatly increased facilities for work and play are features of the physical plants of schools that operate on this plan. The school day is lengthened and the school becomes responsible for the child during the major part of his waking hours.

Cutting across schemes like those just mentioned, which involve complete reorganisation of the school in the interests of a more vitalised curriculum, is the project method. This method focuses instruction around typical problems actually encountered in life outside the school. In the course of solving these problems, or working out the projects, principles are discovered and learned. The topical organisation of instruction largely disappears. The pupils actively seek the solution of the problem wherever the search may lead, even outside the confines of the school. Experiments with the project method are numerous. Some schools have applied it in a few subjects, some in

practically all subjects. A considerable body of teaching material is already available as a basis for such experiments. Instruction in vocational subjects is now largely dominated by some form of the project method. The system of co-operative part-time instruction first developed in the engineering school of the University of Cincinnati and now followed in many other engineering schools and industrial schools is founded on the same underlying concept.

Experiments in the reconstruction of the curriculum are not confined to schools or school systems that are committed to some new departure in method or in organisation. In many institutions where the older type of school regimen has not been radically changed, the curriculum is being experimentally revised by the introduction of new material, the elimination of old material and the alteration of the order of presentation. This movement is officially fostered by the Dept. of Superintendence of the National Education Association.

Numerous private schools have lately sprung up which are frankly experimental. These have come to be known as progressive schools. For the most part they have been inspired by the educational philosophy of John Dewey. They have been quick to take up and test under the most favourable conditions any methods, materials or plans of organisation that muster substantial scientific support. Devices that have proved successful in the progressive schools constantly find their way into the more conservative public institutions.

Experiments in Reorganising the Educational System.—The typical organisation of the American system consisting of an eight-year elementary school, a four-year high school and a four-year college, with entrance upon professional study coming either at the end or in the middle of the college course, has long been criticised. The several institutional units are the product of diverse influences, mostly foreign. The welding of them into a system was largely accidental. It is generally believed that the period devoted to secondary education is too short, that it should begin earlier and that secondary education should embrace much of the present content of the college curriculum. Educators commonly hold that with a rational organisation of the system and with an altered and condensed curriculum, time can be saved and educational results improved.

Two experimental movements looking toward the accomplishment of these reforms are now well under way. One of these involves the reorganisation of the elementary and secondary schools and has come to be known as the junior high school movement, or the six-three-three plan. Where junior high schools have been established the elementary school course is generally reduced to six years. This is followed by a junior high school course of three years, which in turn is followed by a senior high school course of three years. In theory the junior high school curriculum includes algebra, geometry, foreign languages, the social sciences and vocational subjects which were formerly reserved for the four-year high school. The practical difficulty which junior high schools have faced has been the absence of teaching materials in these branches appropriate for younger pupils. In spite of this handicap the establishment of junior high schools proceeds apace and numerous experiments in the production of materials are in progress.

At the other end of the conventional secondary school period another new institution is evolving, the junior college. The typical junior college offers the first two years of the usual college course, with certain modifications dictated by its local environment. There are (1926) between 200 and 300 independent junior colleges in the United States; the majority are private institutions but a large minority are attached to city school systems. Whether the junior college as a separate institution is a transitory phenomenon it is too early to say. Its appearance has had one noteworthy effect upon universities, however. It has led a considerable number of them to divide their colleges of liberal arts into junior and senior colleges and to organise the programme of instruction so that the end of the junior college period marks the completion of general education of a secondary character and the beginning of university specialisation. This tendency, together with the multiplication of junior colleges as upward extensions of public school systems, seems to point to the ultimate assimilation of the work of the first two years of the American college of liberal arts into the scheme of secondary education. (S. P. C.)

V. THE ARCHITECTURE OF SCHOOL BUILDINGS

Recent years have seen a complete change in the school design. Compactness, ease of supervision and convenience for the rapid movement of large numbers were the governing factors of the older type of plan; by eliminating corridors and placing the classrooms on three, or all four sides of a central hall, off which the rooms opened, the maximum amount of concentration was secured, while the head of the school had, from the central hall, an eye upon the door of every room. This form became stereotyped as the normal, but between 1905 and 1910 doubts arose as to whether this type of building was really so satisfactory. Good ventilation could not be secured in rooms having only one external wall, and such a plan made it impossible to secure the proper aspect for more than a few rooms.

The M Type Condemned.—These objections were raised from the point of view of health. The central position of the hall, serving as the access to the classrooms, seriously interfered with full use being made of it. Not only was any occupation liable to interruption, but any noise there interfered with the work in the adjoining rooms, the result being that in practice the hall was used for little more than the opening and closing of the school, while a room of this kind ought to play an important part in the general work of the school, and in fact was so used in schools that happened to have a hall separated from the classrooms. Thus the type of plan that had so long held the field had to give way. The rapidly growing recognition of the value of sunlight and fresh air, and the strikingly successful result of the open-air schools accelerated the remarkably rapid adoption of the newer type of school building. The greatly extended duties now laid upon the local education authorities in Great Britain with regard to the health of the children, and the feeling that they are as responsible for the physical as for the mental needs of the school child, imply that the conditions under which the work is carried on are hardly less important than the work itself and that, where necessary, educational convenience must be subordinated to the demands of health.

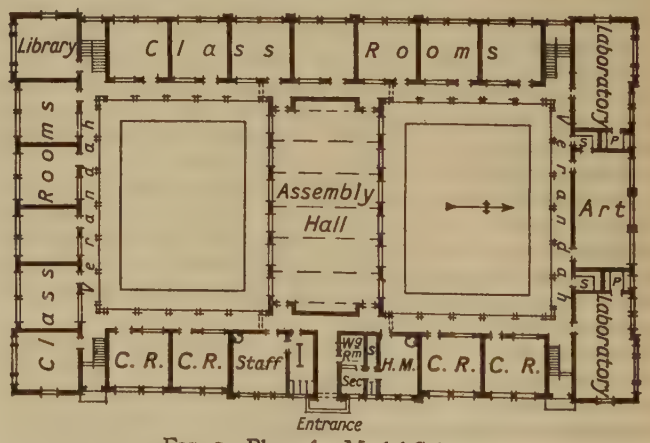

FIG. 1. Plan of a Model School.

The New Model.—In place of solid, compactly designed buildings of several storeys we find light, spreading, single-storey structures, often with radiating wings on the lines of a hospital, set to catch the greatest possible amount of sun, with every room cross-ventilated into the open air, windows opening so freely that practically the whole wall space can be cleared, or even so arranged that both sides can be thrown open; in short, the arrangement of the open-air school being adopted for the ordinary school.

In place of a common, stereotyped plan, schools are now built in an almost bewildering variety of arrangement. The essential features are the cross-ventilated classroom with a sunny aspect,

usually approached by an open verandah or low corridor, with classrooms on one side only, and the hall, so placed as to be neither a passage to the classrooms nor likely to cause inconvenience, is used for any purpose involving noise.

The illustration (fig. 1) shows a quadrangular arrangement that is widely made use of for large schools. The open verandah on the inside secures direct sunlight at some period during the day to the rooms whose main windows have a northerly aspect. For a smaller school all the rooms are placed to the southeast with the hall well out of the way at the back, or are arranged with radiating wings with the usual cross-ventilated classrooms. These single-storey buildings require a larger area of ground, but, where possible, large sites are generally secured in order to make provision for games, and the fact of their being of one storey makes it feasible to lighten the construction, while subsequent alteration or addition is easy. (G.F.N.C.)

EDWARD, PRINCE OF WALES (1894–), eldest son of King George V. and Queen Mary, at that time duke and duchess of York, was born June 23 1894, at White Lodge, Richmond Park, and baptised 23 days later by the Archbishop of Canterbury as Edward Albert Christian George Andrew Patrick David. In 1902 Mr. H. P. Hansell was appointed his tutor, and remained with him from that time until Aug. 1914. During 1902–7 the Prince was prepared for the navy, and in the spring of 1907 he entered Osborne, where he remained for two years before going on to the Royal Naval College, Dartmouth. While a cadet at Dartmouth he performed his first public duty on March 29 1911, by presenting to the mayor and corporation of that town the silver oar which they had held formerly as a symbol of the rights associated with the bailiwick of the water of Dartmouth.

At the close of his Dartmouth training in June 1911, he was invested as a Knight of the Garter, and on July 13 1911 he was created Prince of Wales and Earl of Chester, his father having just become King. About the same time the duchy of Cornwall was bestowed upon him. He was shortly afterwards invested as Prince of Wales in Carnarvon Castle, and on this occasion for the first time an English prince addressed the Welsh people in their own tongue. Shortly after this event the Prince became a midshipman, and was appointed to H.M.S. "Hindustan," in which ship he served for three months. During the spring of 1912 the Prince spent five months in Paris as the guest of the Marquis de Breteuil, during which period he was coached by M. Maurice Escoffier in the language and history of the country. In Oct. 1912 the Prince entered Magdalen College, Oxford, with Maj. the Hon. William Cadogan (10th Hussars) as equerry. At Oxford the Prince took part in the corporate life of his college and the usual athletic amusements of the undergraduates. He resided in college rooms, dined in hall or at one of the university clubs, and mixed freely with his fellow undergraduates. Some of his vacations he spent in European travel, visiting Germany twice, in 1912 and 1913, and Denmark and Norway in 1914. The Prince's university career was ended by the outbreak of the World War in Aug. 1914. On Aug. 7 he was gazetted to the Grenadier Guards, and on the 11th he joined the 1st Battalion at Warley Barracks, Essex.

In Nov. 1914 the Prince, who had been appointed aide-de-camp to Sir John French, arrived in France and took up his new duties at British G.H.Q. at St. Omer. During the next 18 months he served with the Expeditionary Force in Flanders and in France in various parts of the line, being first attached to the 2nd Div. under Sir H.S. Horne, to the I. Corps under Sir Charles Monro, and later to the Guards Div. under the Earl of Cavan. In March 1916 he was appointed to the staff of the general officer commanding the Mediterranean Expeditionary Force, and proceeded at once to Egypt. He took the opportunity of seeing the troops in various parts of the line, and also went as far south as Khartum. On his return journey he paid a visit to the Italian headquarters at Udine, and by the middle of June had returned to the British armies in France. He was then attached to the XIV. Corps (Lord Cavan) in Flanders and France and subsequently proceeded with this corps, in Oct. 1917, to the Italian front, where he remained till Aug. 1918. In May 1918 the Prince paid a semi-official visit to Rome; he then returned to France and was attached to the Canadian Corps, with whom he was serving at the time of the Armistice. He was attached to the Australian Corps in Belgium till the beginning of 1919 after which he visited the Army of Occupation on the Rhine, spending a few days with the New Zealand division, and paying a short visit to Gen. Pershing at the American headquarters at Coblenz.

On his return journey to England at the end of Feb. 1919 the Prince almost immediately took up a number of public duties which had of necessity been deferred during the War, and on May 29 was admitted to the freedom of the City of London. On Aug. 5 1919 he left Portsmouth in H.M.S. "Renown" for Newfoundland and Canada, first setting foot on Canadian soil on Aug. 15 at St. John, New Brunswick. His tour extended through the entire Dominion from east to west, and five days after reaching Victoria on Sept. 23 the return journey began. The Canadian tour ended at Ottawa, and on Nov. 10 the Prince left for Washington to pay a short official visit to the President of the United States. New York was subsequently visited, and after a long series of official engagements, the Prince sailed for Halifax, where he bade good-bye to Canada, reaching Portsmouth Dec. 1.

After a short stay in England the Prince sailed again in H.M.S. "Renown" on March 16 1920 for New Zealand and Australia. The first port of call was Bridgetown, Barbados, and then, passing through the Panama Canal, the Prince paid short visits to San Diego (Cal.), Honolulu and Fiji, Auckland being reached on April 24 after a voyage of 14,000 miles. A month was spent in New Zealand, all parts of the North and South Is. were visited, and on May 26 the Prince landed at Melbourne. During his stay in Australia he visited all the states of the Commonwealth, and eventually sailed from Sydney on Aug. 19. On the return journey he stopped at Fiji, Samoa, Honolulu and Acapulco, and, after passing once again through the Panama Canal, the Prince spent three weeks in the West Indies. The last port of call was Bermuda, and H.M.S. "Renown" eventually reached Portsmouth Oct. 11 1920.

After a brief holiday, spent for the greater part in the hunting field, he resumed his public duties after Christmas 1920. During the first six months of 1921 he was occupied chiefly in London, but found time to visit, among other places, Oxford, Cambridge, Glasgow and the Clyde; his property in Devon, Cornwall and the Scilly Is.; Cardiff, Newport and Bristol. On Oct. 26 he sailed in the "Renown" on a state visit to India, visiting Gibraltar, Malta (where he opened the first Maltese Parliament) and Aden, landing at Bombay Nov. 17. After several weeks in India, he sailed from Calcutta for Rangoon (Jan. 2 1922) and proceeded to Mandalay, returning thence to Madras (Jan 13). There, as previously at Bombay, some rioting occurred in the native quarters on the day of his arrival; but on the whole he was splendidly received, even though attempts were made by the Swarajists, with occasional success, to persuade the population to remain indoors. At Delhi on Feb. 14 he received an address from the Indian Legislature. After visiting the northwest frontier he eventually embarked at Karachi on March 7, sailing thence to Japan, touching on the way at Colombo, Port Swettenham, Singapore and Hong Kong, and reaching Tokio April 12. He remained in Japan till May 9 and on the voyage home visited Manila, Borneo, Penang and Cairo, reaching Plymouth June 20.

In April 1923 he paid a visit to Brussels in order to dedicate the monument of British gratitude erected in that city and subsequently revisited the battlefields in Flanders and northern France. On Sept. 5 he sailed for Canada on a private visit to his ranch in Alberta, returning to England Oct. 20. On April 23 1924, as president of the British Empire Exhibition at Wembley, he received King George at the opening ceremony. He was also present at the close on Nov. 1. In the meanwhile he had again spent a short time on his ranch in Canada; on his way there he visited the United States in a private capacity, in order to witness the international polo matches, and took the opportunity of calling on President Coolidge, with whom he had luncheon at the White House. During 1923–4 he visited

various industrial areas, including West Yorkshire, Birmingham, Newcastle-on-Tyne, Nottingham, Dundee, North Wales and the Potteries district.

On March 28 1925 he sailed in the "Repulse" for West and South Africa. Landing at Bathurst April 4 he visited in turn Gambia, Sierra Leone, The Gold Coast and Nigeria. Leaving Lagos on April 22, he reached Cape Town April 30, and after a short stay proceeded through the Cape Province and into the native territories of the Transkei. His journey was continued through the Orange Free State, and at Maseru he was greeted by 50,000 Basuto horsemen. During his stay in Natal he opened a new dock at Durban and was there welcomed by 23,000 Indians. He went through Zululand, Swaziland and thence to Pretoria and Johannesburg, where he opened the University of the Witwatersrand; then via Mafeking and the Bechuanaland Protectorate he travelled to Buluwayo and Salisbury.

On the return journey to Cape Town he visited Kimberley. After spending three months in South Africa he sailed July 29 for South America, having accepted an invitation conveyed to him in 1924 by the president of the Argentine Republic, to visit that country. Touching only at St. Helena for two days, he arrived at Montevideo Aug. 14. After three days spent in Uruguay, he reached Buenos Aires Aug. 17, stayed for a time in the capital, and made one or two tours in the country, including a journey of 1,500 miles to the cattle-raising districts in the provinces of Entre Rios and Corrientes. He crossed the Andes into Chile, visiting Santiago and Valparaiso, and after some delay, owing to avalanches of snow in the mountains, returned to Buenos Aires. Sailing from Mar del Plata for England Sept. 27, he touched at the Cape Verde Is. Oct. 8 and reached Portsmouth Oct. 16. In 1926 the Prince underwent a slight operation for ear trouble which temporarily interfered with his public duties.

EDWARDS, ALFRED GEORGE (1848–), first Archbishop of Wales, was born at Llanymawddwy Nov. 2 1848 and was educated at Jesus College, Oxford. He was ordained in 1874, and in 1875 became warden and headmaster of the college at Llandovery, holding this position until 1885, when he was appointed vicar of Carmarthen. In 1889 he was chosen Bishop of St. Asaph. In 1920, after the disestablishment of the Welsh Church, of which he had been one of the most active opponents, he was elected first Archbishop of Wales, and was enthroned by the Archbishop of Canterbury at St. Asaph's Cathedral, June 1.

Among his publications may be mentioned *The Church in Wales* (1888); *Common Sense Patriotism* (1894); and *Landmarks in Welsh Church History* (1912).

EGGLESTON, GEORGE CARY (1839–1911), American journalist and author (*see* 9.17), died in New York April 14 1911.

EGYPT (*see* 9.21), a kingdom of northeast Africa. The international boundaries of Egypt were completed in Dec. 1925, by an agreement between the Egyptian and Italian Govts. defining the western frontier. This starts from the Mediterranean 10 km. north of Sollum, takes a southwesterly and southerly direction, excluding the oasis of Jaghbub, and then in latitude 29° 21′ joins the 25th meridian, which it follows southward until it meets the 22nd parallel, this being the boundary between Egypt and the Anglo-Egyptian Sudan. The eastern land frontier approximates to a straight line, joining Rafah on the Mediterranean, to 'Aqaba on the gulf of that name. The total area of Egypt thus defined is 386,000 sq. miles. Population (1917) 12,750,918; (1925, estimated) 14,000,000.

I. POLITICAL HISTORY

The policy of entrusting the Egyptians with larger administrative responsibility was initiated under Sir Eldon Gorst, who succeeded Lord Cromer in 1907. The four years which elapsed before his premature death were too few for a fair trial of an experiment which stimulated rather than discouraged nationalist agitation. In Feb. 1910 Boutros Ghali Pasha, the first Copt to attain the rank of Prime Minister, was assassinated by a young member of the party. Nationalist influence also invaded the Assembly, which rejected a proposal to extend the concession of the Suez Canal Co. after its expiry in 1968. More drastic measures became necessary to check anti-British manifestations. Gorst, who had long been failing in health, requested to be relieved of his functions in July 1911 and died within the month. His knowledge of the country lends special importance to his report for 1910, in which he recognised that the new policy had failed.

Kitchener in Egypt.—It seemed doubtful whether the appointment of a former servant of the Egyptian Govt. to be British representative in Cairo was opportune, but an exception was justifiable in the case of Lord Kitchener, who enjoyed great prestige. He arrived in Sept. 1911. A fortnight later the Italian landing in Tripolitania followed a declaration of war with Turkey. The neutrality of Egypt was declared and strictly observed by the Egyptian people in spite of a natural sympathy with a Moslem belligerent. But Islamic sentiment was roused by the Libyan War, and early in 1912 a plot was detected to kill the Khedive, the Prime Minister and Lord Kitchener.

Kitchener's energies were first directed to the needs of the peasantry, and small holdings were exempted from distraint for debt. But the salient measure of his administration was a revision of the organic law of 1883 and the institution of a single Legislative Assembly on a broader basis than that of the old Legislative Council and General Assembly, both of which had practically the same functions. The new Assembly, with 55 members returned by indirect election, received extended powers, including that of initiating legislation. The president and one vice-president were appointed by the government. For the second elective vice-president Zaghlul Pasha, recently Minister of Education and acknowledged as leader of the Nationalists was chosen. He at once attacked his former chief, Mohammed Said, who had succeeded Boutros, and indirectly the British Agency in a Chamber which the Khedive encouraged to be hostile. Tension with the palace then led to the resignation of Mohammed Said. He was succeeded by Husein Rushdi Pasha, who remained in office till the end of 1918.

The War Period.—After the change in the status of Egypt which followed the outbreak of the World War, the sittings of the Assembly were suspended and not resumed before its mandate expired. Lord Kitchener was on leave when Great Britain became a belligerent, and having been appointed Secretary of State for War, he did not return to Egypt. Martial law was proclaimed in Egypt on Nov. 2 1914. This enabled administrative measures to be enforced without reference to the Assembly and, where foreign subjects were concerned, without obtaining the consent of foreign Powers. A further proclamation, notifying a state of war with Turkey, announced that Great Britain would not call upon the Egyptian people for aid. Units of the Egyptian artillery nevertheless volunteered to defend the Suez Canal, and Labour Battalions, voluntarily raised, played an important part in the War.

As the Egyptians were nominally subjects of the Sultan, the entry of Turkey into the War created an intolerable situation. Turkish suzerainty might have been terminated by a British annexation of Egypt, but that policy was rejected, and a proclamation issued on Dec. 17 1914 by the Secretary of State for Foreign Affairs announced that:—

> In view of the state of war arising out of the action of Turkey, Egypt is placed under the protection of His Majesty and will henceforth constitute a British Protectorate. The suzerainty of Turkey over Egypt is thus terminated and His Majesty's Government will adopt all measures necessary for the defence of Egypt and protect its inhabitants and interests.

A further proclamation issued the following day announced that the Khedive, Abbas Hilmi, who was in Constantinople, was deposed on the grounds of adherence to the King's enemies, and that his uncle, Prince Husein Kamel, had accepted the succession and would bear the title of Sultan of Egypt. The new status was introduced without disturbance if without enthusiasm under the direction of Sir Milne Cheetham, pending the arrival of Sir Henry McMahon, who had been appointed High Commissioner. The British Representative then took over the control of Egyp-

tian foreign affairs. After the abortive Turkish attack on the Suez Canal, the prestige of the Sultan increased, but the failure in the Dardanelles produced some reaction and in 1915 his life was twice attempted. The Egyptian people, however, bore with patience the disabilities and unwelcome requisitions which the War entailed, and thus laid Great Britain under obligations, both moral and financial, for which too little credit was given.

On the other hand the withdrawal of British officials for service elsewhere opened a wider field for Nationalist propaganda, which found ready listeners among the younger men who had not known the pre-occupation conditions. Nationalist sentiment had from the first received an anti-British impulse from rivalries among the western Powers, and it was at one time exploited by the Khedive for his own personal ends. A dissatisfied civil service regarded the growing number of British officials as a bar to promotion and Nationalist ranks were reinforced by the students, whose prospect of obtaining state employment was diminished by foreign competition. A professed intention to train Egyptians to manage their own affairs seemed inconsistent with a constant increase of British officials, disproportionate even to the expanding activities of the departments. These, moreover, had tended to absorb administrative functions and not merely to advise. As their number grew, they became a separate community living aloof from Egyptians, and with loss of contact their moral influence diminished. The strength acquired by the Nationalist movement during the War was not sufficiently realised.

At the end of 1916 Gen. Sir Reginald Wingate, Sirdar and Governor-General of the Sudan since Dec. 1899, replaced Sir H. McMahon as High Commissioner. The declining health of Sultan Husein made a settlement of the succession urgent. His only son, Prince Kemal ed Din, declined the position of heir-apparent, which was then offered to the sixth son of Ismail, Prince Fuad, who had been educated at the military school at Turin. Sultan Husein died in Oct. 1917. It was a misfortune for Egypt to lose a ruler remarkable for his character, public spirit and thorough knowledge of his own country.

End of the War.—The principles formulated by the President of the United States towards the close of the World War had a far-reaching effect on educated opinion in Egypt. Numerous disclaimers by British statesmen of any intention to occupy the country permanently were insistently recalled, and the acceptance of the principle of self-determination was represented as having given international sanction to the aspirations of Egyptians to govern themselves. Their attitude during the War was made a plea for special consideration. When in Nov. 1918, an Anglo-French declaration announced that the Allies contemplated the enfranchisement of the peoples oppressed by Turkish rule, Egyptians regarded their title to manage their own affairs to be even stronger than that of Syria, Mesopotamia or of Arabia, where an independent kingdom had already been established.

Public opinion was at the same time excited by the indiscreet publication of a document which was held to indicate the British attitude toward the re-organisation of the Legislative Assembly. Sir W. Brunyate, the judicial adviser who acted as financial adviser during the illness of Lord Edward Cecil, had mooted the question of the participation of the foreign colonies in legislation, if capitulations were abolished, in a memorandum submitted to the Prime Minister, which was only intended to serve as a basis for confidential discussion. It was represented as a British design for restricting the Assembly to consultative functions and for vesting legislative power in a Senate in which the officially nominated members with a group of elected foreigners would form a majority.

At the end of 1918 a Nationalist Committee was formed under the chairmanship of Zaghlul. His proposal to proceed to England with a programme of complete autonomy was inevitably rejected. At the same time Sir R. Wingate pleaded with insistence for the reception in London of Rushdi Pasha and Adly Pasha Yeghen, the Minister of Education. As the Foreign Secretary was about to start for the Peace Conference and unable to devote due attention to Egyptian internal affairs, the Ministers were begged to defer their visit. Rushdi and Adly, however, tendered their resignations and, though they were pressed to reconsider their decision, the crisis remained unsolved when Sir R. Wingate was summoned to London to make a personal report. By this time many Moderates had rallied to the Nationalists, who were receiving such general support that the Ministers were unwilling to remain in office or to go to London unless Zaghlul were also heard, a condition to which his defiant attitude made it difficult to accede. Meanwhile, the constitution of a "Delegation" with 12 members under Zaghlul's presidency was announced to the foreign representatives. The delegation forwarded to the Sultan, who had declined to receive them, a petition clearly designed to intimidate His Highness and prevent the formation of a new government. Zaghlul and three of his most important adherents were consequently arrested March 8 1919 and deported to Malta.

The Outbreak of March 1919.—The immediate effects of this measure revealed the gravity of the internal situation in Egypt, which had probably been under-estimated. Anti-British demonstrations in Cairo necessitated military intervention. There were disturbances at Tanta and in the Delta provinces where British soldiers and civilians were attacked. Railway lines were torn up, telegraph wires cut and by the middle of March, Cairo was isolated. Foreign colonies were blockaded in Upper Egypt, and at Dairut station a British inspector of prisons, two officers and five other ranks were brutally murdered in the train by a fanatical crowd. Mobile columns were rapidly despatched to disturbed areas, communications were re-established and before the end of March the situation was well in hand. The Nationalist leaders had probably not contemplated such a serious upheaval, which was nevertheless the direct result of their propaganda. The Egyptian Police behaved throughout in an exemplary manner. The Egyptian Army which, all but a few units, was in the Sudan, remained unaffected.

With these exceptions the agitation was supported by every class including the Copts, whose solidarity with the Mussulman was no doubt prompted by prudential considerations. If the movement was only partial among the peaceful unchanging fellaheen it was nevertheless perceptible that their experiences during the War had stirred a spirit of discontent even in the class which had benefited most from the British occupation. Recruiting for the Labour and Camel Corps had not been unpopular in the earlier volunteer stage. But when voluntary enlistment ceased to produce a sufficient number of men some administrative compulsion was exercised by unscrupulous mayors who, alleging British insistence, accepted bribes for exemptions and sent their enemies to serve. The requisition of domestic animals had pressed hardly on the small farmer and still more so that of cereals. Requisition rates, lower than market prices, tempted local officials to collect more than the quotum demanded and to sell the balance. Processes of verification and repayment were inevitably slow and offered opportunity for abuses. The cost of food, clothing and fuel rose in an unprecedented manner and the average wages of the labouring class did not expand correspondingly. Meanwhile the producer of cotton and the privileged foreigner were notoriously accumulating fortunes.

When the outbreak became serious, Lord Allenby, the commander-in-chief in Egypt, who had left for Paris, was directed to return at once as Special High Commissioner during the absence of Sir R. Wingate. After the restoration of law and order a phase of passive resistance succeeded that of aggression. A general strike was only maintained for a few days, but students, lawyers and a number of officials declined to resume their activities. Lord Allenby, however, adopted a policy of conciliation, and a removal of the embargo on the free movement of Egyptians entailed the liberation of Zaghlul and his associates. They left Malta for Paris, where their efforts to obtain a hearing at the Peace Conference were disappointed. Early in April Rushdi succeeded in reconstituting a Ministry with Adly at the Interior but, finding himself impotent to terminate the official strike, he resigned barely a fortnight later. Only a stern proclamation from the commander-in-chief, acting under the powers of martial law, which threatened with dismissal all officials who did not resume duty, had the desired effect.

The Milner Mission.—The British Govt. now decided to send a mission to Egypt under the chairmanship of Lord Milner, "to enquire into the causes of the recent disorders, and to report on the existing situation in the country and the form of the constitution which, under the protectorate will be best calculated to promote its peace and prosperity, the progressive development of self-governing institutions and the protection of foreign interests." It would have been well if the mission could have proceeded at once before the Nationalists had completed an organisation which was now receiving encouragement from sections of the Arab University of El Azhar. But circumstances rendered its departure before the autumn difficult. After some delay, Mohammed Said Pasha (Prime Minister 1910–3) formed an Administration. Changes in the British personnel were also regarded as opportune. Sir Paul Harvey, who had resigned the position of Financial Adviser under Lord Kitchener, returned. Sir W. Brunyate, who had acted in that capacity since the death of Lord Edward Cecil, also resigned his judicial advisership. Mr. Douglas Dunlop was replaced at the Ministry of Education by Mr. R. S. Patterson, Director-General of Accounts, and Brig. Gen. Sir J. F. Clayton became adviser to the Interior.

A period of drift followed during which the Nationalists zealously applied a boycott of the mission. Capital was also made out of an alleged intention to curtail the water supply of Egypt in favour of the Anglo-Egyptian Sudan. The project actually adopted contemplated the construction of barrages at Jebel Aulya and Sennar, on the White and Blue Niles respectively, to create a reservoir which would enable the waste lands of Egypt to be redeemed and extend perennial irrigation to some 1,200,000 ac., which under basin irrigation produced only one crop a year. The Sennar dam would feed a canal to irrigate the region south of Khartoum known as the Gezira, which was eminently suitable for cotton. Unjustified attacks by Sir W. Willcocks and Col. Kennedy on Sir Murdoch Macdonald, adviser to the Public Works Dept., gave encouragement to misrepresentation and rendered inevitable a prosecution for criminal libel which resulted in conviction. The proposal to boycott the mission moreover gained strength from the attitude of the Prime Minister, who resigned when his protest against its despatch before the signature of peace with Turkey was disregarded. Wahba Pasha, the Minister of Finance, courageously undertook to constitute a Ministry of Affairs.

The special mission which reached Cairo on Dec. 7 1919 was thus composed: Viscount Milner, Chairman; Sir J. Rennell Rodd, Gen. Sir John Maxwell, Brig. Gen. Sir Owen Thomas, Sir Cecil Hurst and Mr. J. A. Spender with A. T. Loyd and E. M. B. Ingram as secretaries. Special measures had been taken for their safety in view of an organised antagonism, in which even the Cairene ladies took a demonstrative part. Pickets of students watched their hotel, and individual members were followed into the provinces. A visit to Tanta provoked riots in that city. During the residence of the mission in Cairo, there were repeated assaults on British soldiers and no less than three attempts to assassinate Egyptian ministers with bombs. The chiefs of El Azhar now openly identified themselves with the Nationalists in a manifesto addressed to the High Commissioner. Innumerable letters and resolutions were received denouncing the protectorate.

A declaration issued on Dec. 29, in which the real objects of the mission were clearly stated, had some reassuring influence. But relations with Egyptians were restricted to informal discussions with individuals who had the courage to be independent. As time went on, however, such conversations became general and the mission found no difficulty in estimating the current feeling in the country. The chief British officials were consulted as well as representative members of the non-official community. The working of every department was thoroughly investigated, while Sir Cecil Hurst devoted much time to an examination of the judicial system and the reforms which new conditions might entail. Some days were spent in Alexandria, where the views of the foreign colonies were heard. Sir John Maxwell and Sir Owen Thomas also visited the Sudan. Before the departure of the mission, in March 1920, a large volume of material had been assembled, and certain proposals, unanimously adopted, were provisionally drafted pending the preparation of a final report in England.

Negotiations with Zaghlul.—Shortly after their return occasion was taken, through the good offices of Adly Pasha, to enter into relations with the Egyptian Delegation then established in Paris which, it could no longer be doubted, represented a majority of Egyptian opinion. Zaghlul, with seven other delegates, came to London in June. Meanwhile Wahba Pasha, whose health proved unequal to the strain of office, had resigned and was succeeded by Tewfik Pasha Nessim. After deliberations extending till the middle of Aug., in which Adly also took an unofficial conciliatory part, a memorandum which came to be known as the Milner-Zaghlul agreement, was drafted. It adopted the basis of settlement proposed by the special mission, a treaty of alliance in which Egypt contracted definite obligations in return for the recognition of independence, with certain additions such as the acceptance in principle of the rights of Egypt to foreign representation. Any reference to the Sudan was specifically excluded. As Zaghlul and his colleagues were not prepared to commit themselves to definite agreement without consulting their supporters, four members of the delegation proceeded to Cairo. The substance of the memorandum may be summarised as follows:—

To establish the independence of Egypt on a secure and lasting basis it is essential to define precisely the relations between Great Britain and Egypt and to modify the privileges and immunities actually enjoyed by capitulatory Powers. Negotiations between accredited representatives of the two governments should contemplate: a treaty of alliance between Great Britain and Egypt under which Great Britain will recognise the independence of Egypt as a constitutional monarchy with representative institutions, and Egypt will confer upon Great Britain the rights necessary to safeguard her special interests and to enable her to give foreign Powers guarantees which will secure relinquishment of capitulatory rights: Great Britain will defend the integrity of Egyptian territory, and Egypt will, in case of war, render Great Britain all assistance in her power within her own borders. This treaty will stipulate that Egypt will enjoy right of representation in foreign countries, and in absence of an accredited representative confide her interests to the British representative; Egypt will not adopt an attitude inconsistent with the alliance, or enter into any agreement with a foreign Power prejudicial to British interests; Egypt will confer on Great Britain the right to maintain a military force on Egyptian soil for the maintenance of her Imperial communications; Egypt will appoint with the concurrence of H.M. Government a financial adviser, who will take over powers now administered by the Commissioners of Debt and will be generally available for consultation; Egypt will similarly appoint a British official in the Ministry of Justice, with access to the Minister, to have cognisance of all matters affecting foreigners and be available for consultation regarding maintenance of law and order; Egypt will recognise right of Great Britain to intervene should legislation operate inequitably against foreigners; the British representative will enjoy a special position and precedence; engagements of British or other foreign employees may be terminated by either party within two years after treaty comes into force with pension or compensation to be determined therein.

Further provisions dealt with maintenance of existing treaties, validation of measures taken under martial law, reorganisation of mixed tribunals, closing of consular courts, etc.

Zaghlul and his colleagues once more met the mission in Oct. 1920, after the return of the four delegates from Egypt. The latter reported that the proposed settlement had been well received At the same time they had been urged to invite modifications of certain points, including a restriction of the functions of the financial adviser and the official attached to the Ministry of Justice. The mission held that no good purpose could be served by further discussion at that stage. Zaghlul, whom several members of the delegation regarded as too intransigent, insisted that his efforts to promote a settlement might be compromised if he could give no undertaking regarding the abolition of the protectorate. The delegates then left England and the mission forwarded a report to the Secretary of State on Dec. 29 1920, which was presented to Parliament as Egypt No. 1 (1921).

At the beginning of 1921 Adly Pasha had a strong following in Egypt and Zaghlul's influence appeared to be diminishing. On the other hand the resignation of Lord Milner was regarded as an indication that H.M. Govt. might not endorse the recommendations of the mission, while a reference in a speech from the new Colonial Secretary to Egypt as included in the elastic circle of the British Empire, evoked a number of protesting telegrams.

When, however, the report was published in Arabic, the proposals were welcomed and the ascendancy of the Moderate party was re-established. The following invitation was then addressed to the Sultan of Egypt:—

His Majesty's Govt. after a study of the proposals made by Lord Milner have arrived at the conclusion that the status of protectorate is not a satisfactory relation in which Egypt should continue to stand to Great Britain. While they have not reached final decisions with regard to Lord Milner's recommendations, they desire to confer regarding them with a delegation nominated by Your Highness, with a view, if possible, to substitute for the protectorate a relationship which would, while securing the special interests of Great Britain and enabling her to offer adequate guarantees to Foreign Powers, meet the legitimate aspirations of Egypt and the Egyptian people.

Adly Pasha then formed a Ministry with a programme designed to secure the co-operation of the Nationalists. He invited Zaghlul, who had remained in France, to collaborate in forming a delegation. But the claims which the latter advanced for his party, which included the presidency and a majority of the members, were quite unacceptable. Zaghlul returned on April 5 and was received with enthusiasm. He lost no time in attacking the new Government. His philippics, and the weakness of the Administration in dealing with mob violence at Tanta, led to outbreaks in Cairo and Alexandria, directed in the latter city chiefly against the Greeks. A military court of enquiry attributed responsibility to the Zaghlulist party. Sixteen of the rioters found guilty were executed and a large number were condemned to lighter sentences.

Negotiations with Adly Pasha, 1921.—Six months had elapsed since the presentation of the Milner report before a delegation under the presidency of Adly, pledged to demand the abolition of the protectorate and the maintenance of the reserves formulated, proceeded to London in July 1921 to negotiate with Lord Curzon of Kedleston. In the ensuing conversations, all reference to the Sudan was avoided as it had been in negotiations with the mission, and the Egyptians appeared to have disinterested themselves in the abolition of the capitulations. Certain divergencies seemed capable of adjustment on a basis of compromise, while others, such as the control of foreign affairs, presented greater difficulty. But the negotiations, which were adjourned for some weeks and resumed in Sept., broke down completely on the military issue. The British Govt. were unable to give the delegation an assurance that British troops would withdraw towards the Canal zone as soon as conditions in Egypt were stabilised. Adly, while ready to accept the permanent establishment of a British military force to protect imperial communications, claimed that it should be restricted to a defined area in peace time, and that there should be no interference in the internal affairs of Egypt. A draft treaty, embodying conditions accepted by H.M. Govt. but unhesitatingly rejected by the delegation, was published on Dec. 2 1921, together with the letter to the Sultan in which it was forwarded.

Having failed to achieve a settlement, Adly resigned. The problem of finding a successor under prevailing conditions proved insoluble. The administration, though fortified by a number of British assistants, could not be carried on without the machinery of an Egyptian Govt., in default of which no real co-operation could be expected from Egyptian officials. The assent of H.M. Govt. to the restoration of an Egyptian Minister for Foreign Affairs, the revival of whose office might legitimately be regarded as a preliminary step to the modification of the protectorate policy, encouraged Sarwat Pasha in his efforts to form a Ministry. But they were unavailing. There was in practice an administrative strike.

A visit to Egypt of some members of the Labour party, while the London negotiations were in process, was followed by, if it did not actually stimulate, renewed activity on the part of the extreme Nationalists. Zaghlul himself attempted a progress through Upper Egypt but encountered such a hostile reception at Assyut that he abandoned the project. He continued, however, to agitate in Lower Egypt, where demonstrations assumed a menacing character after the publication of the note to the Sultan, and two British soldiers were shot. In view of their defiant attitude, Zaghlul and his chief supporters were ordered to retire to their country estates; as they proved recalcitrant, he and five others were deported by the British authorities.

Egypt Declared Independent.—The disturbances, which had taken a serious form in Cairo, were vigorously suppressed and by the end of the year (1921) conditions were favourable for a further endeavour to terminate a situation which could not be allowed to continue. No progress could be made until some form of settlement assured co-operation from the Egyptian element. H.M. Govt. were concerned not to surrender a position of vital importance to the Empire without adequate guarantee for the future. On the other hand repeated postponements and abortive negotiations had produced an internal situation in Egypt from which there was no issue save on the one hand by Draconian measures, or on the other by a voluntary abandonment on the British side of non-essential points. Lord Allenby therefore proceeded to London to lay the situation before the Cabinet. The following declaration was sent the Sultan on Feb. 28 1922:—

Whereas H.M. Govt. in accordance with their declared intentions desire to recognise Egypt as an independent sovereign state, and

Whereas the relations between H.M. Govt. and Egypt are of vital importance to the British Empire, the following principles are hereby declared:—

(1) The British Protectorate over Egypt is terminated and Egypt is declared to be an independent sovereign state.

(2) So soon as the Govt. of His Highness shall pass an Act of Indemnity with application to all inhabitants of Egypt martial law as proclaimed on Nov. 2 1914, shall be withdrawn.

(3) The following matters are absolutely reserved to the discretion of H.M. Govt. until such time as it may be possible by free discussion and friendly accommodation on both sides to conclude agreements in regard thereto between H.M. Govt. and the Govt. of Egypt: (*a*) the security of the communications of the British Empire in Egypt; (*b*) the defence of Egypt against all foreign aggression or interference direct or indirect; (*c*) the protection of foreign residents in Egypt and the protection of minorities; (*d*) the Sudan. Pending the conclusion of such agreements, the *status quo* in all these matters shall remain intact.

If the report of the special mission had convinced the British Govt. that the protectorate was not a relation which could be permanently maintained, the rejection of the general settlement then proposed had not rendered the situation more favourable. It had been established in the preliminary negotiations with the mission that agreement on the points reserved and certain others should be a condition of the recognition of Egyptian independence. The concession was now made unilaterally and the British postulates were to await an opportune time for discussion and solution. In the meanwhile, however, the *status quo* was maintained in so far as a British Army remained in occupation.

Sarwat Pasha was then able to form a Ministry with a programme contemplating a democratic constitution, ministerial responsibility and the revocation of martial law. After the British Parliament had approved the declaration of Feb. 1922, the Sultan assumed the title of King and proclaimed Egypt a monarchy. An Egyptian Minister for Foreign Affairs was once more appointed. The British Govt. informed the Powers that special relations between Great Britain and Egypt would always be maintained as an essential British interest. They could admit no question or discussion of those special relations, and any interference in the affairs of Egypt by any other Power would be regarded by them as an unfriendly act.

The constitution, drafted by a representative commission, was completed by Oct. 1922. H.M. Govt. took exception to the ascription to King Fuad in the draft of the title of " King of Egypt and the Sudan " as well as to other clauses referring to the latter region. Acute differences also arose between the Ministry and the King, whose views regarding the suitability of democratic institutions for Egypt seemed hardly consistent with his public utterances. Sarwat consequently resigned in Nov. and Tewfik Nessim became Prime Minister for the second time. A further obstacle to progress was presented by a series of outrages on British subjects, which culminated in the assassination in broad daylight of Prof. Newby Robson by three students. The Egyptian Govt. were informed that the continuance of these attacks would make impossible the abolition of martial law.

Events in 1923.—Tewfik Nessim was anxious to promulgate the constitution before announcing an Indemnity Act. But the King strenuously resisted a modification of his title, and a period of tension ensued which only ended after his signature of a document formally accepting the views of the British Government. Tewfik Pasha then resigned and an interregnum of five weeks followed, during which a recrudescence of murder and bomb-throwing rendered a severer application of martial law inevitable. Yehia Ibrahim Pasha finally formed an Administration which assumed office in March 1923. Shortly afterwards Zaghlul Pasha was released unconditionally from detention at Gibraltar to undergo a cure at Aix-les-Bains. Yehia's Govt. found themselves at once in conflict with the Sovereign, who had availed himself of the compliance of Tewfik Nessim to introduce modifications into the constitution, which would greatly have increased the authority and prerogatives of the Crown. The firmness of the Prime Minister secured their withdrawal and the constitution was promulgated on April 19 1923. The old Legislative Assembly ceased to exist and a new electoral law came into force.

The New Constitution.—A constitutional monarchy is thereby established with two Houses, a Senate and a Chamber of Deputies, and a Ministry responsible to the Lower Chamber. Deputies, 220 in number, are chosen by universal suffrage, under the old system of indirect election, for five years. The Senate cannot be dissolved. Two-fifths of its members are appointed by the Sovereign and three-fifths are elective, with a mandate for ten years. One half of each category are renewable every five years. A two-thirds' majority in each House is necessary for a revision of the constitution.

An Act of Indemnity prohibiting any process or plea calling in question acts under martial law was issued in July and that jurisdiction, continuously in force since Nov. 1914, was then terminated by a proclamation of the commander-in-chief and an exchange of notes between the British and Egyptian Governments. Yehia also carried through a law governing the retirement and compensation of foreign officials in the Egyptian service. After the abolition of martial law, Zaghlul and his associates were free to return to Egypt. Considerable enthusiasm was displayed on his landing at Alexandria and the coming elections proved that his influence was still predominant in the country.

The internal situation at the end of 1923 was not very reassuring. A revival of arbitrary action became manifest after the removal of direct British control, nepotism began to reassert itself and a general sense of insecurity prevailed. On the other hand the continual intrigues of the ex-Khedive Abbas Hilmi for the recovery of his throne had culminated in an attempted *coup d'état* which proved a complete fiasco. Vigorous efforts to repress the murder campaign had also been successful. A large number of students were arrested and three turned king's evidence. Of 14 who were tried, five were acquitted, three were sentenced to death, three to penal servitude and the remainder to lighter sentences.

Events of 1924.—When the elections to the Chamber of Deputies were completed in Jan. 1924, the return of 176 supporters gave Zaghlul an overwhelming majority. He was equally strong in the Senate. Yehia, who had deserved well of his country during the transitional period, resigned and Zaghlul formed a Ministry. The almost simultaneous advent to power of a Labour Govt. in England revived Egyptian hopes that the Sudan policy would be reconsidered. But a declaration made (June 25) in the House of Lords by Lord Parmoor that the British Govt. did not intend to evacuate the Sudan evoked violent protests from Zaghlul. Nor was the statement in the House of Commons by Mr. Ramsay MacDonald a few days later more encouraging, though he expressed the hope that the Egyptian Prime Minister would come to England to discuss the issue.

The latter, who was now completely master of the situation at Cairo, had repeatedly affirmed that he would only accept discussion on the basis of the incorporation of the Sudan in Egypt. In view of the unequivocal attitude of the British Govt. and Parliament, he tendered his resignation, which was, however, not accepted. When about to start for Alexandria, where the court was established for the summer, he was shot at and wounded by a young Egyptian who appeared to be of unbalanced mind and not closely connected with any political movement. He recovered quickly and proceeded to Europe to recruit his health.

Meanwhile Nationalist propaganda had transferred its activity to the Sudan, and disturbances, of which there had been some premonition a few weeks earlier, broke out (Aug. 9–11) at Khartoum, the Atbara post and Port Sudan. A proposal from Cairo for an Egyptian-Sudanese commission of enquiry elicited a firm reply from H.M. Government. The governor-general was alone responsible for order in the Sudan. Egyptian and other troops which were guilty of disaffection would be removed and replaced by such British troops as might be considered necessary.

After the recognition of independence, the Egyptian Govt. claimed an exclusive right of decision in certain international issues hitherto dealt with by the British Government. They declined to be bound by the result of negotiations undertaken in their behalf regarding the boundary of Cyrenaica and the possession of the oasis of Jaghbub, which the British Govt. proposed to regard as Italian territory in return for a rectification of frontier at Sollum.[1] Direct negotiations would therefore be opened with the Italian Government. They also contended that, having ceased to be a dependency of the Sultan, Egypt could no longer be held liable for the tribute to Turkey. As the tribute had been made the security for two Turkish loans, the disclaimer of liability presented serious difficulties. It was proposed that a conference of interested Powers should study the question or that it should be referred to the International Court at The Hague. After June 1924, moreover, the Egyptian Govt. ceased to make an annual contribution towards the cost of the army of occupation. This contribution had been fixed at £150,000 per annum by an exchange of notes in 1907.

Meeting of Prime Ministers.—A meeting between the British and Egyptian Prime Ministers eventually took place in London (Sept. 25–Oct. 3 1924), but it was fruitless in results owing to the inordinate pretensions of Zaghlul who, when once Egyptian independence became an accomplished fact, repudiated any obligation to reciprocal concessions. He was informed by Mr. Ramsay MacDonald that no British Govt. could divest itself of its interest in guarding the Suez Canal, for which security must be provided in any agreement between Great Britain and Egypt. Effective co-operation might have been established by a treaty of alliance. The British force to be maintained in Egypt would neither interfere with the functions of its Govt. nor encroach upon its sovereignty.

He adhered to the declaration made in the House of Commons that no arrangement which would jeopardise the administration and development of the Sudan could be contemplated. The British Govt. had the duty of maintaining order there, and there could be no question of abandoning the Sudan until the work of Great Britain was completed. At the same time the special interest of Egypt in the water supply was recognised as well as certain financial claims against the Sudan Government. These interests Great Britain was prepared to secure.[2]

The contrast between the two points of view was irreconcilable and Zaghlul's Govt. responded by replacing men of moderate opinions in the public service with uncompromising Nationalists. A phase of acute tension between Zaghlul and the Palace now became manifest and the King was openly accused of violating the constitution. At the same time a sense of preoccupation in Egypt at the indefinite prolongation of unsettled conditions was appreciable after the failure of negotiations with a Govt. the attitude of whose members in opposition had aroused unwarranted anticipations. The Minister of Finance, Tewfik Nessim, resigned, and Zaghlul himself, confident of evoking a renewed demonstration of popular support, also offered his resignation on the eve of the meeting of Parliament. The King, impressed by the unanimity of Parliament and popular opinion, refused to accept it.

[1] The agreement for the rectification of the frontier between Egypt and Cyrenaica by which the oasis of Jaghbub was recognised as Italian territory was signed on Dec. 6 1925.

[2] The results of these conferences are summarised in a despatch (Oct. 7) from Mr. Ramsay MacDonald. (Cmd. 2269 of 1924.)

Murder of Sir Lee Stack.—On Nov. 19 1924 Sir Lee Stack, the Sirdar and governor-general of the Sudan, was shot in broad daylight while driving through the streets of Cairo and his aide-de-camp was wounded. The assassination roused a storm of indignation in Great Britain. Rigourous measures were called for. The demands put forward by Lord Allenby (British Note of Nov. 22) were tantamount to an ultimatum. They required:—

1. An ample apology for the crime.
2. An enquiry into the authorship of the crime with the utmost energy and without respect of persons, and the condign punishment of the criminals, whoever and whatever their age might be.
3. The prohibition and vigourous suppression of all popular political demonstrations.
4. The payment forthwith to the British Govt. of a fine of £500,000.
5. The withdrawal from the Sudan within 24 hours of all Egyptian officers and the purely Egyptian units of the Egyptian Army with the resulting changes to be specified later.
6. Notification to the competent department that the Sudan Govt. would increase the area to be irrigated at Gezira from 300,000 feddans to an unlimited figure as need might arise.
7. The withdrawal of all opposition in the respects to be specified later to the wishes of the British Govt. concerning the protection of foreign interests in Egypt.

If these demands were not immediately complied with, the British Govt. would at once take appropriate action to safeguard their interests in Egypt and the Sudan.

The 5th and 6th of these demands being declared unacceptable, while an evasive answer was returned to the 7th, the British authorities took immediate action. The Egyptian Govt. were informed of instructions sent to the Sudan Govt. to effect the removal of all Egyptian officers and of the purely Egyptian units. The restriction of the irrigable area of the Gezira to 300,000 feddans would be regarded as no longer binding. At the same time the customs at Alexandria were occupied by a British force. Certain individuals under suspicion of conspiracy were arrested by the British but handed at once to the Egyptian authority. These vigorous measures inevitably led to the resignation of Zaghlul, who was replaced by Ahmed Pasha Ziwar, the president of the Senate, with a Ministry of moderate views. They lost no time in negotiating a settlement with the British Govt. which secured the evacuation of the customs, after which they were joined by Ismail Sidky Pasha. A mutiny in a section of the Sudanese troops at Khartoum which broke out at this moment was rapidly suppressed. The Egyptian Parliament was adjourned and finally dissolved at the end of 1924. An appeal which it had addressed to the League of Nations and to the parliaments of other countries for intervention remained without response.

Events of 1925.—The elections which followed the dissolution left the political situation uncertain. A new Union party (*Ittihad*), formed under the inspiration of the Palace, had for its object to draw away from Zaghlul's party, the *Wafd*, many of those to whom his intransigence had become distasteful, and while a number of his former adherents adopted the Union programme, others who stood as Independents professed their intention if returned of joining either the Unionists or the Liberals. On the reassembling of Parliament, however, Zaghlul defeated the ministerial candidate for the presidency of the Chamber by a majority of 40, and it became evident that the Independents had repudiated their undertaking to separate themselves from the *Wafd*.

In view of the support thus openly given to the leader whose policy has led up to the British ultimatum, the Ministry could only recommend the King to dissolve the newly elected Parliament. A commission under the chairmanship of Ismail Sidky, in which the Liberal element predominated, was then appointed to revise the electoral law so as to restrict the suffrage to Egyptians whose education and interests would render them less amenable to popular agitation. The opposition appeared for the moment disconcerted and disarmed, and Ziwar Pasha, the Prime Minister, was able at length to contemplate a cure in Europe, leaving the Administration in the hands of Yehia Ibrahim Pasha, the Minister of Finance. Lord Allenby took advantage of this period to retire from the high commissionership.

Sir George Lloyd, afterwards Lord Lloyd, was appointed to succeed him. By the time he arrived to take up his post the political situation threatened once more to become critical. During the absence of the Prime Minister, the influence of Nashat Pasha, the head of the King's privy cabinet, his most trusted adviser, became paramount. In promoting the formation of the *Ittihad* party his object had been to eliminate from power the Liberals, who were strenuously opposed to any extension of the royal prerogative. A plausible pretext having been found for the dismissal of the Minister of Justice, the Liberal colleagues of the latter tendered their resignation, as also did Sidky Pasha who was at the time in Europe. The Liberal Party, in return for Zaghlul's promise that the selection of candidates for the coming election would be made on a basis of administrative capacity, now entered into intimate relationship with the *Wafd*. But the promise made was not fulfilled, and at the meeting of the coalition on Feb. 19 1926, the solidarity of the opposition was seriously endangered. Zaghlul lost no opportunity of impressing on the Liberals, as well as on the *Ittihad*, their dependence upon his support. The collapse of the latter was marked by the transfer of Nashat to a diplomatic post—the first indication of the influence exercised by Lord Lloyd.

The General Election.—Meanwhile the Prime Minister took the wind out of Zaghlul's sails by announcing that the revised electoral law had been withdrawn and that elections would be held under the law of 1924; namely, by direct democratic representation. The meeting of the opposition consequently confined itself to passing resolutions charging Ziwar's Govt. with having violated the constitution by dissolving Parliament, an accusation for which there was in fact no legal justification. Despite their tactics the Liberals soon found themselves in the position of having paid a heavy price for an alliance which benefitted them not at all. Nevertheless, every attempt to induce other Egyptians to join the Cabinet in their place proved abortive. But if the prestige of this body declined that of Ziwar remained high. At the instigation of the opposition a certain number of omdas had refused to draw up the electoral lists under the revised indirect suffrage law; they were dismissed by Ziwar who on this and on several occasions showed courage in standing by his policy. And when he agreed to return to the *Wafd* electoral law of 1924, his promise that the elections should be held under the fairest possible conditions, was duly carried out. The elections which took place in May 1926 resulted in an overwhelming majority for the Nationalists who were returned with some 150 candidates against about 30 Liberals, 5 Nationalists, 20 Independents and 10 Unionists.

The efforts of the police authorities and the support which they received from Ziwar had succeeded by the beginning of 1926 in bringing before the Egyptian courts the remainder of the culprits responsible for the political crimes which had occurred in Egypt since 1920. The miscreants who still remained to be accounted for were brought to trial in May 1926. Among them were two members of Zaghlul's Government, Ahmed Maher formerly minister of education, and Mahmud Nekrashi, under-secretary of the interior. After unsuccessfully attempting to place the blame for the murder of Sir Lee Stack and others on the shoulders of a revolutionary society of their own organisation which had its head quarters in Khartum, the *Wafd* had for some time past made efforts to secure the acquittal of these two personages. To the consternation of the more moderate Egyptians and all foreigners, the trial at the end of May 1926 ended in their acquittal, but the verdict also involved, as a protest, the resignation of Judge Kershaw, the British member of the tribunal on the grounds that it had been given by his two Egyptian colleagues in defiance of the evidence brought before the court.

Prior to the elections, Zaghlul Pasha had several times announced that it was not his intention to form a Government himself. But this wise policy, apparently dictated by the unfortunate consequences which his previous term of office had had, was soon abandoned when the result of the elections and of the acquittal of Ahmed Maher and Mahmud Nekrashi were announced. His *volte-face* received immediate attention in London. During the first week in June the High Commissioner announced that the British Govt. would take steps to secure that a

similar miscarriage of justice was not repeated. Certain demands were presented, in this connection and upon sundry other points. They were made conditional upon Zaghlul assuming the premiership. But their effect was to induce him to return to his original decision, himself to remain in the background. So in his place Adly Pasha was requested by the King to form a cabinet in which three prominent Liberals and an Independent were included.

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II. EDUCATION AND PUBLIC HEALTH

Education.—The University Mosque of el Azhar is the largest and most important of seven well-endowed Moslem institutions in Egypt which provide instruction on traditional religious lines. There are also scattered throughout the country a large number of mosque schools conducted on the same basis. The teaching of Moslem religious law and the instruction of Sheikhs are carried on in two special schools. Steady effort has been directed to develop this indigenous structure without undermining it, not without success, particularly in the case of the last two schools. Upon it a modern system of education, with its primary, secondary and higher stages, and its provision for specialisation, has been imposed.

As elsewhere, the competing demands upon the taxpayer have restricted the funds available for purposes of national education. Until the change in 1922 of the status of the country the Govt's. consequent policy may be described as a general concentration upon the development and encouragement of mosque schools, and primary education and the maintenance of a few secondary schools in Cairo and Alexandria, intended to serve as nuclei and models for the conduct of secondary education by the local educational authorities (provincial councils), Moslem educational trusts and private enterprise. Since the school year 1922–3 there seems to have been a definite move towards taking over secondary schools and direct assumption of the development of secondary education by the state.

The provision of higher and general professional education has throughout been left to the state and effected in a series of separate schools under various Ministries. Some of these schools, notably the School of Medicine at Qasr el Aini, have acquired more than a local reputation; but the local demand for higher education is great and many Egyptian students go to Europe and America to obtain it.

The desirability of uniting the above institutions as faculties of a modern Egyptian university has long been under consideration, and was reported on favourably in detail by a special commission in 1921. Owing, however, largely to difficulties in securing suitable accommodation and to differences in regard to means of government and methods of teaching, the realisation of the project has been continuously delayed. Although these difficulties have only been partially overcome, the formal and administrative incorporation of the specified higher schools to constitute a university was enacted by royal decree in March 1925. (E. M. D.)

PUBLIC HEALTH

All the capital towns of the muderias (provinces) have now been furnished with up-to-date water supplies, either of filtered or of deep well-water, besides many other of the larger towns. As efficient water supplies were installed, water-carriage drainage followed, and it was found that main drainage systems had to be undertaken in order to prevent the land becoming sewage-logged. Drainage systems have now been installed in Cairo, Alexandria, Port Said, Suez, Tanta, El Mansura and Kafr ez Zaiyat, and schemes are under consideration for Zagazig and Damietta. Establishments coming under the law dealing with "établissements insalubres, incommodes et dangereux," which corresponds roughly to the British Factory Acts, are now registered and are visited by special inspectors. A new "milk law," controlling the collection, distribution and sale of milk, and laying down standards for the fat-content, etc., has been drawn up. A "pure food law" is (1926) under consideration.

Very great progress has been made in the prevention and control of epidemic disease. Plague, both bubonic and pneumonic, has been reduced to practically negligible proportions, only a few hundred cases occurring annually over the whole country. The whole organisation for the prevention and combating of cholera epidemics has been remodelled and, although infection has frequently been brought into the country from infected areas, cholera has been prevented from developing into epidemic form, partly owing to an excellent system of port control, under which cases can be traced from the port of arrival and put under observation in their own homes. Typhus and relapsing fever have been combated on modern lines, and by means of careful delousing of patients and contacts the number of cases in the country have been enormously reduced. Systematic vaccination with revaccination in infected areas has now reduced smallpox to an almost negligible quantity.

In 1918 an Anti-Malaria Commission was instituted, on which the irrigation and main drainage and public health departments are represented, and a great deal of work in draining and filling in swamping areas has already been completed in districts known to be malarial. Active campaigns have now been started against ankylostomiasis and bilharzia, and travelling hospitals and dispensaries are at work throughout the country treating the infected peasants.

A large number of ophthalmic hospitals have been built and opened throughout the country, and there is now a permanent ophthalmic hospital in every provincial capital. The Imperial War Graves Commission have built an ophthalmic research laboratory as a memorial to the men of the Egyptian Labour Corps and Camel Transport Corps who gave their lives in the World War. A new general hospital of modern design has just been opened at Damietta. Dispensaries now exist in all the Markaz towns and free medical treatment is given to the poor. A new pharmacy law has been promulgated, as also a law controlling the importation and sale of stupefacient drugs. Under the new law, firms importing cocaine operate under licence, and are to all intents and purposes rationed.

A number of children's dispensaries (welfare centres) and maternity homes for the poor have been opened all over the country during the period under review. There is now a children's dispensary and maternity home in practically every muderia. The death-rate, though considerably reduced during the period under review, is still high. This is very largely owing to the high infantile mortality. (W. Ha.*)

III. ECONOMIC AND FINANCIAL HISTORY

Area and Population (*see* 9.21).—The cultivable area, as now developed, covers some 12,000 sq. m., excluding the fringe of still unreclaimed maritime lakes. In addition to the navigable use of the main irrigation waterways, the cultivated area is well served by networks of broad- and narrow-gauge railways, of telegraphs, of telephones and of roads. The four former have been perfected, and the majority of the roads built since 1910. Except after unusual rain the road system, which includes the larger canal banks and is for the most part unmetalled, provides very serviceable ways for motor traffic, now fast extending in all forms.

It is, however, the development of the irrigation system and especially its steady extension of the margin of cultivation in the Delta, the completion of the conversion of some 40,000 feddans[1] south of Cairo from single to double crop production, and the reduction to a negligible figure of the 90,000 feddans previously in constant danger of being rendered entirely unproductive by a low flood, made possible by the construction (1902) and heightening (1912) of the Aswan reservoir and the building of the Asyut (1902) and Isna (1909) barrages, that more particularly mark the improvement in Egypt's economic resources during the period 1911 to 1925. Further improvement depends upon the execution of storage works on the upper reaches of the Nile now under construction or consideration.

But although Egypt's economic progress would have been impossible without these great developments of her natural advantages, it is the unremitting industry of her agricultural peasantry, stimulated by light and equitable taxation, by the establishment of a great measure of public security and economic freedom, and by care for the public health, that has been the motive force which has turned all these favourable conditions to such remarkable account since 1885. Private and public wealth was gradually built up thereby from impoverishment and bankruptcy, and provided funds which enabled the use of the cultivable area to be progressively extended and a greatly increased population to be supported. In 1882, when the first modern census was taken, the population was 6,800,000 or about 570 to the sq. m. for the most part living and regarded, in their own expressive phrase, as cattle. The population in 1925 was approximately 14,000,000 or about 1,170 to the sq. m.: and in spite of much squalor, difficult to remove under deltaic conditions,

[1] By Law No. 9 of 1914 three measures of length, one of weight and one of capacity are defined in terms of the metric system. These are respectively the dira' baladi = 58 cm., used for textiles; the dira' ma'mari or pic = 75 cm., used by architects; the qasaba = 355 cm., used for agricultural land; the dirhem = 312 centigrammes; and the ardeb = 198 litres.

The derivatives most commonly used and quoted abroad are the feddan = 1·038 ac. and the qantar = 99·05 lb. Cotton prices are regularly quoted in Egyptian dollars of 200 millièmes, per qantar. These can be converted with close approximation into pence per lb. by halving. Otherwise the metric system is used and understood.

the general advance in independence and standard of life has been even more striking. With an area closely corresponding to that of Belgium, the cultivated area of Egypt now supports very nearly twice the population, and is probably the richest and most densely populated land of its size in the world.

Owing to the absence of appreciable rainfall, except along the northern coastline, 98% of Egypt's large territory is desert, supporting a population of under 100,000, and only of economic importance for the production of a certain amount of building stone, road metals and minerals. The camel still constitutes the essential means of desert travel; but the use of the motor-car is increasing and its employment may be expected to extend steadily as bad places are made passable. During the War railway connection with Palestine was effected across Northern Sinai and has since been maintained.

Mines.—During the 20th century a systematic effort has been made by the Egyptian Govt. to facilitate mineral discovery and development. The geological survey of the country, started in 1896, has been steadily pursued ever since; while some 10 years later, standard mining licences and leases were substituted for monopolistic concessions of mineral rights over extensive areas, which closed such areas to general prospecting and only involved tenuous obligations. The mineral output from 1907 to 1924 expressed in millions of metric tons includes 1·7 of petroleum, 1·1 of phosphate rock, 0·6 of manganese ore; while 58,000 oz. of fine gold and £E.55,000 worth of peridots were also extracted.

Currency.—Before the World War the monetary system of Egypt was on a gold monometallic basis, the nominal unit being the Egyptian pound subdivided into 100 piastres and 1,000 millièmes. The British sovereign was legal tender at the rate of 975 millièmes, and constituted the real basis of the system. The notes of the National Bank of Egypt were current to a limited extent, but were not legal tender, being payable in gold on demand. At the outbreak of War the international circulation of gold stopped, and it was found necessary to make these notes legal tender and relieve the bank of the obligation to pay them in gold on demand. It was, however, arranged that adjustments of cover to the note issue could be effected in gold or securities in London, while all the local banks were authorised to deposit or withdraw cash in London against deposit or withdrawal of notes in Cairo. The Govt. and the bank co-operated loyally and effectively, and the Egyptian public rapidly accustomed themselves to the use of notes and the disappearance of gold. The measures taken worked admirably and their effect is still operative. They stabilised the sterling exchange at par throughout the War and provided a steady currency which adjusted itself automatically and without any disturbance to all subsequent requirements. Egypt has now returned to a gold basis, but the notes of the National Bank of Egypt remain inconvertible for internal circulation.

Cotton and Foreign Trade.—The gross returns of Egyptian foreign trade since 1911 are given in Table I., and a comparison of its distribution in 1913 and 1924 among the principal countries concerned in Table II. With the exception of Turkey, those countries whose political boundaries have been radically altered in the interval have been excluded in the second table. Egypt's disposable wealth for purposes of foreign trade is predominantly represented by the value of her cotton exports, as reference to Table I. will show. Although these exports satisfy only about 4% of the world's consumption, the length and strength of the best Egyptian fibre enables it to command a marked premium in price over practically all other cottons. It is this virtual monopoly of the finest cotton and the great rise in the price of cotton generally which have set the scale of Egypt's leap into prosperity. No reliable analysis can be given of the amount of the total payment annually remitted by other countries to Egypt for her cotton, which represents this premium: but its importance and the seriousness of the loss if Egyptian cotton did not possess the advantage mentioned can be gauged from Tables I. and III.

While the premiums quoted are simply indices of the relative demand for Egyptian and American standard cottons in the market of the most important outside purchaser, the maintenance of the higher quality of which they are the reflection is of outstanding importance to Egypt, as otherwise her cotton would become a satellite of American and follow its price levels. While Egypt's primary economic interest is thus the maintenance of the present pre-eminence in the quality of her cotton, the danger that this advantage may be discounted by a falling off in quantity also calls for serious attention. As Table III. illustrates, the general statistics of the crop have indicated for a long time past that there has been a steady diminution in the yield per feddan. But even assuming the dependability and equal weight of the statistics throughout, there have been important disturbing factors at work, which make it advisable to accept with caution as yet the deduction that the culture of the cotton plant is, for one or other reason, generally less successful than it used to be. Among such factors may be mentioned the extension of cotton culture into less fertile districts and the cultivation of varieties, such as Sakellarides, which appear to combine better quality lint with lower yield. (*See* COTTON.)

TABLE I. *Annual returns of value of imports and exports in millions of £E.*

Year	Imports	Exports	Exports Cotton, Cotton Products[1]	Year	Imports	Exports	Exports Cotton, Cotton Products[1]
1911	27·3	28·9	26·4	1919	47·4	75·9	69·1
1912	25·9	34·6	32·0	1920	101·9	85·5	79·4
1913	27·9	31·7	29·2	1921	55·5	36·4	31·5
1914	21·7	24·1	21·4	1922	43·3	48·7	43·7
1915	19·4	27·0	22·0	1923	45·3	58·4	54·3
1916	31·1	37·5	32·3	1924	50·7	65·7	61·4
1917	33·2	41·1	36·1	1925	58·2	59·2	55·2
1918	51·2	45·4	40·8				

[1]This includes cotton, raw cotton, cotton seed, cotton seed cake, cotton seed oil, cotton yarn, cotton waste and grey piece goods manufactured in Egypt. No re-exports are included.

Apart from raw cotton, the only other exports of importance are cottonseed, cottonseed oil and cake, manganese ore, phosphates, raw flax and wool, cigarettes and eggs. The chief imports in 1924, together with the value of each expressed in millions of £E., were cotton piece goods, 8·8; wheat flour, 2·3; coal, 1·6; woollen and worsted clothes, 1·0; and kerosene, 1·0.

General Review, 1910–25.—In response to world demand, approximately from 1902 onward the price of Egyptian cotton increased greatly, so that the country became rapidly and, so far as any effort of its own was concerned, fortuitously enriched. This fortuitous accession of wealth led to a speculative boom in Egyptian affairs, which was succeeded by a sudden and complete slump in 1907. The reaction was inevitable, and was in no way due to any setback in the yield or price of the staple product of the country; but it left the latter with a load of unproductive debt which constituted a new and heavy charge upon its production. During the next seven years two tendencies were in conflict. On the one hand a succession of abundant cotton crops realised at good prices tended to add steadily to the wealth of the country: on the other the pressure of indebtedness and the insidious practice of seeking relief in further debt operated to impoverish it.

The immediate effect of the outbreak of war was to reduce the price of cotton by a third and thus deprive the country at a stroke

TABLE II. *Distribution of foreign trade in 1913 and 1924 expressed in thousands of £E.*

Country	Imports from				Exports to			
	1913		1924		1913		1924	
	Value	%	Value	%	Value	%	Value	%
Belgium	1,100	4·0	1,898	3·8	100	0·3	285	0·4
France	2,300	8·3	4,689	9·2	2,800	8·9	8,614	13·1
Germany	1,500	5·4	2,947	5·8	4,000	12·6	3,972	6·4
Great Britain	7,700	27·6	13,994	27·6	13,500	42·4	31,956	48·6
Greece	500	1·8	922	1·8	50	0·2	405	0·6
India	500	1·8	1,781	3·5	30	0·1	216	0·3
Italy	1,400	5·0	5,231	10·3	1,000	3·2	4,069	6·1
Japan	. .	. .	973	1·9	. .	. .	1,509	2·3
Russia	900	3·2	810	1·6	2,200	7·0	75	0·1
Switzerland	130	0·5	638	1·3	1,000	3·2	2,299	3·5
Turkey	1,900	6·8	827	1·6	500	1·6	142	0·2
United States of A.	500	1·8	1,799	3·6	2,500	7·9	7,086	10·7
Other countries	9,435	33·8	14,227	28·0	3,982	12·6	5,106	7·7
Totals	27,865	100·0	50,737	100·0	31,622	100·0	65,734	100·0

of the increased income it had enjoyed for some 12 years previously. The sudden diminution of the country's purchasing power reacted severely on economic activity, imports fell off heavily, many debts were left undischarged and even gold hoards were dispersed. As elsewhere, emergency measures were taken. A general moratorium was proclaimed, advances were extended to cultivators on their cotton and the notes of the National Bank of Egypt were decreed legal tender and inconvertible. These and

TABLE III. *Average annual return of production and value of cotton crop for groups of seasons*

Group of Seasons	1895–6 to 1901–2	1902–3 to 1906–7	1907–8 to 1913–4	1914–5 to 1920–1	1921–2 to 1925–6
Planted area in millions of feddans	1·1	1·4	1·7	1·6	1·7
Crop in millions of qantars	5·9	6·3	7·0	5·6	6·5
Yield in qantars per feddan	5·2	4·4	4·2	3·6	3·8
Average price pence per lb.: American middling	4·3	5·9	6·8	14·8	14·4
Egyptian[1] standard	5·8	8·8	10·0	27·0	22·0
Premium per cent of Egyptian	35	49	47	82	53
Value of crop in millions £E.	12·6	20·2	26·2	42·3	45·2

[1] Fully good fair Brown till 1916–7; fully good fair Sakellarides 1917–8 onwards.

other measures could, however, only be palliatives operating to reduce the shock of an economic setback which would have been very serious if it had continued.

Fortunately the price of cotton, stimulated by the demand for War purposes, gradually recovered until by the end of 1915 it again reached its pre-War level. The conversion of Egypt into a huge British military base for the Near Eastern theatre of war and the paradoxical political connection between the two countries, which characteristically gave Egypt the benefits of being on the winning side without the financial drain of actual belligerency, combined with the demand for Egyptian cotton, completed the economic rescue and converted it to prosperity.

Thus the maintenance of Egypt as a great base involved considerable expenditure on labour, military works, supplies and commodities of all kinds, which was defrayed by the British Govt. or by the troops themselves, and materially contributed to the financial recovery of the country. It caused the British Govt. to provide and ensure the import of the coal necessary for the working of the railways, of the water supply, lighting and sewage systems of the towns, and of the thousands of irrigation pumps on which the cotton, food and fodder harvests largely depend. It necessitated the protection of the maritime routes to Egypt and brought large volumes of shipping to her ports, which greatly facilitated the export of cotton and the import of food, fuel and other necessaries. These favourable conditions continued throughout the War, and were accompanied by a steady increase in cotton prices and a great growth in the wealth of the country.

In the middle of 1919 the prices of Egyptian cotton soared in response to a feverish post-War demand and early in 1920 stood at more than 10 times the pre-War figure. Soon after reaching this peak, prices, in response to an abrupt cessation of demand brought about by the contemporary world crisis in production, fell as precipitously as they had risen, till in March 1921, they stood at little more than their pre-War level. The combined effect of the abnormal expansion in wealth when cotton prices were soaring and of the contemporary relaxation of War-time restrictions on transport is reflected in the record import and export returns for 1920. The shock of the subsequent sudden contraction of the national income to the pre-War standard was felt most severely by the landholding population, which was in a good position to stand it, having been able to accumulate profits practically untouched by taxation during the previous years. On the other hand, the general fall in prices brought relief to the classes which had suffered from the continuous increase in the cost of living. For the growth of the national wealth since 1914 had been most unevenly distributed, and was accompanied by extreme contrasts of ease and want. The poorer classes in the towns, and large numbers of officials and others on small fixed salaries or purely money wages had suffered severely.

The sudden fall in prices also caught the Govt. with large stocks of depreciated coal and cereals in its possession. For, as in other countries, the obligation to ensure essential supplies and partially to redress depreciation of the pay of public servants led the Govt. during the War to adopt special measures of food and fuel supply and in supplement of salaries. The liquidation of practically all these special liabilities and the reaction on public finance of the heavy fall in cotton prices fell into the working of the financial year 1920–1, which accordingly may most fittingly be held to terminate the War period for Egypt. She emerged from it, as reference to Table IV. will show, at a net cost to her public finances of just over £E.2,500,000; with moderately increased taxation and with greatly increased national wealth.

TABLE IV. *Summary of Public Finance, 1910–25, in millions of £E. in the pre-War, War and post-War periods*

Date and Period	Total Revenue over each period	Total Expenditure over each period	Reserve Fund	Consol. Debt[1]
Jan. 1910 to March 1914	72·8	73·7	6·4 5·1	95·2 94·1
April 1914 to March 1921	184·0	187·6	5·1 1·5	94·1 93·0
April 1921 to March 1925	151·5	127·4	1·5 25·6	93·0 92·2[2]

[1] Excluding the Ottoman Tribute Loans.
[2] Of which the Govt. and the Caisse de la Dette held 8·5 in March 1924.

In the above table revenue and expenditure are totalled for each period, and the reserve fund and consolidated debt for first and last years of each period are given. In reading the totals the unequal lengths of the periods must of course be considered.

While there have been important private losses, notably owing to investments in, and speculative purchases of, depreciated currencies, Egypt's economic position has been greatly fortified both absolutely, and even more relatively, as a result of the War and of the post-War stabilisation and recovery that followed. This is established by many indices covering the period 1910–25. Among these may be mentioned a great growth in Egypt's foreign trade, a great increase in bank deposits, a notable transfer of the Egyptian debt from European to Egyptian holders, the high level of Egyptian securities, a marked discharge of agricultural debt. Table I. illustrates the first, Table V. the last.

TABLE V. *Mortgage debts due to four leading Banks in 1911 and 1925 expressed in millions of £E.*

Bank	1911	1925
Crédit Foncier Egyptien	27·9	18·7
Agricultural Bank of Egypt	8·2	2·7
Land Bank of Egypt	3·5	4·2
Mortgage Company of Egypt	2·0	3·1
Totals	41·6	28·7

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EHRLICH, PAUL (1854–1915), German bacteriologist, was born in Silesia March 14 1854, of Jewish parentage. He was educated at Breslau and Strasbourg, where he studied medicine. He was soon drawn toward research in chemistry, and in his earlier years carried out various important investigations in aniline dyes. He was at the same time winning fame as a bac-

teriologist, and in 1907 discovered a red dye, known as "trypan red," which effected the complete sterilisation of animals infected with trypanosomes, a work of enormous importance for the treatment of diseases caused by these parasites. He considerably improved the technique of serum preparation, and also discovered a method by which the potency of the anti-diphtheria toxin could be tested. He also investigated the problems of cancer. Ehrlich's most famous discovery, however, was made in connection with his researches into venereal diseases. It was announced in 1910 that he had prepared an arsenical compound, known as salvarsan or "606," which was a cure for syphilis. He lectured in London in 1907, and in 1913 attended the medical congress held there. In 1908 he, together with Mechnikov, was awarded the Nobel Prize for Medicine. He received many honours from his Government and marks of distinction from almost every university and scientific society. He died at Homburg Aug. 20 1915.

See *Paul Ehrlich: eine Darstellung seines wissenschaftlichen Wirkens*, Festschrift zum 60. Geburtstage des Forschers (1914).

EINSTEIN, ALBERT (1879–), German-Swiss physicist, was born of Jewish parents at Ulm, Württemberg, May 14 1879. His boyhood was spent at Munich where his father, who owned electro-technical works, had settled. The family migrated to Italy in 1894, whilst Albert Einstein went to a cantonal school at Aarau in Switzerland. He attended lectures while supporting himself by teaching mathematics and physics at the polytechnic school at Zürich until 1900 and finally, after a year as tutor at Schaffhausen, was appointed examiner of patents at the patent office at Berne, where, having become a Swiss citizen, he remained until 1909. It was during this period that he took his Ph.D. degree at the University of Zürich and published his first papers on physical subjects. These were so highly thought of that in 1909 he was appointed extraordinary professor of theoretical physics at the University of Zürich. In 1911 he accepted the chair of physics in Prague, only to be induced to return to his own polytechnic school at Zürich as full professor in the following year. In 1913 his pre-eminence had become so evident that a special position was created for him in Berlin, director of the Kaiser-Wilhelm Physical Institute. He was elected a member of the Royal Prussian Academy of Sciences and given a stipend sufficient to enable him to devote all his time to research without any restrictions or routine duties. He was elected a foreign member of the Royal Society in 1921, having also been made previously a member of the Amsterdam and Copenhagen Academies, while the universities of Geneva, Manchester, Rostock and Princeton conferred honorary degrees on him. In 1925 he received the Copley Medal of the Royal Society and in 1926 the gold medal of the Royal Astronomical Society in recognition of his theory of relativity. He received a Nobel Prize in 1921.

Einstein's work is so important and has proved fertile in so many various branches of physics that it is not possible to do more than enumerate a few of the most salient papers. The work by which he is best known, the theory of relativity, was begun in 1905 with the publication of the restricted principle with its consequences (*see* RELATIVITY: SPACE-TIME). Though considered fantastic by many, it had secured fairly general acceptance in Germany in 1912, and was followed by the generalised theory in 1915. But Einstein's work has been by no means confined to such abstract questions. One of his earliest publications gave the complete theory and formulae of the phenomenon known as Brownian motion, which had puzzled physicists for nearly 80 years. He showed that the heat motion of particles, which is too small to be perceptible when these particles are large, and which cannot be observed in molecules since these themselves are too small, must be perceptible when the particles are just large enough to be visible, and gave complete equations which enable the masses themselves to be deduced from the motions of these particles.

Much of his time again was spent on the obscure problems usually combined under the heading "quantum theory." The importance of these has become more and more evident, and the difficulty of reconciling the apparently inevitable discontinuities of the product of energy and time which experiment indicates, with our accepted habits of mind, always had a peculiar fascination for Einstein. Sooner, probably, than anybody else he realised the far-reaching implications of the theory propounded by Planck. His paper on the variation of the specific heat with temperature, which appeared in 1907, was the first extension of Planck's fundamental hypothesis, and its verification in essentials is one of the most convincing arguments in its favour. Numerous other papers on molecular physics, including an experimental research on magnetism, appeared in the *Proceedings* of the Russian Academy of Science, the *Physikalische Zeitschrift*, the *Proceedings* of the German Physical Society, the *Annalen der Physik*, etc. (F. A. L.)

EISNER, KURT (1867–1919), Bavarian politician and writer, was born in Berlin May 14 1867. He became a journalist, and at an early stage of his career had the first of his many experiences of imprisonment because of the socialist tendency of his writings. He was successively on the editorial staff of *Vorwärts* in Berlin (1898–1905) and of socialist newspapers at Nuremberg and Munich. After the outbreak of the World War he turned against his old allies, the Social Democrats, and attacked them for supporting the War. Convicted of treason in Jan. 1918, he was released on account of his candidature for the Reichstag, and was in time to organise the mass meeting which was held at Munich on Nov. 7 1918 and resulted in the overthrow of the Bavarian monarchy. A Bavarian revolutionary government, with Eisner as its president, was established. He was opposed to the re-establishment of the federal system of the German Reich and to the election of a National Constituent Assembly. His revelations regarding Germany's responsibility for the War increased his unpopularity with the Bavarian reactionaries; and on his way to open the Bavarian Assembly on Feb. 21 1919 he was shot dead in the street by Count Arco. Among Eisner's various written works are *Psychopathia Spiritualis* (1892); *Eine Junkerrevolte* (1899); *Wilhelm Liebknecht* (1900); *Feste der Festlosen* (1903); and *Die Neue Zeit* (1919).

ELBE (*see* 9.161), a river of Central Europe. Under Article 331 of the Treaty of Versailles the Elbe from its confluence with the Vltava (Moldau) was declared international. The administration of its system was entrusted to an international commission composed of four representatives of the German riparian states, two of Czechoslovakia, and one each of Great Britain, France, Italy and Belgium. This commission drew up the Navigation Act signed at Dresden Feb. 22 1922 (League of Nations Treaty Series, vol. 26, No. 649, 1924). The commission has to provide for freedom of navigation and equality of treatment; to take decisions on complaints arising out of the application of the Act; to see that the navigable waterway is kept in good condition and to supervise improvements. Its jurisdiction may be extended, subject to the unanimous consent of the commission, by decision of the riparian state or states concerned. A supplementary convention signed at Prague Jan. 27 1923 laid down detailed regulations for navigation tribunals and for appeal.

Railway Competition.—The question of railway competition has become important. The railway practically follows the same route as the river and thus naturally competes with river-traffic. Moreover, before the War the German railways had granted exceptionally favourable tariffs to encourage railway transport from Saxony and Bohemia to Hamburg, in competition with the transport to Trieste. At the same time Saxon railways assisted shipping by granting special tariffs to traffic to or from Elbe ports in Saxony. The Peace Treaties prohibited Germany for a time from granting special tariffs to seaports, while maintaining the favourable tariffs to Trieste; Czechoslovak traffic was thus diverted. In 1920 the German railways introduced low rates for long distance traffic, and recently re-established exceptionally favourable tariffs for seaports, but not for the fluvial Elbe ports. The shipping companies have formed a combine, which since Dec. 31 1923 has applied only to downstream traffic. In 1924 a new common fluvial tariff was introduced for both the German and the Czechoslovak sections of the river, which introduced bills of lading at flat rates, applicable to the chief ports above Teschen

in respect of shipments consigned to Hamburg. The Elbe is divided into (1) the Czechoslovak zone, with fixed rates; (2) the Saxon zone, with rates varying according to whether the goods come from near the river or not; (3) the middle Elbe zone, with variable rates.

The results have been fairly satisfactory, and although the railways have captured part of the heavy goods traffic from the waterway, the waterway has secured the transport of certain classes of valuable goods. Statistics show that the proportion of shipments at Hamburg by rail to those by water in 1924 was approximately the same as before the War (1924: 64% by water, 36% by rail). Czechoslovakia has considerable interests in the Elbe navigation. The total quantity of goods exported from Czechoslovakia in 1924 amounted to 1,112,000 tons (321,550 tons of sugar). In addition 181,855 tons of timber were floated. The total tonnage entering the ports of Hamburg, Harburg and Altona from upstream was 3,023,833 tons. The total tonnage shipped upstream from these ports was 3,317,248 tons, of which 754,455 tons went to Czechoslovakia. (R. Rn.)

ELECTORAL LAWS, CHANGES IN (*see* 9.169).—A survey of the world's electoral laws since 1910 shows a steady democratic development, most marked since the end of the World War. The various implications of accepted democratic theory are swiftly on the way to complete legal consummation in almost every self-governing country in the world. The end, already in sight, is to make the franchise direct, equal, universal, with the minimum of property qualification, or none at all, to make the ballot secret, and registration simple. The universality of the franchise in any real sense has come to mean its extension to women. And further, in pursuit of the principle of equity of representation, the systems of proportional and minority representation have been adopted in many countries. The age at which the citizen is entitled to vote varies widely; in Soviet Russia and in modernised Turkey and in Argentina it is 18, in Germany and Switzerland 20, in Norway 23, in Italy and Denmark and Japan it is 25, in Great Britain a woman must be 30 before she is entitled to be registered.

Women's Suffrage.—The new European states, in whose composition the democratic doctrine was necessarily an essential ingredient, have given women the right to vote, with the exception of monarchial Yugoslavia. The European states which still deny the women the parliamentary franchise are Belgium, France, Greece, Portugal, Yugoslavia and Spain. It is curious to find France in this category, since she was the pioneer in the realisation of universal male suffrage. The many projects before the French Chambers have foundered against the Latin-Christian objection to women having aught to do but with domestic politics. In the United States the ratification, in 1920, of the 19th Amendment to the Constitution, put women on an equal footing with men. The amendment runs: "The right of the citizens of the United States to vote shall not be denied or abridged by the United States or by any state on account of sex. Congress shall have power to enforce this article by appropriate legislation." This clause has the more importance since the 17th Amendment, in 1913, commands the election of Senators by direct vote of the citizens. The Dominion Elections Act of 1920 gave women in Canada an equal right with men to vote. In Australia the female franchise is of date prior to 1910. South Africa has defeated several projects for women suffrage, in Argentina the Election law of 1912 gave the vote to males only of 18 years of age, and in Brazil political practice has excluded women from the franchise. Nor have women the suffrage in Japan. The Mexican constitution of 1917 gave the vote to all Mexican citizens: that is, to all over 21 if unmarried, and all over 18 if married.

Compulsory Voting.—The vote in Mexico is for all electors, not merely a prerogative, but a duty. If the duty is not fulfilled and that "without sufficient cause," then according to the constitution the right is suspended. This conception of the vote as a civic duty finds its counterpart in the recent enactments of compulsory voting for the Australian Commonwealth House of Representatives and Senate (1924), for the Queensland Legislative Assembly (1915) and in the Argentine Republic (1912) where the penalties are not strictly administered, and the Belgian compulsory vote enacted in 1896. The substance of the electoral laws of Great Britain, Germany, Japan and India have since 1910 undergone the most far-reaching alterations of all with the exception of Soviet Russia, whose system is based on a radically different principle, and Canada, where the Dominion Elections Act of 1920 laid down a Federal qualification overruling previous provincial legislation.

Changes in Various Countries

Great Britain.—In Great Britain the Representation of the People Act, 1918, cleared away the diversity of franchises then existing. Occupation as owner or tenant for six months is the basis of the franchise for both men and women of 21 in local government elections. A woman may receive a vote not as occupier in her own right, but as wife of a local government elector. The parliamentary franchise is, for men, based upon a six months' residence in a constituency; or upon six months' occupation of land or premises of not less than £10 yearly value. Holders of university degrees have a further vote. Women are entitled to vote where they are over 30 and entitled to be local government electors as occupiers, but their occupancy must be of £5 annual value. They may also be registered if they are wives of local government electors, but here the occupancy, again, must be of £5 annual value. They also have a university vote. Plural voting was restricted to two votes, inclusive of the university vote. Receipt of poor relief is no longer a disqualification for the local government franchise. The shortening of the registration period to six months, and the institution of two registers per year substantially decreased the existing evil of disqualification through industrial migration. In 1917 there were 8,357,000 men on the registers. In 1923 there were 10,449,820 men and 7,831,583 women. The Act also regulated the maximum amount of election expenses allowable. In counties expenses are at the rate of 7d. per registered elector, in boroughs 5d.

Germany.—The German constitution of 1919 swept away the three-class and indirect systems of elections of the various German states and substituted a system of equal and direct suffrage throughout the entire Reich, for imperial, state and municipal elections. Proportional representation was also instituted, and, its execution necessitating large constituencies, resulted in a redistribution of seats which rectified the crying political injustice done since 1867 to the populous parts of the country. The system was enacted in detail in the law of April 1920.

Japan.—The growing potency of the democratic idea in Japan in the last quarter of a century, immensely quickened by the War, and marked by some 15 attempts at substantial electoral reform, gained a partial reward in 1920, when the direct-tax qualification was reduced from 12 to 3 yen. The electorate was thereby increased from about 1,500,000 to 2,800,000, and this had expanded to 3,500,000 by 1925. In that year an electoral law regulated the franchise with greater approach to completeness. Male suffrage was enacted for all over 25 resident in their constituency for six months prior to registration, and with their own means of subsistence. The electorate increased to over 14 million.

India.—The Indian constitutional reforms of 1919 worked a small revolution in the electoral system and franchise opportunities in that country. The rules under section 7 of the Reforms Act (electoral rules for provincial legislative councils) and under section 23 (electoral rules for the Indian Legislature) are too detailed to be summarised here with any pretence to exactitude.

Proportional Representation

During the War, the neutral nations of Denmark (1915), Holland (1917) and Switzerland (1918) adopted the system of proportional representation for the Lower House of Parliament; and after the War, the system favoured in some cases by the necessity of making provisions for racial minorities was adopted for parliamentary and generally also for local, relations by Germany and Austria (1919), Italy (this was abandoned in 1921 under the Fascist régime), Luxembourg and Poland (1919), Czechoslovakia, Estonia, Latvia, Lithuania, Norway and Jugoslavia (1920). A similar development has been taking place in English-speaking countries. In Great Britain the Speaker's Conference on Electoral Reform of 1916–7 recommended a partial adoption of proportional representation for the House of Commons, extending to about one-third of the seats. This recommendation was rejected by Parliament, but the principle of proportional representation applies in university elections. The system is provided for parliamentary elections under the constitution of the Irish Free State. South Africa (1909) instituted proportional representation for municipal elections, but has rejected the system for the national representative assembly. Proportional representation has been introduced in Canada for some municipalities and in one provincial constituency, *i.e.*, the

city of Winnipeg, but projects for its national application have been rejected.

The alternative vote has been adopted almost universally in Australia. Argentina and Brazil have adopted systems of minority representation. France is not happy under its system instituted in 1919, because an unfortunate compromise has resulted in a hybrid régime of majority representation with a small and accidental element of proportional representation. The German system puts the power of organising the lists of candidates into the hands of the party machine, and "star" candidates carry in lists of mediocre colleagues.

Miscellaneous Matters

The Soviet Franchise.—The development of political representation so far indicated went along familiar paths. But the Russian system, as planned by the Bolshevik theorists, constitutes a startlingly new orientation. To the orthodox democratic theorists the vote itself was an abstract attribute of a theoretically perfect body of citizens, between whom there could be no discrimination at the polls. The integrated complex of material results likely to be consequent upon the exercise of the vote was rarely the impetus or the guide to reform. The granting of the vote was prior to the aim of the vote. The Bolshevik theory denies the validity of such political liberalism. It commences with a definite conception of the kind of state it wants, and proceeds to arrange its electoral system to bring about the desired result. The "non-workers" in Russia have not the franchise. This class includes all persons who hire others for profit-making purposes, those who have unearned incomes, merchants and middlemen, the satellite helpers of the bourgeoisie, monks and ministers of religion, and former police officials. All "working" citizens over 18 may participate in the elections. The second point in which the Soviet régime diverges from its contemporaries is in its denial of the principle of the direct representation of a constituency in the supreme legislative body. Popular consent in the Soviet system is attainable through the Councils, called soviets, established in the smallest town and rural districts; and thence by a process of pyramidical delegation, upwards through various district and gubernial congresses or soviets, to the all-Russian congress of Soviets. Elections take place annually, since short periods of election are deemed to intensify political activity and increase the vividness of the representative quality.

Economic Councils.—Economic councils centring in the Federal Economic Council (*das Reichswirtschaftsrat*), in Germany, embodied in Article 165 of the constitution, constitutes a system of representation of the citizens on the basis of their vocations, occupations or professions. It stands by the side of the Reichstag in an advisory capacity. It is the outcome of the idea of the representation of estates of the realm, and the acknowledgment of the importance of vocational groupings and the difficulty of obtaining a true micro-mirror of the weal and knowledge of the citizens by the old orthodox method of territorial representation.

Secret Voting.—Almost all countries now make provision for secret voting, with more or less careful regulations for ensuring their object. Some, notably Great Britain, the Dominions, the United States and Belgium, use the Australian ballot system, *i.e.*, ballots prepared by the state and distributed under proper supervision to the voter in the isolated booths. Others, like Argentina (1912), Italy (1912), France (1913–4) and Germany (1919) allow ballots, conforming to certain regulations to be distributed by the parties, and then a state-provided envelope is handed by the officials in the polling station to the voter in which to enclose his completed ballot paper. Hungary and Russia are exceptions to the rule of secret voting. In the former, by the electoral rules of April 1922, rural constituencies, numbering 200 out of a total of 245, are subject to open voting. In Russia the constitution and various decrees establish public voting, with a curious procedure. Voting takes place in specially convened "works" and "institutional" assemblies, and there is a "general" assembly for people outside these categories. Where the district is small there is a general meeting of all categories of voters. Here lists of candidates are publicly put forward by parties, trade unions or groups of electors. The electoral commissioners are not impartial. Being the agents of the Communist party, they invariably prepare and present the lists of candidates, and they are entitled to oppose the election of persons who have previously shown "incapacity" in office, and by order of the gubernial authorities may unseat those elected.

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ELECTRICITY: NATURE AND USES.—Reference should be made to the following articles: Atmospheric Electricity; Atom; Atomic Weights; Broadcasting; Chemistry; Dynamo; Conduction, Electric; Ether; Gases, Electrical Properties of; Isotopes; Magnetism; Matter; Photoelectricity; Quantum Theory; Rays; Relativity; Spectrum; Super-Power; Telegraphy; Wireless Telegraphy.

Remarkable progress has been made since 1910 both in the scientific study of electric and magnetic phenomena and also their application for technical purpose.

On the scientific side these advances have been closely connected with an increased insight into the nature of material atoms as electrical structures and our powers of interpretation of observed effects have been enhanced by the introduction into physics of a novel hypothesis called the Quantum Theory, originally suggested by Max Planck about 1900 to explain the distribution of energy in the spectrum but since found to have important applications in all atomic phenomena.

Electrons.—There is now but little doubt that the agency we call negative or resinous electricity exists in small, indivisible particles called electrons (*see* Electron) and that these are constituents of all material atoms. The mass of an electron is about 1/1800th of that of an atom of hydrogen and its electric charge (e) according to the careful determinations published by R. A. Millikan in 1913 is $(4{\cdot}774 \pm {\cdot}009) \times 10^{-10}$ electrostatic units. Thus 6·28 million billion electron charges are nearly equal to one coulomb or that quantity of electricity conveyed by one ampère in one second. The mass (m) of an electron is $0{\cdot}899 \times 10^{-27}$ of a gramme. The theory of atomic structure widely adopted at the present time is that an atom (*see* Atom,) comprises a central nucleus which is very small compared with its over-all dimensions and that round this circulate a number of electrons in various orbits. This view, originally suggested by Sir Ernest Rutherford in 1911, is called the nucleus theory of the atom and by the aid of the quantum theory has been developed of late years (in 1913) by Niels Bohr, Arnold Sommerfield and others in a manner which gives a plausible explanation of the properties of the atom in radiating and absorbing energy.

Protons.—The nucleus of the atom is assumed to be a structure built up of elements called protons, which are the units of positive electricity in the same sense that electrons are units of negative electricity. Since similar units repel each other the protons must be held together by electrons owing to the strong attraction between electrons and protons, but the protons outnumber the electrons in the nucleus and the total gravitative mass is almost entirely due to that of the protons, the electric charge on the proton being equal but opposite in sign to that of the electron but the mass nearly 1,800 times greater. On this theory the simplest atom is that of hydrogen, which consists of one electron and one proton revolving round their common centre of mass. In other words, the proton or unit of positive electricity is the nucleus of the hydrogen atom. In the nuclei of other atoms the number of protons in excess of the nuclear electrons is called the atomic number. In electrically neutral atoms the number of planetary electrons circulating round the nucleus in various orbits is also equal to the atomic number.

Isotopes.—The atomic weight of the atom is the sum of the weights of all the protons plus a small excess due to the electrons.

The true atomic weight is therefore an integer multiple, or nearly so, of the weight of the hydrogen nucleus. If the mass of the nucleus is increased by adding an equal number of protons and electrons to it the atomic weight is increased but the atomic number remains unaltered. Atoms of equal atomic number but slightly different atomic weights are called isotopes (*see* ISOTOPES) and many of the elementary substances, for example chlorine and mercury, are mixtures of isotopes. Hence the resultant or mean atomic weight is not always an integer multiple of that of the proton. It has been shown that the chemical properties of an atom depend more upon its atomic number than upon its atomic weight. There are, for instance, two kinds of lithium atoms of atomic weights 6 and 7 respectively, and two kinds of chlorine atoms of atomic weights 35 and 37, and ordinary chlorine gas is a mixture of these two varieties. The search for isotopes has been conducted of late with great success by F. W. Aston, employing a method devised by Sir J. J. Thomson depending on the deflection of the so-called positive rays in a vacuum tube.

Quantum Theory.—The theory of atomic structure now in vogue is that the planetary electrons circulate round the nucleus in elliptic orbits arranged in different planes. Niels Bohr in 1913 introduced the novel idea that an electron cannot revolve round its nucleus at any and every distance but only in certain distinct orbits called Quantum paths or stationary states and that when rotating in these orbits it does not radiate its energy. Also there is a relation between the dimensions of the possible orbits and between these and the nuclear electric charge. If the orbits are circular the radii of the successive orbits would be in the ratio of the squares of the integers 1, 2, 3, etc.; or 1, 4, 9—and the size would be inversely as the atomic number or charge on the nucleus so that the orbits would be more compact the greater the nuclear charge. Bohr's second principle is that an atom radiates energy only when an electron jumps from one orbit to another or falls back into an orbit from outside. These orbits reckoned from the inmost one are called the K, L, M, etc., orbits. An electron can be expelled or moved from one orbit to another by the action of X-rays or of ultra-violet light rays. When this happens the energy of the atom changes suddenly from one value, say A_1, to another, say A_2. When an electron falls back into an orbit it vibrates in settling down into its Quantum path and sends out radiation (*see* ELECTRIC RADIATION) of a frequency (n). This frequency is fixed by the equation $hn = A_2 - A_1$, where h is Planck's unit of action, an extremely important constant in modern physics, the numerical value of which according to recent work is $(6{\cdot}55) \times 10^{-27}$ (*see* QUANTUM THEORY).

The Rydberg Constant.—When a neutral atom has lost one or more electrons it is said to be ionised and when it takes back an electron and emits radiation this last consists of vibrations of one or more definite frequencies. The radiation can be examined spectroscopically by a prism or diffraction grating or, if of very short wave length, by the use of a crystal section as a grating in the manner devised by Laue and Bragg. Bohr was able in 1913 by the aid of his postulates above mentioned to arrive at a formula which enabled him to predict exactly the wave length or frequency (n) of the radiations emitted by a hydrogen atom, which consist of a series of lines in the visible spectrum called the Balmer series and also a series in the ultra-violet part of the spectrum called the Lyman series and again a series in the infra-red part of the spectrum called the Paschen series, all of which are predetermined by a formula $n = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$, where n_1 has respectively the value 1, 2 or 3 and n_2 the values 3, 4, 5, etc.; or 2, 3, 4, etc.; or 4, 5, 6, etc.; and R is a constant called Rydberg's constant. Bohr deduced as a consequence of his theory of stationary or non-radiative orbits that the Rydberg constant should have the value $2\pi^2 e \frac{m}{h^3}$ where e and m are the charge and mass of the electron and h is Planck's unit of action. Taking the measured values of these constants, viz., $e = 4{\cdot}774 \times 10^{-10}$, $m = 0{\cdot}899 \times 10^{-27}$ and $h = 6{\cdot}55 \times 10^{-27}$, we have $R = 3{\cdot}27 \times 10^{-15}$ which agrees closely with an observed value, viz., $3{\cdot}29 \times 10^{-15}$ of the Rydberg constant. This success of Bohr's theory is a strong indication that it has in it a large element of truth.

X-Rays.—Great attention has been given to the problem of the structure of the atomic nucleus. Röntgen discovered in 1895 the type of radiation called X-rays, and Ch. Barkla and others proved in 1904 that there are two kinds of X-rays, one consisting of pulses produced when electrons have their velocity suddenly changed and the other, called the characteristic radiation, produced when electrons strike a target of material substance and set some part of the atoms of that target vibrating very quickly, which radiation consists of two or more rays of short but definite wave lengths.

Spectrography.—H. G. J. Moseley, a young British scientific man who unhappily was killed in the World War in 1915, published in 1914 an account of a very important investigation in which he photographed the characteristic X-ray spectrum for various metallic elements by placing them as anticathodes in an X-ray bulb and employing a crystal as diffraction grating. He found that as the atomic number of the metal increased the wave lengths of the corresponding spectral lines decreased, so that the square root of the frequency is proportional to the atomic number or nuclear charge. This enables the position and atomic number of missing or undiscovered elements to be fixed and shows that the nuclear charge is an exact multiple of that of the hydrogen atom. This work, since Moseley's death, has been continued by M. Siegbahn and we therefore know the atomic number of all possible or known elements between hydrogen (=1) and uranium (=92) (*see* CHEMISTRY). R. A. Millikan has pointed out that the Lyman ultra-violet lines in the hydrogen spectrum are the X-ray radiations belonging to its innermost or K-orbit. The corresponding X-ray vibrations of uranium would have a frequency $92 \times 92 = 8{,}464$ times as great as hydrogen. We are therefore now acquainted with a range of X-ray radiation extending over about 6 octaves, using the term in its musical sense, below the shortest of the ultra-violet rays, of which last there are 5 octaves beyond the end of the visible spectrum. Beyond the X-rays there are 5 octaves of still shorter wave radiation commonly called the Gamma rays.

Infra-red Rays.—Extending beyond the red end of the visible spectrum there are 9 octaves of infra-red radiation overlapping with very short Hertzian waves, which last shade into the longer waves used in wireless telephony and telegraphy. The longer dark heat rays were isolated toward the end of the last century by H. Rubens and his co-workers by a method depending upon repeated reflection of heat by polished surfaces of certain materials, which reflection selects those rays which would be most strongly absorbed by the reflecting substance on transmission. Rubens called these the "Reststrahlen" or residual rays.

Hertzian (Short) Waves.—Up to the year 1911 such dark heat rays had been isolated and studied by Rubens, Nichols and R. W. Wood with wave lengths up to about $\frac{1}{3}$ mm. but there remained a considerable gap between these longest heat waves and the shortest Hertzian waves studied by Righi, Bose and others. In 1923 E. F. Nichols and J. D. Tear succeeded in creating by Hertzian methods electric waves only 1/100 in. or $\frac{1}{4}$ mm. in wave length and measured this wave length by a form of interferometer. The same appliances served to measure the wave lengths of Restsrahlen of 1/75 in. wave length. Hence Hertzian waves created by purely electrical methods have now been made of shorter wave length than known dark heat rays. More recently still A. Glacolewa-Arkadiewa in Russia (May 1924) has created Hertzian waves of only 0·082 mm. in wave length.

The Spectrum.—The work of the period 1910–26 has therefore filled in the gaps on the two sides of the visible spectrum (*see* SPECTRUM) and has made us familiar with a range of more than 60 octaves of radiation, extending from the shortest Gamma rays emitted by radium, which have a wave length near to one-fifteenth of a hundred millionth of a centimetre, up to the longest wireless waves of 20,000 metres or more in wave length. The evidence shows that all this radiation is electromagnetic in

nature and it travels through space with identical velocity of 3×10^8 metres per second.

Ether.—A question which has been much discussed is the nature of this wave propagation. Scientific opinion until a few years ago, was almost unanimous in describing it as a vibration of some kind in an imponderable space-filling ether. The celebrated Michelson and Morley experiment first performed in 1887, which seemed to show that the velocity of light was the same in all directions, was considered by many to prove that as relative motion of the earth in its orbit (about 30 km. per sec.) and an assumed stagnant ether could not be detected by optical means, doubt was therefore thrown upon the existence of any such medium. As a matter of fact all that this experiment showed was that this relative motion of the earth and the assumed ether *at the surface of the earth* was, as far as could be judged by the experiment, not greater than 7·5 km. per second. That is to say, a greater relative velocity could have been detected but not a much less. Recent prolonged experiments of the same kind in 1921 to 1924 performed at the Mount Wilson Observatory, U.S.A., by Prof. Dayton C. Miller and others show that there is at that elevation a difference in the velocity of light in different directions relative to the earth's orbital motion and ether of as much as 10 km. per sec. in certain directions. This suggests a partial drag of the ether by the earth which decreases with altitude. If, therefore, the experiment could be performed, say at the summit of Mount Everest, this difference might amount to much more than 10 km. per sec. and might even approximate to 30 km. per sec., and in such a case would demonstrate a motion of the earth relative to the ether.

Relativity.—Starting, however, from the assumption that relative motion of matter and ether cannot be detected and that the velocity of light is an absolute constant, independent of the motion of the observer or of the source of light, A. Einstein founded on it in 1905 his special theory of Relativity (*see* RELATIVITY), and in 1915 he promulgated the general theory of relativity in which a new and radical departure was made in the mode of viewing physical phenomena. Space and time were no longer to be regarded as separate entities or concepts independent of each other, but merely as modes of division of a single entity called space-time having four dimensions just as the two-dimensional plan and elevation of a house are not separate realities but only modes of viewing a section of a single solid thing of three dimensions. The ether, at any rate by some relativists, was then dismissed as an unnecessary hypothesis and the Newtonian concept of force regarded as a mathematical fiction, the observed effects being simply due to a curvature or distortion of the space-time in proximity to material substances.

The hypothesis of an ether seems, however, essential as a starting point for logical thought (*see* ETHER). If there are undulations in space through which radiation is passing, then there must be something which undulates. We know that there are two periodic vectors or directed quantities in a ray, the electric and the magnetic vectors, and these have directions in space and make that space physically different from places where the ray does not exist. Moreover, the radiation conveys energy and this exists in the space after it has left the radiating atom and before it reaches the absorbing atom. We cannot attribute these properties to mere emptiness and to speak of space as having properties is to endow it with reality equivalent to the hypothesis of an ether.

On the other hand, we cannot rightly attribute to the ether such qualities as elasticity or inertia, or earmark a portion of it and consider it as retaining identity during displacement or distortion. If it is hypothecated to explain the properties of matter, it must be in essential nature different from and more fundamental than the material substance, the powers of which it is invoked to explain.

Photo Electrics.—The properties of short wave radiation in causing discharge of electricity from metals by liberating electrons from their atoms and also ionising gases, have been much studied during the last 15 years and are described as photo-electric phenomena (*see* PHOTOELECTRICITY). The first observation was made by H. Hertz in 1887, who noticed that when ultra-violet light fell upon spark bells it promoted electric discharge.

In 1888 Hallwachs made the discovery that a negatively charged conductor of zinc or aluminium rapidly loses its charge when ultra-violet light falls upon it. This effect is better exhibited in the high vacuum. P. Lenard discovered that the velocity of the electrons emitted is independent of the intensity of the light and other observers found that the number of electrons emitted per second is proportional to the intensity. The speed of ejection of the electron increases with the frequency of the light.

In 1905–6 A. Einstein suggested that Planck's quantum theory must be valid in connection with photo-electric effects and proposed the equation $\frac{1}{2}mv^2 = hn - P$ where m and v are the mass and velocity of the ejected electron, h is Planck's constant, n is the frequency of the incident light and P is the energy necessary to liberate the electron from the metal. Ten years later this relation was fully established experimentally by R. A. Millikan, who made use of it to determine the value of Planck's constant.

The equation shows that unless the light has a frequency exceeding a certain limit, no photo-electric effect can take place; also that the more electropositive the metal, the greater the wave length of the liberating light can be, thus ultra-violet light is effective in causing electronic emission in the case of zinc but ordinary visible light in the case of potassium.

Properties of Gases.—The ionising power of X-rays was noticed soon after their discovery by the fact that they make gases electrically conductive when sent through them (*see* GASES, ELECTRICAL PROPERTIES OF). The remarkable thing is that a beam of X-ray does not ionise every atom in a mass of gas through which it passes. This extraordinary fact has been held to prove that the energy of light is not uniformly distributed over the wave front but confined to certain places. This theory, however, is quite inconsistent with the facts of interference of light. Nevertheless it is evident from photo-electric phenomena that radiant energy must be concentrated in some way in certain parcels, or quanta as they are called, the unit of energy for any frequency n being hn where h is Planck's constant. The vibrating atom radiates and absorbs only in integer multiples of this unit. No one has yet been able to reconcile this quantum theory of radiation with the classical wave theory of uniform distribution of energy over the wave front.

Conduction Phenomena.—Another department of electric research which has claimed much attention is concerned with electric conductivity especially in metallic conductors. It has long been recognised that the conduction of electricity through gases and liquids depends upon the atoms or molecules being ionised. A gas composed of electrically neutral atoms is a nonconductor. If, however, exposed to X-rays or ultra-violet light, electrons are separated from the atoms by a photo-electric action the atomic residues being left positively charged. Under the action of an electric field, these ions move in opposite directions and constitute an electric current through the gas.

The theory was originally suggested by Riecke and P. Drude, that the conduction of electricity through metals is due to a drift, under the action of impressed electro-motive force, of free electrons which exist and are moving irregularly in the interspaces between the metallic atoms. These electrons may therefore be compared with the molecules of a gas. When set drifting by an E.M.F. they collide with the atoms of the conductor and give up energy acquired during the motion from atom to atom. If we make the supposition that the velocity of free motion is much greater than that of the drift motion, which is equivalent to assuming that the electrons are moving with the same average kinetic energy that the gas molecules would possess at the same temperature, we can show that Ohm's law is fulfilled in that the conductivity will be dependent on the E.M.F. or current. Also if we postulate that heat conduction consists in an equalisation of electronic energy in a metal in which electrons are moving more rapidly in one part than in another, we can show that the Wiedemann-Franz law is predicted, viz., that the ratio of electric to thermal conductivity is constant and is proportional to the absolute temperature. In spite of these confirmations of

the theory there is the serious difficulty that the postulate of equi-partition of the heat energy between atoms and free electrons leads to a value of the specific heat which is much greater than that which is actually observed, and it would not decrease with temperature as the observed specific heat value does (*see* CONDUCTION, ELECTRIC).

Low Temperature Effects.—Very important experimental results have been obtained since 1911 by Kamerlingh Onnes at Leyden on the electric conductivity of metals at very low temperatures. Using liquid helium he was able to obtain temperatures down to about 1·5° K (absolute). It had long been known that the electric resistance of pure metals was greatly reduced by cooling in liquid air and hydrogen, but Onnes found that the resistance of a thread of pure mercury vanished completely at 4·1° K. Similarly, that of tin vanished at 3·78° K, lead at 7·2°K, thallium at 2·3°K. These metals became as he called it, "supra-conductive." Electric currents in such helium-cooled metals continue to flow without any impressed E.M.F. Thus in a lead ring, in which an E.M.F. has been created by drawing a magnet away from it, a current of 320 ampères flowed for 30 min. without 1% reduction in strength and in a cooled lead wire of 1,000 turns the current did not decrease 1% in an hour and would have been detectable for days.

Bridgman in the physical laboratory of Harvard University, U.S.A., has studied the effect of enormous pressures up to 12,000 atmospheres on the electric conductivity of metals. Usually, but not always, this great pressure increases electric conductivity by about 10%, but it is 40% for sodium, 70% for potassium and 25% for bismuth.

This electron theory of conduction has been chiefly developed by H. A. Lorentz and ably discussed by Sir J. J. Thompson, M. Planck, M. Wien and N. Bohr. Although it has much in it to commend it, there are many unsolved difficulties. If there are free electrons possessing inertia in the interspaces of the atoms of a metal, then if a rod of this metal is set moving longitudinally and suddenly stopped, the free electrons should lurch forward like passengers in a train when there is a collision. Experiments by R. C. Tolman and J. D. Stewart in the U.S.A. in 1916 have shown that there is an effect of this kind in a suddenly arrested moving coil of wire which is considered by H. A. Lorentz to give strong support to the electronic theory of electric conduction.

Atmospheric Electricity.—The ionisation of the earth's atmosphere by solar light or radiation or cosmic dust creates a state of electric conductivity in the upper air and gives rise to the effects of atmospheric electricity (*see* ATMOSPHERIC ELECTRICITY). These have been much studied of recent years as they are of great importance in long-distance wireless telegraphy. It is generally believed that the earth as a whole has normally a charge of negative electricity, though the source of this is obscure.

This charge is continually escaping or being neutralised by a downward flow of positive electricity from the air and it must therefore be renewed in some way. As we go up into the air, the positive potential increases at an initial rate of, roughly, 150 volts per metre rise but it varies very greatly with time and place. According to the measurements of Prof. C. T. R. Wilson this earth-air current is 2×10^{-16} ampères per sq. cm. or the total current for the whole earth is about 1,000 ampères and the total charge of the earth is some 700,000 coulombs. Rain brings down, in general, positive electricity, but sometimes negative. There is also a discharge of electricity between air and earth in the form of lightning. The nature of thunderstorms has been particularly studied of late years by Prof. C. T. R. Wilson. Although lightning is not frequent in temperate climates yet the number of thunderstorms taking place over the whole earth per day is very large and there is therefore a continual passage of electrons to and from the earth. The study of wireless telegraphy and also of aurorae has shown that there must be a highly ionised or conducting layer in the earth's atmosphere at a height, roughly, of 70 to 100 kilometres. There are, however, great differences in the state of ionisation on the sides of the earth turned toward or from the sun and great changes at places of sunset and sunrise and variations with the changes in the state of the solar surface. These cause corresponding differences in the facility with which wireless waves travel by day and night and in different directions. Also the incessant lightning discharges cause vagrant electric waves called "atmospherics" which are a source of great trouble in wireless telegraphy and telephony. (*See* BROADCASTING; WIRELESS TELEGRAPHY.)

Magnetism.—The subject of Magnetism has also engaged much attention since the year 1910. Even in spite of all the investigation which has taken place we are still in ignorance as to the true cause for the peculiar magnetic properties of three common metals, iron, nickel and cobalt. Remarkable alloys have been prepared of late years which are non-magnetic, though containing a considerable percentage of iron. In addition to the non-magnetic manganese steel (12% of Mn.) produced by Sir Robert Hadfield in 1882, there is now a non-magnetic cast iron prepared in 1920 by S. E. Dawson and Messrs. Ferranti containing 85% of iron, 5% manganese and 10% nickel. Certain nickel-iron alloys such as the 25% Ni. alloy can exist in either of two states, magnetic or non-magnetic, according to the previous heat-treatment. Again alloys have been prepared which are magnetic and yet contain no iron, such as the Heusler alloys of manganese, copper and aluminium.

Permalloy.—Perhaps the most notable magnetic discovery of recent years is the nickel-iron alloy prepared in the laboratories of the American Telephone and Telegraph, and Western Electric Companies, United States of America. It consists of 78·5% nickel and 21·5% iron. It has a magnetic permeability of 13,000 for nearly zero magnetic force, whereas the best soft iron has not more than 100–200. For magnetic forces not exceeding 0·05 C.G.S. units its permeability may reach 100,000 or more. The meaning of this is that for very weak magnetising forces or in very feeble fields this alloy, called permalloy, can attain a magnetisation hundreds of times greater than that of the purest iron. This alloy is being used for the "loading" or overwinding of submarine telegraph cables and the result is to increase the speed of signalling through the cable to two or three times that in a similar unloaded cable.

Magnetic theory has also been revised in the last few years. In 1922 Sir Alfred Ewing, whose researches on magnetism are classical, published an important paper suggesting fresh ideas on the process of magnetisation.

Structure of Iron.—The methods of examining the arrangement of atoms in solids by X-ray spectrography devised by Sir William Bragg and his son, Prof. W. L. Bragg, have been applied in study of the molecular structure of the various types of iron. This metal is now recognised by metallurgists to exist in two phases at least: called alpha-iron and gamma-iron. The form of crystal lattice in each is different. Alpha-iron is magnetic but gamma-iron is non-magnetic. There is, however, no definite relation between magnetic properties and crystal lattice structures so far as at present known.

TECHNICAL ADVANCES

Hydroelectrical Progress.—The advances in the technical application of electrical science must next be noticed. In the period 1910–26 great progress has been made in the erection of stations for generating electric current on a very large scale. These stations are either hydroelectric, that is, derive their power from falling water, or are steam driven by boilers and engines consuming coal as fuel. In a few cases internal combustion (Diesel) engines are used. As regards type of current generated they are either direct current or else single-phase or three-phase alternating current supply. For large scale transmission of power for factory supply or traction, the generation and transmission are by three-phase current and it is then converted by rotary convertors or mercury arc rectifiers into direct current (*see* DYNAMO). In hydro-electric stations, power may be derived from a high fall of water driving impulse turbines of the Pelton wheel type or else low fall of water in large volume actuating reaction or inward flow turbines. The dynamo or alternator is then coupled directly to it. Automatic arrangements are provided for controlling the water supply as the load on the dynamo varies. In typical cases a

three-phase electric current is generated at a frequency of 50 periods per sec. and at a voltage of a few thousand volts, which pressure is raised by transformers to 100,000 or 220,000 volts for transmission and then reduced again in voltage by other transformers for utilisation. Similarly large hydroelectric stations exist for utilising either high or low falls of water from high level natural lakes or valleys dammed by barrages, or low falls from rivers by diverting a portion of the water into canals which short circuit bends of the river. A cubic metre of water falling in one second through a height of one metre is equivalent to 13 H.P. and about 70% of this can be captured and transformed into electric current power by modern machinery.

In the case of steam-engine and boiler electric stations the combustion of 1·25 lb. of coal under good modern boilers is capable of yielding one kilowatt-hour of electric energy at the dynamo terminals when employing the best types of steam turbine and direct-coupled dynamo. As the calorific power of coal varies much it is generally stated that 10 to 11 lb. of steam are required for producing one kilowatt-hour.

The economical production of electric power is, however, largely controlled by the scale on which it is carried out and by the load factor of the demand, that is, by the ratio of the total energy taken up in any time to the total quantity which would be taken if the plant were always working at full load.

Transmission Problems.—The problem of the economic generation of electric power involves also that of transmission from place of generation to that of consumption. The line is, generally speaking, the most costly part of the installation if the distance is at all large, say 20 m. or more. The power transmitted electrically is measured by the product of three factors, viz., current, voltage and the power factor of consumption, which may be anything between 0·7 and 1·0.

The use of large currents involves thick and therefore expensive copper conductors, hence for long distance working high voltages and aerial, overhead, relatively thin conductors are used. This requires high insulation which is achieved by supporting the wires by chains of porcelain insulators attached to the cross arms of wooden or steel lattice poles or masts. The current is generated at a pressure of a few thousand volts and raised in voltage by static transformers and reduced again for use. Great improvements have been made in these. The use of silicon steel for the transformer cores has greatly reduced the magnetic losses. The use of aluminium is increasing greatly and in spite of disadvantages is efficient as a material for conductors. Knowledge has been expensively acquired as to the best way to prepare and purify the insulating oil in which the transformers must be immersed and means have been devised for recording the temperature of this oil when the transformer is working. Alternating transformers up to 10,000 kilowatts (13,000 H.P.) are now made and used for electric pressures up to 100,000 volts (*see* ELECTRICITY, TRANSMISSION OF).

Corona Effect.—The means necessary to protect the transformers and alternators from damage by electric surges set up by lightning discharges striking an aerial line or those produced by flash-over discharges on the insulators have been much studied in Switzerland, Canada and the United States. In the case of high voltage aerial lines there is a notable loss of power due to the ionisation of the air. This is called the corona effect since it makes the lines appear luminous in the dark. It may amount to many kilowatts per mile. Its causes and variation have been very thoroughly studied in recent years. The damage done to aerial lines by lightning is no longer considered very serious.

Telegraphy.—The progress made in the arts of telegraphy and telephony must be very briefly mentioned. The direction of improvements in telegraphy of late years has been to abolish the necessity for skilled labour in sending or interpreting messages and substitute for it transmitting machines with keyboards like typewriters which prepare a strip of paper punched with holes in a certain way for each letter key depressed. This strip is then sent through another instrument which sends groups of electric currents into the line corresponding to each letter. By means of a distributor several messages can be sent at the same time, the letter signals being sandwiched in between each other so that the line is never idle. At the receiving end a machine employs these received currents to punch holes in a paper strip which are identical with those in the sending strip. This again passing through a second machine like a typewriter reproduces the message in type ready for sending out (*see* TELEGRAPHY).

Telephony.—In telephony the great advance in the last 15 years has been the extended use of " loaded " lines, that is, lines having inductance coils inserted at intervals of 1 to 10 or 12 m., the effect of which is to decrease the " distortion " of the electric waves sent along these lines when telephonic speech is transmitted. In some cases the loading is effected by iron wire closely coiled round the copper conductor and both the coil and this uniform loading have been applied with success to improve the speech through submarine telephone cables. The most important improvement has, however, come from the introduction of the thermionic repeater as a telephone relay. This appliance, which is the basis of modern wireless telegraphy and telephony, consists of a small incandescent lamp with glass bulb and a tungsten filament or else a platinum iridium wire coated with oxides of barium and strontium. The bulb is highly exhausted. The filament is surrounded by a spiral of wire called the grid and this again by a cylinder of metal called the plate; a battery of cells is connected between the filament and plate, and another circuit between the grid and filament. The filament when incandescent emits electrons copiously and any change in the potential or voltage of the grid is instantly followed by a corresponding change in the electron current. This instrument is also called a thermionic valve. It can be used to magnify electric currents. Telephone speech, electric currents flowing along a line, are weakened by its resistance but the thermionic repeater can be used to impart to them fresh energy and send them on their way reinvigorated. Hence the use of thermionic repeater stations enables smaller and cheaper trunk conductors to be used. Another great advance is in so-called carrier wave telephony in which high-frequency electric currents are transmitted along a line and thermionic valves and microphones used to modulate these currents so as to reproduce the speech sounds at a distance. Many currents of different frequencies can be transmitted along the same line and multiple telephony conducted. (*See* AMPLIFIERS.)

Wireless Telegraphy.—In the case of wireless telegraphy (*see* VACUUM TUBE; WIRELESS TELEGRAPHY) the thermionic valve (vacuum tube) is used not only to detect but to generate the high frequency currents and electric waves required. The most striking advance of recent years is the invention of the " beam " system by Marconi. Employing electric waves from 30 to 100 metres in wave length it is possible to use skeleton parabolic mirrors to project a beam of electric radiation in a given direction, which beam is concentrated along a rather narrow path. There is great economy in power, far less interference and much less obstruction by ionisation of the atmosphere. Marconi has in this way communicated not only signals but speech to the antipodes.

Broadcasting.—In wireless telephony the most wonderful advance during the period 1910–25 has been the creation of the new art of broadcasting music and speech (*see* BROADCASTING) which can be picked up anywhere by proper receiving appliances and telephones. Most large countries now possess many broadcasting stations at which there are powerful thermionic valve transmitters and from which music and speech are sent out. The manufacture and sale of appropriate receivers to be used by the public has created a vast new industry and the industry itself has added a new pleasure to life.

The uses of wireless telegraphy and telephony in aerial and marine navigation have been greatly improved and, without the use of directional wireless, aerial travel would be impossible in cloud or fog, but by its means the position of an aeroplane can be exactly located and given to it, and the same with a ship at sea. The improvements in thermionic valves themselves have been many and important. One of these is the dull-emitter filament made of tungsten in which thorium is incorporated, and this can give a large electron emission even when worked at only a dull red heat. (J. A. F.)

ELECTRICITY, TRANSMISSION OF (*see* 22.233) —Substantial progress was made during the years 1911–26 in the art of transmitting electricity. This progress was due distinctly to the stimulus of the World War and the imposed necessity for economy of fuel and other sources of energy. The development of the art during this period may be gauged from the fact that the maximum quantity of power transmitted over one circuit increased from 20,000 to nearly 200,000 kva., the maximum line voltage being raised from 110,000 to 220,000, and, while the longest distance covered by a straightaway transmission remains at approximately 250 miles, individual lines have been grouped and interconnected so as to form widespreading systems involving a number of generating and receiving stations electrically tied together (*see* SUPER-POWER).

Progress in Various Countries

Great Britain.—In this country the advances in the science of transmitting electricity have been significant but less spectacular than elsewhere. This is partially due to the reasonably wide distribution of the coalfields and to the early growth of a large number of steam-power stations, each serving its own limited area according to its own specific needs. Unfortunately, this has led to a serious diversity in the type of current, frequency and voltage employed; consequently, the desirability for interconnection is discounted by the difficulty attending its achievement. Early development of overhead power transmission in Great Britain was also hindered by two causes: (*a*) the difficulty of securing way-leaves from local authorities and property owners, and (*b*) the ultra-conservatism of the rules provided by the Electric Lighting Acts of 1882, *et seq.*, administered by the Board of Trade under which all overhead construction was regulated. To some extent these factors stimulated the use of underground high tension cables, but the cost of such installations is too high to permit of widespread transmission of electricity.

In 1922 a code of regulations was issued by the newly formed Electricity Commission, which superseded the Board of Trade in administering the various Electric Lighting Acts. This code calls for safe construction which may at the same time be entirely economical. Among other matters, it recognises aluminium as well as copper conductors, and specifies that overhead lines shall be designed to withstand a loading of ½ inch ice on the wires together with 8 lb. per sq. ft. wind pressure with a maximum stress in the wires of one-half the ultimate figure. For steel poles or towers the maximum working stress shall not exceed 40% and for wood or concrete poles 28% of the ultimate strength. Suitable rules are framed for the crossing of telephone lines and highways. Earthing devices are to be provided in case the wire fails at a crossing. Needless to say, this code of regulations distinctly encourages the increase of high-tension power transmission, and a number of installations have been constructed in England and Wales which would not have been economically possible under the earlier code.

Notable modern British transmission line construction is illustrated by a very extensive network in South Wales operating at 20,000 volts. This is built with both reinforced concrete and lattice steel poles using pin-type insulators with suspension units at tension positions. Another important system is that of the North Wales Power Co., operating at 35,000 volts using both wood pole and steel tower construction. The highest voltage employed is 66,000 on the overhead system of the County of Durham Electric Supply Company. This latter incorporates the use of heavy-type creosoted poles with steel cross-arms and suspension insulators, and both mechanically and electrically represents the highest grade of engineering.

United States and Canada.—These countries have shown the most rapid development and afford the most important illustrations of modern transmission practice. At the beginning of the period under review some five systems in the United States and Canada were operating at a voltage of 110,000. Earlier installations using pin-type insulators were virtually limited to 66,000 volts, but the introduction of the suspension design, in which a number of units are linked together according to the requirements of the operating voltage, opened a new field in the direction of high-tension working.

A characteristic 110,000-volt line incorporates the use of galvanised structural steel towers supporting two circuits on three cross-arms. One circuit is arranged on each side of the tower, usually with the centre conductor slightly offset out of the vertical plane to minimise possibility of short circuit. An average span is 600 ft., giving eight to nine towers per m., each tower being of the order of 70 ft. high and weighing from 5,000 to 7,000 pounds. At occasional intervals in the line it may be necessary to introduce an anchor or dead-end tower which would probably weigh 50% more. Conductors are generally of stranded copper 0·16 to 0·25 sq. in., or the equivalent aluminium. Along the top of the towers it has been customary to string a galvanised steel earth wire to increase the capacity of the line to ground and minimise inductive interference. Three-phase alternating current is universal with a frequency of 60 cycles predominating. Transformers are generally connected Y on the high tension side with the neutral point connected directly to earth, so as to ensure the quick operation of relays in the event of a short circuit.

Before long the limitations of 110,000 volts began to be felt, and in 1912, 140,000 volts was used by the Au Sable Power Co. in Michigan, followed a year later by the adoption of 150,000 volts for the Big Creek system transmitting to Los Angeles, 240 m. away. In this case single circuit towers were employed, each carrying the three conductors in a horizontal plane 17 ft. apart. A number of other systems were built of 130,000, 150,000 and 165,000 volts, this voltage being selected more with reference to the load to be carried than the distance of transmission. In the year 1923 the Big Creek system, after reinsulating the lines and raising some of the towers, changed to 220,000-volt operation. Shortly after this the Pacific Gas and Electric Co. began operation of a 220,000-volt line from Pit river to Vaca, California, 202 miles. In addition, two further 220,000-volt transmission lines were under construction in 1926: (*a*) Great Western Power Co., Brighton to Merced, California, 103 m., and (*b*) Pennsylvania Power and Light Co. from Wallenpaupack to Allentown, 60 miles. A fifth 220,000-volt line was planned in connection with the Conowingo development on the Susquehanna river, which would transmit to Philadelphia. In the United States and Canada there are not less than 30,000 m. of circuit operated at 110,000 volts or over, all of which has been put into operation since the year 1910.

Germany.—Since the adoption of 100,000-volt transmission constitutes such an important step in the art, it is interesting to note its successive introduction into countries where electric development is most fully advanced.

The first European 100,000-volt line was built from Lauchhammer to Riesa in Saxony in 1911, transmitting 15,000 kva. over 30 miles. Steel structures of the lattice type were used set in concrete foundations. By the use of extra long cross-arms each circuit was arranged in an equilateral triangle, while the relative position of the conductors was transposed 36 times in the length of the line. This careful method of balancing the reactances would seem to be quite unnecessary, and has probably been the cause of mechanical trouble on this line. Construction has been standardised in favour of lattice steel poles set in concrete carrying three cross-arms of heavy channel section. The conductors are for the most part of stranded aluminium 0·189 sq. in. or of steel core aluminium 0·11 sq. in. section. Suspension insulators are usual together with a steel earth wire.

Italy.—In the year 1912 the first 90,000-volt system was operated in Italy, followed by further installations at 100,000 to 135,000 volts, and the art became more fully developed in this country than anywhere else in Europe. All these lines are of the most modern design with steel construction. Notable installations are the following: Societa Interregionale from Brugherio to Reggio Emilio (95 m.), Societa Lombardo, Val Brembana to Lecco, Cislago, etc. (56 m.), Societa Adamello, Tema to San Polo (140 m.), Societa Piemontese, Ponte Tresa to Novaro (38 m.), Societa Tridentina, Meran to San Polo (168 miles). In addition to the foregoing a considerable further mileage of 125,000-volt transmission was already planned in 1926; and lastly the Societa Forze Idrauliche is constructing 600 m. of transmission to operate at 150,000 volts extending from Sila to Naples and across the Straits of Messina to Palermo.

India.—The year 1912 also saw the first 100,000-volt transmission in India, this being the double circuit line from the Tata hydro-electric plant at Khopoli to Bombay, a distance of 43 miles. This installation was the first of its type to be designed and carried out by British engineers, although in some of its characteristics it resembled the high-tension network in the Transvaal, which had been designed by the same group and put into operation about two years earlier at 88,000 volts. Some elements of the mechanical design in the Tata transmission are similar to those of the early German designs, especially in respect of the long cross-arms and equilateral conductor arrangement. These have not been repeated in later installations. In 1926 several systems were being constructed in India to operate at 110,000 volts.

Spain.—The Ebro Irrigation and Power Co. inaugurated in 1914 the first 100,000-volt transmission system in Spain from a plant on the Sagre river to Barcelona, 105 m. away. American engineers were responsible for the work, and the designs followed those employed on certain installations in Mexico. A somewhat unusual

feature was the use of pedestal type insulators on the Ebro system, this being the only instance of their use on 110,000 volts. Subsequent experience has not confirmed this practice, and more recent extensions to the Ebro transmission network employ suspension strings. This transmission now comprises about 500 m. of 110,000-volt line, in addition to which two or three other systems have been built in Spain for the like voltage.

Japan.—The first 110,000-volt transmission in Japan was a double circuit steel tower line from Lake Inawashiro to Tokyo built in 1913, a distance of 144 miles. This line followed American engineering practice very closely. Conductors were of copper 0·155 sq. in. section with seven and eight unit suspension insulators. Towers were spaced 550 ft. apart on the level and the customary steel ground wire was strung. Since the year 1914 there have been built in Japan four important trunk transmissions operating at 150,000 volts, while a fifth is under construction. Each of these lines is from 150 to 200 m. in length. In addition, an interconnection line of 127 m. in length is planned for operation at 220,000 volts.

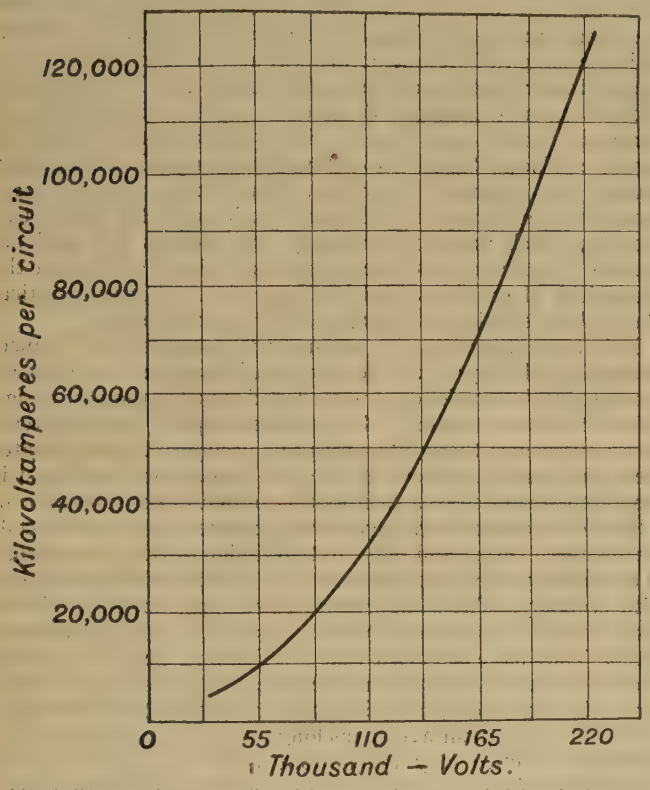

FIG. 1.—Diagram showing increased capacity per circuit, at higher voltages.

France.—In 1918 the first 100,000-volt transmission was built in France. Prior to this time industrial districts had been tied in with power plants (notably in the Pyrenees and the Mediterranean coast) with power lines of economical design but operating at much lower voltage. In the year mentioned a 110,000-volt steel-tower line carrying 15,000 kva. was constructed from Goesgen in Switzerland to Pouxeux in France, a distance of 115 m., of which one-half was in each country. Lattice steel, concrete-set poles were used of single circuit design carrying two conductors on one side and one on the other. The wires used are of stranded copper 0·12 sq. in. section suspended on 8-unit insulators with standard spans of 591 ft. and special crossings up to 1,600 feet. Subsequent to the reclamation of the war zone a series of transmission networks was developed under government control to supply energy for the work of reconstruction. These systems have since been extended and now connect Vincey, Nancy and Mohon with 120,000-volt lines, amounting to 135 m. in length in what is known as the Eastern system. Construction was being completed in 1926 on the northwest system of a 100,000-volt network connecting Labuissère, Beuvry, Bully, Abbéville, Amiens and Calais, a mileage of more than 300. It is estimated that the total circuit mileage of 100,000-volt line in France is not less than 2,500.

Sweden.—The waterfalls at Trollhättan have long provided a source of power for the southwestern peninsula of Sweden. The power was developed under government control prior to 1910, the energy being transmitted at 50,000 volts. In 1921, however, a power line was built across the entire width of the country from Trollhättan to Vesterås, a distance of 200 m., and this is being extended to Stockholm. This installation is designed for 132,000 volts with ultimate operation at 220,000 volts. Single circuit construction is used, the wires being hung from a horizontal cross-arm. For part of the route the twin structures supporting this cross-arm are of lattice steel, and for the other portion reinforced concrete poles are employed, the intention being at a later date to add a third pole to each support and extend the cross-arm sufficiently to accommodate a second circuit. This line is remarkable in respect of the economy and simplicity of its construction. A similar transmission line is planned which will extend from Stadforsen in the north to Vesterås, a distance of nearly 300 miles.

Australia.—From the great 125,000 kva. power station at Yallourn to Melbourne, a 112-m., 132,000-volt, double-circuit transmission line was constructed in the year 1922, this being the highest operating voltage in British territory. The design of the line was on American principles, but in some respects it marked a distinct advance. The average span employed was 1,056 ft., a procedure made possible by the use of steel-cored aluminium conductors of 0·264 sq. in. section. A further mileage is now being added to this system.

The foregoing summary is not to be regarded as complete, because it takes no account of the construction of 100,000-volt transmission in South Africa, Chile, Austria and Switzerland, as well as in other countries where the transmission of power is beginning its development.

Conductors, Insulators and Supports

Conductors.—The most important element in overhead transmission is the conductor. Copper wire is the most widely used in the hard-drawn form, such wire having a density of 8·89 at 68° F. and a resistivity based on the international standard of 0·15328 ohms-metre-gramme. For practical purposes conductors are stranded to achieve maximum strength and flexibility, from 3 to 37 wires being laid up in spiral form, giving a sectional area of from ·025 to ·75 sq. in. (British Engineering Standard). In America it is usual to strand a smaller number of heavier wires. To allow for the twist it is customary to add 2% to the weight and resistance. Tensile strength of hard-drawn copper is from

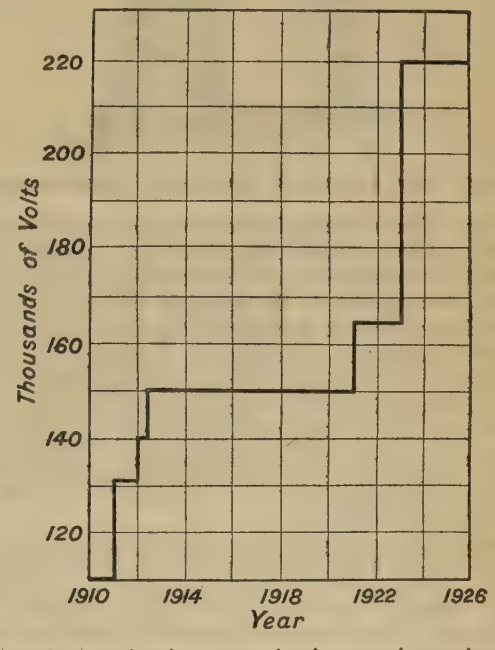

FIG. 2.—Diagram showing successive increase in maximum transmission-line voltage.

51,000 to 65,000 lb. per sq. in. with an elongation of from 1 to 2½% on 10 in., depending upon the size of the wire. Aluminium wire is now very extensively used; it has 60% the conductivity of copper and about one-third the density; consequently the equivalent conductor will be only half the weight of copper with a diameter 30% greater. In most cases the aluminium is reinforced with a core of high tensile steel wires, thus forming a composite conductor.

This development is one of the most important in the art, and it is estimated that since its commercial introduction in the year 1910 more than 150,000 m. of aluminium-steel conductor have been installed. The high ratio of tensile strength to weight

makes it possible to erect with long spans and so economise construction cost. Being some 40% larger in diameter than the equivalent copper, the corona loss is minimised or eliminated entirely. Copper-steel and copper-bronze composite conductors are also coming into use for special purposes, notably for catenary wires on electric railways. Copper-clad wire is used as a conductor on special long-span construction as well as for earth wire. It is drawn down from a composite wire bar made by casting copper around a steel billet. Steel conductors have a limited use for long crossings, some of which are as long as 6,200 ft. between towers. In such a case the highest tensile strength is necessary; the steel must be thoroughly galvanised, and usually is painted periodically in addition. A variety of rope strands is used with such steel wire to secure the best combination of flexibility and strength.

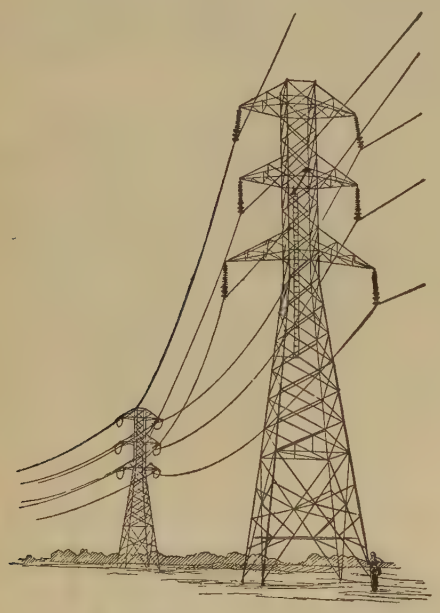

FIG. 3.—View of a modern 220,000-volt transmission line.

Insulators.—The modern high-tension line usually incorporates porcelain insulators of the suspension type. In most cases the unit consists of a disk with metal attachments such as a cap and pin, which are cemented to the porcelain element and provide a means of linking two or more units together. Certain designs have been brought out, especially in Germany, by which the attachments are fixed without the use of cement; in another design (the Hewlett insulator) two metal links engage in holes through the porcelain. Only the perfection of insulator porcelain has made 220,000-volt transmission possible, and although the ceramic art is an old one it has to be modified by the most careful precautions in this industry.

A mixture of clay (usually English ball clay and China clay) with potash feldspar and flint forms the basis of porcelain. The last two constituents are ground very finely and mixed with the clay in a digester or "blunger," next filter pressed, and the resulting "body" set aside to age. It is afterwards kneaded in a pug-mill, which extrudes the pug in a suitable form for moulding, which is done on a modification of the potter's wheel. The shells are then oven-dried, trimmed, glazed, kiln-fired, cemented, tested and issued as a complete insulator unit. Careful inspection follows almost every operation. Most of the earlier troubles with insulator porcelain have been eliminated. "Blebs" or air bubbles have been eradicated by ageing or by the use of vacuum pumps for handling the slip. Capillary holes have been traced to threads from the filter lawns; brittleness and porosity have been corrected by careful thermostatic control of firing temperatures. Cracking in service due to hydration and swelling of the cement has been prevented by setting the cement in an atmosphere of high pressure steam as well as by an admixture to provide elasticity. Insulator testing has also developed to an advanced stage. The customary porosity test on a batch of shells after firing is to break up a sample and immerse in an alcoholic solution of red fuchsine for 24 hours under a pressure of not less than 2,000 lb. per sq. in. (British Engineering Standard). Any porosity will be shown by permeation of the red dye. The above standard specification calls for a flash-over test of 300,000 volts dry and 220,000 volts wet on a 100,000-volt insulator, the same to withstand a voltage of 525,000 under oil without puncture. A mechanical load $2\frac{1}{2}$ times that used in service is to be applied without failure of the insulator. The number of units per string is of course a function of the voltage, the usual practice varying from four or five on 66,000 volts up to 13 or 15 on 220,000 volts. For tensioning positions where the mechanical stress on the insulator is greater, the electrical stress is reduced by adding one or two extra elements to the string. The same applies to districts liable to considerable fog or smoke. For the highest voltage service it is customary to suspend a metal shield ring round the lowermost unit; this equalises the voltage drop across the various elements as well as protecting them by carrying any arc which may form.

Supports.—Steel construction is coming to be universal except in regions where suitable timber is unusually good and plentiful or steel is difficult to obtain. At 110,000 volts a spacing of 10 to 12 ft. between conductors becomes necessary; this requires very long cross-arms, and although twin poles would carry one circuit a simple design of steel structure will accommodate two with a greater factor of safety and probably double the life. In Europe such a support is generally designed as a pole or beam having a relatively narrow base three to six ft. square set in a block of concrete. The post is built up of four corner angles laced together, usually shop assembled by rivets. Three heavy channel cross-arms are used of graduated length, usually with the shortest at the top, which provides symmetry and reduces the torsional loading. Conductors are hung from suspension insulators at the extremities of the arms, and as they are in different vertical planes there is little risk of contact due to excessive sag.

This type of structure is virtually the standard in France, Germany and Italy; it will be seen that it requires a very heavy concrete block to resist overturning, and is not of the best design to resist torsional loads. The American type of double circuit tower overcomes these difficulties but occupies a much greater area, the base being from 15 to 25 ft. square, and each post is separately anchored to a steel footing buried in the ground or in a light concrete footing. Overturning moment is therefore converted into a thrust and pull. Actual design of the tower is that of an entirely determinate structure; it can therefore be laid out with economy. The same general rules apply to single circuit towers which support the three conductors in the same horizontal plane. They have the merit that "whipping" and short circuit due to ice load on the wire are precluded, and this type of structure is favoured for mountain regions where altitudes are high, snow and ice frequent and spans long. A double circuit tower in American practice may weigh from 5,000 to 9,000 lb. and a single circuit from 4,000 to 9,000 lb., including foundation steel. Heavy anchor or strain towers are used at important points along the line; these will probably weigh up to 50% more. In American practice, which is also followed in Japan, Australia, India and South Africa, the tower members are bolted together in the field. Galvanised sections are universal, but in Europe there is a tendency to paint the towers wholly or partially.

Mention should be made of reinforced concrete, which, although not widely used, appears on at least one very important installation—the transmission from Trollhättan to Vesterås in Sweden already referred to. Here a structure consists of two 60-ft. hollow concrete poles set 20 ft. apart and supporting a horizontal steel cross-arm from which the conductors are hung. Each pole is fully reinforced and made by the Schleuder centrifugal process; it tapers from 20 in. to 9 in. and weighs 8,000 pounds. A transverse load of 7,000 lb. applied at the top has been withstood with safety. The chief merits of the construction are its simplicity, small disturbance of the ground when setting, absence of painting or other protection and economy in first cost. The disadvantages are those attaching to the great weight, the high cost of transportation and the heavy tackle necessary in the field.

SOME SPECIAL PROBLEMS

Lightning.—Successive increase in the operating voltage of high-tension systems has eliminated some problems and introduced others. For example, lightning in its direct or indirect effects is no longer feared on the highest voltage lines because

the quality of the insulation employed is so high. Ground wires and lightning arresters are therefore being eliminated on these systems. Flashover due to an induced surge will take place at one of the many arcing rings without damaging the insulators.

Current Difficulties.—Charging current is a most embarrassing problem, because the capacity of transmission lines has increased owing to the increased length and size of wire. Adding the effect of the extra high voltages employed, the charging current has become in many cases commensurate with the load current. In starting up the line, therefore, the generator must supply virtually full load amperes of leading current, with the result that it becomes self-exciting and a dangerous rise of voltage results. The solution of this and other difficulties has been found in the so-called synchronous condenser or motor permanently connected at the receiving end of the line with adjustable excitation by which the line current can be made to lag or lead or to run in phase. In starting up, the under-excited synchronous motor is brought up to speed with the generator, and it supplies approximately half the charging kilovolt-amperes.

Instability.—This is an effect of resonance or tuning by which a line of given frequency and physical characteristics may be liable to excessive rise in voltage and other abnormal conditions. At a frequency of 60 cycles a complete alternation occupies a distance of 3,000 miles, and one-fourth of this, or 750 miles, is occupied by a rise in voltage from zero to maximum amplitude. A line of this critical length is virtually impossible to charge. While such long distance lines have not yet been built, they have already been planned, and it has been made obvious that an entirely new set of conditions has to be met which will probably be by means of distributed synchronous condensers throughout a sectionalised line.

Corona.—This is an important phenomenon, especially at high altitudes; it connotes the breaking down of the insulating properties of air, and is shown by a purple glow surrounding the conductor. The voltage at which corona takes place is higher for large conductors and wide spacing, and it can therefore be kept under control by careful design, use of aluminium-steel or other large conductors. The actual loss will be proportional to the square of the difference between the operating voltage and the corona voltage if the former is the higher. For 220,000-volt operation at sea-level under good conditions it has been found that one inch is the minimum practicable diameter of conductor. According to F. W. Peek, who has made many years' research of this problem, for 1,000,000 volts a 6-in. diameter conductor would be necessary.

Underground Transmission.—The high engineering and economic status attained by the overhead transmission line will react against any very wide use of insulated cables. Nevertheless, there are occasions where the high cost of these may be justified and the gradual development of extra high-tension cables is promising. According to C. H. Merz, many miles of 33,000-volt underground cable are in use in England with satisfactory results, and not less than 8 m. of 66,000 volts. In Holland there is an important installation of 55,000-volt cable. All these examples are of three-core construction; although single-core cables have been made for much higher voltage, they cannot be regarded as a final development.

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ELECTRIC LIGHTING.—Progress in electric lighting since 1910 is chiefly a story of the development and application of the tungsten filament lamp and its accessories. *See* also ILLUMINATING ENGINEERING.

Filament Lamps.—From 1907 until 1911 the tungsten filament was extremely fragile, but in the latter year Coolidge developed ductile tungsten. The ductility of the tungsten wire made it possible to construct the filament in various forms, which greatly increased the application of the filament lamp. Extremely controllable light was now available, because point sources could be approximated and various optical principles could be taken advantage of in designing reflecting, refracting and transmitting accessories. In 1913 Langmuir developed the gas-filled lamp, in which the filament is wound into a fine helical coil, and the bulb is filled with nitrogen or argon instead of being completely exhausted, as in the case of the so-called "vacuum" lamp. This helical coil is in effect a thick filament, and it was found to lose a relatively smaller percentage of energy by conduction than a thin one for equal amounts of emitted light. The efficiencies of these gas-filled lamps are approximately twice those of the vacuum lamps.

The lumen has been introduced as a unit of quantity of light, and lamps are now rated in lumens per watt or in total lumens.[1] The temperature of the filaments of vacuum lamps is of the order of magnitude of 2050° C., and their average efficiency approximates 9 lumens per watt. The higher efficiencies of the gas-filled lamps (from 10 to 25 lumens per watt) are due to the higher temperatures (up to about 3,000° C.) at which the filaments can be operated satisfactorily when immersed in a gas. The blackening of tungsten filament lamps is due to the evaporation of the filament material, and this metallic vapour is deposited upon the relatively cool bulb. The function of the gas is to reduce this evaporation. Other improvements have been made which reduce the blackening by the insertion of chemicals that alter the metallic vapour to compounds which are less black. Filaments after a period of operation at incandescence used to sag considerably. This was undesirable in the vacuum lamps, and was very objectionable in the fine helical coils of the gas-filled lamps. Pacz developed a process which produced "non-sag" filaments, thereby removing a serious cause of lamp deterioration.

In earlier lamps it was necessary to use platinum for that part of the leading-in wire which was sealed into the glass of the bulb. A relatively inexpensive substitute has been developed by using a copper-sheathed nickel-iron wire of the proper proportions, so as to have the same expansion coefficient as platinum or glass. This equality of expansion coefficient is necessary in order that a leakage may not develop at the place where the wire is sealed into the glass. A later improvement was the introduction of the tipless bulb. This was achieved by exhausting the bulb through the tubular stem which supports the filament. A still later development was the evolution of "inside-frosted" bulbs, which were introduced in the smaller sizes up to 100 watts. This frosting diffuses the light and reduces the brightness of the lamp. It makes it possible to standardise lamps, thereby reducing the number of kinds through a reduction in the number of different finishes. Simultaneously various shapes of bulbs have been eliminated, with great resulting economies in manufacture. This development fits nicely into the programme of shaded light which better lighting demands. The filament lamp possesses the great advantage of divisibility, and this is evidenced by the extreme range of sizes which have been produced. The smallest is about the size of a grain of wheat, and the largest actually used by 1926 was 30,000 watts.

The increased efficiency of light production made it possible to produce lights of various quality. For example, by the use of a special blue-green bulb the so-called daylight lamp emitted a light approximating daylight in quality. By the application of a yellow-orange coating on the bulb the so-called "flametint" lamp was produced. This provided the "warm" light of flames.

[1] A lumen is the amount of light that would fall on a surface so placed that all its parts are at a distance of 1 ft. from a light source of one-candle power.

The average luminous efficiency of all filament lamps sold in the United States in 1910 was 4·42 lumens per watt. This average steadily increased so that in 1924 it was about 12·5 lumens per watt. This great increase in luminous efficiency is responsible for almost the entire decrease in the cost of light during that period, and this decrease in cost greatly increased the amount of light used. However, the usual intensities of artificial illumination were still far below what is best for vision as evolved under natural light.

Consumption of Electric Lamps.—Inasmuch as the tungsten filament lamp is a good index of development of electric lighting, the following approximate statistics for 1922 are of interest:—

	Number of Lamps	% of Total
Entire world	706,000,000	100·0
United States	337,000,000	47·7
Europe	266,000,000	37·6
Germany	95,000,000	13·5
Japan	37,000,000	5·3
France	28,000,000	4·0
Great Britain	24,000,000	3·5
Italy	22,000,000	3·1

In 1922 the average consumption of filament lamps per person was as follows:

	Lamps per capita		Lamps per capita
Entire world	0·42	Norway	1·54
United States	3·10	Sweden	1·30
Switzerland	1·75	France	0·70
Canada	1·70	Great Britain	0·50
Germany	1·60		

From 1911 to 1922 the percentage increase in the *per capita* consumption of filament lamps for various countries was as follows: United States, 227; Germany, 220; Japan, 114; The Netherlands, 93; Sweden, 81; France, 67; Italy and Belgium, 60; Switzerland, 49; Great Britain, 18. The percentage increase for Europe was 49.

Other Light Sources.—The mercury vapour lamp was somewhat improved, but no radical developments took place. The gaseous-conductor lamp, employing various gases and producing light sources of various colours, was introduced to a slight degree in special fields. The use of the arc-lamp for lighting rapidly receded in the face of the invasion of the gas-filled tungsten lamp. Magnetite and flame arcs were still being installed to some extent in "whiteway" street lighting. The tungsten arc confined in a bulb was commercialised for very special purposes.

Fields of Lighting.—In all fields the intensities of illumination generally increased markedly, and with the introduction of better equipment great strides were made in controlling and diffusing light and in shading the light sources from the eyes. In street lighting arc-lamps were generally superseded by filament lamps; the watts per unit increased; and more attention was paid to ornamental equipment. Highway lighting outside the cities began to develop. In industrial lighting the tendency toward higher intensities of illumination became particularly marked. Intensities as high as 20 foot-candles were found in many factories and offices. Where, in 1910, three foot-candles were recommended, in 1926 10 foot-candles were commonly suggested. Industrial lighting equipment became gradually more or less standardised.

The tendency away from the earlier localised lighting to a general distribution of light became well established, although localised lighting became recognised as a desirable supplement to general lighting. Localised supplementary lighting was made practicable through filament lamps. In residence lighting the tendency moved toward more adequate wiring, the increased use of portable lamps, and the shading of light sources. In stores and schools the diffusing glass lighting unit became widely adopted, and improvements were marked throughout these fields. Sign lighting and electric signs developed very greatly after 1910. So it is with stage and show window lighting, where the filament lamps of higher efficiencies add greatly to the ease with which lighting effects may be produced. The use of light as an expressive medium has been extended enormously since 1914. By the use of spot-lights, of lamps concealed behind architectural details, of coloured accessories, etc., theatres and other public buildings have become palaces of light. Flood-lighting of exteriors almost entirely developed since 1910, not only for spectacular and artistic purposes but for utilitarian needs, such as the flood-lighting of railroad yards and the grounds of industrial plants. One of the most spectacular displays was the illumination of Niagara Falls. In headlighting for automobiles and locomotives, filament lamps very generally superseded the flame light sources. In signals and traffic control, filament lamps were responsible for most of the development. Electric lighting has been extensively developed for night-flying. In the projection of motion pictures the arc lamp has been dispensed with. It was apt to set fire to the easily combustible film and also to burn out in the middle of a reel.

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(M. L.)

ELECTRIC POWER, GENERATION OF.—A marked advance in the utilisation of electrical power has taken place since 1910, as is shown in the development of water-power resources in many countries and in the extent of high-pressure transmission covering vast distances; the electrification of main and suburban railways and the advance in the installed capacity of power stations and in the sizes of the units of plant contained in them.

Marked improvements have also been effected in fuel-fired stations by reason of the greater evaporation capacities of the boilers (*see* BOILERS), higher steam pressure, the admission of pre-heated air to the grates, the use of pulverised fuel and of oil fuel and the consequent progressive improvement in the thermal efficiencies of boiler house plant. For example, in Great Britain, while the average thermal efficiency of public power stations in 1924 was only 12·45%, the efficiency of the Barton generating station of the Manchester Corp., taken over a whole year's operation, was 20%, while recent records show an advance even on that figure and nearly 22% has been obtained on a 55% station load factor.

Developments are also being made in the processes for the low temperature carbonisation of coal (*see* FUEL PROBLEMS) enabling valuable by-products to be recovered, such as heavy oils and other derivatives from which dyes and other necessary products can be distilled, and by which smokeless fuel with valuable properties can be obtained for domestic use.

This process, combined with power station practice, would enable boilers to be gas-fired or fired with the by-product coke applied in a pulverised form and though, according to the latest report of the Fuel Research Board of Great Britain, no process has yet been evolved which can claim to be commercially successful, developments and improvements are continually taking place which may render this process of great utility, not only by reason of the valuable by-products resulting therefrom, but also in the application to steam raising in combination with electrical power stations.

The employment of large water-tube boilers working at high steam pressures, the usual figure nowadays being from 350 to 550 lb. per sq. in., but with experimental plants already working at pressures considerably in excess of these figures, viz., up to 1,200 lb.; the employment of super-heated steam at 750° F.; marine casings and settings which eliminate air leakage; the adoption of pre-heated air and of both induced and forced draught fans so as to obtain a balanced draught in the boiler grate; overhead economisers and steel stacks—enable a self-contained boiler unit to be designed which is of great value in the lay-out of the larger and more important stations.

To these advantages may be added the improved grates of the two main forms, namely, chain and underfeed types: the water-trough system of ash disposal and the closed system of feed water supply combined with the further de-aeration of the whole or the make-up portion only of the feed water, the conservation of heat from the condensate delivered from the main turbine condensers, supplemented by live steam " bleeding " from one or more of the stages of the turbine, and by exhaust steam taken from some of the steam-driven station auxiliaries, have all brought up the boiler house efficiency, so that figures well over 80% are now (1926) claimed. The most recent practice in feed water supply is to run constant speed motor-driven turbine pumps in parallel with variable speed steam pumps for easy regulation.

The instrument attachments which readily enable records of the draught and percentage of CO_2 to be obtained as well as temperatures at various points in the flue circuit and in the feed water circuit, super-heater temperatures, etc., are a recent addition contributing greatly to the increased efficiencies obtained during the last few years; in fact boiler house practice has been greatly improved and is now generally carried out in a thoroughly scientific way.

Reference should also be made to automatic control of boiler plants, a popular system being one which regulates both the pressure and proportion of CO_2.

In the engine-room, turbines are commonly constructed for speeds of 3,000 r.p.m. on a 50-cycle system, which is the adopted standard frequency in Europe, up to sizes of 20,000 kv.a., while for speeds of 1,500 r.p.m. units of 30,000 and 40,000 kv.a. are in use. In the United States single units and combination units with an aggregate output of 60,000 kv.a. or more are in vogue.

Improvements in the steel and alloys employed (*see* IRON AND STEEL; METALLURGY) have enabled these large machines to be constructed and a notable advance in design has been made in recent years. Turbines continue to be made of both the impulse and the reaction types and in some cases the combination of the impulse type for the H.P. end with reaction type for the L.P. end have been employed. In another design both the stator and rotor of the turbine revolve, and so double the relative velocity by which an increased efficiency has been obtained with a reduced steam consumption.

Generally speaking, a steam consumption well under 9 lb. per kw. hour can now be relied upon with the larger machines when running at full load. Improvements in the metals used and in balancing have brought about a great advance in the reliability, efficiency and cost of these large units.

Improvements have been made in the closed system of air ventilation of alternators which minimise the risk of serious combustion of the insulation of the machine in the event of faults developing. The " closed " system of circulating the air over or through coolers supplied with water in shunt to the main circulating water system is generally used to-day.

In the surface condensers and pump equipment the general practice now is to employ dry and wet air pumps (*see* PUMPS), generally of the rotary or injection type in conjunction with, or as an alternative to, a system of high- and low-pressure steam and water jets to deal with the incondensable gases, with a supplemental condensate wet pump to raise the condensed steam to the hot well and boiler feed system. From the turbine to the switchboard it is now general practice to introduce a buffer in the shape of reactance coils and thus to minimise the effect of a breakdown on any part of the distribution system or occurring in the power house. The most modern practice is to put the reactance into the machines themselves. Alternatively where, as is now quite common, step-up transformers are used, the necessary reactance is embodied in the latter.

In the switchroom the practice now is to provide a central control-room, from which not only can the boiler-house and engine-room plant be controlled by simple telegraph systems, but also, through remote control, effectively to command the various oil break switches controlling the various generators and outgoing feeders, and to sectionalise the station in emergencies or during special tests. It is the general practice to sectionalise the busbars, and to insert reactances between the sections so as to minimise fault disturbances. Switching is generally now confined to the stepped-up voltage and smaller currents. Much research has been made into the design of heavy oil break switches with valuable results upon their reliability. The American practice for extra high voltage is to install outdoor switches and transformers, indoor gear being now regarded as out of date.

The tendency in modern stations is to design them on big lines and to employ large units of plant. The self-contained boiler unit referred to enables simplicity of design to be made effective and reduces the cost of buildings while maintaining ample room for inspection and overhaul. The construction of large stations of 500,000 kw., or more, generally embodies the grouping of, say, five sections, each self-contained and equipped with 100,000 kw., with complete fuel handling, condensing and switchroom arrangements which, from economic and even military reasons, is an advantage in design and does not adversely affect the economic cost of the equipment.

Power stations of this size are under construction at Crawford avenue, Chicago; in the Philo Station of the Ohio Power Co.; East River, New York; at Barking Creek, London, and elsewhere. Briefly, the modern tendency is toward the establishment of larger generating stations ranging from 200,000 to 500,000 kw., properly situated with reference to economic fuel supplies and liberal supplies of circulating water and also to interconnect such stations with others by transmission lines working at high pressure (*see* SUPER-POWER).

The advance in design has resulted in a notable increase in the thermal efficiency of the equipment due (*a*) to boiler equipment improvements, (*b*) to turbine design at higher speeds consequent upon the improved materials available, (*c*) to the practice of extracting live steam from one or more of the later turbine stages for feed water heating, and thus reducing the volume of steam exhausted into the condenser—a matter of importance with the very large machines now employed and (*d*) the utilisation of the waste flue gases to pre-heat the air required for combustion.

The transverter has been evolved during the last few years, a machine consisting of fixed transformer and commutator with brushes revolving at synchronous speed, by which three-phase alternating current energy can be converted to direct current at one end of the line and re-converted at the terminal point, thus substituting two conductors for three and indeed only one conductor for three if the earth be used as a return, as in the Thury system. Two transverters may then be used to provide a link between two systems of differing frequencies. Experimental trials of a favourable character have been carried out, but the transverter can hardly be said to have yet emerged from the experimental stage, though giving great promise of success.

To sum up, it may be said that circumstances arising out of the World War and the economic disturbances which have followed have given a great impetus to electrical development in recent years in the utilisation of water power, in the transmission of energy over wide areas, in the increased use for railway traction and in the wider use for industrial and metallurgical requirements and domestic applications. All this has developed a tendency toward generation on a concentrated but greatly increased scale, coupled with schemes of inter-connection between widely separated centres of generation. It would appear that this constant expansion, bringing in its train cheaper and more efficient production and wider distribution, must inevitably greatly extend the use of electricity to meet the necessary requirements of civilisation in the immediate future. (J. SN.)

ELECTRIC RADIATION.—Radiation, in the most general sense of influences travelling with finite speeds along definite paths, has been concerned intimately in all the most striking discoveries of physics since 1910 with the exception of the general theory of relativity. But the word is generally used in one or two narrower senses. Radiation may mean the class of rays to which light belongs, distinguished from rays which consist of material particles by travelling with the same speed and by possessing a periodicity which is displayed in interference. Experimental knowledge of such radiation has been greatly extended by the definite proof that X-rays and γ-rays are forms of it, and differ from light only as light differs from Hertzian waves, namely in possessing a much greater frequency. Radiation in a still narrower sense may mean the form which is emitted from hot bodies and determined by their temperature.

Saha's Views.—This temperature radiation was the main subject of the earlier article (22.785); subsequent investigation has not added much. All doubts have been removed concerning the validity of Planck's formula, which has become the basis of all modern methods of measuring the highest temperatures (*see* THERMOMETRY, 26.821). The most important theoretical ad-

vance is due to Saha, who suggested that temperature radiation may contain part or the whole of the line spectrum of the elements from which it is emitted. He applies Gibbs' thermodynamical theory of chemical equilibrium to an assemblage of similar atoms, and supposes that the energy required to ionise an atom may be taken as analogous to the heat of dissociation of a chemical compound. In such an assemblage there will be a rate, increasing rapidly with the temperature, at which the atomic electrons are raised to higher states, including that of ionisation, and an equal rate of return; the lines of the spectrum will therefore appear with an intensity proportional to the rate of the corresponding transitions (*see* below). Temperatures attainable in the laboratory are generally so low that this spectrum is masked by the continuous spectrum; it was formerly believed that line spectra could not arise from pure temperature excitation. But a re-examination of the facts in the light of Saha's theory indicates that such excitation plays an important part in the high temperature arc and in "furnace" spectra. In the stars, conditions are much more favourable; there the theory has wide application (*see* ASTRONOMY; SPECTROSCOPY).

Origin of Spectra.—Concerning radiation in the sense of all rays similar to light, the chief question mentioned in the earlier article which has been the subject of later investigation is that of the origin of spectra. This question has been completely answered. According to Bohr's theory, which is the key to modern physics, line and band spectra arise from the transition of the emitting system between two stationary states of different energy content. If the transition takes place from a stationary state of higher energy W_1 to one of lower energy W_2, ν, the frequency of the line emitted, is given by $h\nu = W_1 - W_2$, where h is Planck's constant (*see* QUANTUM THEORY). Line spectra are emitted by atoms, the different stationary states of which are different orbits of the electrons about the nucleus; band spectra are emitted by molecules, the different states of which are different orbits of both the electrons and the nuclei. The problem of the interpretation of various spectra is simply that of determining the stationary states; it belongs to the study of the structure of the ATOM (*q.v.*).

Nature of Radiation.—The great modern problem of radiation in the wider sense had only just appeared when the earlier article was written; and a question which was thought to have been quite settled has arisen again. What is the fundamental nature of radiation? For two generations the work of Young and Fresnel had seemed to leave no doubt that light was a form of vibration; the only question that remained was what form. A mechanical theory was first attempted which assimilated the vibrations that constitute light to the transverse vibrations of an electric solid. By the end of the 19th century it was recognised that no aether could be devised, reacting to disturbances like any material medium and yet propagating these disturbances according to optical laws. The theory had been abandoned in favour of the electromagnetic theory which assimilated light vibrations to those originating from the oscillations of charged particles and consisting of alternations in the electric and magnetic fields at a distance from it. This theory was also in a sense "mechanical," although it did not refer radiation to the motions of material particles. For, by the time of its appearance, the principles of Newtonian mechanics had been generalised by Lagrange and Hamilton so as to cover a field much wider than that of the motion of material particles. The laws of electromagnetism were consistent with these general principles; and since mechanics had come to mean the wider field rather than the narrower, the electromagnetic theory of light was as mechanical as a theory of an elastic solid aether could have been.

The electromagnetic theory explained all those laws of the propagation of radiation through empty space that are explicable by any wave theory, and, unlike the electric solid theory, it related the speed of propagation to other natural constants. Further, in conjunction with the electric theory, it could explain many of the mutual reactions of radiation and matter. It covered qualitatively the whole and quantitatively a very great part of the known optical laws. But in the early years of the 20th century difficulties had already begun to attract attention.

Difficulties in Theory.—The first discrepancy was much less striking than those which appeared later and was disclosed only by somewhat abstruse arguments. It concerned temperature radiation. According to generalised mechanics, if any system is left undisturbed to reach a state of equilibrium, its energy will distribute itself equally on the average between all its "degrees of freedom," that is to say between the different independent ways in which the system can change. The degrees of freedom of radiation are plausibly identified with its different frequencies, for experiments seem to show that the energy associated with any one frequency can vary independently of that associated with any other. The number of degrees of freedom is infinite, but the ratio to the total number of those lying within a given range of frequency $d\nu$ increases with the frequency, being proportional to $\nu^2 d\nu$. It seemed therefore that when radiation is in equilibrium, as it must be in an undisturbed enclosure of uniform temperature, the energy of radiation between ν and $\nu + d\nu$ must be proportional to $\nu^2 d\nu$ and increase indefinitely with the frequency. But according to Planck's law, established by experiment, at any temperature T has a maximum at a finite frequency ν_{max} given by $\nu_{max}/T =$ constant.

Difficulties arose again in the study of spectra. Electronic theory indicated that the origin of spectra must be sought in the disturbance of the electrons of the atoms emitting the radiation. If the electrons vibrated under quasi-elastic forces after disturbance, the emission of radiation of definite frequency would be a direct consequence of the electromagnetic theory. But on this theory the series discovered in the spectra of a single element (*see* SPECTROSCOPY) must indicate the different modes of vibration possible to disturbed electrons in its atom. But all attempts failed to devise atomic models, subject to mechanical principles, which would actually possess these modes.

The third, simplest and most striking discrepancy arose from the study of photoelectrics *i.e.*, the ejection of electrons from material bodies under the influences of radiation. Electromagnetic theory could well explain how radiation might exert forces on electrons and thus eject them from their atoms; but no mechanical theory could explain why the energy of the ejected electron should be independent of the intensity of the radiation and dependent only on its frequency.

These discrepant or "unmechanical" phenomena can be related to each other by means of the Quantum Theory (*q.v.*). As applied to the photoelectric effect, the theory states little more than the experimental facts, namely that if an electron takes up energy from radiation of frequency ν, then whatever the intensity of the radiation, it will take up an amount of energy $h\nu$, neither more nor less; the intensity determines only the chance of its taking up any energy at all. As applied to the origin of spectra, it denies that the frequency of radiation is that of the system from which it is emitted. As applied to temperature radiation, it states again that energy of frequency ν can be gained or lost only in quanta $h\nu$, and therefore, since "equipartition of energy" follows only if energy is gained and lost by infinitesimal steps, that this doctrine must be abandoned. The equal distribution of energy among the degrees of freedom is replaced by an equal probability of the occurrence of certain distributions of energy among the radiators. As for the mechanism by which the equilibrium between matter and radiation is established, the theory of Einstein, departing somewhat from the original conceptions of Planck, supposes that a given radiator influenced by the radiation has a chance of gaining quanta and another chance of losing them, the first being wholly, the second partly, dependent on the intensity of the radiation; equilibrium is attained when the intensity is such that these chances are equal. By assigning suitable values to these chances Planck's law can be deduced very simply.

Common Explanation Impossible.—Thus all these unmechanical phenomena are explained in the sense that they, and many other phenomena having no direct connection with radiation, are deduced from a few simple and self-consistent principles. These principles have the same right as those of mechanics to be

regarded as fundamental. If the mechanical or optical phenomena were explained by the quantum theory the discrepancy would be solved as satisfactorily as if the unmechanical were explained by the mechanical theory. But they are not; indeed so long as the two classes of phenomena are described in terms of the concepts which have so far seemed appropriate to them, a common explanation for both appears logically impossible.

For, consider a source of radiation surrounded by matter. If we are to explain how the matter produces regular reflection, refraction, diffraction, or interference of this radiation, we must suppose that the influence of the radiation on the matter is continuous both in space and time; we must imagine that at each instant the radiation is influencing all the matter; that between two regions separated from each other there is a continuous series of intermediate regions each differing infinitesimally from its neighbour; and that each elementary region of the matter undergoes a regular sequence of change passing from one state to another through a continuous intermediate series. On the other hand, if we are to explain how the radiation produces the photoelectric effect and its associated phenomena, we must suppose that the influence is discontinuous both in space and time; we must imagine that at any instant all but a very small fraction of the matter is wholly uninfluenced by the radiation; that the isolated points at which influence is being exerted at any instant are widely separated from each other by regions in which there is no influence; and that the instants at which the radiation influences a given region are separated by intervals of much greater duration in which there is no influence. But if these two sets of phenomena are aspects of the same process, this process must be either continuous or discontinuous; it cannot be both.

Possible Reconciliation.—One way to reconciliation is yet open. It is just possible that the whole process is really discontinuous and that the continuity is only apparent, or, conversely, the continuity real and the discontinuity apparent. Suggestions have been made in both these directions. The first possibility is represented by J. J. Thomson's theories of radiation and by Einstein's light-quanta. Thomson proposes to attribute physical reality to the " lines of force " which Faraday introduced as the mechanism of all electromagnetic actions. In the simplest form of Thomson's theory, the line of forces are supposed to consist of discrete strings which are attached to the electric charges emitting the radiation and along which the vibrations are transmitted. The wave-front would consist of discontinuous specks at the points where it cut these strings; the appearance of continuity is due to the large number of strings concerned in radiation of ordinary intensity. Einstein's theory does not profess to give so definite a mechanical picture, but it also assumes that the radiation is made of discrete bundles, separate in space, the energy associated with each bundle of frequency ν being $h\nu$ and the momentum $h\nu/c$. On either of these views, interference must arise from the interaction of two strings or bundles and should vanish if the intensity of the radiation and the number of the bundles is sufficiently reduced, so that the chance of an encounter becomes small. No sign of such diminution of interference can be detected experimentally.

The second possibility is represented by theories which suppose that the action of radiation on matter appears discontinuous because atoms can store the effects of the action without obvious change, until it ultimately produces instability; an analogy is to be found in a striking clock, where the continuously progressive change manifests itself only in discontinuous changes separated by intervals very long compared with their duration. Here again the direct experimental test fails; no evidence of any kind can be found that in the interval between the discontinuous changes the atom undergoes any alteration whatever, either spontaneously or as the result of radiation incident on it. Moreover no theory of this kind is of much value unless it can suggest the mechanism by which the continuous changes are stored until the final catastrophe. Numerous mechanisms of this kind have been invented, but they are all enormously elaborate, and none of them give any adequate account of the relatively simple laws, of which Bohr's quantum theory of atomic structure gives so strikingly successful an explanation.

The only remaining alternative is to deny that the continuous and discontinuous phenomena are really aspects of the same process. Continuity appears in the action of matter on radiation; discontinuity in the action of radiation on matter. It is not possible to divorce these processes quite completely from each other; for in all optical experiments what is immediately observed is an action of radiation on matter, which probably is always reducible ultimately to a photoelectric effect; and on the other hand, we cannot fully describe the influence of the quality of the radiation on its action on matter without the concept of frequency, derived from optical experiments. But if we agree to overlook the experimental methods by which our knowledge is attained and consider only theories to explain it, divorce may be possible.

Conservation of Energy and of Momentum.—One of the reasons why it has appeared necessary hitherto to regard the action of radiation on matter and that of matter on radiation as merely different aspects of the same process, lies in the doctrines of the conservation of energy and of momentum. If matter changes the energy or momentum of radiation, then, if these doctrines are true, there must be an exactly corresponding change of the energy or momentum of matter. Bohr, Kramers and Slater have proposed to deny these doctrines in their detailed applications and to regard them as merely statistically true. On this view the electromagnetic theory is true of radiation itself. Radiation consists of continuous waves, the frequency, intensity and distribution of which are determined, according to that theory, by the atoms from which it arises and with which it is in contact. Conversely, it determines changes in these atoms. But while a change in the state of the atoms immediately and definitely produces a change in the radiation, the converse is not true; a change in the nature of the radiation merely alters the chance that the atoms it encounters will undergo certain changes of state. If an atom A suffers a change of state such as is associated, by the quantum theory, with the emission of radiation of frequency ν, then there is established round this atom a field of radiation which confers on all atoms in it a definite chance of suffering the converse change; this field will endure until some atom B somewhere actually suffers this converse change. In the interval between the two changes, the energy lost by A and later acquired by B does not reside in the radiation; for, on the electromagnetic theory, the energy required to maintain a given field of radiation in a given region is proportional to the time that the field endures; this time is determined wholly by chance and may be infinite or infinitesimal. Energy is conserved only in so far as the energy lost by A is acquired sometime by B.

On this theory the complete divorce is effected. The action of matter on radiation is determined by one set of laws, definite and regular; the action of radiation on matter by another set in which chance is a fundamental factor. The concepts involved in the two sets are essentially different; and the only connection possible between them is that of numerical laws, formal and physically inexplicable, of which Planck's quantum relation is the chief and the type. The other laws necessary for a complete formulation of the theory may be derived from Bohr's " Principle of Correspondence " (*see* QUANTUM THEORY) which states roughly, that in certain limiting cases, when the discontinuities pass over into continuity, both sets of laws must become identical and the concepts in one set must correspond, term by term, with those in the other. It has proved possible, for example, to establish a " quantum theory of dispersion " in which the refractive index (a concept derived from the continuous laws) is related numerically to the chances and energy-differences of quantum states (concepts derived from the discontinuous laws); but it must be remembered that this is not a theory in the sense of suggesting a reason why this relation should hold or in reducing to common concepts the quantities between which it holds.

The Bohr-Kramers-Slater theory has aroused great interest, but unfortunately there is evidence against it. In the scattering of X-rays, there is known to be interchange of energy and

momentum between the scattered ray and the scattering electron which recoils from it (*see* X-RAYS). On this theory the interchange should be merely statistical; recoil electrons on the whole should receive the energy and momentum lost by scattered rays on the whole; but in the scattering of any individual ray, there should be no constant relation either in time or in magnitude between the scattering of the ray and the recoil of the electron. Experiment has shown on the other hand that there is a correlation as close as would be expected if energy and momentum were conserved at each encounter. In view of these experiments Bohr is inclined to abandon theory in favour of the yet more revolutionary ideas of Heisenberg.

Since there cannot be contradiction between facts, Heisenberg suggests that our difficulties arise because we import into our description of the facts things that are not facts and quantities which are not actually observed. Thus we do not actually observe temporal periodicities in radiation; the frequency is measured by experiments in which there is no change with time; the conception of frequency must therefore be dismissed from our description. With it must go most of the spatio-temporal conceptions that dominate much of physical theory, including the conception of radiation. There are left a few conceptions, such as energy and the transition from one state to another, which do not necessarily involve either space or time. Heisenberg proposes to state in terms of such conceptions, general principles which shall cover the range of both quantum and mechanical theory, and to reject as meaningless the principles of narrower range but (so far at least) of deeper content which lead to nothing but inconsistency. His theory is too recent and as yet too incomplete for discussion here; but it becomes every day more likely that the difficulties which have so far beset the theory of radiation are to be overcome only by a fundamental reconstruction of physical theory far more sweeping even than that introduced by the general theory of relativity.

BIBLIOGRAPHY.—For Saha's theory see M. N. Saha, *Phil. Mag.*, vol. 40 (1920); it has been greatly developed by R. H. Fowler, *Phil. Mag.*, vol. 45 (1923), and R. H. Fowler and E. A. Milne, *Monthly Notices Roy. Astr. Soc.*, vol. 83 (1923), vol. 84 (1924). J. H. Jeans' *Report on Radiation and the Quantum Theory*, 2nd ed. (1923), is an admirable summary of the position at that date. For later developments, see an article by N. Bohr, *Nature*, vol. 116 (Dec. 5 1925), which gives full references to the most important papers.

(N. R. C.)

ELECTROCHEMISTRY (*see* 9.208).—Electrolytic alkali works are now operated in all the leading manufacturing countries where the raw materials of the industry are found; and those who controlled the operation of the old Le Blanc process of alkali manufacture in the United Kingdom found themselves in 1921 compelled, by the force of circumstances and by the changing conditions of the trade and industry, to adopt the newer method of decomposing salt.

The cells now being operated industrially may be classified either as diaphragm or non-diaphragm cells. In the former class, a porous diaphragm, composed of cement, asbestos or other material unacted upon by the electrolyte or by the ions produced by the electrolysis, is employed to separate the cell into two or more compartments; and in this way the chlorine liberated at the anode is to a large extent prevented from taking part in secondary reactions with the sodium hydrate or potassium hydrate formed at the cathode.

The "Elektron," Hargreaves-Bird, Outhenin-Chalandre, Basel, Billiter-Siemens, Nelson, Allen-Moore, Gibbs, Wheeler and Townsend cells are all of this type, the chief difference between them being in the construction or position of the diaphragm, and in the arrangements made for withdrawing the sodium-hydrate solution from the cathode compartment of the cell, before it has had time to be decomposed by the electric current. The defects of all diaphragm cells are the higher voltage required per cell, and the increased costs of maintenance, due to the non-durability of the diaphragm.

For these reasons non-diaphragm cells have always attracted the electrochemist. Many of these have been patented and tried, but only two types have survived industrial trial—namely (1) the Castner-Kellner, Whiting and Solvay cells, which employ a moving mercury electrode in the cathode compartment of the cell, and thus produce an amalgam of sodium which can be removed from the cell before it is decomposed with water to yield the hydrate; and (2) the "bell" type of gravity cell, which makes use of the different specific gravities of the brine, and of the newly formed sodium or potassium hydrate solution, in order to effect a separation of the two. The Aussig "bell" cell and the Billiter-Leykam cell are now the only two representatives of this class in actual operation. The attempts to use molten lead, in place of the more expensive mercury as the liquid or moving electrode, failed after trial upon an industrial scale in the United States of America.

The answer to the question as to which type of cell is the best for the production of caustic soda or caustic potash, depends largely upon the relative costs of electric power and of fuel in the locality where the cell is to be operated.

The diaphragm cells with the highest efficiency, unfortunately, give the weakest solution of sodium hydrate at the cathode; and in order to obtain a concentrated cathode liquor it is necessary to sacrifice to some extent the energy efficiency of the cell.

The Whiting, Castner-Kellner, and Wilderman types of mercury cell all yield cathode liquors of a fairly high degree of concentration, namely, 200 to 240 grammes per litre of NaOH. But for the high cost of mercury, the mercury type of cell would probably be generally adopted for the production of caustic hydrates, for this type yields a specially pure product, both at the anode and the cathode.

The Billiter-Siemens, Billiter-Leykam, Townsend and Nelson cells all yield a liquor containing 120 to 160 grammes per litre NaOH, and therefore come next to the mercury cells, as regards the concentration of the caustic liquor. The Gibbs and Wheeler cells produce a liquor containing 100 to 120 grammes per litre NaOH, but as compensating advantages have a very low capital cost and a low maintenance charge, due to their cylindrical shape and small size. At the present time (1925) these two types of cell are in extensive use both in Great Britain and in the United States of America, and it is noteworthy that the United Alkali Co., after exhaustive enquiries in 1920–1 adopted one of these cells (the Gibbs) for the equipment of their new Electrolytic Alkali Works at Widnes.

The Aussig bell, Griesheim, and Outhenin-Chalandre cells on the other hand, yield a liquor containing only 60–80 grammes NaOH (or under) per litre, and in view of the amount of fuel required to produce solid caustic from weak liquor, it is surprising that these cells have attained such wide use on the continent of Europe.

The War caused a considerable increase in the number and capacity of the works for the electrolytic decomposition of brine, liquid chlorine being required in very large amounts by the military authorities, for gas warfare and for sterilising water supplies.

Chlorates and Perchlorates.—The electrolytic method of manufacture of chlorates and perchlorates is now operated in all countries where cheap power is available, the most notable works being located at Chedde in the Haute Savoie, and at Mansboe and Trollhättan in Sweden. The cells in use at Chedde are constructed of cement, and are arranged in terraces so that the electrolyte can flow through them by gravity. Very thin sheets of platinum foil fixed in ebonite frames are used in series as bipolar electrodes; and the number of these in a cell, and the number of cells in a circuit, are arranged to suit the voltage of the generators.

When potassium chloride is employed as the electrolyte, the chlorate can be easily separated from the unaltered chloride by crystallisation. When sodium chlorate is to be produced, a different treatment is required to obtain separation of the chloride and chlorate, since the sodium salt is much more soluble than potassium chlorate. The current efficiency, when producing either sodium or potassium chlorate can be raised, under the best conditions, to 90%, and the conversion of the chloride into chlorate can be completed in one operation.

Perchlorates.—The conditions required in order to obtain perchlorates in an electrolytic cell are: (1) Insoluble electrodes; (2) A high current density at the anode; (3) The prevention of any reducing action by the hydrogen gas liberated at the cathode. This latter condition is obtained either by the use of a diaphragm, or by the employment of salts which suppress the cathodic reduction, chromates or cyanides being used for this purpose.

Under normal conditions, the conversion of the chlorate into perchlorate takes place without evolution of ozone, and shows an average current efficiency of 85%. The power required to produce one kgm. of sodium perchlorate from sodium chlorate, is about 3½ kw. hours; and as the sodium salt is deliquescent, it is usually at once converted into the potassium salt by treatment with potassium chloride or sulphate. Ammonium perchlorate, which is used largely in the manufacture of explosives, is prepared in a similar manner, by treating a sodium perchlorate solution, produced electrolytically, with ammonium sulphate. An alternative method of manufacturing the ammonium salt is to start with calcium chloride, and to convert this by successive stages of anodic oxidation into calcium perchlorate, which is finally decomposed by ammonium sulphate.

Sodium perborate.—This persalt is most easily produced by the electrolysis of solution of sodium borate. The process of manufacture employed is based on the use of a mixed electrolyte of sodium borate and of an alkaline carbonate. The latest theory of the conversion is that a percarbonate is formed first, and that this salt then reacts with the sodium borate.

Persulphates and Hydrogen Peroxide.—Persulphates are another class of highly oxidised salts which are finding wide application, especially in photography. Here again the electrolytic method of production is the cleanest, simplest and most efficient. As a rule, the desired persalt can be produced by one simple operation in an electrolytic cell or bath, an important factor in the production of what are usually known as "fine" chemicals. When comparing the merits of chemical and electrolytic methods for producing persalts, it is necessary to note also that the cost of electric current is not the main item in the total cost of production.

The method of producing persulphates in the electrolytic cell is based upon the discharge of SO_4 ions at the anode of the cell. The conditions required to effect this discharge are the same as in the production of perchlorates, namely, (1) a low temperature, (2) a high current density with a smooth platinum anode, (3) a neutral or acid solution. A concentrated solution of ammonium sulphate may be employed in the anode compartment of a diaphragm type of cell, with sulphuric acid of medium strength in the cathode compartment. Platinum must be employed as anode material, but lead can be employed for the cathodes, and these may be of much larger surface area than the anodes.

Hydrogen Peroxide.—Two methods have been employed for the electrolytic production of hydrogen peroxide, the first based upon the use of persulphuric acid as an intermediate product, and the other upon the use of potassium or ammonium persulphate. The density of the sulphuric acid in the first case should lie between 1·35 and 1·50, and the electrolysis should be carried out as rapidly as possible, with a current density of 950 amp. per sq. foot.

Hypochlorites.—Charles Watt, in his very remarkable Master Patent No. 13755 of 1851, clearly explained all the conditions which must be maintained in order to produce hypochlorites by the electrolytic decomposition of sodium or potassium chloride solutions.

The advance since then relates simply to the form and design of the cell used for carrying out the electrolytic method. The leading features of the cells now employed specially for hypochlorite production are, however, very similar. They possess graphite or platinum electrodes, placed so close together, that the chlorine liberated at the anode reacts at once with the alkaline hydrate formed at the cathode; and they possess also some means for promoting that rapid circulation and cooling of the electrolyte which is necessary in order to avoid the formation of chlorate.

The three leading types of electrolyser for the production of hypochlorite solutions are:—(1) the Haas and Oettel, (2) the Kellner and (3) the Mather and Platt.

In recent years, the electrolytic production of hypochlorites has suffered a set-back, owing to the large amount of low-priced chlorine in the liquid form which has been placed upon the market by the electrolytic alkali works. It has proved in many cases more economical for large bleaching firms to purchase this liquid chlorine in place of the usual bleaching powder, and to absorb the gas either in milk of lime, or in solutions of sodium hydrate in their own works. In the latter case, the absorption of the gas may take place in the actual bleaching vat, and numerous patents have been applied for, in connection with this application of liquid chlorine.

Oxygen and Hydrogen.—Cells for producing these two gases by the method of electrolytic decomposition of water, have been patented in very large numbers; and many have been operated upon a commercial scale, for production of the hydrogen required for oil hardening, for ammonia synthesis (*see* AMMONIA) and for metallurgical work. The Schoop, Schuckert and Schmidt (or Oerlikon) cells have been most widely employed in Europe, while the Knowles, the International Oxygen Company and the Levin types of cell, have found most favour in Great Britain and in the United States of America.

A remarkable expansion of the electrolytic process for hydrogen production occurred after Sabatier & Senderens' discovery in 1897–9 that, with the aid of a suitable catalyst, the hydrogen content of liquid vegetable fats could be raised and the fat thereby converted from a liquid to a solid form. This oil hardening process is adversely affected, however, by the presence of other gases as impurities of the hydrogen, even in very small amounts, and for this reason the very pure form of hydrogen obtained by the decomposition of water has been employed on an immense scale for the operation of the oil hardening plants which have been erected since the War, in all parts of the world.

It is stated on good authority that over 100,000,000 cu. ft. of hydrogen are being produced per annum for oil hardening, by an English type of electrolytic cell, and the aggregate annual production of electrolytic gases in this and other countries, by all the types of cell employed, must amount therefore to an inconceivable volume.

Ozone.—When a high-tension electric discharge is passed through dry air, ozone is produced, and as most of the early patents covering the apparatus used have lapsed, the essential details of construction of the general type of ozoniser have now become standardised. The apparatus consists usually of an inner cylinder of sheet copper or aluminium, connected to the high-tension side of the transformer; and of an outer metal cylinder connected to the casing of the ozoniser, and maintained at zero potential. The two cylinders are separated by a glass tube, through which the air is passed, and the silent electric discharge which produces condensation of the oxygen to ozone takes place in the annular air space between the two sheets of metal. Alternating current with frequencies up to 60 cycles is employed, and the practical limit for the E.M.F. used is found experimentally to lie between 10,000 and 12,000 volts.

Ozonised air is employed for bleaching purposes; for the sterilisation of air and food; for the acceleration of the drying and hardening processes in paints and varnishes, and the rapid oxidation of oils.

Organic Products.—The use of electrolytic methods for reducing and oxidising purposes is extending in the field of organic chemistry. All the best equipped works both in Germany and America, where synthetic dyes and drugs and other organic chemicals are produced, are now provided with special cells for this type of work.

Anodic oxygen is a most energetic oxidising agent, and electrolytic oxidation methods are used to produce saccharine, ethane, nitrobenzoic acid and other organic products. The electrolytic preparation of salicyl aldehyde is also practiced.

Miscellaneous Products.—Anhydrous aluminium chloride, lead arsenate, chromic acid, potassium ferricyanide and potassium permanganate, are now being produced by electrolysis.

(J. B. C. K.)

ELECTROMETALLURGY (*see* 9.232).—This article deals with the application of the science of electrometallurgy to the various metals.

Aluminium.—The mineral bauxite remains the chief raw material of the aluminium industry. The increased demand, however, has led to several new deposits of bauxite being discovered and worked, and the mineral has been found to be much more widely distributed than was supposed. Not one of the numerous attempts to dispense with the preliminary purification and to operate the baths with raw bauxite in place of the pure alumina, in order to reduce the cost of the metal, has proved successful. Weaver (Canadian patent, No. 190054 of 1919) has proposed to extract aluminium chloride from clay, with the aid of liquid chlorine. The pure aluminium chloride obtained from this source would then be fed into a bath containing molten sodium and aluminium chloride, and the process would be worked for the continuous production of aluminium and chlorine gas. An appa-

ratus for carrying out this electrolysis was described in U.S. patent No. 1,297,946, for 1919, and a process of this kind may eventually solve the problem of providing a cheaper raw material for the industry.

The electrolytic process, by which the metal is produced at present, differs but little from that by which Heroult in Switzerland, and Hall in America, first carried on the manufacture in 1889. The metal now ranks fourth in the list of non-ferrous metals, both as regards production and consumption; for only copper, lead and zinc are produced and used in larger amounts in the arts and industries. During the War, aluminium was used largely in powdered form as an ingredient of an explosive known as " ammonal," and for pyrotechnical work, and, either as pure metal or in the alloyed state, for the construction of air-ships, aeroplanes, motor-cars, bombs, radiators and many forms of measuring instruments.

The increased demand for aluminium and its alloys in the domestic arts and industries since 1920, however, has now quite compensated for the loss of the special demand for war purposes. In the electrical trade, it is employed for transmission lines, busbars, field coils and armature windings. In the motor-car industry it is employed in sheet form for the body work of cars, for gear and crank casings, for engine cylinders, and for pistons and connecting rods. The metal is also being used to a rapidly increasing extent in the construction of vessels for the chemical, brewing, sugar refining, margarine, dyeing and soap industries, and the manufacture of domestic cooking utensils affords another large and rapidly growing outlet for the metal.

Aluminium can be efficiently protected against corrosion by air by a thin layer of hydrogenated cotton-seed oil. The local corrosion which often occurs, is due to minute traces of oxides and other impurities which are trapped in the metal when in the molten state before casting or rolling. Aluminium carbide, which forms at a comparatively low temperature, is one of these and its presence can be avoided by preventing the access of gases containing carbon to the metal when in the molten state.

Artificial Abrasives.—Carborundum, or silicon carbide, is formed by heating a pure form of sand and carbon to a very high temperature in an electric furnace of the resistance type. This manufacture has not undergone any technical changes since 1910, but the industry has developed considerably, and now that the limitations of the material are recognised, and the attempts to apply carborundum wheels to the grinding and finishing of fine steel goods have ceased, the industry is on a very sound footing. Silicon carbide is intensely hard and very brittle, and is most suitable for grinding and finishing similar materials, while artificial corundum (fused alumina) has taken the place of carborundum, for a variety of other grinding purposes.

Peters states that carborundum brick as a refractory lining for electric and other furnaces is highly resistant to the action of silicious slags, but is readily attacked by slags high in lime, lead or iron. The manufacture of corundum as an artificial abrasive is expanding, and has become one of great importance in Canada. It is carried out by heating bauxite, iron and coke, in an electric arc furnace, the proportions used being as follows: calcined bauxite, 1,750 parts; coke, 100 parts; iron borings, 350 parts.

Brass and Bronze.—In 1914 there were no electric furnaces in operation for melting brass, but by the end of 1919, 40 American firms were reported to be using or installing such furnaces in their brass foundries, and over 100 of these furnaces were in actual operation. By adopting electricity as the agent for heat production when melting brass, the losses occasioned by the volatilisation and oxidation of the zinc are avoided, and larger furnace units can be employed with greater uniformity in the melt, and lower labour costs. The electric furnace has therefore now almost entirely supplanted fuel-heated furnaces for brass-melting in all countries, and has been found the most economical way of melting brass, and also conducive to improvement in the health and safety of the workpeople engaged in the foundry.

The following types of furnace have been used successfully for brass-melting: (1) The direct arc furnace, of which the Snyder and Giolitti are the chief representatives. (2) The indirect arc furnace, of which the Rennerfelt and the G.E.C. or Detroit are the most successful examples. (3) The vertical ring induction furnace, of which the Ajax-Wyatt is the best known. (4) The granular resistance furnace, of which the Baily is the only example.

New furnaces of the induction type have been brought out recently by the General Electric Co. of U.S.A. and by the Compagnie Française de Métaux, the furnace of the latter being designed for use with three-phase current. The Ryan is another new resistance furnace, but in this case the heat is developed by means of a central graphite electrode, through which a strictly regulated current of electricity is passed.

The direct and indirect arc furnaces are quite unsuitable for the rolling mills which use yellow brass as the higher temperatures they produce lead to zinc volatilisation and loss. The induction type of furnace is also unsuited for foundries where alloys high in lead are produced, or where frequent changes in the composition of the brass are necessary. The type of furnace to be chosen therefore must be determined solely by the character of the alloy or metal which is to be melted. Brass founders should obtain expert and skilled advice in the selection of the furnace best suited to their needs and requirements before embarking upon any changes in their present methods or equipment.

Bullion.—Bullion is the technical name for alloys of the precious metals silver and gold, but the name is also applied to the commercial bars or ingots of these metals which are sold for minting purposes to the Governments of the various countries.

Chemical and metallurgical methods are still employed here and there for separating or " parting " silver and gold from one another (*see* CYANIDES), and from the baser metals with which they are often associated, but electrolytic methods of separation have been making steady progress since 1910 and a very large proportion of the silver and gold output of the world is now refined by electrolytic methods. The Moebius process, or some modification of it, is employed for silver refining, while the Wohlwill process is used for gold bullion.

The chief disadvantage of the electrolytic method is due to the large amount of gold and silver which is locked up as anodes and electrolyte in the vats used for the process. Improvements therefore have been directed chiefly towards reducing the volume of the solution, and the time required for the refining operation. One of the newer cells which has been devised for refining silver, is an improved form of the Moebius cell, and is in operation at the Ottawa Mint in Canada. The crude silver in this case contains from 10% to 16% of base metal, and by means of specially designed cathodes and multiple grouping of the anodes, the current which passes through the cell is made a pulsating one. This causes the silver to be deposited on the cathodes so loosely, that it can be easily removed, and the process is made thereby a continuous one. The cells are annular, 36 in. in diameter, and are provided with a hollow centre; the electrolyte is contained in the space between the inner and outer walls of the cells. A rotating cathode is employed, and the silver is stripped continuously from the cathode as it rotates and falls into the trays, which are removed and emptied at intervals of four hours.

Cadmium.—This metal was produced during the War, by electrolysis of acid solutions of the sulphate which had been previously freed by chemical treatment from all impurities. The electrolysis was carried out in semicircular lead-lined tanks, provided with rotating disc-shaped cathodes of aluminium sheet, $\frac{1}{8}$ in. in thickness. The output of the metal in the United States increased from 91,000 lb. in 1914 to double this amount in 1917. In Germany, also, large amounts of cadmium metal were produced during the War, and were used as a substitute for tin in the manufacture of solder. The production of cadmium is still carried on in the U.S.A. at works located at Kennett and at Midvale, the raw materials in each case being obtained from the refuse and waste products or fumes of the lead and zinc smelting works. At Midvale these residues contain 15% of cadmium, 20% of lead and 50% of arsenic; and the solutions obtained after roasting and leaching, are treated with lime, and the filtered liquor is then passed on to the electrolytic vats for electro-deposition of the metal.

Calcium Carbide and Cyanamide.—The applications of calcium carbide for generating acetylene gas for domestic or public lighting have not expanded during the period under review, but its use in the cyanamide process, for fixation of atmospheric nitrogen, has increased rapidly (*see* CYANAMIDES; NITROGEN, FIXATION OF). According to a recent estimate 900,000 tons of calcium cyanamide are now being manufactured yearly, more than half of this total (500,000 tons) being produced in Germany. The greater proportion of this output is applied directly to the soil as a fertiliser, and a small amount only is converted into the ammonium salt.

The tendency in recent years has been to reduce the costs of manufacture by the installation of very large furnaces, using from 5,000 to 10,000 kw. for the production of the carbide; the use of polyphase

current also has greatly improved the efficiency of the process of manufacture. The latest American carbide furnaces are equipped with nine electrodes, using triple three-phase current, and an output of 160 tons of carbide per 24 hours is obtained. These large furnaces are covered in and the carbon monoxide gas evolved by the operation is collected and employed for preheating the raw materials or for other purposes. A continuous process for the manufacture of cyanamide from carbide is also now being operated at Marignac in France, by the Société d'Azote Française, where a yield of 85 to 90% is reported.

Copper.—The remarkable expansion of the electrolytic method of refining copper is due to the presence of small amounts of silver, gold and other precious metals, in the original copper ore. These impurities accumulate in the raw copper from the smelters, and finally appear in the slimes from the electrolytic vats. In many cases the value of these slimes covers the whole cost of the refining operation.

The aggregate output of copper by all the mines in the world is approximately 1,000,000 tons p. a., of which 75 to 85% is now being refined by the electrolytic process. The greater number of refineries are located in the U.S.A., for over half the world's output of copper is still produced in that country. When judged by mere tonnage capacity, or by the capital sunk in the refineries, the electrolytic copper refining industry ranks first, therefore, among the electro-metallurgical industries.

The latest improvement in the conduct of the technical side of the refining operations is based upon the use of colloidal (*see* COLLOIDS) and other agents for improving the character of the deposit. At the Works of the Boston and Montana Refining Co., Ltd., Great Falls, Montana, gelatine is being employed in the vats for this purpose.

With regard to the use of electrolytic methods for the direct extraction of copper from its ores, dilute sulphuric acid is employed as leaching agent for the roasted ore, and the solution of copper sulphate is purified by chemical methods before passing it into the electrolytic vats. At the extraction works operated by the Cornelia Copper Co. the solution obtained from the leaching operation is treated with sulphur dioxide gas, in order to reduce the ferric sulphate to ferrous sulphate. The liquor is then electrolysed in the ordinary way, and the efficiency of the process depends on keeping down the percentage of ferric sulphate which is allowed to enter the vats. In the McKay extraction process now being operated in Australia, a sulphide silicious ore, containing 4% of copper, is roasted in a special type of furnace which enables the temperature of the air and its rate of supply to be so regulated that the copper is obtained as soluble sulphate, while the iron and other impurities of the ore are converted into insoluble basic sulphates. The small amounts of iron and aluminium which accumulate in the electrolyte, after being used, are removed by means of a stream of air.

Graphite.—The production of artificial graphite by the electrothermal process has become one of the most flourishing of the minor electro-metallurgical industries. The original patent has now lapsed, and there has been consequently a great expansion of the industry, which is carried on in practically every country where cheap power is available. The method described by Acheson in his original patent is employed and has undergone very few modifications since it was first operated on an industrial scale at Niagara Falls in the year 1897.

Artificial graphite can be employed for any of the purposes for which natural graphite has been used, but its chief application is for the construction of electrodes for electrolytic and for electric furnace work. Its electrical conductivity is high and it can be produced in large blocks, which may be sawed, tapped, screwed or turned in the lathe, to produce electrodes of any desired shape. Some graphite electrodes manufactured for electric steel furnaces have been 24 in. in diameter and 72 in. in length, and could not have been produced from natural graphite. It is also used for the manufacture of lubricants, paints, dry batteries, packings for engine glands, and of preventives for scale in steam boilers.

Electric Steel Furnaces.—During the year 1910–25 there has been a remarkable increase in the number and capacity of the electric furnaces employed in steel works, and in steel foundries for melting and refining the higher grades of steel. In 1913 Germany produced more than one-half of the world's supplies, but before the end of the War the United States took the lead and has since retained it.

The electric furnace may be employed either alone or with the Bessemer or open-hearth furnace, and may be operated either with acid or basic slags. It can be employed also as an adjunct of the blast furnace or of the cupola furnace, for producing grey or malleable iron and for semi-steel castings, and the smaller sized furnaces are particularly advantageous when only small quantities of castings of a particular steel or iron are required.

Recent improvements have been confined chiefly to the mechanical and electrical equipment of the furnaces, such as better-fitting doors; water-cooled arches; improvement in the electrodes and holders, and automatic electrode control. As regards the holders, the tendency has been to substitute cast steel for the bronze holders which were formerly employed; and the mechanism for tilting the furnace has also been much improved, controllers of the reversing type now being used, with a motor brake which prevents overtravel of the furnace, and holds it stationary in any desired position.

With regard to electrical features, the transformers are now more strongly constructed, and only two main types are in use; namely, the Heroult, operated at 110 volts, and the Pittsburgh or "Lectromolt" with a voltage of nearly twice this amount. The transformers are placed as close to the furnace as possible, in order to improve the power-factor by shortening the leads. The majority of furnaces are now operated with three-phase connections, and the use of a bottom electrode is being discarded. As regards linings, the larger number of furnaces have silica brick walls; and silica brick is also generally employed for the roof, although carborundum brick has been employed. Another special refractory material, which has been tried with success, is fused magnesite which does not shrink and seems to have great possibilities.

The majority of the arc furnaces are built on the Heroult principle, and have capacities of from 1 to 40 tons, and in those, both arc and resistance heating is employed. The power expenditure for melting steel for casting ranges from 500 to 600 kw. hours per ton, and for refining the metal from 700 to 1,200 kw. hours per ton. Since the War, fine steel for castings is being produced. The two types of furnaces which are popular for foundry work are, the small furnace delivering from a half to one ton, and a larger one with a capacity of three to four tons. A wide field for the application of the electric furnace lies in the production of high-grade grey and white iron, since it is possible for the electric furnace to superheat the metal, both under acid and basic conditions.

In Great Britain the chief progress to be recorded is in the manufacture of high-grade steel. In the Sheffield district the old established crucible process of steel manufacture is being gradually displaced by the electric process. At the works of Messrs. E. Allen & Co., Sheffield, scrap steel is being melted and refined in two stages. The preliminary melting and oxidation is carried out in a 10-ton furnace, and from this the molten metal is transferred at short intervals to a smaller 3½-ton furnace, in which the refining operation is finished.

In France the latest improvement in the Heroult type of furnace has been the use of copper tubing as conductor and as carrier for the cooling water required by the electrode holders. This plan saves two-thirds of the copper, and the current leads can be brought much closer together. In the latest design of Heroult furnace the superstructure, which carried the conductors and electrodes above the furnace, also has been dispensed with; and the electrode arms and holders are supported from below. The transformers and high-tension switch gear are now placed beneath the floor. Improvements have also been made in the density of carbon electrodes; but on account of the impossibility of producing these electrodes satisfactorily beyond a certain limit of size, Heroult furnaces of 40 tons capacity cannot be exceeded.

In Canada a new form of Heroult furnace has been applied to the melting of "monel-metal" at the works of the International Nickel Co. at Huntingdon. A basic lining is used for this furnace, and the desulphurisation and deoxidation are carried out under a basic slag. The latest form of Greaves-Etchells furnace adopted in the U.S.A. introduces two phases of the three-phase power supply, through two or more top electrodes, and the third phase through the furnace hearth. By the use of four or more electrodes with this furnace, considerable flexibility of operation is possible, as the top electrode and higher voltage can be employed when starting up a cold furnace, and the top and bottom electrodes when the bath is molten and the refining and superheating of the metal is in progress. Furnaces of this type, with capacities of from 60 to 80 tons, are reported to be under trial by the Ford Motor Co. at Detroit, U.S.A.

A multiple system of electric heating has been introduced into some American steel foundries, in order to diminish the interval between one heating and the next. The method is based upon the use of two furnaces, mounted on a movable turn-table, so that either furnace can be brought under the fixed furnace cover and electrodes. Where this method is adopted, the average time between successive heats is reduced to 3½ min., and a load-factor of from 95 to 98% is obtained. The units employed are of 1½-ton capacity, and these provide small batches of hot metal for light castings, ready for pouring at regular intervals of three-quarters of an hour. By the use of this system only one charging and pouring position is required, and continuity of operation is being obtained.

The largest electric furnaces employed in America for steel melting and refining are the 25-ton Heroult three-phase arc-type furnaces

erected at the South Chicago works of the Illinois Steel Co. during the War. In 1918, these furnaces were producing steel at the rate of 16,500 tons per month, when operated under the triplex system of charging, referred to above. Other types of electric furnaces used in the American steel industry are the Booth-Hall, the Girod, the Greaves-Etchells, the Grönwall-Dixon, the Ludlum, the Snyder and the Von Baur.

Ferro-alloys.—The applications of ferro-alloys in the iron and steel industry have increased enormously since 1911, and the Sheffield steel trade is now dependent upon these alloys for some of its most valuable products. The discovery made many years ago, that very small percentages of chromium, nickel, manganese, vanadium and other rare metals, either separately or in combination, could produce great changes in the physical properties of steel, has, in fact, revolutionised modern steel manufacture, and the production of rustless or "stainless" steel (*see* RUSTLESS STEEL) was one of the most notable advances made during the war period. These special steels are known as binary, ternary or quaternary steels, according to the number of elements (other than impurities) which are present in the finished steel, and it is the quaternary steels, containing carbon and two other elements, which are now finding very wide application in the arts and industries.

The ferro-alloys used in the manufacture of these special steels came chiefly from the large electro-metallurgical works located in the French and Swiss Alps and dependent upon hydraulic power for their source of electricity and heat. During the War, ferro-alloys were produced in the United Kingdom, at Newcastle, Widnes and other places, the manufacture having been scheduled as a "key" industry. Since the return to peace conditions, the bulk of our supplies are once again being drawn from the more economically operated works abroad.

The furnaces used for the production of ferro-alloys are of the resistance, not of the arc, type, and their design is based on that of the furnaces employed for the manufacture of calcium carbide. They are generally constituted with a cylindrical receptacle of masonry or metal lined with a refractory metal, and equipped with one hearth-electrode and with two or more electrodes suspended above it. The chief difference between the various types is in the method of constructing the base electrode, which may be either a plate of steel embedded in the lining used to form a hearth, or a series of steel bars arranged in fan fashion above a similar lining. In the Keller furnace, a large water-cooled graphite electrode is employed, terminating above in a graphite hearth.

The older furnaces had open tops, and the gases produced during the reduction of the ore and production of the alloy, were allowed to escape with their heat unused. Modern furnaces are closed, and after recovering the dust, which may prove in certain cases to be valuable, from the gases, these latter are used for heating purposes. This improvement in the heat economy of process, together with the use of higher current densities and temperatures, has led to considerable economies in the operation of the furnaces, and it is now possible to produce ferro-alloys from low-grade ores, and thus to reduce their price to the consumer. The demand for ferro-alloys containing low percentages of carbon and silicon, has led also to considerable improvements in the refining operation, and it is now possible to obtain ferro-alloys containing under ·5% of carbon. As regards the size of furnace, the tendency is towards the use of larger units, and a recent paper contributed to the *Jour. Amer. Inst. Elec. Engineers*, described a furnace of 12,000 kv.a. capacity for the production of ferro-alloys.

Electric Iron Smelting.—Pig iron can be produced in an electric furnace, either by reduction of the iron ore with coke or charcoal by aid of electric heat, or by melting steel scrap. The latter method is termed the "synthetic" production of pig iron, and has been practised chiefly in France and Canada; while electric smelting is carried on only in Scandinavia and Italy, where very cheap electric power is available. The smelting furnaces now employed are an improved type of the shaft-furnace which was first tried in 1911 in Sweden.

Two types of furnace are now in use for electric smelting, namely, (*a*) those with a deep charge and shaft, as exemplified in furnaces of Grönwall, Linblad and Stalhane type, and (*b*) furnaces with a low charge and shaft, of which the Hilfenstein is the best known example. Furnaces with a deep shaft are adapted for use with charcoal as reducing agent, while coke is the fuel used with the Hilfenstein furnace. The latest improvements in electric smelting have been the recovery of the heat from the waste gases, automatic charging, the use of continuous electrodes, and progress in transformer construction.

Magnesium and Magnesium Alloys.—Magnesium and its alloys have come to the front as metals of considerable industrial value and importance in recent years, owing to the demands of the aeroplane and motor industries for a metal combining lightness, strength, toughness, and ability to resist the effects of vibration and shock. The alloys of magnesium and aluminium which contain from 5 to 30% of aluminium have approximately the same mechanical properties as brass, and can be employed for the manufacture of screws, nuts, wire, tubes and sheets. The hardness of these aluminium magnesium alloys increases with the proportion of the latter metal present in the alloy, and with 70% magnesium the hardness is equal to that of mild steel. An alloy containing 92% magnesium and 8% aluminium has been patented also by a German firm, and is stated to have a strength equal to that of gun metal, with a specific gravity of only 1·75.

In the manufacture of the magnesium-aluminium alloys, it is of great importance that the metals should be pure. The aluminium is first melted in a graphite crucible, and a small amount of cryolite is added as a flux. The magnesium in the required amount is then introduced and in order to prevent loss by oxidation it is held beneath the surface of the molten aluminium by tongs, until it is melted. As regards the best contents of magnesium for alloys designed for various uses, Klaudy states that a 2 to 5% magnesium alloy is best for wire drawing; 5 to 8% for rolling; 12 to 15% for casting, and that the average strength of a cast of 10% magnesium alloy is 20,000 lb. per square inch. An alloy he recommends for aeroplane construction work has the following composition: aluminium, 80 parts; magnesium, 12 parts; cadmium, 8 parts.

As regards the methods of manufacture, magnesium is being produced by the electrolysis of fused carnallite in Germany, carnallite being the naturally occurring chlorides of magnesium and potassium. In America the metal is produced from pure magnesia (MgO) by a process very similar to that used for the production of aluminium. In this case, however, the magnesium oxide is added continuously to a bath composed of chlorides of potash and magnesium, and the metal is removed from the fused electrolyte as it collects at the negative electrode. Details of the method used to prevent oxidation are lacking. At Wolverhampton the metal is reported to be manufactured by a two-stage process. An alloy with lead is first obtained by the electrolysis of magnesium chloride, and this lead-magnesium alloy is electrolysed in the molten state.

Quartz Glass.—Quartz is an impure form of silicic acid (SiO_2) and quartz glass is, therefore, a glass consisting chiefly of silicic acid; whereas ordinary glass contains silicic acid in combination with lime, soda, potash or lead. Quartz glass for chemical use as compared with ordinary glass has a much higher melting point, and is not fractured by sudden changes of temperature. It is neither hygroscopic nor soluble in acids, and alkalies affect it less then ordinary glass except at the higher temperatures. It is, therefore, of great value for chemical and research work of various kinds.

In the early days of its manufacture only tubes were made. The electro-thermal method of production was to embed a graphite rod in sand, and to heat this with a current of high amperage. A white opaque tube of quartz was obtained in this way, of much greater diameter than the graphite core. The opacity was due to the air entangled in the raw material, this air being imprisoned as minute air bubbles in the pasty mass, when it softened under the application of heat.

A new method for producing clear quartz in various forms is now in use in the U.S.A. Clean crystals of quartz are packed in a graphite crucible, and are melted under low pressure in a vacuum furnace, heated either by the oxyhydrogen blow-pipe flame or by electricity. A clear, transparent pellet of quartz, containing a few air bubbles is thus obtained. This is next placed in another graphite crucible suspended in a vertical carbon-tube electric furnace. A graphite piston which just fits the crucible and loaded with a weight on top, is placed above the quartz pellet which is again brought to its fusion point. The air bubbles in this way are caused to collapse, and the clear quartz is forced out below through openings, and is moulded as required, in the form of rods, tubes, ribbon, etc.

Sodium.—This metal is now produced almost entirely for commercial and industrial purposes by the electrolysis of fused sodium hydrate, using the type of cell and process originally patented by Castner. Danneel has recently stated that it can be more economically produced by electrolysis of the fused chloride, and that industrial trials of this method were made before the War at Chevres, near Geneva, and at Bozel, in the Haute-Savoie. The electrolyte used for this process is composed of a bath of mixed chlorides and fluorides of sodium and potassium, and the sodium chloride is fed into this bath at the same rate as that of its decomposition.

Tin.—Electrolytic methods for stripping tin from the waste cuttings of can factories and from the old tin cans collected from towns' refuse, were at one time operated in Germany, and also

in other countries, but have now been displaced by chemical methods, depending upon the use of liquid chlorine. The electro-deposition of tin is still employed, however, in some places for refining the metal, as at Perth Amboy, New Jersey.

Electrolysis is used here, to separate the tin from impurities such as antimony, arsenic, lead and bismuth, which cannot be successfully removed by any other process. The electrolyte used is a fluosilicate of tin, which is prepared in the vats, and the cathodes are protected from its action by a porous vase. The electrolyte should contain 20% of hydrofluosilicic acid, and about 1% of sulphuric acid; the latter is added to precipitate the lead. The current density employed is about 18 amp. per sq. ft., and the temperature of the electrolyte must be kept below 20° Centigrade.

Zinc.—The electrolytic process for the recovery of zinc from the solutions obtained by leaching the roasted ore with dilute sulphuric acid has made remarkable progress since 1910, and the total output of electrolytic zinc is now estimated to lie between 125,000 and 150,000 tons per annum. The extraction of zinc, therefore, is now the most important electrolytic industry after those of copper and aluminium, and its growth is explained by the fact that the electrolytic method is useful for treating complex ores, which cannot be dealt with satisfactorily by the older dry methods. Recent study of the conditions which yield the best result have shown the necessity for producing a high percentage of soluble zinc during the preliminary roasting of the ore, and the best temperature for attaining a high sulphatising action is found to be a dull red heat, 550° to 600° Centigrade.

The latest progress in the electrolytic recovery of zinc centres around the systems of purification, circulation and regeneration of the electrolyte, and one of the most recent of these improvements is to separate zinc ferrite from the roasted ore by passing it over a magnetic separator. Two products are thus obtained, a magnetic one containing all the ferrite and some zinc oxide, and the other containing pure zinc oxide. The magnetic product is then leached with 28% sulphuric acid and on neutralising this with the zinc oxide from the non-magnetic portion of the roasted ore, the iron is precipitated as dense ferric hydroxide, which carries down with it all the arsenic, antimony and silica present in the ore. The purified solution is then electrolysed with a current of 100 amp. per sq. ft., and during the electrolysis glue is added to the electrolyte, to the extent of 3 lb. per ton of zinc produced. The zinc deposit obtained from this high acid process is dense and smooth, and may be detached readily from the aluminium sheet by a slight tap.

Electrolytic zinc works have been established in Italy and in the Pyrenees, one of the most recent being the works of the Société de la Vieille Montaigne at Viviez, where 4,000 H.P. is being used, from a water power located 40 m. away. The largest plant in which electrolytic zinc is being produced is that erected in 1918 by the Anaconda Copper Co. at Great Falls, Mont., for recovery of the zinc from the complex zinc-lead ores of the Butte district, by a sulphate leaching process. The tankhouse of this plant contains 864 vats, each 10 ft. long by 3 ft. wide by 5 ft. deep; each vat holds 28 anodes and 27 cathodes. The latter are of rolled sheet aluminium, from which the deposited zinc can be stripped easily. The anodes are of chemical lead. The current for each unit of 144 cells is supplied by a rotary converter of 5,800 kw. output, 10,000 amp. at 580 v. being required to run this number of cells. At full load the current density employed is 30 amp. per sq. ft. of cathode area; but 22 to 25 amp. yields the most satisfactory deposit.

Electro-thermal processes of zinc extraction are practised in Scandinavia, resistance furnaces being used in Norway and arc furnaces in Sweden. The resistance furnaces employed in the former country are those designed by Thorledsen. In this type of furnace, the roasted ore and carbon form the resistance material for the passage of the current. The zinc condensed in the first part of the receiver contains 10% of lead, further on in the receiver a deposit of 98% of zinc is obtained, finally pure zinc and zinc mixed with a small amount of cadmium. The condensed metal, however, is not pure, but contains 35% of zinc powder.

The Swedish process is used at Trollhättan, and the works there now employ 18,000 horsepower. The mineral is first roasted, and after mixture with coke and fluorspar is submitted to the action of the electric arc. Oxide of zinc and grey metal are recovered, and on submitting this to the process a second time, a metal containing 99·8% of zinc is obtained.

Electrogalvanising.—The electrolytic deposition of a coating of zinc, from sulphate solutions upon iron articles is now a well-established industry in all the leading manufacturing countries.

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(J. B. C. K.)

ELECTRON (*see* 9.237).—The reader should consult the article GASES, ELECTRICAL PROPERTIES OF, by Sir J. J. Thomson, for an account of the electron and its properties. The electrons are particles whose mass is about 1/1800 part of an atom of hydrogen. There is only one kind of electron, for all have the same mass and carry the same electric charge. (*See* also ELECTRICITY; MATTER.)

ELECTROTHERAPY (*see* 9.249).—Four different types of electricity are employed in medicine:—

(1) The constant, continuous or galvanic current.
(2) The interrupted currents of low frequency (the interrupted galvanic current, the alternating and sinusoidal currents, the faradic current).
(3) The interrupted currents of high frequency (high frequency currents, and diathermy).
(4) The high voltage unidirectional currents derived from the static machine.

The Constant Current.—It is now generally accepted that the chief curative action of the constant current is due to the reflex action resulting from the stimulation of the cutaneous and subcutaneous nerves immediately beneath the area over which the pads conveying the current are applied. By this reflex stimulation, an increased blood supply with its valuable consecutive effects is obtained. This stimulation is very similar in nature to what has been termed "counter-irritation," with the great advantages that the amount of stimulation is capable of exact regulation, that it takes place within the epidermis, thus acting directly on the nerve endings and that it can be continued daily for a long period, improving the condition of the skin rather than destroying it, as the constant painting on of an irritant would do. The extent of this stimulation is dependent on the strength and duration of the current employed and the nature of the solutions with which the conducting pads are moistened.

When a positive pole of zinc or copper, or when salts of these metals in solution are employed, a caustic and destructive compound such as the chlorides or oxychlorides of zinc or copper is formed in the submucous or subcutaneous area by the combination of the negatively charged atoms of zinc (zinc ions), proceeding from the positive pole to the tissues, with the positively charged chlorine atoms (chlorine ions) proceeding from the tissues toward the positive pole. In the process of combination the atoms get rid of their electrical charges, the process is therefore rather one of de-ionisation. This method is very valuable for the thorough and safe destruction of the diseased membranes of cavities, such as the unhealthy mucous membrane of the uterus or the lining of septic cavities.

Similarly, by the employment of less destructive solutions, a reflex stimulation of the tissues can be brought about. The amount of stimulation depends on (1) the nature of the solution, (2) the strength and duration of the current. In general the best results are obtained by a solution causing the minimum of irritation and the application of the maximum current which can be readily tolerated by the patient for at least 40 minutes.

This form of treatment is indicated when increased local nutrition or the re-absorption of fibrotic thickening is desired: such as in the local treatment of chronic rheumatics, neuritis, sprains and many other conditions. It is especially valuable in the treatment of tic douloureux, for which the employment of strong currents of from 40 to 80 milliamperes is necessary.

Interrupted Currents of Low Frequency.—The therapeutic effects obtainable from the employment of the interrupted currents of low frequency have been greatly increased by the methods recently introduced by Prof. Lapicque, Prof. Leduc and Dr. Morton Smart. In the method of Lapicque, by the interposition in parallel of condensers with capacities varying from 2 to 30 micro-farads, we obtain an interrupted current of such

progressive onset and decline that we can excite contractions in paralysed muscles without exciting corresponding or overpowering contractions in the neighbouring healthy muscles, due to the physiological fact that the contraction excited in a paralysed muscle is less dependent on a sharp make and break than with a healthy muscle.

In the treatment of infantile paralysis objection has been raised to the electrical excitation of the paralysed muscles on account of the over-excitation of the opposing healthy muscles which accompanies such stimulation. By the method of Lapicque this objection is entirely overcome. The defined and isolated contraction elicited by this method has a valuable re-educative effect in cases of recovering motor-nerve lesions. Lapicque's technique is especially useful in the treatment of facial palsy.

The Leduc current consists in the interruption at a frequency of about 100 per sec. of the galvanic current at the very low intensity of from two to four milliamperes. Leduc claims that it is possible by employing these minute currents interrupted at such frequency to induce successively local anaesthesia and, if applied through the brain, general anaesthesia, electric sleep, coma and eventually death. Applied locally, avoiding the region of the brain, this treatment is perfectly safe and has proved valuable in the treatment of certain forms of neuritis and especially in that otherwise intractable condition, causalgia.

The advantages of the instrument and technique elaborated by Dr. Morton Smart for the application of faradism to muscles deficient in excitability and tone, which have very greatly enhanced the therapeutic value of the faradic current, are that the pain of the treatment is abolished or reduced to a minimum, the vigour and amplitude of the contractions are increased; and, above all, when employing this method, the operator can at once appreciate when the muscles are becoming fatigued and so can at once discontinue further stimulation before any of the bad effects which were liable to occur when employing the older methods, can take place.

High Frequency Currents and Diathermy.—Although the researches of D'Arsonval which led to his discovery of the high frequency currents and diathermy were commenced in 1888 and concluded in 1890, diathermy the most valuable result of his research, only began to be employed in Great Britain in 1911 or 1912. D'Arsonval, when experimenting with alternating currents in 1888, noticed that, with a constant strength of current, the more rapidly the interruptions occurred, the more vigorous were the resulting muscular contractions.

When, however, a frequency of from 2,500 to 5,000 excitations a second was reached, a decrease in the vigour of the contractions occurred and progressively decreased with the increased frequency of excitation. At this time, the instruments at D'Arsonval's disposal did not permit a further increase of frequency, but in 1890, by employing the wireless apparatus of Hertz, he obtained what he rather exaggeratingly termed "billions of oscillations a second." With these frequencies he found that he was able to pass a current of two or three amperes through the human body without producing any muscular contraction or other sensation than that of heat. He thus obtained the clinical high frequency currents. Diathermic currents were subsequently evolved from the high frequency currents by such modifications in the instruments as permitted currents of lower voltage, higher amperage and higher frequency to be obtained.

The main therapeutic effect of diathermy is the generation of heat deeply in the tissues by the friction from the oscillation of the electrically charged atoms. Any organ of the body, any limb or part of the body, or the whole body to any extent required, can be heated by this current. Before the advent of diathermy we were able to heat only the superficies or the accessible cavities of the body; even under such limitations the application of heat formed one of the oldest and most useful therapeutic measures. Moreover, the heat obtainable from diathermy admits of exact and easily regulated adjustment to a degree never before obtainable.

The consecutive effects of heat applied in this manner are an increased blood supply, relaxation of tension and spasm with consequent relief of pain, increased local drainage, increased local nutrition. The heat thus generated is an expression of the mechanical or dynamic force excercised by the oscillations of the ions within the tissues and this primary action (the so-called "ionic massage") appears to be of value in aiding the dispersal of recent effusions. Some of the main indications for the application of diathermy are the relief of pain and spasm, the treatment of rheumatism, neuritis, sciatica, asthma and pneumonia.

Diathermy in Surgery.—Apart from its medical application, diathermy is of considerable value in surgical practice for the destruction of superficial morbid growths, such as rodent ulcers, warts, naevi, etc. When applied for this purpose, in place of the two electrodes of large size employed in medical diathermy, one large (the indifferent electrode) and one small metal point (the active electrode) are substituted. In this way the heat, which is distributed and is only appreciated as a slight warmth over the large pad, is concentrated at the small metal point and almost immediately coagulates and destroys the tissue with which the point is brought in contact. Very satisfactory results have been obtained from the treatment of haemorrhoids in this manner.

The point of a metal wire can be employed as the active electrode and by inserting this wire through a cystoscope (an instrument for viewing the interior of the bladder) small growths can be readily destroyed and serious surgical operation avoided.

High Voltage Unidirectional Currents.—The therapeutic effects obtainable from the static machine were so exhaustively worked out towards the end of the 19th century, notably by Drs. W. J. Morton and Benham Snow of New York, that no important developments in the use of these machines have been made in recent years. Recent research, however, has enabled the therapeutic action of the currents derived from these instruments to be rationally explained on a physiological basis and the claims formerly put forward for this form of treatment have been fully justified. (W. T.)

ELEMENTARY EDUCATION (*see* 8.981).—The changes which have taken place in elementary schools since 1910 represent the natural development, perhaps accelerated, of the principle that elementary education is an integral part of a comprehensive national education which aims primarily at the all-round development of each human personality. (*See* EDUCATION.)

I. GREAT BRITAIN

In England and Wales the policy of the Board of Education [1] indicates clearly enough the official ideal of the responsible department of state during this period.

> The only uniformity of practice that the Board of Education desire to see in the teaching of public elementary schools is that each teacher shall think for himself, and work out for himself, such methods of teaching as may use his powers to the best advantage and be suited to the particular needs and conditions of the school. Uniformity in details of practice (except in the mere routine of school management) is not desirable even if it were attainable. But freedom implies a corresponding responsibility in its use.

The administration and inspection of public elementary education upon lines broad as these have combined with other influences to produce the variety which at the moment characterises English and Welsh elementary schools and which indeed makes it difficult to generalise about them with accuracy. Influences other than those directly exercised by the Board of Education are in the nature of things far less easy to trace, yet some of them require specific mention.

Influence of Psychological Science.—The study of psychology has exercised a powerful and widespread influence upon elementary school teaching, which shows no sign of waning. For example, the emphasis placed by W. MacDougall (*Social Psychology*, 1908) and his school upon the importance of the factor of "interest" in education has been almost universally reflected in school methods and schemes of work and has been largely although not entirely responsible for many attempts—often singularly original and successful—to co-ordinate the life

[1] See the Prefatory Memorandum of the *Suggestions for the Consideration of Teachers and Others concerned in the work of Public Elementary Schools* published in 1905 and re-affirmed in subsequent issues of this pamphlet. (Cd. 2638.)

of the child in school with his life at home and for the adoption of "imaginative methods," *e.g.*, free drawing, dramatisation, modelling, etc., in the teaching of subjects which have hitherto been taught almost entirely by oral instruction by the teacher.

Intelligence Tests.—Again, teachers everywhere have taken great interest in both the theory and practice of intelligence tests (*q.v.*). The recognition of the possibility that much ability may pass through the elementary school undetected by the traditional methods and content of teaching has led to much original experiment under both these heads. In particular it has led to a critical scrutiny of traditional examinations.

Physical Training.—The criticism of medical authorities (closely associated with the development of the school medical service) has checked any tendencies to regard education as an exclusively intellectual process. The modern elementary school has an equal regard for the physical as for the mental development of its pupils and, quite apart from the specifically remedial action of the school medical officers, now does much to improve the physique of its children (*see* PHYSICAL TRAINING). Considerable time and attention are devoted to suitable games (largely musical in character) in the infants' schools; and organised games, such as cricket, football, swimming, netball and folk dancing are practically universal in the senior schools. Steady progress has been made in the provision of special schools for blind, deaf, physically and mentally defective children, though much yet remains to be done.

Individual Methods.—The influence of Mme. Montessori's theories (*see* MONTESSORI SYSTEM) has been very marked, not indeed by any wholesale adoption of them, but in directing criticism against the traditional classroom methods of teaching and so leading on to a particularly fruitful experimentation in individual methods of instruction, which has been remarkably general and often remarkably successful in the infants' schools. Perhaps the great majority of English infants' schools now employ "individual methods" to a substantial extent, although seldom relying upon them to the entire exclusion of the more traditional classroom methods. Somewhat similar methods—such as those adopted under variations of the well-known "Dalton plan"—are now being largely applied to the case of older pupils, the broad aim being to train the children to use books and to work individually with self-reliance and effect.

Curiously enough, too, the elementary schools in their endeavour to increase the effective interest of school-life have found it worth while to take a leaf out of the book of the most traditional of English educational institutions—the English Public Schools. The house and team systems, now frequently adopted, covering both work and games, represent an attempt to cultivate the healthy spirit of group rivalry.

Teachers' Courses.—Some reference must be made to the growing importance of "Teachers' Courses" in the development of elementary school teaching. Year by year since the War the popularity of "refresher courses" for teachers already fully qualified has increased and these courses are now attended by thousands of teachers annually (*see* SUMMER SCHOOLS). The courses may be held during the school holidays or the school terms; they may take the shape of continuous fortnights of study or of weekly demonstrations and lectures; they may be conducted by a local education authority, the Board of Education or private enterprise; they may deal with the theory or practice of education or aim merely at deepening the teacher's knowledge of a particular subject. But whatever their system they have exerted a very beneficial influence upon elementary school teaching by helping to keep the teacher alive and interested in his work and in touch also with current developments in educational ideas and contemporary scholarship.

Special Developments.—Administrative action during the period 1910–25 has increasingly recognised the necessity for the unification of the system of public education and has made a steadily increasing provision for the advanced education of elementary school children who are capable of profiting by it. The brighter children are now drafted away in increasing numbers from the elementary schools at the age of 11–12 to continue by means of scholarships and free places their education in the secondary schools. Notwithstanding recent financial stringency, the action of the secondary schools in this respect has been considerably intensified by the establishment in a large number of areas of "Central Schools," "Central Classes," "Higher Tops" and distinctively vocational schools which also draw their pupils from contributory elementary schools, generally on a selective basis. Thus more and more the children remaining in the elementary schools beyond the age of 12 are those that are left after the cream has been drawn off. The process is inevitable and all to the good from the point of view of the individual child. But the elementary school is left with a new problem to solve, viz.: the evolution of a new type of education for children not of the first ability, who have only two or three years more of school life before them, but who have nevertheless outgrown the methods of the middle-school and now require to be prepared effectively for life as adolescents in trade or business. The present tendency is to favour the application of individual methods with an increasing amount of practical work of all kinds for these children. In conclusion it may be well to endeavour to characterise briefly, in so far as the variety of the schools makes this possible, the outstanding features of the public elementary school at the moment.

Relations with Parents.—First, the elementary school as a whole since 1910 has very definitely resisted any tendency to become an educational machine for the instilling of mere information into children. Year by year it has become more and more clearly an organ of general social welfare—with a particular function of its own, it is true, but none the less for that, part of the great general movement of the age making for social betterment. It has won general recognition among the parents; it has ceased to be the enemy of the family as it once often seemed, and has become instead a friend to be trusted and assisted. Few things are so significant as this changed relationship between the teachers and the parents, so strikingly exemplified since the War by the widespread popularity of the "Education Week"—a week set apart by a local authority in order to explain and exhibit its system of education to the public.

Infants' Schools.—As regards the infants' school, the special aim here is, not only to impart the rudiments of the 3 R's—and much ingenuity has gone since 1910 to the formulation of rapid and interesting methods of teaching these—but to develop interest and the natural activities, special weight being laid perhaps upon oral responsiveness. The lively, eager interested child, although with the powers of concentration proper to his age, is increasingly regarded as the typical product of the good infant school.

Senior Schools.—In the Senior schools the general aim is to train the child in habits of independent work and self-reliance and to cultivate in him an interest and ability in intelligent work—at least of some sort—which will stand him in good stead long after he has passed the age of compulsory attendance. In particular, it seems as though the position of arithmetic as the weightiest subject in the elementary school curriculum has now been severely shaken, if not definitely occupied by English—a subject which has made great advance during the last 10 or 15 years. In any case, the old multiplicity of subjects is now defining itself into two groups—the English group, including reading, spelling, compositions, the study of elementary literature, geography and history; and the mathematical-scientific group, including arithmetic, elementary mathematics and physical science. This process of definition with its accompanying simplification of the whole and co-ordination of parts is doing a great deal to liberalise both the content and method of teaching.

Handwork.—Handwork has established itself firmly as a teaching method; as a subject in the shape of laundry, cookery and housewifery for girls, and wood, metal and varied work for boys, its value is increasingly allowed, especially for the kind of children likely now to remain in the elementary schools until their school-life finishes; its development in these more specialised directions has, however, since the conclusion of the World War been unavoidably checked by financial considerations. Still more recently some reaction may be discerned

against the more extravagant doctrines of self-expression and self-development. This reaction is likely perhaps to lead to an increasing emphasis upon the value of the more formal elements in education. *See* EDUCATION and the bibliography thereto.

(K. M. A.)

II. THE UNITED STATES

Progress in the development of elementary education has been made during the years 1910–25: (1) through the adoption of compulsory education laws by all of the states which did not have such laws; (2) through consolidation of rural schools; (3) through the enrichment of the curriculum, especially in the upper grades; (4) through the improvement of the training of teachers; (5) through the lengthening of the school year; and (6) through the erection of many modern school buildings with enlarged equipment.

Compulsory Laws.—Compulsory education laws were enacted in 1915 by Alabama, Florida, South Carolina and Texas; in 1916 by Georgia and in 1918 by Mississippi. The movement to make compulsory education universal in the United States, which began in 1852 in Massachusetts, was thus consummated by the Legislatures of the states mentioned. In these states public education developed slowly after the Civil War and the enactment of compulsory education was delayed by economic and social conditions. In 15 of the older states recent legislation has raised the age limit of compulsory school attendance from 14 to 16 years. There seems to be a tendency to carry the limit finally to 18, which limit is now set by Idaho. If this tendency is realised in legislation it will undoubtedly be accompanied, as was similar legislation in England, by provision for supervised entrance of a part of the school population upon industrial occupations (*see* CONTINUATION SCHOOLS).

Rural Schools.—Rural schools, which have always been meagre and ill-equipped as compared with urban schools, have been greatly improved, especially through the consolidation of several school districts and the transportation of pupils to a single central building, where better facilities are provided because of the type of organisation which can be adopted when larger numbers of pupils are grouped together in classes. The U.S. Commissioner of Education is authority for the statement that in 1924 approximately 1,000 school consolidations were made; about 5,000 one-room schools were absorbed into consolidated centres; and expenditures for the transportation of pupils increased in that year by $3,500,000.

Curriculum Changes.—The fact that modern life because of its complexity makes a broader education necessary for success, has led to an expansion of the curriculum by the introduction of new materials of instruction and by the great enlargement of some of the traditional subjects. Where pupils used to read one book a year they now read 10 to 20 books in the reading class. Nature study is common as an extension of geography and as a means of introducing pupils to the principles of science. Practical activities, such as cooking, sewing and manual training, are now very general. Health education has been enlarged as never before, and takes either the form of scientific teaching of hygiene and physiology or the form of practical exercises in the gymnasium or clinics. A general tendency has appeared to carry down into the elementary school certain courses which were formerly regarded as the exclusive property of the high schools. Such are courses in foreign languages and mathematics beyond arithmetic. This tendency to enlarge the work of the upper grades is directly related to the development of the junior high school (*see* SECONDARY SCHOOLS).

Training of Teachers.—Much agitation has in recent years led to a serious consideration of the very general lack of training on the part of teachers. It has been estimated that from 25% to 40% of the teachers in public schools, especially the one-room rural schools, are without a high-school training. Probably less than one quarter of the teaching staff of all schools is made up of normal school graduates. The agitation has resulted in legislation empowering state departments of education in the various states to raise the requirements for teachers' certificates and to compel communities to pay higher salaries. Twelve states increased the requirements for teachers' certificates in 1924.

Attendances.—The school year has been lengthened steadily during the period in which the U.S. Bureau of Education has collected statistics, as has also the average number of days of attendance of individual pupils. The following table gives details of these increases since 1900.

	1900	1905	1910	1915	1920	1922
Average No. of days schools were in session	144·3	150·9	157·5	159·4	161·9	164·0
Average No. of days attended by each pupil enrolled	99·0	105·2	113·0	121·2	121·2	130·6

New Buildings.—The erection of new school buildings has gone on at an unprecedented rate since the World War. In 1910 expenditures for sites, buildings and equipment were $69,978,370; in 1920 they were $153,542,852 and in 1922 $305,940,965. The buildings are better planned and more hygienic and include in many cases auditoria, gymnasia, science laboratories and shops, thus providing more adequately for the enriched programme of instruction, and also for the use of the buildings for many community purposes.

(C. H. J.)

ELEMENTS, TRANSMUTATION OF: *see* TRANSMUTATION OF ELEMENTS.

ELEVATORS AND ESCALATORS (*see* 9.263).—The chief advances in elevator design in the period 1910–26 have been initiated in the United States, where the increasing congestion in business districts has forced up land values and made it desirable to increase the height of buildings, a necessary condition to this change being an improved type of elevator. The famous skyline of New York is thus intimately dependent on the most notable improvement of the period, the perfecting of the gearless traction elevator.

Prior to 1906, when the first electric gearless traction elevator was installed, practically all electric elevators had been of the drum type. This type had inherent limitations, such as the available width of face of the drum upon which the hoisting cables were wound and a maximum car speed of 400 ft. per minute. These restricted the electric elevator to lower buildings, the higher ones being equipped with the geared vertical or horizontal hydraulic elevators, which provided car speeds up to 600 ft. per minute.

The Electric Elevator.—The advent of the electric elevator, which was evolved from the earlier drum type of electric elevator, provided 600-ft. car speeds without restrictions on the height of buildings. It substituted a traction driving sheave for the drum of the earlier type of electric machine and direct drive instead of the worm gearing. The first cost of such an installation was much less than the hydraulic elevator, with its steam pumping plant; the operating costs were less; the machines were easier to operate and required less space in the building, being placed over the hatchways and thus saving the valuable space in the basements formerly required for the pumping plants. These advantages speedily made the gearless traction elevators popular, and by 1910 installations of hydraulic elevators had practically ceased. From that time, improvement consisted largely of development and refinement of operation and control. Direct current only can be used with this machine.

The drum type of electric elevator, employed for slower speed service, is gradually being replaced by the geared (single wrap) traction types, except for special uses, such as mine or blast-furnace hoists, where it is still desirable to wind the ropes on a drum. Electric elevators having car speeds up to approximately 350 to 400 ft. are usually of this type. It differs from the old drum type merely in its use of a traction driving sheave, which is substituted for the drum. The change was prompted by the success of the traction drive on the gearless machines, its advantage lying in the safeguarding of the car or counterweight against being drawn into the overhead work. The driving sheave is mounted on a spider, or directly on the gear shaft, just as was

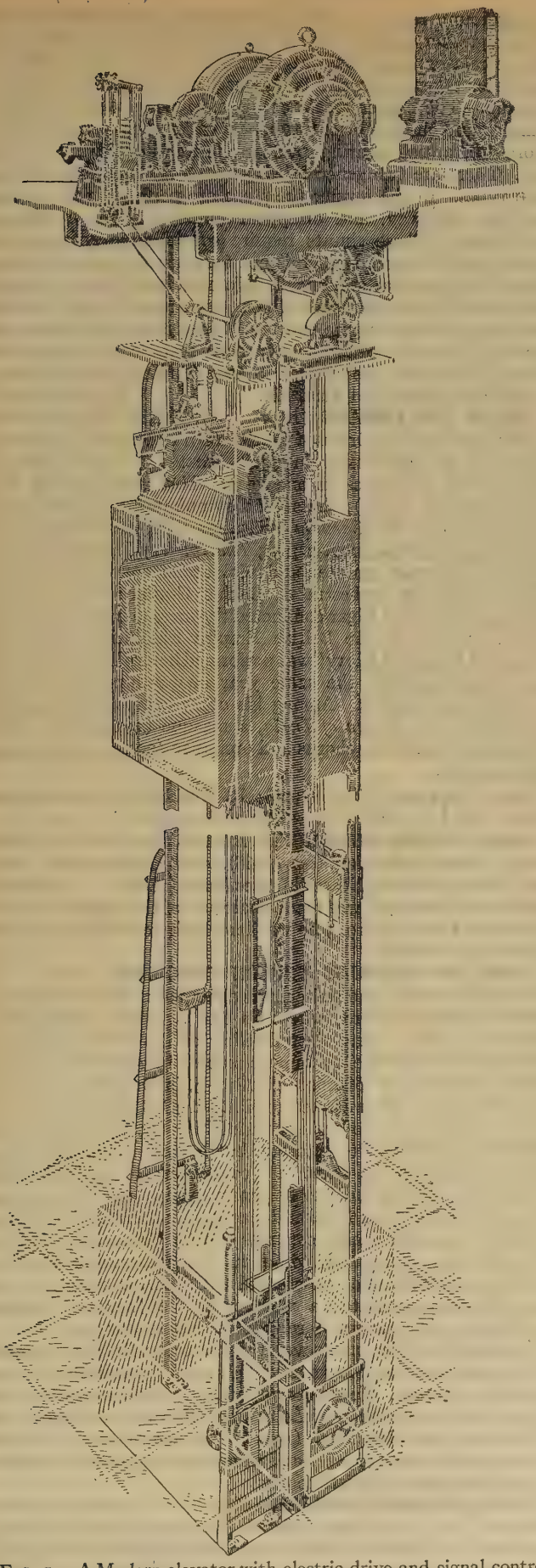

FIG. 1.—A Modern elevator with electric drive and signal control. (Otis Elevator Co.)

formerly done with the drum. The ropes are attached to the car, then pass up and over the driving sheave of the machine, which is usually mounted over the hatchway, and then, passing down, are attached to the counterweight. Thus, if by any chance the car should travel too far beyond the top landing, the counterweight will land in the pit and the tractive effort will at once be lessened so that the car cannot be drawn up further. This also applies to the drawing of the counterweight into the overhead. These machines are provided with hand-rope control for the very slow speeds and, for higher speeds, with car switch control or automatic push-button control. The hand-rope control is being displaced by the double-button controls, a feature of which is the providing of a contact and lock on hatchway doors or gates so that the elevator cannot be started until they are all closed. Both geared and gearless machines have been provided with two almost revolutionary improvements in control, the micro drive or self-levelling operation and the unit multi-voltage control or variable voltage operation.

The micro drive (self-levelling operation) is designed to bring the car platform automatically to rest on an exact level with the floor landing, this level being maintained irrespective of the stretch of ropes or change of load on the platform. The mechanism is brought into action by the operator, who centres the car switch to stop the car within the "micro zone" above or below a landing. A cam on the car then engages levelling switches in the hatchway and operates through the controller to bring the car automatically to an exact landing. The micro drive is particularly valuable in elevators used extensively by women and children, as in large stores, hotels and apartments, where it lessens the danger of stumbling. It is valuable also for heavy-duty freight elevators, assuring a level landing for trucks.

Unit Multi-Voltage Control.—Unit multi-voltage control provides much greater smoothness in starting and stopping the car, while increasing general operating efficiency, in comparison with the so-called resistance control. It produces the highest class of service for high-speed elevators of all types. It is also particularly valuable in locations where alternating current source of supply only is available, as it permits of the use of the highest class of direct current elevator machines operating through special motor generator sets provided for this purpose. Otherwise it would be necessary to use commercial motor generator sets, which are not satisfactory for this purpose, or else to use regular alternating current elevator machines, which cannot provide a high-speed service.

Signal Control.—A further development of elevator operation is known as Otis signal control. This is primarily intended for the highest class of elevator service in the tallest buildings, or indeed in others in which intensive service is required. The control is entirely automatic and is exercised by means of a series of buttons in the car, and "up" and "down" buttons at each floor landing. This adaptation of ordinary slow-speed push-button control is applicable to elevators travelling as fast as 800 ft. per min. or more. This machine is always provided with micro-drive operation and unit multi-voltage control.

The following brief description shows the kind of service possible with the Otis signal control operation. As the car is standing at the ground floor, each entering passenger calls the floor at which he wishes to alight. The attendant then presses the button in the panel numbered to correspond to that floor. When he receives the signal to start he merely releases the door, which closes automatically, the elevator starts automatically, and then, without further action on the part of the attendant, stops automatically at the first floor for which a button has been pressed. As the micro drive brings the platform exactly level, the doors open automatically. This course is repeated at each floor for which a button has been pressed. A waiting passenger at any floor merely presses the usual signal button, which call is then automatically registered on the controller of the first car travelling in the desired direction. This car automatically stops at the floor and the doors open automatically. Such stopping of the car to answer calls at the floors is entirely independent of the attendant and is indeed unknown to him until the car stops.

There is thus no possibility of an attendant neglecting to stop for a waiting passenger, although if his car is full he can transfer all calls to the next car. The adoption of the signal control with micro drive permits of car speeds being raised to 1,000 ft. per min. or more with perfect stopping at the floors, thus anticipating the requirements of still higher buildings in the future.

New Controls.—Two new forms of control, known as department store control and collective automatic push-button control, were being placed upon the market in 1926. These are both adaptations of the signal control and designed to provide automatic operation for slower-speed elevators. Department store control is intended primarily for use in that type of building and provides automatic operation, so that the attendant in the car may devote his entire attention to his passengers, and to announcing the departments on the floors. The elevator starts automatically as soon as the doors are closed at the first floor, and without the necessity of pressing any buttons in the car, stops automatically at each floor. As the car is slowed down with the micro drive the doors open automatically, and upon being released by the attendant they close automatically and the car immediately starts for the next floor. No hall buttons are necessary as the car stops at each landing.

Micro-drive operation and unit multi-voltage control are essential features of this machine as they are of the collective automatic push-button control. This latter type combines the advantage of requiring no regular operator and of attaining speeds impossible for the earlier slow-speed elevators with push-button control. The use of the earlier type was confined to private residences, small apartments or small office buildings, because the car could only serve one floor at a time and was restricted to speeds not exceeding 150 to 200 ft. per min. in order to make accurate landings. With this new control there is no restriction on car speed; the car will automatically pick up all calls registered from the hall buttons in the direction in which the car is travelling, and the system may be used in much larger buildings. A so-called operatorless elevator is designed for use in large warehouses where there are a number of elevators operating in banks, and so arranged with a telephone system at each floor that the elevators are operated entirely by one person at a central dispatch point, thereby effecting a great economy in operation. Such systems are provided with the micro drive and automatic push-button control.

Safety Devices.—In addition to minor improvements in the earlier devices underneath the platform to prevent falling of the car in case the ropes break, there has been developed a switch which acts to slow down the elevator if descending at excessive speed and which acts prior to the application of the safety device. Automatic stopping and limit switches also are provided on all high-speed cars, whereby the machines are automatically slowed down as the car approaches the terminal landings. If the car runs past the final limits of travel, the final limit switch cuts off all power from the machine and applies the brake. The governors are also provided with governor switches, which cut off current to the machine and apply the brake upon application of the safety devices. Buffers are provided in the bottom of the elevator pit, arranged to bring the car or counterweight to rest if they should overrun their travel. On high-speed elevators these buffers are usually of the oil type with telescope casing, in which the oil percolates through holes into the outer oil chambers at a predetermined rate so designed as to permit of the car's landing on the buffers at normal operating speed and being brought to rest without injury to the occupants. Building regulations frequently provide that elevator hatchway doors shall be so equipped that the elevator cannot be started until all doors are closed. The car also often has a door or gate provided with mechanisms to prevent the elevator from starting until the door is closed.

The Uses of Escalators

The escalator has greatly increased in popularity in places where it is necessary to transport large crowds of persons from one level to another, such as in stores, railway terminals and underground railways, the transfer being possible with perfect safety, greater rapidity and less crowding than by elevators. The first escalator was shown at the Paris Exposition in 1898. It was later taken down and is now used in a large store in Philadelphia. The earlier escalator has now been superseded by a simpler and more efficient type, in which the construction is more substantial, wearing parts are few and operating costs are low. There are two general designs—the flat step and the cleat step types. In the former the steps are perfectly flat, as in an ordinary stairway, and disappear under a shunt at the top or bottom. These shunts require considerable space on the floors, a disadvantage which is not found in the cleat step escalator, the principal superficial difference being that the steps have several cleats attached which pass through comb plates at the top or bottom of the runway. Since these new types were perfected, many escalators have been installed in department stores throughout the United States, England and Germany, as well as in Japan and Australia. (J. H. VAN A.)

ELGAR, SIR EDWARD (1857–), British composer (*see* 9.266), received the Order of Merit in 1911. His first symphony, produced at Manchester in 1908, created a furore and was played over 100 times in one year. This was followed by a violin concerto (1910); the second symphony in E flat (1911); *Falstaff* (1913); *The Carillon*, recitation with orchestra (1914); *Polonia*, symphonic poem (1915); *The Spirit of England*, choruses (1917); a quartet, quintet and violoncello concerto (1919); a transcription for orchestra of Bach's C-minor fugue (1921). In 1924 Sir Edward Elgar conducted the massed bands and choirs at the opening of the British Empire Exhibition, where his "Land of Hope and Glory" was performed before King George V., and 100,000 people; the same year he was appointed Master of the King's Musick. Among his other compositions may be mentioned: *The Crown of India*, a masque (1912); *The Music Makers*, for contralto, chorus and orchestra (1912); choral songs, anthems, etc.

See E. Newman, *Elgar* (1906); R. Buckley, *Sir Edward Elgar* (1904); and J. F. Porte, *Sir Edward Elgar* (1921).

ELGIN, VICTOR ALEXANDER BRUCE, 9th EARL OF (1849–1917), British politician (*see* 9.268), died at Broomhall, Fife, Jan. 18 1917. His son, Edward James Bruce (1881–), who then became the 10th earl, was made chairman of the Carnegie United Kingdom Trust. In 1925 he was lord high commissioner to the Church of Scotland.

ELIOT, SIR CHARLES NORTON EDGCUMBE (1864–), British diplomatist and writer, was educated at Cheltenham and Balliol College, Oxford, where he had a highly distinguished university career, being elected fellow of University College in 1885. He entered the diplomatic service in 1886 and acted as chargé d'affaires in Morocco in 1892–3, in Bulgaria, 1895 and in Serbia, 1897. He was created C.B. in 1898 and K.C.M.G. in 1900. In Jan. 1901 he was appointed high commissioner of the British East Africa Protectorate, but he resigned in Jan. 1904, being opposed to the grant of a concession to the East Africa Syndicate, which he held to be detrimental to genuine colonisation. For some years he abandoned public service, but in Aug. 1918 he was named high commissioner in Siberia, and in Nov. 1919 became ambassador to Japan, being thereupon sworn of the privy council. He was created G.C.M.G. in 1923. In Jan. 1926 he was appointed a member of the Japanese Imperial Academy, being the first foreigner to receive this honour.

In early life Eliot paid several visits to the Balkan Peninsula and under the pseudonym of "Odysseus" published in 1900 *Turkey in Europe*. He also travelled in Central Asia, China and Japan and is the author of *Letters from the Far East* (1907), and *Hinduism and Buddhism* (1921). He wrote also *The East Africa Protectorate* (1905), and compiled *A Finnish Grammar* (1890) and other linguistic books.

ELIOT, CHARLES WILLIAM (1834–), American educationalist (*see* 9.274), was offered the post of ambassador to England by President Taft in 1909, but preferred to serve his country in a private capacity at home. He received a similar invitation from President Wilson in 1913 but again declined.

He continued to take an active part, by writing and speaking, in all the important public questions of the day. His theories concerning necessary changes in education toward the concrete and practical had great influence upon American schools. The vocational movement, so marked after 1910, was without doubt accelerated by his continued insistence upon the training of the senses of sight, hearing and touch, as being the sources of the best part of knowledge. In 1914 he was elected president of the American Association for the Advancement of Science. In his educational writings he maintained that the traditional systems had dealt too exclusively with language and literature. In 1916, however, he was awarded a gold medal by the American Academy of Arts and Letters for his literary influence in his educational work.

In the field of religion he was an authoritative spokesman on the Unitarian faith. In his later books, *The Religion of the Future* (1909) and *Twentieth Century Christianity*, he rejected obscure dogma, emphasised freedom in place of authority, and held that the teaching of Christ had been "the undying root of all the best in human history since He lived," and that He would be the supreme teacher in the new religion, the outcome of which would be the brotherhood of man. Dr. Eliot gave much attention to labour problems and declared that "profit-sharing, combined with co-operative management, in which the employees take active and reasonable part, is the only road to industrial peace." He condemned limited output by labour as well as uniform hours and wages. The settling of industrial strife he considered to be second in importance only to the establishment of a league of nations.

Eliot was a strong supporter of President Wilson's administration, and approved his personal appeal to the country in 1918 to return a Democratic Congress. He favoured Prohibition as a War measure, and later as an amendment to the Constitution. He wrote in favour of military training after the Swiss method, but maintained that, after a league of nations was formed, no country should be allowed to have an army "whose officers have entered for life the profession of soldier." In 1920 Dr. Eliot was an active worker for the Democratic party because he regarded the immediate adoption of the Covenant of the League of Nations as a moral obligation. His 90th birthday, March 20 1924, was made the occasion of a striking demonstration of esteem in Sanders Theatre, Harvard University, Cambridge, Mass., on which occasion Chief Justice Taft, representing the President of the United States, testified to the great influence wielded by Dr. Eliot in the field of education.

ELIZABETH (1843–1916), QUEEN OF RUMANIA (*see* 9.286), died at Bucharest, Rumania, March 2 1916.

ELLIOTT, HOWARD (1860–), American railway manager, was born in New York City Dec. 6 1860. After graduating from the Lawrence Scientific School, Harvard, in 1881, he was for several years a clerk in various offices of the Chicago, Burlington and Quincy Railroad. Later he was appointed general freight agent and then general manager of several lines belonging to the Burlington system. In 1902 he became second vice-president of the company and the following year president of the Northern Pacific Railway. In 1913 he was made president of the New York, New Haven and Hartford Railroad and at the same time chairman of its board of directors. In 1917 he resigned and was made chairman of the committee on intercorporate relations of the New Haven system, a position which he retained until 1922. In the same year he was nominated by the American Railway Assn. one of the six members of the Railroads War Board. In 1917 he also became chairman of the executive committee of the Northern Pacific Railway Co., was president 1919–20 and then chairman of the board of directors. He took an active part in obtaining legislation from Congress for the protection of the railroads, urged higher freight rates and suggested the creation of a department of transportation, with a secretary in the Cabinet.

ELLIS, HENRY HAVELOCK (1859–), British psychologist, was born at Croydon, Surrey, on Feb. 2 1859. Both his father and his maternal grandfather were sea captains, and much of his childhood was spent on the Pacific. After teaching for four years in New South Wales, he proceeded to St. Thomas's Hospital, London, where he qualified for the medical profession. For a short time he was engaged in general practice but very soon he abandoned it for literary and scientific work. The more popular researches of the Freudian school have to a considerable extent overshadowed the methods of Ellis, in which more emphasis is laid on biology and less on clinical experience. In the last century, moreover, the extension of his fame beyond medical circles was impeded by the repugnance aroused in the ordinary reader by the subject matter of his studies. Only of late has it become possible to adjudge his work without prejudicial heat.

Yet Ellis has the unusual advantage of being able to expound his scientific theories in a clear and often beautiful style. The patience of a Darwin is combined with the literary brilliance of a Huxley, and even when he is unable to convince he is sure to amuse. Moreover, as is sufficiently proved by his occasional writings, both early and late, he brings to the totality of human experience a generous sympathy, a sharp intelligence and a daring wit. Whatever his studies had been, he would certainly have won a reputation as a literary artist. The curious may find in the first number of *The Savoy*, an illustrated quarterly of the 'nineties, together with an article by G. B. Shaw on "Going to Church" a study of Zola by Ellis. This calm and bold analysis of a French novelist is typical of Ellis' work. "And Zola pours out the stream of his pitiful, pitiless irony on the weak, erring children of men." Ellis has done much the same.

His works include: *Studies in Psychology of Sex*, 6 vol. (1898–1910); *Affirmations* (1898); *The World of Dreams* (1911); *Impressions and Comments*, 3 series (1914–24); the *Dance of Life* (1923). See also: D. Isaac Goldberg, *Havelock Ellis: a Biographical and Critical Survey* (1926). (H. C. HA.)

ELLIS, ROBINSON (1834–1913), British scholar (*see* 9.294), died at Oxford Oct. 9 1913. Among his later publications were a lecture on the *Amores* of Ovid (1912) and an edition of the second book of Ovid's *Tristia* (1913).

EL PASO, Tex., U.S.A. (*see* 9.298), almost doubled its population in the decade after 1910, reaching 77,560 in 1920, of whom 30,769 were natives of Mexico; and (census bureau estimate) 104,929 in 1925. About 30% do not speak English. Elephant Butte dam was completed in 1916 and by 1925 over 125,000 ac. of the rich valley land in the Rio Grande reclamation project, of which El Paso is the centre, was under cultivation, including 25,000 ac. in Mexico, producing a crop worth $12,000,000, of which $8,000,000 was cotton. The principal industry was still the smelting of copper and lead ores (500,000 tons annually), but cotton-growing brought in new industries, including a textile-mill, three cotton seed oil-mills, 35 gins and two compresses by 1925. The total value of manufactured products rose from $3,637,000 in 1909 to $16,650,000 in 1919. A high school and stadium were built in 1916, a county courthouse in 1917 and a scenic drive around Mt. Franklin in 1919. A memorial park of 43 ac. is the tribute to the soldiers and sailors who fell in the World War. In 1922 a city plan commission was appointed, and the budget system was introduced into the city government. A junior college was added to the public school system in 1920. The University of Texas school of mines and metallurgy, established in 1914, is located at El Paso.

EMBRYOLOGY (*see* 9.314).—It remains here to deal with the more recent discoveries as to the nature and meaning of the developmental processes.

The Cell.—We take for granted (*see* CYTOLOGY) a general acquaintance with the structure of the bodies of adult animals. It is now a matter of universal agreement to conceive the active living parts of these bodies, which are included under the general name protoplasm, as built up of a series of units termed cells, each normally containing a single nucleus and separated from one another by quasi-solid membranes termed cell-walls.

The doubts as to the validity of the concept of the cell, which were raised in the later years of the 19th century, have not been sustained by later discoveries. A more refined technique has enabled us to demonstrate a cell-wall in cases where it was

supposed to be absent; and where it really is absent, as for instance in the ectoderm of the Nematode worms, it has been proved that this is a secondary state of affairs, due to the degeneration of a well-developed layer of cells, which in younger stages of the life-history are clearly and sharply delimited from each other. In many, perhaps in most, cases the cell-walls are perforated so that adjacent cells are connected by bars of protoplasm, but this circumstance in no way invalidates the idea of the cell as the unit of structure.

Scope of Embryology.—The lowest grade of animals, termed the Protozoa (*see* PROTOZOÖLOGY), do not exhibit cellular structure. Either their bodies are so small that they possess only one nucleus, and may be regarded as free-living cells; or they contain more than one nucleus and attain a greater size, and then their protoplasm is not divided into compartments in accordance with the distribution of these nuclei.

Some of the largest of the Protozoa, such as the extinct genus *Nummulites*, were disk-like in form and attained a size of an inch in diameter; the bodies of these animals were divided into thousands of compartments by calcareous septa. To judge from what we know of the structure of their nearest living representatives they must have possessed numerous nuclei; but these nuclei were not distributed in accordance with the divisions of the protoplasm. Some compartments contained several nuclei, some one nucleus only and many none; so that true cell-structure was absent.

In other cases the protozoön may be described as a colony of small uninucleate forms, connected together either by strings of protoplasm or by stalks springing from a common base. But all these more complex Protozoa are distinguished from the true higher animals or Metazoa by the fact that when reproduction takes place the whole body of the parent breaks up into germs, each containing a single nucleus, whereas in true Metazoa small portions only of the parent's body are set aside for reproductive purposes; in other words, in the Metazoa there is a persistent "soma" or body distinct from the germ-cells. Now of course the development of the Protozoa ought to form part of the subject matter of embryology, but in the case of the smaller species it is exceedingly difficult to say which stage corresponds to the adult condition of Metazoa, since reproduction by the division of the mother's body into two can take place at various periods in the life-cycle; therefore purely as a matter of convenience it is customary to confine the subject matter of embryology to the study of the life-histories of the higher animals which exhibit definite cellular structure, in a word, to the Metazoa.

Metazoa.—If we now examine the development of the Metazoa we find a few cases where, side by side with other methods, reproduction by *fission*, that is by the division of the mother's body, does actually take place.

Thus in the marine annelid *Procerastes* described by Allen[1] the mother worm breaks up into groups of one, two or three segments and each of these groups regenerates the missing parts and thus reconstitutes a new worm. In much more numerous cases an outgrowth of the mother's body, termed a "bud," is produced. The bud may consist from the beginning of one or of several tissues, and is slowly moulded into the likeness of the parent and when fully grown separates from it, or in the case of a colonial animal remains connected with it and helps to build up a compound organism. Such compound creatures are found amongst the sponges, the Coelenterata, the Polyzoa and the Ascidians, the last-named group being degenerate allies of the Vertebrata.

The Germ Cells.—The laws of bud-development have not been as clearly elucidated as those of the germ-cells. Development by germ-cells is universal amongst the Metazoa; and in all but two phyla the form in which they appear is remarkably constant. They are of two kinds, viz., male and female, and are normally incapable of development unless they have previously united in pairs to form what are called "zygotes" (Gr. ζυόγν, a yoke).

The male cell or spermatozoön consists of a head which is a condensed nucleus made up of a compact mass of chromatin, and a tail which is a vibratile filament. Amongst the nematode worms, however, the male cells are devoid of filaments and appear under the form of small amoeboid cells, whilst amongst the higher Crustacea (*i.e.*, the shrimps, lobsters and crabs) the tail is replaced by a peculiar open vesicle lined with chitin, which under certain circumstances absorbs water and becomes turned inside out, thus propelling the head forwards and bringing about the union of the two germ-cells.

The female cell or ovum (egg) is typically rounded and motionless but it is of very different sizes in different species of animals. These differences in size depend entirely on the varying amounts of food-yolk (*i.e.*, reserve material) deposited in the cytoplasm (extra-nuclear protoplasm). The food-yolk in turn differs in amount according to the extent to which the young organism must grow before it can obtain nourishment for itself. Thus the human egg is only about 0·1 mm. in diameter, since at a very early period of its development it becomes attached to the wall of the womb and subsequently draws all its nourishment from that source. The egg of the ostrich on the contrary is one of the largest known, being about 15 cm. in diameter, since it has to provide all the food necessary to build up a good-sized chick.

Eggs which have a very small amount of yolk and in which this is evenly distributed throughout the cytoplasm are termed "alecithal"; such are the eggs of Hydrozoa, Echinodermata, Brachiopoda and of Amphioxus and Mammalia amongst Vertebrata. Eggs in which the yolk is concentrated at one pole of the egg are termed "telolecithal"; this pole is termed the "vegetative pole," whilst the opposite pole where the bulk of the cytoplasm is concentrated and where the polar bodies (see below) are given off is termed the "animal pole." The eggs of most Annelida and Mollusca and of Pisces, Amphibia, Reptilia and Aves amongst Vertebrata are telolecithal. Eggs in which the yolk is massed in the central part of the egg and is surrounded by a layer of cytoplasm almost free from yolk are termed "centrolecithal." In this class are the eggs of nearly all Arthropoda.

Both types of germ-cell before attaining maturity undergo two ripening (*maturation*) divisions, so that in each case four daughter cells are produced. Whereas in the case of the male germ-cell all four daughters become fully formed "spermatozoa," in the case of the female germ-cell only one daughter is converted into the ripe egg; the remaining three are small vestigial cells destined to perish, which are termed "polar bodies." During the maturation divisions the number of chromosomes in the nuclei of both male and female germ-cells is reduced by one-half (*see* CYTOLOGY).

When the spermatozoön enters the egg, the head, which is a condensed nucleus, swells up and assumes the ordinary nuclear structure and is termed the "male pronucleus"; behind it is situated a very active centrosome which produces a series of radiating rays termed the "spermaster." The nucleus of the ripe egg is termed the "female pronucleus." The male pronucleus approaches the female pronucleus, and becomes closely apposed to it; the spermaster then fades out, the centrosome which gave rise to it becomes divided into two which become connected by a so-called "spindle." New asters are then formed from the daughter centrosome at the poles of the spindle; this spindle initiates the development of the egg by bringing about the first division of the combined male and female pronuclei and of the fertilised egg (zygote) itself. The tail of the spermatozoön is either left outside when the head penetrates the egg, or if it penetrates the cytoplasm it degenerates there; its remnants can sometimes be detected in one cell of the embryo, up till the stage of 32 cells has been attained, but it takes no part in cell-division and no portion of it is transmitted to any other cell, the conclusion being that it plays no part in the transmission of hereditary qualities.

The nucleus of the zygote, as we have just seen, has double the number of chromosomes which are present in the nucleus of the ripe egg but half of these are of male origin. Every nucleus of the developing embryo therefore inherits from the zygote nucleus an equal number of male and female chromosomes, so that the body of the embryo has with justice been likened to a piece of cloth of which the warp is paternal and the woof maternal.

Parthenogenesis.—In the earlier article it was pointed out that the unfertilised egg could be induced to develop by a variety of agencies varying from the addition of a small quantity of butyric acid to the sea-water in which it is placed, followed by exposure to the action of hypertonic (*i.e.*, over-salted) sea-water in the case of echinoderm eggs, to the prick of a pin in the case of the eggs of Amphibia. This is termed *artificial parthenogenesis*.

In the case of the eggs of sea-urchins parthenogenesis has been minutely studied by Loeb[2] who has put forward various theories as to action of the agents which he employed. He imagined that the action of the butyric acid was to start cytolysis, one result of which was the formation of a definite egg membrane, but which if unchecked destroyed the egg, which became resolved into a mass of globules. The exposure to hypertonic sea-water was supposed to arrest this injurious action. This explanation was obviously not applicable to the parthenogenesis of the frog's egg.

The whole subject has been attacked from a new point of view by Herlant[3] and Brachet[4] who have pointed out that the agent employed to provoke parthenogenesis does not exercise a specific chemical action on the egg but merely acts as a stimulus to which the egg as a living organism responds. Whether butyric acid or a needle be employed the response is the same; the egg "wakes up" so to

[1] E. J. Allen, "An Autotomy and Regeneration in the syllid worm Procerastes," *Phil. Trans. Roy. Soc. Lond.*, Series B, vol. 211 (1921).

[2] J. Loeb. Numerous papers summarised in his book, *Die chemische Entwicklung des tierischen, Eies* (1909).

[3] M. Herlant, "Le Mécanisme de la Parthénogenèse Expérimentale," *Bull. Scientifique de la France et de la Belgique*, 7th series, vol. 50 (1917).

[4] A. Brachet, "L'Oeuf et les facteurs de l'Ontogenèse," *Encyclopédie Scientifique* (1916).

speak, the nucleus emits something which acts as a centrosome and from this is developed a great series of radiating rays traversing the cytoplasm, a huge "monaster" in fact. The chromatin of the nucleus becomes resolved into chromosomes which are split longitudinally and which become adherent to the rays of the "monaster." In the case of the egg of the sea-urchin it is only extremely rarely that the monaster becomes changed into an ordinary mitotic spindle by the division of the centrosome. In most cases after persisting for about an hour the monaster disappears; the nucleus returns to the resting condition and then after a short interval it passes through the same phases, a monaster being again formed. After this process has been repeated about six times over a period lasting twelve hours the egg dies and cytolysis supervenes.

If, however, after the egg has been exposed to the action of the butyric acid and then washed in sea-water, it is placed in hypertonic sea-water, and then after a limited period of immersion in this fluid replaced in ordinary sea-water, additional asters are formed in the cytoplasm. When the egg forms a monaster this becomes connected with these other asters by longitudinal fibres so as to form a complex spindle. By properly choosing the period of immersion in hypertonic water it is possible to arrange that only one additional aster should be formed; the centrosome of this aster then joins with that of the monaster to form a normal mitotic spindle on to which the egg chromosomes migrate; a regular division of the nucleus follows and thereafter a division of the whole egg into two cells, and so parthenogenetic development is initiated.

These two cells are generally very unequal in size, whereas in normal development the first division of the egg results in the production of two cells of exactly the same size. This inequality results from the fact that the aster induced by the action of the hypertonic water is small in comparison with the size of the monaster produced by the butyric acid. The size of the cell produced at the division of the egg is therefore determined by the size of the aster at one pole of the mitotic spindle. The aster is a framework of semi-rigid gelatinised protoplasm, which becomes continuous with the viscous protoplasm forming the outer layer of the cytoplasm of the cell.

The course of events in the frog's egg is fundamentally similar to the process which we have just described, although there are differences in detail. A prick with a sterilised needle induces the formation of a huge monaster, the centrosome of which then divides into two, between which a short mitotic spindle is formed on to which the chromosomes of the egg migrate. Since, however, the length of the spindle stands in relation to the number of chromosomes in the nucleus and as these chromosomes are only present in half the number found in the nucleus of the fertilised egg, the spindle which is formed is only four-fifths of the length of the first spindle formed in the fertilised egg. The length of spindle in turn determines the length of the astral rays from its poles, and if these are too short to reach the periphery of the egg the spindle is unable to bring about the division of the egg into two cells. This is the case with the spindle formed in the parthenogenetic egg, and although abortive and transitory furrows on the egg's surface are formed no division into cells results; the nucleus, it is true, divides and a multiplication of nuclei follows in which the numerous short spindles formed interfere with one another and make orderly development impossible, and so after a short time the egg dies.

If, however, the needle be "infected" by being dipped into frog's blood before being used to prick the egg, then the foreign substance thus introduced produces additional asters in the cytoplasm just as did the hypertonic water in the sea-urchin's egg. These asters have a tendency, as their rays develop, to repel one another, and they push the mitotic spindle developed around the egg nucleus over to one side. *If this side happens to be the side of the egg at which the cytoplasm is concentrated*, then the spindle is able to start the formation of a furrow which cuts right through the egg and divides it into two cells, and so parthenogenetic development is begun. We see then that the difficulty of initiating parthenogenesis depends on two factors, viz.: (1) the quiescent condition of the egg and (2) the small amount of chromatin present in the nucleus. If we choose the unripe eggs of the sea-urchin as the subjects of our experiment, then it is sometimes possible to induce them to develop by the use of one reagent alone, such as hypertonic sea-water; since in these eggs the "reducing" division of the nucleus has not occurred and the chromatin is consequently present in undiminished quantity.

Parthenogenetic development is closely related to the problem of heterogeneous fertilisation. It has been shown that under certain circumstances it is possible to fertilise the eggs of the sea-urchin with the sperm of creatures so diverse in zoological affinity as an annelid worm (*Chaetopterus*) and the sea-mussel (*Mytilus*). In the first case the male and female pronuclei fuse, but the male chromatin falls out of the zygote nucleus before the first division takes place. In the second case the male pronucleus refuses to enter into union with the female pronucleus at all, but the spermaster brings about the division of the egg. When the eggs of the sea-urchin (*Echinus*) are fertilised with the sperm of the heart-urchin (*Echinocardium*), in the vast majority of cases cytolysis results exactly as it does after the exposure of the echinus eggs to the action of butyric acid, but in some few cases the egg develops and produces a hybrid. We conclude that in most cases the sperm of *Echinocardium* is so alien to the cytoplasm of the egg of *Echinus* that it is not even able to bring about the formation of a spermaster.

Under certain circumstances (slight staleness of the egg, excess of sperm, etc.) more than one spermatozoön may enter the egg. In large eggs such as those of cephalopods, reptiles and birds, this seems to be a normal occurrence; only one of these nuclei unites with the female pronucleus and forms the zygote nucleus from which begins the cell-division which initiates development; but the other spermatozoa also form centres for cell-division, which gives rise to the so-called free cells which are characteristic of these eggs. These free cells are gradually crushed out and destroyed by the developing cells produced by the activity of the zygote nucleus.

Brachet, however, has shown[1] that when the frog's egg is entered by spermatozoa in moderate numbers, whereas only one fuses with the female pronucleus, the others form centres for the formation of cells which are built up into the body of the embryo. As these sperm-heads, however, contain only half the quantity of chromatin contained in the zygote nucleus, the cells to which they give rise are markedly smaller than those which contain nuclei descended from the zygote nucleus, and so it is possible to distinguish in the growing tadpole the regions which contain cells which have nuclei derived from the zygote nucleus from those which contain cells having nuclei derived from the supernumerary spermatozoa.

Brachet's observations prove in the clearest manner that the differentiation of organs in the frog's egg is due to the differentiation of regions in the cytoplasm and not to the differentiation of the nuclei produced by the division of the zygote nucleus as Weismann[2] had supposed, for some of these nuclei can be replaced by sperm-nuclei, each of which carries in it the potentiality of producing the whole organism—not a mere region of it—and yet no dislocation of development results.

The entry of two or more spermatozoa into small eggs such as those of the sea-urchin usually produces abnormal development followed by early death. The reason is that the centrosomes which are carried into the egg by these spermatozoa are so near each other that instead of leading to the formation of separate spindles they give rise to three- (triaster) or four-poled (tetraster) spindles along which the chromosomes are arranged in an irregular manner. This causes the formation of abnormal nuclei incapable of properly fulfilling their functions and the embryo dies.

Development of the Egg.—If we now turn to consider the normal development of the egg we find that this can be divided into three stages which in primitive forms are sharply delimited, but which in more modified forms tend to overlap one another. These stages are (1) segmentation, or the division of the egg into a number of indifferent cells or blastomeres; (2) the formation of the so-called germ-layers, *i.e.*, the differentiation of the blastomeres into the primitive organs, viz.: (*a*) the ectoderm (or epiblast) which is the primitive skin, (*b*) the endoderm (or hypoblast) which is the primitive lining of the gut, and (*c*) the mesoderm (or mesoblast) which is the primitive peritoneum or lining of the body-cavity; (3) organogeny, *i.e.*, the formation of the separate organs of the body, such as brain, liver, kidneys, etc., from the germ-layers.

Segmentation of the Egg.—Considering first the process of segmentation, we find, as Balfour[3] pointed out long ago, that the effect of the accumulation of yolk in the egg is to impede cell-division. It acts exactly as if it were a dilutant of the cytoplasm in lowering surface tension. Cell-division is accompanied by partial gelatinisation as is obvious from the way each daughter cell rounds itself off from its sister. This is particularly evident in the segmentation of alecithal eggs, for in them, in the early stages of segmentation, all the blastomeres divide simultaneously, and just after each period of division these take on the appearance of a pile of balls only touching each other in points; whereas during the interval between two such periods the gelatinisation diminishes and the blastomeres become flattened out against each other.

In all alecithal and telolecithal eggs there is a pole (see above) from which the polar bodies are given off which is termed the animal pole of the egg. This pole is the region of the egg which contains least yolk; here cell-division is most rapid and the smallest blastomeres are produced, whereas as we pass towards the vegetative pole of the egg, where the yolk is concentrated, the blastomeres become fewer and larger.

When the yolk is very much increased in amount, the nuclei produced by the division of the zygote nucleus are unable to produce

[1] Brachet, *loc. cit.*
[2] A. Weismann, *The Germ-Plasm. A Theory of Heredity* (1900).
[3] F. M. Balfour, *Comparative Embryology*, vol. 1, p. 95 (1880).

an amount of gelatinisation sufficient to divide the cytoplasm, and so we get a multiplication of nuclei without the formation of blastomeres. When this happens segmentation is confined to the animal pole of the egg and results in the formation of a thin disk of blastomeres termed the "blastoderm," resting on an unsegmented "yolk." Such eggs (for instance the hen's egg) are termed "meroblastic" (gr. μέρος, a part) in contradistinction to eggs, like those of the frog, which are completely divided and are termed "holoblastic."

In centrolecithal eggs, like those of the cray-fish, the egg appears to be completely divided into cells, but although division may at first be complete, when gelatinisation diminishes the inner yolky ends of the blastomeres flow together so as to form a common inner yolky mass. Such eggs are said to exhibit *superficial segmentation*. Later, the outer protoplasmic ends of these incomplete blastomeres become completely cut off, so as to form a skin of cells of blastoderm surrounding a central "yolk." A still further modification of this type is found in the eggs of insects in which the yolk is so abundant as to prevent all segmentation. The zygote nucleus alone divides and gives rise to daughter nuclei each surrounded by an island of protoplasm; these are at first dispersed throughout the "yolk," but they gradually migrate to the surface and here form a blastoderm.

In primitive alecithal eggs segmentation results in the formation of a hollow ball of cells one layer thick. This ball is termed the "blastula" and its cavity the "blastocoele," "segmentation-cavity" or "primary body-cavity." The formation of the blastula marks the accomplishment of an important step in development. Although typically formed only in alecithal eggs, it appears in a modified form in telolecithal eggs, even in those in which there is so much yolk that they have meroblastic segmentation. Thus in the case of the frog the blastula is a hollow ball of which the roof is two cells thick and the floor is many cells thick, whilst in the case of the pigeon the blastula is represented by a stage in which the blastoderm is one layer thick and forms the roof of the slit-like segmentation cavity, whilst the immense mass of the unsegmented yolk forms the floor of this cavity. This floor, in its uppermost layer, contains a few nuclei which are representatives of the cells which should constitute the vegetative pole of the blastula but these nuclei are utterly unable to cut the yolk up into cells.

Formation of Germ Layers.—As soon as the blastula stage has been attained, the "formation of layers" begins. The cells at the vegetative pole become turned inwards, forming a tube-like structure which projects into the blastocoele and partially obliterates it. This tube is the primitive gut or "archenteron" and the cells forming it are termed "endoderm," whereas the cells forming the outer wall of the blastula give rise to the primitive skin and are termed "ectoderm." Recently, von Übisch[1] has introduced an ingenious method of staining certain blastomeres during life. By the aid of this method he has been enabled to determine definitely not only the fate of individual blastomeres in normal development but also their powers of development (prospective potencies) when separated from their fellows. When in the 8-cell stage of the sea-urchin's egg the four upper cells are isolated, they will produce a blastula, but this blastula will neither produce "mesenchyme" (that is, wandering cells which migrate into the blastocoele) nor an archenteron, but the lower four cells will give rise to a blastula which will produce mesenchyme and an archenteron and which eventually grows into a perfect larva of reduced size. In normal development these four lower cells are entirely used up in the formation of archenteron and mesenchyme; whence von Übisch concludes that prospective ectoderm is unchangeable but that prospective endoderm retains all the primitive potencies of the egg and can be changed into ectoderm.

When the archenteron has been formed, the developing egg has assumed the shape of a double-walled cup, the opening into which is termed the "blastopore." This stage is clearly and sharply marked in the development of almost all eggs in which the yolk is small in amount, and it can be recognised in an obscured and altered form in the development of large yolky eggs. It is of equal importance with the blastula stage, and it is termed the "gastrula."

The primary body-cavity has now become reduced to the slit intervening between the wall of the archenteron and the outer wall of the gastrula and this slit becomes largely filled up by the development of the third germ layer, the "mesoderm." We have defined this layer as the primitive peritoneum or lining of the body-cavity, but the body-cavity now indicated is termed the "coelom" or "secondary body-cavity" in order to distinguish it from the primary body-cavity. In the eggs of primitive animals, where the yolk is small in amount, the coelom is always formed as a series of pouch-like outgrowths of the archenteron which become cut off from this tube. It follows that the mesoderm is differentiated from the primary endoderm. Driesch[2] has shown that if the front half of the gastrula of the starfish which includes the apex of the archenteron be cut off, the hinder half will heal up and will form a perfect larva, forming, of course, the coelom in the normal way. If, however, this operation be performed after a swelling of the tip of the archenteron (the first rudiment of the coelom) has appeared, then, although the hinder half will heal up and form a larva, it never forms a coelom.

Driesch concludes from this experiment that at first all parts of the archenteric wall have the power of giving rise to a coelom, that is of forming mesoderm, but that later a definite portion of this wall becomes set aside as the rudiment of the coelom and that then the rest of it becomes the definitive endoderm devoid of this coelom-forming power. In Echinodermata the coelom arises as a single pouch from the apex of the archenteron; in primitive Vertebrata it originates as five pouches of which one is apical and four are paired and lateral; in Chaetognatha and Brachiopoda as a lateral pair of pouches. The remnant of the primary body-cavity becomes almost filled up with cells budded from the wall of the coelom which are termed "mesenchyme." The primary "mesenchyme" of the developing echinoderm, however, is formed from that portion of the blastular wall which will later be converted into the archenteron. After the archenteron has been formed the production of mesenchyme continues but is now confined to its apex, *i.e.*, that portion which will be converted into the coelom. These cells may become joined to one another by their processes and thus constitute a network which becomes converted into connective tissue by the secretion of fibres; or they may remain separate from one another, and then they become developed into blood and lymph cells, the remnants of the primary body-cavity constituting the blood-spaces. In the Coelenterata, in which no coelom is formed, similar cells are budded from both ectoderm and endoderm; in Annelida and Mollusca, in addition to the mesenchyme given off the coelomic wall, some is likewise budded from the ectoderm, and to this the name "mesectoderm" has been given. In Vertebrata the most recent research indicates that no mesenchyme is given off from the ectoderm.

Organogeny.—Turning now to the third stage of development, viz., the formation of special organs, we find that from the ectoderm are derived the central nervous system and the sense organs, and also the lining of the mouth-cavity and of the terminal portion of the alimentary canal near the anus. The endoderm gives rise to the middle portion of the gut and to the glands which are developed from it, and in Vertebrata to the primitive elastic axis of the backbone or "notochord." From the mesoderm arise the majority of the muscles, the connective tissue and, in Vertebrata and Echinodermata, the internal calcareous skeleton which is derived from the connective tissue. The mesoderm also gives rise to the genital organs and their ducts in all Metozoa above the rank of Coelenterata, and in Mollusca and Vertebrata to the kidney tubules.

Now we have pointed out that, in telolecithal eggs, segmentation proceeds most rapidly at the animal pole; here the second stage of development rapidly supervenes, and the archenteron is begun before segmentation is even initiated at the vegetative pole. In meroblastic eggs the upper pole of the egg may become converted into an embryo in which all the important organs of the adult are mapped out before the lower pole is even invested with cells. Finally in Amniota (reptiles, birds and mammals) the lower pole of the egg, after all the yolk has been absorbed from it, is torn from the rest of the embryo at birth and cast off as a useless embryonic membrane.

In the earlier article doubts were expressed whether the primitive germ layers corresponded to one another in different eggs; in a word, whether the same name had not been given to different things. The result of the labours of embryologists has been to establish the universal homology of the germ layers on an ever firmer basis.

If, for instance, we define the mesoderm as the wall of the coelom then it is found that this organ originates in one of two ways, viz., either as a pouch or a mass of cells. The pouch (recognisable in Chaetognatha, Brachiopoda, Echinodermata, Enteropneusta and the lowest Vertebrata) quite clearly originates as an outgrowth from the endoderm; the mass of cells can be traced back to its source in one large cell, the mother mesoderm-cell. This cell, as was first shown by Shearer[3] in the annelid *Hydroides* and by Conklin[4] in the mollusc *Crepidula*, originally forms part of the wall of the archenteron, and its ejection from this wall is evidently a modification of the more primitive method of coelom-formation by the outgrowth of a gut-pouch. Meissenheimer[5] and Harms[6] stated that in certain Mollusca the coelomic pouches originated from cells budded from the ectoderm. Later workers have shown that in these very Mollusca the mother mesoderm cell gives rise to the pericardium which is representative of the coelom in these animals. The so-called "mesectoderm" of Annelida and Mollusca gives rise to some superficial muscles, but to confound this with the coelomic wall and its derivatives by calling both mesoderm and then to complain that the mesoderm is not an homologous structure in various groups of animals is to introduce a perfectly gratuitous confusion.

The gut epithelium of certain Arthropoda has been alleged to arise

[1] Von Übisch, "Entwicklungsphysiologische Studien an Seeigelkeimen," *Zeit. für Wiss. Zoologie*, vol. 124 (1925).

[2] H. Driesch, "Zur Analysis der Potenzen embryonalen Organzellen, *Arch. f. Entwicklungsmechanik*, vol. 2 (1896).

[3] C. Shearer, "On the development and structure of the Trochophore of Hydroides," *Quar. Jour. Micr. Sci.*, vol. 13 (N.S.) (1911).

[4] E. G. Conklin, "The Embryology of Crepidula," *Journal of Morphology*, vol. 13 (1897).

[5] J. Meissenheimer, "Entwicklungsgeschichte von Dreissensia polymorpha," *Zeitschrift f. wissenschaftliche Zoologie*, vol. 69 (1901).

[6] W. Harms, "Postembryonale Entwicklungsgeschichte der Unioniden," *Zool. Jahrbücher* (Abt. für Ontogenie), vol. 28 (1909).

from the ectoderm. If we examine the embryo of the most primitive land Arthropoda *Peripatus* we find a large slit-like blastopore which later became divided by a constriction into mouth and anus. It has been suggested that a portion of the gut epithelium, viz., that forming the midventral portion, is formed from ectoderm turned in round the edges of the slit. Now in the primitive annelid *Polygordius* Woltereck[1] has described a similar slit-like blastopore and he has followed the process of its closure in great detail, describing the division of every cell involved. In this case the midventral epithelium of the gut is formed by the union of *endoderm* cells lying at the sides of the blastopore—whilst the *ectoderm* cells lying in the blastoporal lips by their union reconstitute the midventral skin. Doubtless a renewed investigation with a more modern technique would show that this is also true of *Peripatus*.

Embryological research is based on a comparison of embryos of different ages with one another—not, as would be the ideal method, on a continuous observation of the progress of one and the same embryo. It follows that too large an age-difference between the embryos examined may give rise to a totally wrong conception of the process which is taking place. So is to be explained the statement by Heymons[2] that the mid-gut of the higher insects is entirely formed from ectoderm and that by Watase[3] who attributed a similar origin to the mid-gut of the cephalopod *Loligo*. Hirschler[4] has shown how the first error originated, and the second has been corrected by Faussek[5]; and should further statements of this kind occur the strong presumption is that they also are founded on mistakes.

Organ-forming Substances.—We have arrived at the conclusion that the establishment of the validity of the germ-layer theory is one of the great achievements of embryological research, and we now turn to the question of how the differences which distinguish the layers from one another are brought about. We have learned that in primitive alecithal eggs like those of echinoderms the lower portion of the blastula wall has the capacity of giving rise to a complete larva and that this capacity only becomes restricted when the first traces of gut-formation are visible. We have also learned that all parts of the primitive gut or archenteron are alike in their coelom-forming powers, and that the separation of endoderm from mesoderm only becomes apparent when the first indication of the coelom appears. But this progressive differentiation of the embryo might be due to a differentiation of the nuclei of various regions or of the cytoplasm or of both. We have, however, learned from the development of the polyspermic frog's egg that there is a strong presumption that the nuclei of the embryo are alike in their nature and that the differentiation of the layers must be due to the separation of organ-forming cytoplasmic substances from one another. This conclusion is confirmed by a large number of observations on many different kinds of eggs; a few of the more striking follow.

Hertwig[6] allowed frogs' eggs to develop under pressure between glass plates and in capillary tubes. Under these circumstances the divisions took place by planes normal to the pressure and flat plates and rows of cells were produced. When the pressure was removed, however, these deformed embryos recovered, multiplication of cells took place and the normal form was regained and normal development proceeded. It was easy to show that nuclei which under undisturbed conditions would have occupied certain definite regions of the embryo had been forced into quite other regions, and yet perfectly normal embryos resulted. Hertwig concludes that the nuclei could be juggled about like a handful of balls without affecting the formation of the embryo.

In many eggs the differentiation of the layers is indicated at a far earlier period than that at which it occurs in the egg of the Echinodermata or even of the lower Vertebrata like the frog. The egg of the ascidian *Cynthia partita* which has been studied in great detail by Conklin[7] may be adduced as an example. This egg when it develops becomes converted into an elongated blastula consisting of few cells: this blastula changes into a gastrula in the typical way and, though no distinct coelomic pouches are formed, large portions of the archenteric wall are directly converted into muscles which lie at the sides of the tail of the tadpole-like larva. In this species the nucleus of the unripe egg is, as usual, a vesicle filled with fluid (the so-called germinal vesicle). The cytoplasm contains numerous yolk globules of a slaty-blue colour and also larger yellowish globules which are concentrated in its superficial layer. When the maturation divisions of the nucleus occur the nuclear wall is dissolved and the fluid contents escape and form a cap of clear material at the animal pole of the egg.

When fertilisation takes place profound rearrangements of the substances in the cytoplasm are effected. The yellow globules stream downwards to meet the spermatozoön which enters at the vegetative pole, and they finally form a crescentic layer of yellow material round the lower pole of the egg. As the egg develops first into a blastula and then into a gastrula, and finally into the characteristic ascidian tadpole, it becomes evident that the clear substance forms the ectoderm, that the slaty-blue material is contained in the endoderm, whilst the yellow material is confined to the masses of mesoderm which give rise to the tail muscles. When the egg is in the four-cell stage the yellow material is confined to the two posterior cells; if one of these be killed the remainder of the egg will give rise to a larva with muscles on one side only of the tail. That the nuclei have nothing to do with this separation of substances is shown by what occurs at the lip of the blastopore. Here we find an arc of what Conklin calls " neurochordal " cells. Each of these has of course a single nucleus, but the cytoplasm of each consists of two zones, one clear and one slaty-blue. At the next division two daughter cells are produced from each neurochordal cell; one of these contains the clear substance and is added to the nerve plate which is a part of the ectoderm; the other is composed of the blue substance and forms part of the notochord which in *Cynthia* as in other Vertebrata is a derivative of the endoderm.

From this development we conclude that the *germinal layers owe their origin to the segregation of cytoplasmic substances in the growing egg;* that these substances assume their final arrangement under the influence of the spermatozoön which thus, on its path to meet the female pronucleus, *determines the symmetry of the embryo.* But it would be a mistake to conclude that in these visible yellow and blue materials we have the actual organ-forming substances themselves. The nature of these substances in the egg of *Cynthia* has not yet been determined but similar substances occur in the eggs of many mollusca and more particularly in those of *Limnaea Planorbis* and *Physa*. In these eggs, too, as development proceeds these substances are distributed to definite regions of the egg. Conklin[8] has centrifuged the eggs of these snails and produced thereby a completely abnormal distribution of these substances and yet the development of the egg proceeded in a perfectly normal manner to the formation of a healthy young snail. Brambell[9] has shown that the greyish or bluish material is in all probability Golgi yolk and the yellow substance swollen mitochondria (*see* CYTOLOGY). Brachet[10] has shown that there are also organ-forming regions in the frog's egg. It was for long a puzzle why competent observers like Roux[11] and Hertwig[12] should differ so profoundly on the results of killing one of the first two blastomeres of the frog's egg. Roux asserted that the surviving blastomere gave rise to a half blastula which developed into a half tadpole, whilst Hertwig maintained that it tended to form a normal tadpole, being only impeded in its development by the mass of dead material constituted by the other blastomere. Brachet has shown that both are right, for the plane separating the first two blastomeres need not by any means coincide with the future median plane of the embryo, but may make any angle up to a right angle with it. If it coincides with this plane by killing one blastomere Roux's result is obtained; if it is oblique the result accords with Hertwig's researches.

Thus the potency of each of the first two blastomeres of the frog's egg depends entirely on the cytoplasm which it happens to include and in no way on the nucleus. Brachet[13] has shown that the fixing of the median plane of symmetry in the frog's tadpole, as in the ascidian tadpole, is effected by the spermatozoön. As the spermatozoön penetrates the egg in its path towards the female pronucleus, it leaves behind a trail of pigment which persists for a considerable time and can be detected at a much later period in the development of the egg. On the opposite surface of the egg to that at which the spermatozoön enters it, there is formed the so-called " grey crescent." This is in reality the upper lip of the blastopore; it is here that the differentiation of ectoderm from endoderm begins. Therefore we

[1] Woltereck, " Beitrag zur praktischen Analyse der Polygordius-entwicklung," *Archiv. f. Entwicklungsmechanik*, vol. 18 (1903).

[2] R. Heymons, " Über die Bildung der Keimblätter bei den Insecten," *Sitzungsb. der Preussischen Akad. der Wiss.*, vol. 1 (1894).

[3] Watase, " Observations on the Development of Cephalopods," *Studies from the Biol. Lab. Johns Hopkins Univ., Baltimore*, vol. 6 (1888).

[4] J. Hirschler, " Embryonalentwicklung von *Donacia crassipes*," *Zeitsch. f. wiss. Zool.*, vol. 92 (1909).

[5] V. Faussek, " Untersuchungen über die Entwicklung der Cephalopoden," *Mitteilungen a. d. Zool. Station zu Neapel*, vol. 14, p. 83 (1901).

[6] O. Hertwig, " Ueber den Werth der ersten Furchungszellen für die Organbildung des Embryos," *Archiv f. mikr. Anatomie*, vol. 42 (1893).

[7] E. G. Conklin, " The Orientation and Cell-lineage of the Ascidian Egg," *Jour. Acad. Sciences, Philadelphia*, series 2, vol. 13 (1905).

[8] E. G. Conklin, " The effects of centrifugal force on the organisation and development of the eggs of fresh-water Pulmonates," *Jour. Exp. Zool.*, vol. 9 (1910).

[9] F. W. R. Brambell, " The Nature and Origin of Yolk," *British Jour. Exp. Biol.*, vol. 1 (1924).

[10] Brachet, *loc. cit.*

[11] W. Roux, " Über das entwicklungsmechanische Vermögen jeder der beiden ersten Furchungszellen des Eies," 6th. *Verhandl. der anat. Gesellschaft* (1892).

[12] O. Hertwig, " Über den Werth der ersten Furchungszellen für Organbildung des Embryos," *Arch. f. mikr. Anatomie*, vol. 42 (1893).

[13] Brachet, *loc. cit.*

conclude that the arrangement of the organ-forming substances in the frog's egg is caused by the spermatozoön.

In the mollusc Dentalium when the egg has reached the four-cell stage one of the blastomeres emits a protuberance termed the "yolk-lobe" or "polar lobe." This lobe is devoid of a nucleus and before the attainment of the eight-cell stage is reabsorbed into the blastomere. Nevertheless, if this lobe be cut off, the remainder of the egg develops into a larva which is fatally devoid of mesoderm.

That the materials which form the basis of the different substances embodied in the germinal layers are formed in the growing egg under the influence of emissions from the nucleus is rendered certain, first by the close relationship of the nucleus to assimilation and secondly by the fact (*see* CYTOLOGY) that the nucleolus of the unripe egg breaks up into fragments and is extruded into the cytoplasm. It is, however, a surprising fact that the nuclei of the segmenting egg are alike and apparently without influence on the differentiation of the primary organs. In fertilisation a second nucleus of alien origin is introduced and portions of this nucleus, as we have already seen, are incorporated in all these "segmentation" nuclei. Now it is common knowledge that the influence of the father is as potent as that of the mother in heredity and therefore there must arrive a period of development at which the nuclei again influence the cytoplasm.

An attempt to determine this period was made by MacBride[1] by fertilising the eggs of *Echinocardium* with the sperm of *Echinus*. The result of this cross is in most cases to produce cytolysis of the egg, but in a minority of cases a hybrid develops.

The egg of *Echinocardium* is oval whereas that of *Echinus* is spherical and the shape of the blastula of each species follows that of the egg. The blastula of the hybrid is oval, like the maternal blastula, and the gastrula is also like that of *Echinocardium*. But the typical larva (the four-armed echinopluteus) resembles in several points the larva of *Echinus;* in the vast majority of cases it is totally devoid of a large aboral club supported by a special skeleton which is characteristic of the larva of *Echinocardium*. It is clear therefore that at this stage the paternal nucleus is influencing the structure of the organism. When the eggs of *Echinus* are fertilised with sperm of a still more divergent character, such as that of the crinoid *Antedon*, a hybrid occasionally develops as far as the gastrula stage, but it always resembles the larva developed from the normally fertilised egg in every detail and shows no trace of paternal influence.

Nuclei and Cytoplasm.—We are thus led to the conception of an intermittent action of the nuclei on the cytoplasm, and in this it seems as if we had reached the deepest point to which analysis of development has so far led us. Perhaps it would be more accurate to speak of an intermittent reaction between cytoplasm and nucleus, for in some embryos there is evidence that the nuclei undergo alteration as development proceeds. It is on cases like these that Weismann's theory of development was founded.[2] According to this theory, as growth proceeds, differential division of the nuclei takes place, some becoming specialised as ectodermal nuclei, others as endodermal nuclei, and so on, whilst some retain the constitution of the original zygote nucleus. These last give rise by division to others like themselves which eventually engender the nuclei of the germ cells. The lineage or line of descent leading from these germ-cell nuclei back to their ancestors amongst the nuclei of the first blastomeres is termed the "germ-track." Now in the Nematode worm *Ascaris megalocephala* the zygote nucleus contains only four chromosomes, but as the egg divides into blastomeres the nucleus of one blastomere after another undergoes the change termed *diminution of the chromatin*. This change involves the nipping-off of the ends of the chromosomes, and these portions are ejected into the cytoplasm and are absorbed; the remainder of each chromosome becomes fragmented into a large number of minute granules. These granules act as chromosomes in the next nuclear division. The nucleus of one blastomere remains exempt from this change and this blastomere eventually gives rise to the genital organs.

Boveri[3] has shown that the fact that one nucleus undergoes diminution of the chromatin whilst another does not is not the consequence of a differential division of the mother nucleus of them both, but is due to the fact that one nucleus takes up its position in a region occupied by a particular cytoplasmic substance. This he proves in two ways, viz.: (1) by considering the case of eggs fertilised by two spermatozoa, and (2) by the results obtained by subjecting eggs about to segment to the action of strong centrifugal force.

In doubly fertilised eggs the extra spermatozoön forms an independent nucleus whilst the other fuses with the female pronucleus to form the zygote nucleus. The first division of the egg results in the formation of four nuclei and four blastomeres. In the development of the normally fertilised egg one of the two first nuclei undergoes diminution, and the cell containing it gives rise to a large part of the dorsal ectoderm; the other nucleus remains undiminished and amongst the progeny of the cell containing it are found the genital cells. Now amongst the four cells produced by the division of the doubly fertilised egg, three may contain nuclei which undergo diminution, and one may remain undiminished and in such cases the egg develops into a single embryo with an unusually abundant ectoderm. In other cases only two of the nuclei undergo diminution; such eggs form twin embryos of normal aspect; whereas in still other cases one nucleus alone may undergo diminution and in these cases a monstrous triple embryo is formed. These differences are accounted for on the assumption that one region of the egg contains a substance which induces diminution and one, two or three nuclei of the doubly fertilised egg may be in it.

When eggs about to segment are exposed to the action of long-continued and intense centrifugal force the plane separating the first two blastomeres will in some cases be found to lie along a radius of the circle of rotation, and in these cases a small mass of material will be found to be ejected from the egg which then becomes divided into two appreciably equal and similar blastomeres, the nucleus of neither of which undergoes reduction. This suppression of reduction must be attributed to the even distribution of the cytoplasmic materials under the stress of the centrifugal force, so that no region of the egg contains more of the peculiar substance than any other. Diminution of the chromatin apparently results from the action of an excess of this substance on any nucleus contained in it.

Regeneration.—In the phenomena of regeneration and of budding we meet with evidence of the renewed influence of the nuclei in causing the formation of cytoplasmic substances.

When one of the first two blastomeres into which a frog's egg divides is killed the survivor frequently develops into a half gastrula which may even grow into a half tadpole. Roux[4], however, has shown that if this half tadpole survives it becomes a whole tadpole by what he calls the "post-generation" of the missing half. This is effected by the multiplication of the cells lying at the edges of the half embryo. The nuclei increase in number and confer on the cytoplasm in their neighbourhood new powers. In this case it might be objected that each kind of tissue in the old half gives origin only to the same kind of tissue in the new half. But Morgan[5] has shown that if the head (including the pharynx) of the annelid *Nereis* be cut off, a new head with pharynx will be regenerated from the stump; whereas, however, the original pharynx was formed by an intucking of ectoderm, the new pharynx is formed by an outgrowth from the endodermal tube in the stump. The new powers thus conferred on the cytoplasm of the endodermal gut can only be explained as the result of the calling-forth of new potentialities in the nuclei lying in the cut edge. More remarkable evidence still has cropped up in connection with the regeneration of the lens of the eye of the newt. In the embryo the lens is formed as a thickening of the ectoderm on the side of the head. But if the original lens be torn out, a new lens is developed from the edge of the retinal portion of the iris—a tissue which has no connection with the skin of the head. Some try to meet this difficulty by the phrase that in these cases the organism acts as a whole, independently of the germ layers into which we analyse it. But what meaning can be attached to this phrase, except that the organism under different circumstances uses different means in order to effect a restoration of its integrity, it would be difficult to say. In fact we approach very closely to the celebrated "entelechy" of Driesch[6]; that is an indwelling "something" in an organism which strives to realise a purpose.

Vitalism and the Theory of an Entelechy.—It may be argued that such an idea is unscientific, because it introduces "vital force" and similar mystic ideas amongst our biological conceptions. It may be answered that in the last resort *all explanation is comparison*, and that those who reject vitalism seek to compare all the activities of living beings to phenomena which go on outside the body in test-tubes. But this is equivalent to referring all the phenomena of life to structure, in other words to the juxtaposition of definite chemical substances in a definite spatial arrangement; in regeneration, however, we encounter phenomena where structure appears to be irrelevant. If we are to do justice to such phenomena we must have some working hypothesis similar to that of Driesch. Whether the assumption of an "entelechy" is better or worse than the statement that all the nuclei in the body are totipotent and that varying potentialities are called forth in different cases seems to be a matter of taste.

Budding.—Regeneration is in many respects akin to budding, since buds in many cases may be regarded as portions of the mother organism restored after natural amputations.

In the growth of buds we often meet with a wide divergence between the materials used to build up certain organs and those used to construct similar organs in the embryo. To give an example—the bud of the ascidian *Botryllus* begins its existence as a little two-layered vesicle very similar to the gastrula of the same species. But

[1] E. W. MacBride, "Studies on the Development of Echinoidea: (II.) The early larva of *Echinocardium cordatum* and the result of crossing this species with *Echinus esculentus*," *Quar. Jour. Micr. Science*, vol. 58 (1912).

[2] A. Weismann, *The Germ-Plasm. A Theory of Heredity* (1900).

[3] Th. Boveri, "Die Potenzen der Ascaris-Blastomeren bei abgeänderter Furchung," *Festschrift zum 60sten Geburtstag Richard Hertwigs*, vol. 3, No. 8 (1910).

[4] Roux, *loc. cit.*

[5] T. H. Morgan, *Regeneration* (1901).

[6] H. Driesch, *Zwei Vorträge zur Naturphilosophie* (1910); see also Gifford lectures for 1907 and 1908.

in the embryo the central nervous system is developed from the outer layer as it is in all other Vertebrata. In the bud, on the contrary, it is formed as an outgrowth from the inner layer. Hjört,[1] who described this phenomenon, suggested as the explanation for it the fact that the outer layer of the bud is an outgrowth of the adult maternal ectoderm, which is specialised for the secretion of the cellulose "mantle" and not sufficiently plastic to be turned into nervous tissue. This is only another way of saying that the formative nuclei act differently in different cases and distribute the organ-forming cytoplasmic substances in a different manner in the bud from their arrangement in the egg.

One or Two Embryos.—The primary organs, *i.e.*, the germ layers, are the material out of which the higher organs are built up, and one of the most remarkable of recent discoveries in embryology is the fact that the question of whether this material shall be used to build up one embryo or two depends on the special relations which these primary cytoplasmic substances sustain to one another.

If the eggs of a frog be placed dry on the surface of a slide with their animal poles uppermost and fertilised in that position by the addition of small quantities of the fluid extracted from the seminal vesicles of a male; if then another slide be placed on top of them and the two slides clamped together by rubber bands; if when the eggs have divided into two blastomeres the whole preparation be inverted and left in water in a shallow dish for five or six days tadpoles with two heads or two tails will be developed. The materials in the unsegmented egg are of different specific gravities; the first furrow often (*see* above) divides them into two symmetrical halves; when the two-cell stage is inverted they tend to re-arrange themselves in *each cell* in the same manner as they would have done in the whole egg had it been inverted. Nothing has been added or taken away, yet the altered position of the materials in each cell has led to the formation of two organs where normally only one would have been formed. In the case of the newt's egg a similar procedure leads to the formation of two complete embryos, whilst if the blastula of the newt be constricted longitudinally by a hair a two-headed monster is formed. When a lizard's tail is broken off, if the little regenerating bud which forms at the wounded surface be indented the animal will regenerate two tails instead of one.

Internal Environment.—When the higher organs begin to develop we can in many cases prove that the whole course of their growth is governed by what may be called their internal environment, *i.e.*, by influence emitted by other organs.

This may be clearly seen in the development of the common sea-urchin *Echinus miliaris*. The "echinopluteus" larva of this species is a transparent bilaterally symmetrical free-swimming creature. It is provided with a complete alimentary canal consisting of oesophagus, stomach and rectum, and at the sides of the oesophagus are situated two flattened coelomic sacs. As development proceeds each sac becomes divided into anterior and posterior portions, and the latter move backwards so as to be pressed against the stomach. Still later from the posterior end of the left anterior sac a little bud termed the "hydrocoele" grows out. This is the rudiment of the water-vascular system of tubes in the adult. The ectoderm lying over this bud becomes depressed so as to form a sac (the "amniotic cavity") from the floor of which grow up the spines which will cover the test of the future sea-urchin.

The hydrocoele bud overlaps the front end of the left posterior sac, and from this part of the posterior sac there grow out five pockets from which will be developed the dental apparatus—the so-called "Aristotle's lantern." From the outer wall of the right posterior coelomic sac cells are given off from which are developed a pair of "pedicellariae" (pincer-organs) which will be situated on the upper surface of the future urchin. If we now allow[2] the young larvae at the time the coelom is being formed to grow in hypertonic water, then many of them will develop from the *right* anterior coelom a second hydrocoele bud. If this bud develops—and it does so if plentiful nourishment be supplied to the larva—then a right amniotic cavity is formed from the overlying ectoderm, whilst the right posterior coelom gives rise to a second Aristotle's lantern. If the development of the second hydrocoele bud be slow, then one or even two pedicellariae may be formed on the right side as in normal larvae, but if it be rapid the formation of pedicellariae may be inhibited altogether. If after the bud has appeared the larva is nearly starved for a time, both this abnormal bud and the normal hydrocoele may remain small and undeveloped and then pedicellariae may be formed on the left side as well as on the right.

We conclude from these facts that the hydrocoele bud tends to inhibit the formation of pedicellariae on its own side of the larva but to cause their production on the opposite side, and we see further that the right hydrocoele bud can totally alter the development of the right side of the larva, forcing the right ectoderm to form an amniotic cavity and the right posterior coelom a dental apparatus.

Another still more striking case of the influence of the internal environment is afforded by the results of experiments performed on the tadpole of the frog.[3] The vertebrate eye consists of two main parts, viz.: (*a*) the retina, formed as an outgrowth from the brain; and (*b*) the lens, formed as a thickening of the ectoderm of the side of the head. If before the lens is formed the skin of the head of a tadpole be slit open and the retina cut off from the brain and pushed back till it occupies a position in the region of the shoulder or even farther back, the slit in the skin will soon heal up and then the tadpole will recover; the cut-off retina will continue to live and grow in its new position, and it will force the ectoderm covering it to form a lens—although never in the history of the race has a lens been normally formed in this position. Numerous other similar instances could be adduced suggesting the conclusion that in many embryos *the primary organs are indifferent material and that the manner in which the secondary organs will develop out of them is fundamentally a matter of their spatial relations.* We shall, however, confine ourselves to citing one more case of this phenomenon, the most striking that has yet been discovered.

We have already mentioned the fact that the differentiation of organs in the frog's egg begins in the upper lip of the blastopore. This is also true of the eggs of newts and apparently of all other Amphibia. Spemann[4] removed a small piece of this upper lip from the gastrula of the newt *Triton taeniatus* which is deeply pigmented and implanted it in the midst of the lateral wall of the gastrula of the newt *Triton cristatus* which is devoid of pigment. The small dark piece of foreign tissue effected a complete union with its alien surroundings and as development proceeded a nerve cord was developed in front of it from the tissues of the host, entirely independent of and supplementary to the proper nerve cord of the host which developed in the usual way from the dorsal legs of the blastopore.

Here we have the clearest demonstration of the fact that all the potentialities of the development of the entire embryo slumber in each cell and can be awakened if the appropriate stimulus reaches them, a stimulus which in this case is produced by the tissue of another species.

External Environment.—We now approach the subject of the possible influence of the external environment on the course of development. In the earlier article attention was drawn to the fact that development presents itself under two principal aspects, viz., the embryonic and the larval. In the embryonic phase the young organism is sheltered from the external world, either within an egg-shell or in the mother's womb, whereas in the larval phase it leads a free life, using its larval organs to seek its own food and escape its enemies.

It was further pointed out that if we compare two nearly allied animals such as *Salamandra atra* and *Salamandra maculosa*, in the first of which development is mainly embryonic, whereas in the second it is largely larval, we arrive at the conclusion that the embryonic phase is secondarily derived from the larval phase, since the organs such as gills which are functionless in the embryo are functional in the larva. It was also pointed out that larval organs frequently resemble the adult organs of other animals of simpler and more primitive structure.

On these facts was founded the celebrated biogenetic law first enunciated by Haeckel[5] which affirms that "the embryo in its development recapitulates the ancestral history of the race." It is this law which provides a large part of the fascination of embryological research, though it was vigorously attacked in the earlier article when an effort was then made to show that it is not valid, since it was maintained that whilst it is true that larvae retain ancestral characters, the same is true of adults, and that larvae in their structure are not more reminiscent of the former history of the race than are adults.

Now the outcome of recent investigation has in large measure tended to reinstate the doctrine of recapitulation in its former position of pre-eminence, to show in fact that recapitulation forms the central thread in every life history, although it has been blurred and deflected by secondary influences, as indeed all believers in the biogenetic law have from the first admitted.

The first point to which we wish to direct the reader's attention is that larval and embryonic phases occur in all life histories. Every

[1] J. Hjört, "Germ-layer Studies Based on the Development of Ascidians," *Zool. Results Norwegian N. Atlantic Exped.* (1890).

[2] E. W. MacBride, "The Artificial Production of Echinoderm Larvae with Two Water Vascular Systems," *Proc. Roy. Soc.* (*London*), series B, vol. 90 (1918).

[3] W. H. Lewis, "Studies on the Development of the Eye in Amphibia. 1. The Lens," *American Jour. Anat.*, vol. 3 (1904).

[4] H. Spemann, "Die Erzeugung tierischer Chimaeren durch heteroplastische embryonale Transplantation zwischen *Triton cristatus* und *taeniatus*," *Arch. f. Entwicklungsmech.* vol. 48 (1921).

[5] E. Haeckel, *Generelle Morphologie* (1866).

animal begins its existence as an egg which is quite incapable of feeding or of defending itself and this egg is always protected by an egg-shell although this shell may be very thin, and no animal upon leaving its early shelter and beginning to seek its own food attains at once the structure of the sexually ripe adult. Hence every animal in the course of its development may be said to pass first through an embryonic and then through a larval phase, although the latter phase may be very short and the difference in structure between the larva and the adult inconsiderable. Now, the larval phase being the later is the most recent addition to the life history, and therefore the least likely to be modified by secondary factors; if therefore the biogenetic law is valid, it is the larval phase which will possess most ancestral significance. But in the earlier article attention is called to the fact that the identification of a larva as the representative of an ancestor must always be hypothetical because we have no direct knowledge of what the ancestor of any living animal was like. It behoves us therefore to look a little more closely at the reasons which actually do induce us to regard a given stage as ancestral.

First, we may call attention to the fact that quite recently direct experimental proof of the validity of the biogenetic law has been obtained. Kämmerer[1] placed young specimens of *Salamandra maculosa* which had just completed their metamorphosis in cages the floors and walls of which were coloured differently in different cases. The larva of this species has a skin of a uniform dark-greyish tint but the skin of the adult is gaily coloured with bright yellow patches on a black background. The salamanders which were confined in cages having a floor of moist yellow loam and walls coloured yellow became yellower as they grew to maturity—a process which occupies between four and five years. The yellow patches increased in number and size and tended to become joined together in bands. Those confined in cages with blackened walls and a floor of black garden earth became darker since the yellow patches dwindled in size.

When the salamanders had attained sexual maturity and were allowed to pair, it was found that the offspring of two which had been reared in yellow surroundings, if they continued to live in the same environment, became still yellower than their parents until the black pigment had been almost entirely displaced; whilst the offspring of two which had become darker, if reared in cages with black walls and floor, became practically completely black by the time they reached maturity so that they came to resemble the mountain species *Salamandra atra*. If, however, the offspring of two salamanders reared in yellow surroundings were allowed to grow up under black surroundings, they nevertheless *for the first six months of their lives became progressively yellower;* then and only then did the influence of the black environment begin to tell—the yellow patches became invaded by numerous small black spots and grew smaller. In short, the young recapitulated the process of "yellowing" that their parents had undergone.

If these results are confirmed the doctrine of recapitulation will change its status from that of an hypothesis to that of a proved fact; and further proof will be furnished that changes acquired by the individual in response to the demands of the environment are to a certain extent at least inherited.

The Recapitulation Theory.—Once we have grasped the mutual relationship of the embryonic and larval phases of development, indirect proofs of the reality of recapitulation begin to crowd in on us. If we find, for instance, one or two aberrant forms in an order or even a family the majority of whose members have a uniform type of structure, no reasonable doubt can exist that the ancestors of these aberrant forms had the typical structure of the group. If this conclusion be admitted and we find that the younger stages of the aberrant species also show the typical structure, does any one seriously question that these young forms recapitulate the history of the race? Two very striking instances of this kind have come to light within the group Ctenophora.

The typical Ctenophora are ovoid organisms of a glassy transparence which swim in a vertical position in the sea. Their locomotor organs are eight vertical rows of vibratile combs, each comb consisting of a short horizontal row of powerful cilia fused together at their bases. A certain creeping organism resembling a flat worm, named *Coeloplana*, had been believed by some zoölogists to exhibit ctenophore affinities but its relationships were very obscure. Quite recently a Japanese zoölogist[2] has described its development. Its larva is a small typical ctenophore with eight rows of perfectly formed combs; these it discards after swimming for a few hours—it sinks to the bottom and flattens out and gradually assumes the adult structure. Another extraordinary organism, named by its discoverer Tjalfjella,[3] was discovered amongst dredgings collected in the Arctic Ocean. This creature superficially resembled a sponge or an ascidian. It was gelatinous and sessile and seemed to consist of a pair of upright tubes like towers whence proceeded smaller tubes which ramified in its substance. In pockets connected with these smaller tubes were discovered groups of the larvae. These were small ovoid creatures of typical ctenophore structure with the eight vertical rows of combs.

Change of Habits.—If recapitulation of ancestral history forms an unquestionable element in the life history of some animals, it is probable that it constitutes a factor in all life histories. What is, then, its meaning? The recapitulatory element is most obvious in the latest larval stage of development, the most recently added page of the life history. Now the organs of the larva are adapted to its environment; therefore this environment in its broad outlines at least must represent the ancestral environment of the race.

The present condition of the race both as regards structure and habits has been produced as a consequence of migration from the original haunts of the race. Change of habits therefore reveals itself as the great driving-force in evolution, and change in habits usually means the choice of a different type of food.

We may conclude that the period of life at which this change most frequently occurred was when the adult organs had developed but before sexual maturity had been attained—in a word, at the stage of what we may call the young adult. As one change of habits succeeds to another in the course of evolution, the life history is not lengthened in the same proportion, since the new phase takes the place of the sexual phase in the previous condition of the race. In some Crustacea, *e.g.*, in the shrimp *Penaeus*, at least four larval stages are passed through before the adult stage is attained, but in the majority of life histories when a new phase is added there is a tendency for some of the older phases to be pushed back into the embryonic period, so that as an animal passes from stage to stage in evolution it leaves behind a trail of stages at first larval and then becoming embryonic.

Secondary Modifying Factors.—The principal factors which modify and tend to obscure the recapitulatory factor can only be defined by a truly comparative embryology based on a wide survey.

One of these factors is "tachygenesis" or precocious development; that is to say, we find that organs originally developed as a response to the stimulus of a new environment come in course of time to be developed before the habits to which they correspond can be exercised—in fact *acquired habits tend to become innate.* Thus the young hermit crab when adult thrusts its abdomen into the cavity of a spirally coiled gastropod shell, and in this way imposes a twisted form on this part of its body. But if all such shells be removed from the hermit crab's neighbourhood at the time of its metamorphosis, it will still develop a curved abdomen, although the extent of the curvature will be less than that which occurs normally. When the tadpole of the frog acquires limbs, these do not develop in the form of fins, from which they have been undoubtedly evolved, but grow directly into the ordinary type of five-toed limbs, although weeks must elapse after their form is fully defined before they can function as the limbs of land animals. The tendency to hurry on development may be compared to the increasing facility with which a difficult operation is performed after long practice, but this tendency obviously obscures the distinctive features of early development.

A second powerful modifying factor is the change from the larval to the embryonic phase, so far as the development of a particular organ is concerned. This change of phase is sometimes caused by an unfavourable alteration in the environment of the larva. It was actually effected artificially in the development of *Salamandra maculosa* by Kämmerer.[4] This species is viviparous and normally gives birth to between 30 and 40 young which are provided with gill-slits and long gills and which live in the water for six weeks before they metamorphose into land animals. If the parents are exposed to successively colder and drier conditions, the number of young produced at a birth diminishes with each breeding period, and these young are born at a progressively more advanced stage of development. If these young are reared to maturity under similar conditions of coolness and dryness, they will in turn give birth to young which will be still fewer in number than those produced by their parents and which are born at a still more advanced stage of development. The process goes on till only three or four are born at one time and these are provided with the merest stumps of gills; such young never

[1] P. Kämmerer, "Vererbung erzwungener Farbveränderungen. IV. Das Farbkleid des Feuersalamanders (Salamandra maculosa) in seiner Abhängigkeit von der Umwelt," *Arch. f. Entwicklungsmech.*, vol. 36 (1913).

[2] Taku Komai, "Notes on *Coeloplana bocki* and its development," *Annotationes Zoologicales Japonenses*, vol. 9 (1920).

[3] Mortensen, "Ctenophora," *Danish Ingolf Expedition*, vol. 5, No. 2 (1912).

[4] P. Kämmerer, "Vererbung erzwungener Fortpflanzungsanpassungen. I. & II. Die Nachkommen der spätgeborenen *Salamandra maculosa* und der frühgeborenen *S. atra*," *Arch. f. Entwicklungsmech.*, vol. 25 (1908).

enter the water at all but at once take up the adult mode of life. This is the normal mode of development of *Salamandra atra*.

The change of phase from the larval to the embryonic type entails many other changes. The embryo must be fed and it obtains its food from one of three sources, (*a*) devouring its sisters; (*b*) secretions from the mother's womb; (*c*) inclusions of yolk in its own ectoplasm. When the embryo devours its own sisters, this, as in the case of *Salamandra atra*, may entail little change of structure because in this case the habit has been recently acquired; but where, as in the case of the platyhelminth worms, the habit is of old standing, then the embryo may be distorted out of all recognition. In these worms one viable egg is shut up in a capsule along with thousands of small sterile ones; and it is difficult to find in the embryo any vestige of resemblance to the larvae of those Platyhelminthes which lay their eggs singly.

When the embryo derives its nourishment from the mother's womb, then it frequently develops organs of adhesion to the wall of this. To this category belongs the placenta which profoundly distorts the ventral surface of the human embryo, so that this surface gives rise to a treelike outgrowth whilst the dorsal surface is moulded into a ludicrously exact copy of the early tadpole of the amphibian. When the embryo is fed by yolk, this, as we have already pointed out, modifies all the processes of development; cell division becomes slow and the cells produced few and large, and folding, which plays a large part in the development of small alecithal eggs, becomes impossible and is replaced by solid outgrowths of cells.

Still a third factor which tends to hide the recapitulatory element is the development of special larval adaptations. This occurs when the larva retains its free life but when its circumstances become changed, these special adaptations have been developed in thousands of insect larvae. So generally is this the case that Balfour[1] denied to these larvae any ancestral significance at all; but modern research has succeeded in revealing the original ancestral larval type beneath the secondary modifications.

All the evidence at our disposal points to the conclusion that the ancestors of insects were creeping myriapod forms—scavengers which fed on the débris of both animal and vegetable nature in the undergrowth of primeval forests. Such is in fact the life of the lowest insects known to-day, some of which, such as *Machilis*, nourish themselves on the decaying seaweed on the seashore, and retain throughout life vestigial limbs attached to the abdominal segments which aid them in their crawling movements. Now the myriapod or polypod larva survives as the caterpillar of the Lepidoptera and the primitive Hymenoptera. It is also found amongst the primitive Neuroptera and amongst the may-flies (Ephemeroptera). These last-named insects were supposed to possess a larva showing great secondary modifications, for it is provided with leaf-like gills attached to its abdominal segments; but Heymons[2] has shown that these gills are nothing but modified abdominal legs. It is a curious fact, however, that amongst the lower insects, such as the cockroach, this polypod stage is usually passed through during the embryonic phase of development. The reason for this change seems to be that these insects lay their eggs in situations where a grub-like larva would perish, whereas the higher insects, in which the stage is larval, are gifted with instincts which lead them to lay their eggs in situations where an abundance of easily procured and easily masticated food is available and a scavenging existence like that of the ancestor is possible.

A fourth factor which modifies development, and which is potent in its effect although it is usually overlooked, is *loss of size in the larva as compared with the ancestor which it represents*. As conditions change and the larval life becomes more dangerous there arises a tendency in which we may trace the influence of tachygenesis to pass quickly through the larval stage and to metamorphose at as early a period of growth as possible into the adult condition. Thus in the American lobster the adult stage is attained when the animal is 1½ in. long but this lobster eventually attains a length of from 18 in. to two feet. A consequence of this change is that the larva assumes a new relation to its environment, for many qualities of the surrounding medium, such as the viscosity and the supporting-power of water, acquire an altered importance as the organism decreases in size. If the ancestral organs were reduced in the same scale as is the whole body of the larva, this would often result in their becoming incapable of being used. As a consequence we find that in many cases where the ancestor had a series of organs, this series is represented in the larva by fewer members or only one member of larger relative size, and that where in the ancestor there was a pair of organs there is frequently only one in the larva, but this is on a larger scale than the rest of the body.

If we now select a few examples to illustrate this principle, we may consider the free-swimming larva of that most primitive of all vertebrates *Amphioxus*. This larva has only a single series of gill-slits which are so enlarged as to occupy the whole ventral surface of the body. If the double series of slits, which the ancestor in common with all other fish possessed, had been developed in the larva, they would necessarily have been of such minute size that the capillarity of the water would have prevented them from being functional. Similarly there is no doubt that the eyes of vertebrates were from the beginning paired structures, but they are represented in the ascidian tadpole by a cup-like outgrowth of one side of the brain. Again no serious doubt can be entertained that the primitive arthropod was evolved from a long many-segmented annelid with flexible parapodia. But the most primitive larval form of the Crustacea is the Nauplius which in most cases is a little, oval, unsegmented creature with but three pairs of legs. In some of the most primitive Crustacea, however, such as *Estheria* and *Chirocephalus*, the Nauplius possesses when hatched a comparatively long "abdomen" which though devoid of appendages is divided into a series of narrow ring-like segments. The ordinary type of Nauplius larva seemed to indicate that the Crustacea must have been derived from an unsegmented animal totally distinct from the ancestor of other Arthropoda, for the progenitor of these must have been long and segmented, since the embryos of all these Arthropoda have many segments.

But if we look at the Nauplius larva from the standpoint of function rather than of structure we have no difficulty in seeing in it the recapitulation of the first step in the "arthropodisation" of the annelid. This step was a change of habits which consisted in using the foremost parapodia as oars to propel the animal and as organs to seize food. As a consequence in the front of the body the cuticle was thickened and the "arthropodous" type of limb produced, whilst in the rest of the body the annelid condition of affairs persisted as indeed it may be almost said to do in the posterior portions of the bodies of this most primitive Crustacea, the long-bodied Phyllopoda such as *Artemia*. Once begun in front, this "arthropodous" modification was gradually propagated backwards so as to involve the hinder segments of the body and in this way the higher Crustacea were evolved. In the Nauplius larva, the anterior arthropodised portion of the ancestor with its appendages is alone represented; the hinder annelid portion in which function was less intense and less important is feebly or not at all developed.

One last instance of the principle may be adduced which we select from the embryology of the higher vertebrates. In the development of those types of Vertebrata in the life history of which there is a long larval phase (Cyclostomata, dipnoan, "ganoid" and teleostean fish, Amphibia), a larval excretory organ termed the *pronephros* makes its appearance. Its duct later becomes the duct of the permanent kidney, but the pronephros itself consists of very few tubules and these originate from the wall of the general body-cavity and not, as do the tubules of the permanent kidney, from special sacs (the malpighian capsules). The earlier workers regarded the pronephros as a last trace of a primeval excretory organ of quite different structure from the permanent kidney which later supersedes it. Hatta[3] working on the development of the lamprey and Kerr[4] on the development of Polypterus, have proved that the pronephros is nothing more than the foremost section of the permanent kidney, early called into action and enlarged whilst the hinder section of the metamerically repeated series of tubes of which the kidney consists remains undeveloped. Further, the portion of the general body-cavity from which the pronephric tubules arise is proved to consist of several malpighian capsules fused together and secondarily communicating with the general body-cavity.

Life History of Animals.—It might be supposed that with so many modifying factors at work it would be a hopeless task to attempt to disentangle the recapitulatory element from them and that therefore the ancestral history of animals, except in its latest and least modified chapters, would remain a closed book. But when we recollect that the life history of every species constitutes a separate edition of this history, and that the modifying factors have affected no two of them to the same extent, it becomes evident that comparative embryology built on a broad basis can attack the problem with a fair prospect of success.

Bearing in mind the priority of the larval over the embryonic phase, and beginning therefore our survey with the larvae of the simplest metazoa, we are able to recognise the first step in the evolution of the metazoa from the protozoa in the blastula, the hollow ball of cells which may be regarded as representing a colonial protozoön like the living Volvox. This stage was followed by the formation of a gut by the intucking of one side of the ball; and this second step is represented in the life histories of all the lower and simpler animals by the gastrula stage. Following on this stage came the formation of the coelom as a series of pouch-like outgrowths of the gut, and the change of the single opening of the gastrula, the blastopore, into two openings which became the mouth and the anus by the constriction of its middle portion.

It has been possible to show that two groups so utterly diverse

[1] F. M. Balfour, *Comparative Embryology*, vol. 2, p. 365 (1881).

[2] R. Heymons, "Über die Lebensweise und Entwicklung von *Ephemera vulgata*," *Sitzungsber. d. Gesells. d. Naturf. Berlin* (1896).

[3] Hatta, "The Development of the Renal Organs in the Lamprey," *Journ. Coll. Sci. Imp. Univ. Tokio* (1912).

[4] J. Graham Kerr, "Vertebrata with the exception of Mammalia," *Textbook of Embryology*, vol. 2 (1919).

in appearance as the Annelida and the Mollusca have originated from a single group of free-swimming ancestors represented by the trochophore larva, and since Arthropoda are admitted by all to be descended from Annelida, this conclusion involves the ancestry of four-fifths of the animal kingdom.

We can form a very plausible guess as to the nature of the divergence of habits which led to the differentiation of the Annelida and Mollusca from one another. The original stock was free-swimming but both groups derived from it are typically bottom-dwellers. Two modes of seeking their food were open to them: they could either glide over the bottom by means of their cilia as young Gastropoda and Lamellibranchiata still do, or they could burrow into it. The first of these habits led to the evolution of Mollusca, the second to that of Annelida.

Two other groups of very diverse structure, which embryology has given strong reasons for believing to have been derived from a single race, are the Echinodermata and the Vertebrata. The lowest form which gives distinct evidence of the vertebrate affinities is the worm-like creature *Balanoglossus*. The larval form of *Balanoglossus* is a free-swimming organism called *tornaria* which shows the closest resemblance to the typical larva of Echinodermata, the *dipleurula*. The recognition of this affinity has assisted in the elucidation of a difficult subject to which considerable space was devoted in the 11th ed., viz., the origin of the central nervous system.

It is characteristic of the most primitive Annelida and Arthropoda that this system develops as a ring round the blastopore and an endeavour was made in the 11th ed. to prove that this was originally true of vertebrate embryos also. But it is a peculiarity of the vertebrate-echinoderm alliance which is still unexplained that in them the blastopore gives rise to the anus alone, whilst the mouth is formed as an apparently independent perforation at a considerably later period of development. A long succession of embryologists, with their eyes fixed only on the embryos of Annelida, Arthropoda and the higher vertebrates, have held that the vertebrate mouth is a new structure formed by the fusion of a pair of gill-slits and have prosecuted vain searches for traces of the old mouth.

Others have imagined that the mid-dorsal line of the vertebrate embryo along which the nerve-cord develops corresponds to the line joining mouth and anus in the arthropod, the line in fact which is occupied by the slit-like blastopore in *Peripatus*. They hold that the nervous system of the vertebrate originally extended round the front end of the embryo so as to include the mouth. There is, however, strong evidence that in Vertebrata the blastopore originally extended along the ventral surface. In Amphioxus the blastopore is at first a large wide opening beneath the nerve, the diameter of which is at right angles to the long axis of the nerve cord. As development proceeds this opening closes from below upwards and the blastopore is finally reduced to a small pore immediately posterior to the nerve cord. The anus arises as an apparently new perforation along the line of this closure. In the newt the lower part of the blastopore remains permanently open as the anus. In elasmobranch fish (sharks and rays) the blastopore is at first an enormous opening occupying the whole under surface of the egg which gradually closes by the approximation of its sides. As the anus can develop as an apparently independent opening along the line of the closed blastopore, it does not require a great stretch of the imagination to assume that this line really extends so far forward as to include the area where the mouth later develops. The independent and late development of the mouth is as marked a feature in the echinoderm larva as in the vertebrate embryo and there are no gill pouches in the echinoderm on which we could fall back to explain the phenomenon; and, further, in all four types of Echinoderm larvae develop a wide mouth leading into a shallow funnel-shaped gullet situated in the same position in the larval body and showing no relation whatever to the blastopore.

In two groups of Echinodermata (Ophiuroidea and Holothuroidea) as development proceeds this mouth moves to the left: its inner portion forms the adult mouth whilst its outer portion shallows out and forms the circular lip (peristome) surrounding the adult mouth. In two other groups (Asteroidea and Echinoidea) the larval mouth entirely disappears and the adult mouth is formed as an independent perforation on the left side—yet no one would question the homology of the mouth in all four groups. These facts afford conclusive proof that the shift of an organ from one position to another may be represented in embryology by its disappearance in one position and its apparent new formation in another. In the adult echinoderm the whole of the ectoderm is underlain by a nervous plexus of which the central nervous system is only a specialised and intensified portion, and the same thing is true of the anterior region of *Balanoglossus*. It is therefore futile to look for exact correspondence between the central nervous systems of two stocks which diverged from one another at such a primitive level as did the Vertebrata and the Annelida. In fact the descendants of the trochophore stock (Annelida, Arthropoda and Mollusca) on the one hand and the original Vertebrata on the other seem to have adopted two different modes of life which led to concentrations of the nervous system in different parts of the body. The trochophore stock took to crawling on their ventral surfaces and their locomotor organs were developed in this region of the body and in connection with them the motor ganglia which make up the ventral nerve-cord; whereas the vertebrate stock took to swimming by lateral blows of their blade-like bodies and this led to the concentration of the central nervous system in the mid-dorsal line.

Enough has been said to give evidence for our belief that the most recent research has tended to re-establish the recapitulatory element as the fundamental factor in life-history, and if this be admitted the study of comparative embryology opens up a means of investigating the early history of life at a stage long before it left evidence of its existence in the stratified rocks; and, further, the acceptance of recapitulation involves a conception of the laws of heredity entirely distinct from and supplementary to that suggested by Gregor Mendel and his followers.

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(E. W. MACB.)

EMIGRATION: *see* MIGRATION.

ENCEPHALITIS LETHARGICA.—The virus is unknown. Filtrable organisms have been described and also the transmission of the disease by injection of nervous tissues, but these experiments are at present inconclusive. The incubation period is uncertain but it is probably about two weeks. The degree of infectivity must be small. The duration of infectivity and of the persistence of the virus in the body are unknown. Apparently the virus may lie quiescent and return to activity after long periods since late manifestations have been known to develop after periods of two to four years, sometimes after apparent cure in the intervals. No age is immune to infection though the disease is not common in very young children.

Symptoms.—It is very difficult to classify the different cases. The best scheme provisionally is that of MacNalty which has been adopted by the Ministry of Health. This classifies the cases under the following main types:—

1. In which there is general disturbance of the functions of the central nervous system but without localisation.
2. In which, in addition to general disturbance, there are various localisations in the central nervous system. The most frequent of these are affections of the third pair of cranial nerves, but no portion of the nervous system is immune.
3. Mild or so-called abortive cases (*formes frustes*).

The clinical manifestations are very variable and complex and are best classified, according to Walshe's scheme into general and nervous.

I. General: (1) negative, (2) positive.
II. Focal: (1) negative, (2) positive.

The positive symptoms denote exaltation of function which may be due either to irritation of nervous tissue or to a loss of the control exerted normally by the higher centres of the brain, while negative symptoms denote depression or loss of function due principally to destruction of nervous tissue.

The onset of the disease may be sudden or insidious. Occasionally the onset is extraordinarily sudden, the patient falling asleep almost without warning or sometimes becoming delirious. More frequently it is insidious either with the development of drowsiness or with more general symptoms. The general symptoms are not in themselves distinguishable from those of other conditions. Headache is common, and nausea and vomiting are frequent without being very severe. The temperature is very variable. It may be about 102° F. at the onset, falling after a few days, or it may be normal at the onset and rise later in the first week. A persistent rise is a serious sign. Some cases are apyrexial throughout. There is no characteristic eruption. In the mild and abortive types the general condition may suggest influenza and the nature of the illness only be recognised long subsequently by the development of characteristic late manifes-

tations. Most cases undoubtedly commence with some grade of the characteristic symptoms of lethargy and double vision.

Lethargy.—The depth of this varies from apathy or drowsiness to deep sleep. The patient can usually be roused and may then answer questions with unexpected clearness. Occasionally the lethargy gradually deepens to stupor and fatal coma. Most commonly the lethargy lasts for two to three weeks, but it varies from a few days to several months. Rarely is it completely absent. Occasionally there may be somnolence by day and insomnia by night.

Double Vision.—Diplopia or double vision also occurs in the majority of cases, and is due to some form of paralysis of the ocular muscles. Other ocular manifestations may occur, such as ptosis or drooping of the eye-lids. The pupils may exhibit every possible variation from the normal in size, shape and reactions. Coarse nystagmoid movements are also common. Optic neuritis is never marked and a definite degree of swelling of the optic disk suggests an error in the diagnosis.

Nervous Symptoms.—Certain of the nervous manifestations which occur more commonly during convalescence or after the acute stages have passed will be referred to under the heading of "Residual" or "Late Manifestations," but any of them may occur at the onset or at any point in the course of the disease.

The positive symptoms are represented by restlessness, delirium, acute mania and various degrees of excitement. General convulsions are not common but are usually fatal. Negative symptoms are represented by the characteristic lethargy referred to above. Not uncommonly a patient may vary rapidly between a positive and a negative state.

Among the positive symptoms may be mentioned muscular pains which are occasionally severe and may simulate many diseases. In the positive group fall also the rigidity, Parkinsonism and the various involuntary movements which are referred to below among the late manifestations. The negative symptoms are represented by paralysis. The ocular manifestations have been mentioned above. Affection of the remaining cranial nerves may produce facial paralysis, difficulty in swallowing, rapid respiration and paralysis of the pharyngeal and laryngeal muscles. Aphasia and paralysis of the limbs may also occur. The deep reflexes are usually absent in the acute stages of severe cases, but there is no constant rule. The cerebro-spinal fluid may show a moderate increase in the number of lymphocytes but in at least one-third of the cases the fluid is normal.

Residual and Late Manifestations.—These are of the highest importance. The manifestations here referred to develop most frequently during convalescence, yet they may be present from the very outset of the disease, while in other cases long intervals, even of years, may elapse after the acute stages before their appearance. The initial attack may be so mild as to be overlooked at the time.

The most important of these manifestations are as follows:—

The Parkinsonian Syndrome.—This is characterised by the remarkable absence of facial expression which is termed the "Parkinsonian mask." There is also general muscular rigidity and a striking absence of slight and automatic movements. The general appearance resembles the condition known as paralysis agitans though the general effect is not quite identical. As mentioned above this state may be fully marked within a week or two of the onset. The progress is more rapid than in senile paralysis agitans, but on the other hand recovery may take place, especially in those cases in which it has developed early in the attack. Mental changes are not uncommonly associated with this complication especially in childhood.

Mental Changes.—These are of great importance from their frequency and character and are present to some extent in about 75% of cases. The changes may be of all grades from slight weakness of the intellectual powers to definite dementia and insanity. The development of certifiable insanity is, however, rare.

In adults the usual manifestation is a general weakness of the intellectual powers. The subject shows a marked lack of attention, concentration and initiative. Definite melancholia is not very common. There may be some irritability of temper but the excitement which occurs in children is not often seen in adults. Insomnia is a not infrequent symptom and may be very persistent. On the other hand there may be persistent drowsiness.

In children the mental changes are far more varied and of greater importance than in adults. As in adults the commonest effect is a weakening of the powers of concentration. This becomes very obvious during school life, since these children pay little attention either to their work or to their surroundings. Such a child makes but little progress and appears to remain at the age at which the illness began, but is seldom troublesome.

A second group, numerically smaller, is characterised by excitement. These children are usually under 10 years of age. They are restless, troublesome, noisy and uncontrollable. The excitement may be most marked during, or even be confined to the night. As the afternoon passes on these children become restless and excited and the entire night is spent in shouting and constant movements. For the time, they are quite beyond control.

This group merges into a third group in which there are definite alterations in the moral character. Most of the children are between the ages of 10 and 18 years. This group, though small, is important owing to the difficulty in dealing with the subjects. They become morally and sexually perverted. These changes are more common in children of families with a bad record mentally and criminally. There is a small group in which idiocy develops, usually in children under 5 years of age, and in a few cases there has been definite certifiable insanity. In addition to these mental changes Parkinsonism may be present and also the myoclonic and other movements described below. The treatment and especially the disposal of children in the second and third groups is a matter of great difficulty. Home surroundings are rarely suitable and the child will render ordinary family life impossible. The moral pervert may also lead to trouble with the law. Special institutions may need to be provided for these children.

Involuntary Movements.—This group of "excitomotor" symptoms includes numerous varieties of involuntary movements and muscular contractions. Though they are more common late in the disease many of them occasionally occur at the onset. The most definite type is myoclonus which is characterised by short, rapid, rhythmic contractions of the muscles: a single muscle such as the diaphragm, or even a part of a single muscle may be affected. There is generally no movement at the joints, but in some cases the contractions are of a slow rhythmic type and may lead to very complex movements. Various choreiform and athetoid movements are also met with. Tremors and tics of all types may also develop. Epidemic hiccough may be a variety, but this is at present uncertain.

Respiratory Abnormalities.—Rapid or deep breathing may be present, either continuously or in paroxysms at any period of the acuter stages. Violent spasmodic cough occasionally develops in in children or sniffing and various respiratory spasms.

Paralysis.—The persistence of these is relatively uncommon. Diplopia is rarely permanent. Many nervous diseases, however, are occasionally simulated such as disseminated sclerosis. Numerous other late manifestations are observed more rarely. Among these may be mentioned obesity which is occasionally associated with polyuria, suggesting disturbance of the pituitary gland.

Progress and Prognosis.—A. J. Hall states as a rough approximation that of 100 cases, 25 recover completely, 25 die, and 50 have various residua of which at least 25 exhibit Parkinsonism. It is impossible to give a good prognosis during the acute stages in any case of encephalitis lethargica, owing to the fact that serious late manifestations may develop after a mild initial attack. Further, long quiescent periods may occur with subsequent recrudescence of activity and fresh manifestations. Such intervals may be several years, but the limit is at present unknown.

In the acute stages the outlook for life is bad with severe general symptoms, with a rapid onset, with high temperature, with acute delirium or with mania. Slight early symptoms may, however, also progress to serious grades. Deep early lethargy is not

necessarily a serious symptom. Early myoclonus and involuntary movements do not appear to be especially unfavourable. Most deaths occur within the first month and the prognosis for life improves after this.

With regard to special manifestations, the Parkinsonian syndrome may be recovered from partially or even completely when it develops early in the disease, but when it appears later it usually progresses and mental changes may also occur. The outlook in the cases with the severer mental changes is poor; recovery is rarely more than partial and relapses may follow.

The influence on pregnancy has been carefully studied by Hall. He considers that there is no evidence that pregnancy pre-disposes to infection with encephalitis lethargica, or that it is associated with a higher mortality or influences the course of the disease in any way. Residual manifestations, however, may be aggravated in a woman who has passed through an attack and become pregnant subsequently. No advantage is apparently gained from induction of labour.

Diagnosis.—The disease is often easily recognised from the combination of lethargy and double vision. The milder forms, however, are easily overlooked at the onset and may frequently be unavoidably mistaken for influenza. When the more complex nervous symptoms are present the diagnosis may be of great difficulty. The conditions with which confusion most often occurs are meningitis (especially tuberculous), cerebral tumour, cerebral vascular lesions and cerebral syphilis. The confusion with senile paralysis agitans is not common.

Treatment.—This is on the general lines of treatment of acute febrile disease. Unfortunately there are no specific measures. The administration of hexamine may be recommended. The withdrawal of cerebro-spinal fluid by lumbar puncture is frequently performed but there is no evidence that it is beneficial.

Bibliography.—The monograph on Epidemic Encephalitis by A. J. Hall (John Wright & Sons, 1924) contains a complete and classified bibliography. The following articles include the earliest reports:—

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(H. L. T.)

ENDOCRINOLOGY.—This science deals with the structure and function of the organs of internal secretion (*endocrine*, or *incretory organs*), in health and disease, and has been vigorously developed since 1910. Through observations upon man in private clinics and in university hospitals, and through experimentation upon animals in laboratories, many important new facts have been accumulated concerning these organs, their products (*increta*) and their functions during different periods of the life-cycle of individual organisms. Attempts are being made to co-ordinate these recent discoveries with what was known before, in order that knowledge in this domain may be better systematised and formulated and that the diagnosis and treatment of endocrine disturbances in man may find securer foundations than the speculative suppositions, often groundless, that have been advanced in a period of expanding research to eke out a store of facts that was felt to be lamentably meagre.

Limitation of the Field.—There is, as yet, no general agreement as to the limits to be set to the field of endocrinology(1). Some would include all parts of the body in the category of organs of internal secretion, on the ground that all organs give off chemical substances to the blood and lymph; others would limit membership in the class to a few organs—(*a*) the ductless glands and (*b*) certain glands that, despite the possession of ducts and the production of an external secretion, yield to the blood directly (or through the lymph) materials that are of profound significance either for the growth and differentiation of distant parts or for the automatic regulation of the physiological functions of those parts. In this latter and more restricted sense, the endocrine organs include the thyroid gland, the parathyroid glands, the hypophysis cerebri (or pituitary gland), the suprarenal glands, the islands of Langerhans of the pancreas, and, perhaps, the endocrine portions of the sex gland or gonads. Organs, the products of which serve merely the nutrition of the body or are mere waste substances to be excreted from the body by other organs, would not be so included.

Even with this restriction there is doubt as to just how many organs should be classed as " incretory " and, particularly, as to whether the pineal gland, the posterior lobe of the hypophysis cerebri, the thymus, the liver and the chromaffin tissues should, or should not, be so classed. For practical reasons it would seem better to regard endocrinology, for the present at least, as limited in its field to the structure and functions of the organs of internal secretion in the narrower sense mentioned above rather than to extend its scope so as to include all the organs of the body whose products on entering the blood play any part in chemical regulation. The science which deals with the " hormones " or " chemical messengers " (*cf.* E. H. Starling) in general within the body has been called " hormonology "; endocrinology in the narrower sense would appear to represent an important part or domain of that more comprehensive subject.

Anatomy, Histology and Embryology of the Endocrine Organs.—The gross and microscopic appearances of the principal ductless glands are described in 8.633. Recent advances in the morphology of these glands have consisted (*a*) of intensive studies of their finer structure by means of more delicate histological technique and (*b*) of more accurate determinations of the mode of origin and the chronological development of these structures in the embryos. Systematic (and quantitative) statistical studies of the normal variations of these organs and their relations to the body as a whole have been undertaken for certain animal species (*e.g.*, the rat). An attempt is also being made to determine precisely the evolutionary processes responsible for the organogenesis and histogenesis of the structures that manufacture the internal secretions, a phase of research regarded as important by biologists and especially by embryologists(2).

General Physiology of the Endocrine Organs.—The increta produced by the endocrine organs and delivered to the blood, either directly, or by way of the lymph, appear to be of great importance for the organism as a whole in all phases of the life-cycle (evolution, maturity and involution). During the *period of evolution*, the progressive phases of the life-cycle (that is, during the development of the individual), these increta play a rôle in the processes of growth, of organ formation and of tissue differentiation(3). The endocrine substances that participate in the building of the bodily organs and are of significance in the initiation and the continuance of the metamorphoses that occur during growth have been called " harmozones." It is believed that they react with the autochthonous chromosomal substances of the cells of different regions of the body, perhaps in an enzyme-like way, and so form a part of the stimulative and assimilative processes concerned in normal growth and differentiation.

The endocrine organs themselves undergo changes during growth and development; the several organs appear at somewhat different times in the embryo, and vary somewhat in size in structure, and doubtless, too, in function, at different stages of an organism's unfolding. That the functions of these organs are correlatively connected is certain; and that there are individual, racial and generic variations in these correlations seems very probable. The different varieties of habitus (pyknic, asthenic, athletic) met with inside the limits of normal variation in a single human race, and the skeletal and other somatic peculiarities that characterise the different races of man (*e.g.*, Nordic, Mediterranean, negro, etc.,) or of any other animal, say the dog (*e.g.*, bulldog, dachshund, greyhound), though dependent in part on regional chromosomal specificities, are believed to be also in part determined by the differing endocrine " formulae " or " constellations " of their bearers, the hypophysis being dominant, perhaps in one, the thyroid in another, the gonads in a third and so forth. The different combinations and permutations of the incretory influences that are possible are interesting and at the same time appalling to the student of human and animal constitutions(4).

During the period of maturity the hormones from the incre-

[1] The figures throughout the text refer to the bibliography at end of the article.

tory organs are believed to subserve many important functions, particularly those concerned with automatic adjustments within the organism when disturbances endanger equilibrium(5).

Thus a hormone from the thyroid gland participates in the control of the basal metabolic rate, one from the parathyroid in the control of calcium metabolism, and one from the islands of the pancreas in the control of sugar metabolism. These hormones may act, as is gradually being found out, through the utilisation of various mechanisms; sometimes they exert their influence through affecting other endocrine organs than those by which they are produced, sometimes through the vegetative nervous system and sometimes through direct attack upon the body cells in general. Ignorance here is as yet profound. Slowly, however, facts are emerging, as a result of clinical-pathological studies, of experimental removal of an endocrine organ and observing what follows, of transplantation experiments and of experiments in which substances derived from endocrine organs are fed to, or injected into, healthy or diseased organisms.

During the period of involution of an organism, the incretory organs change as do all the other parts of the body. In the ageing process of normal involution, there may be steady general decline through a long series of regressive phases to physiological death. But premature senescence, partial or general, may appear as a result of abnormalities of one or more endocrine organs (gonads, thyroid, etc.), for such abnormalities lead to disturbances of equilibrium of the correlating systems of the body. To a certain extent," rejuvenescence " can be experimentally achieved by injection or transplantation of certain endocrine tissues (*see* REJUVENATION). It is possible that the appearance of certain malignant growths may come to be correlated with changes in the incretory glands, for in man, alterations in the thymus, thyroid, hypophysis and suprarenals have been found in association with neoplastic growths and, in experimental animals, definite influences of incretory conditions upon the " taking " and growth of neoplastic grafts, have been demonstrated(6). Adenocarcinomata, for example, are transplantable to certain normal mice but not to castrates of the same species, though if a young testis be also grafted into the castrate, the neoplastic graft can then be made to grow.

Physiological chemists have made progress in isolating various potent chemical substances from the organs of internal secretion. Among the more important of these may be mentioned *epinephrin* (or *adrenalin*) from chromaffin tissues, *thyroxin* from the thyroid gland, *pituitrin* and *antuitrin* from the hypophysis cerebri, *lutein* from corpora lutea of the ovary and insulin (*q.v.*) from the islets of the pancreas. Recently, from the parathyroid glands has been extracted a *parathyroid hormone* that will prevent or control tetany due to parathyroid insufficiency and will regulate the level of the calcium content of the blood; from pituitrin has been isolated an active principle of great potency that will in extremely dilute solutions cause contraction of uterine muscle; and from ovarian follicular fluid has been separated a hormone that will, on injection, induce a sexually mature condition in immature females(7).

Clinical Endocrinology.—Knowledge of clinical syndromes due to disorders of the endocrine organs has also made rapid strides since 1910, and the symptomatology of the endocrine disorders has been extended and made more precise. Thus the principal endocrine disturbances manifested as Graves' disease, myxoedema, tetany, acromegaly, adiposogenital dystrophy, eunuchism and eunuchoidism, Addison's disease, suprarenal virilism and hirsutism and diabetes mellitus are now far better understood than ever before. There has been a tendency, however, to attempt to push the clinical applications of the scientific advances in endocrinology further than is warranted, and much confusion has arisen both in the profession and among laymen because of failure to distinguish between mere speculations and well-established facts(8). Fortunately, warnings have been sounded, and more careful workers emphasise the necessity of a more rigidly critical approach to the solution of clinical endocrine problems. This is particularly true of endocrine therapy, which has recently almost run riot. The wishful thinking of unskilled practitioners and their uncontrolled impulses therapeutically to act by administering endocrine products singly and in the form of divers " polyglandular formulae " bade fair, for a time, to become scandalous, aided and abetted as such ill-founded therapy was by ignorant or unscrupulous vendors of endocrine products. Organotherapy and hormonotherapy have scored genuine triumphs; it is unfortunate that their reputation should be sullied by uncritical extravagances(9). The effects of thyroid extract or thyroxin in myxœdema, of iodine in the prevention of colloid goitre (*q.v.*), of surgical removal of part of the thyroid gland in exophthalmic goitre of insulin (*q.v.*) in diabetes (*q.v.*) are brilliant examples of therapeutic successes in endocrine domains. The utilisation of certain hormones for their pharmacodynamic effects in disorders not primarily of endocrine origin is proving profitable; the control of paroxysms of bronchial asthma by injections of epinephrin and the restriction of water-excretion through the kidneys in diabetes insipidus by injections of pituitrin, and the use of pituitrin in obstretrics and surgery, of adrenalin in local anaesthesia and of lutein in ovarian dysfunction are notable examples. Organotherapy and hormonotherapy undoubtedly have an important future, but genuine success in these fields can be achieved only by thoughtful, painstaking, rigidly controlled work; progress is only too likely to be retarded and science to be discredited by the rash enthusiast and the credulous ignoramus.

In the United States the Assn. for the study of Internal Secretions and its journal, *Endocrinology*, are doing much to foster the development of endocrine research.

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(1) *cf.* A. Kohn *Ueber den Begriff der inneren Sekretion*, Med. Klinik, Berl., 1924, 20, 1272–1274.

(2) For summaries of the morphological and developmental discoveries of recent years, the reader may consult E. A. Schäfer's *Endocrine Organs; an Introduction to the Study of Internal Secretion* (1916). Swale Vincent's *Internal Secretion and the Ductless Glands* (2nd ed., 1922), and the series of articles in the first two vol. of *Endocrinology* and *Metabolism* (1922).

(3) *cf.* Harms " Das Wesen der Inkretion und ihre Bedeutung für das normale und experimentell beeinflusste Geschehen innerhalb der Lebensphasen der Tiere," *Deutsche Med. Wchnschr.*, 1925, 51, 631–633.

(4) *cf.* G. Draper, *Human Constitution: a Consideration of Its Relation to Disease* (1924); also, J. Bauer, *Die konstitutionelle Disposition zu inneren Krankheiten* (3. Aufl. 1924).

(5) *cf.* W. B. Cannon and Associates " Studies on Conditions of Activity in Endocrine Glands," *Am. Jour. Physiol.*, 1924, 69, 46; 71, 153; 1925, 72, 283; 295; also G. N. Stewart, *Physiol. Rev.*, 1924, 4, 163–190.

(6) *cf.* Brown and Pearce " Malignant tumor of rabbit: results of miscellaneous methods of transplantation, with discussion of factors influencing transplantation in general." *J. Exper. Med.*, 1923, 37, 811; 38, 385, 1924, 40, 603.

(7) For references to some of these newer studies, the reader may consult A. C. Crawford's " Chemistry of the Suprarenal Glands," *Endocrinology and Metabolism* (1916), 2, 77–98; E. C. Kendall's " Isolation of Thyroxin," *J. Am. M. Assn.*, 1915, 64, 2042–2043; J. J. Abel's " Physiological, Chemical and Clinical Studies on Pituitary Principles," *Bull., Johns Hopkins Hosp.*, 1924, 35, 305–328; F. G. Banting and C. H. Best's " Internal Secretion of the Pancreas (insulin)" *J. Lab. & Clin. Med.*, 1922, 7, 251–464; J. J. R. McLeod and F. G. Banting's " Antidiabetic Functions of the Pancreas and the Successful Isolation of the Antidiabetic Hormone–Insulin," (1924); E. Allen and E. A. Doisy's " Ovarian Follicular Hormone," *Am. J. Physiol.*, 1924, 69, 577–588; *J. Biol. Chem.*, 1924, 61, 711–727; and J. B. Collip's " Parathyroid Hormone," *J. Biol. Chem.*, 1925, 63, 395–438.

(8) *cf.* H. A. Christian " The Use and Abuse of Endocrinology," *Canada M. Assn. J.*, 1924, 14, 102–106.

(9) *cf.* H. Lisser, " Organotherapy; Present Achievements and Future Prospects," *Endocrinology*, 1925, 9, 1–20. (L. F. B.)

ENGINE: *see* INTERNAL COMBUSTION ENGINE; STEAM ENGINE.

ENGINEERING: *see* BREAD MAKING; CELLULOSE; CHEMICAL ENGINEERING; DAMS; DYNAMO; ELECTRICITY; FACTORY DESIGN; FERRO-CONCRETE ENGINEERING; FUEL PROBLEMS; GAS, MANU-

FACTURE OF; HYDROELECTRIC ENGINEERING; INTERNAL COMBUSTION ENGINES; ILLUMINATING ENGINEERING; IRRIGATION ENGINEERING; MATERIALS, STRENGTH OF; PAPERMAKING; PUMPS; RESEARCH, INDUSTRIAL; RIVER AND CANAL ENGINEERING; STEAM ENGINE; TEXTILE MACHINERY; TURBINES, STEAM.

ENGINEERS, MILITARY (*see* 9.406).—In the ever-expanding application of engineering science to the ends of war, we note the evolution of a natural process, and a modern classification of engineer work. The former evidences itself in the tendency to fissiparism; that is to say, the separation from the parent body of specialised engineer branches.

Thus from the Royal Engineers arose the Signals Corps; the Tank Corps may be regarded as a specialised branch of the original Corps of Ordnance; the Royal Air Force had its origin in the balloon units of the Royal Engineers; and in the World War the Royal Engineers were required to father a special organisation of troops for gas warfare. When a nation expends its military forces and puts forth a serious military effort, this fissiparous tendency becomes more marked, as it becomes essential to form specialised branches for electrical and mechanical work, railway construction, inland water transport, road maintenance, quarry operation, forestry, etc. It is in these specialised units that full opportunity offers for the utilisation to the best advantage of the civil engineer expert.

I. THE EUROPEAN SERVICES

Engineer work in war is now classified under two heads (1) Field engineering and (2) Engineer services.

Field Engineering.—For this purpose, field engineer units (field companies and field squadrons, R.E. in the British Army) are incorporated in infantry and cavalry divisions as integral portions of these divisions, taking their orders only from the commander of the division, and entirely at his disposal. These constitute the true engineer arm. They may at any moment be required to execute works of very diverse natures, whether they are bridges or roads, or the development of water supply for the troops to facilitate an advance, or construction of works of defence or obstacles to assist in the holding of a position of defence, or demolitions to hamper a pursuing enemy.

The essential conditions are speed and the adaptation to the end in view of the materials available at the moment on the spot. For this purpose, the engineer officer must possess a thorough knowledge of the methods and psychology of troops of other arms; he must be able to grasp intuitively the intention or wishes of the commander of the force; whilst, technically, he must know the utmost limit to which he may risk stressing the available materials.

Engineer Services.—Apart from the field engineer units, however, there is a vast volume of engineering to be performed in the zones in rear of the fighting troops. For an army operating overseas, *i.e.*, for the normal wars of the British Army, it is necessary to provide, in the theatre of war, bases of supply from which radiate lines of supply: through these bases and along these channels flow all the reinforcements in men and animals and the munitions, food and innumerable stores required to maintain the army in the field. It is inevitably found that the volume of these supplies far exceeds that for which the available ports, railways, roads and waterways, have been developed for the purposes of commerce. The necessary development of the rear zones, for the purposes of the army, thus involves normally port, railway and road construction, as well as the provision of camps, electric power stations, waterworks, etc., on a scale which would be required to house the population of a large city. In addition, development of local resources and the provision of repair factories in order to ease the strain on sea transport demands the organisation of other specialised engineer activities. These services are, in the British Army, organised under and directed by engineer commanders, and require, in the case of a serious national effort, the mobilisation of civil engineer resources.

Engineers in European Armies.—In the case of European armies, whose serious efforts always are directed to the defence of their land frontiers, the problem of maintenance of these armies can be foreseen by provision of suitable rail communication in time of peace, so that, on the outbreak of war, the problem is reduced to that of diverting the manufacturing energy and the peace trade routes of the country to the purposes of war. In consequence, the function of their military engineers in effect begins and ends with field engineering. Even in this rôle the problem which confronted the staffs of Continental armies immediately before 1914 was essentially different from that of the British War Office. For the national armies of Continental Powers, it was not only possible, but desirable, to provide specialised units for separate branches of field engineering, *e.g.*, railway construction units, bridging units, etc. For several obvious reasons, this is not feasible in the case of the small British Army; nor is it normally essential in the first stage of war to provide engineer troops in the proportion which will be necessary after the first few months of war. During the first stage of intense mobility it may be possible to obtain effective help from engineering science with a 5% proportion of engineers; but this proportion must inevitably be increased to 10%, or even higher, if the war tends towards static conditions. The proportion of engineers in the British Armies in 1918 had risen to 12½%.

Training of Engineers.—The primary aim in the education of the engineer officer being to produce the field engineer, the cadet in the British Army is given an 18 months' course between the ages of 18 and 20 years at the Royal Military Academy, Woolwich, where elementary military knowledge is imparted and special attention is given to elementary sciences. From the Royal Military Academy he passes as a commissioned officer to a two years' course at the School of Military Engineering at Chatham and the University of Cambridge, where, in addition to the continuance of his military studies, he is specially and intensively trained in elementary engineering. Subsequently, after some years of practical experience with engineer units, a proportion are given courses of education in specialised subjects, *e.g.*, electrical and mechanical engineering, while another small proportion are put through the Staff College course. During their subsequent career a large number of engineer officers are employed on the supervision of construction of barracks, fortifications, roads, water supplies and other military works at home and abroad.

The rank and file of the Royal Engineers are obtained from two sources, (1) the enlistment of artisans and "mates" and (2) the apprenticeship of boys to trades at military technical schools. The objective of subsequent training in engineer units is to impart military training and improve the handiness of all ranks with a view to obtaining the versatility required for field engineering and the co-ordination of all ranks in a unit to effect field works, especially the construction of bridges, in the minimum possible time. (*See* BRIDGING.) (J. W. S. S.)

II. THE UNITED STATES

The engineer component of the Regular Army of the United States is the Corps of Engineers, which is charged with the engineering duties appropriate to the military establishment, and also certain public works functions mainly in connection with the improvement of rivers and harbours.

Prior to the National Defense Act of 1916 the maximum strength of the corps was 240 officers and 1,968 enlisted men forming three battalions of four companies each. Under the Act of 1916 the Corps of Engineers was to consist of 505 officers (including those assigned to public works), seven regiments (foot), two battalions (mounted) and one band. As the increase was to be made in five successive increments, the corps, on April 6 1917, when the United States decided to enter the World War, numbered 256 officers and 2,228 enlisted men, organised in three regiments and one mounted company. There were in existence a few companies of engineers in the National Guard, as also the rudiments of an organised reserve. During the War several changes were made in the organisation of the army, and many regiments of engineers were organised for special (non-divisional) purposes. However, under the system of recruitment, voluntary at first and later compulsory, craftsmen of all sorts were to be found in the combatant regiments of engineers attached to

infantry divisions. The change from trench warfare to the war of manoeuvre eliminated the need for specialist troops, and all engineer regiments performed service as pioneers and sappers. At the Armistice the divisional regiment, with its train, had a strength of 49 officers and 1,695 enlisted men. During the War, 13,527 officers were commissioned as engineers, of which the maximum enlisted strength was approximately 285,000 men. Of this number 233,000 served in the theatre of operations.

Reorganisation.—Under the reorganisation Act of 1920 the Corps of Engineers was fixed at 602 officers and 12,000 enlisted men, to be formed into tactical units as the President might direct. Engineer troops were classified as general and special; the former including combatant regiments and mounted battalions for infantry and cavalry divisions, with general service regiments and auxiliary battalions (coloured) for the line of communications. Special engineer troops included bridge and motor-truck trains, topographical and camouflage troops, railway and other special units as might be needed. Lack of appropriations has necessitated certain reductions, and on Dec. 31 1925 there were actually in service 500 officers and 5,040 enlisted men including 330 native Philippine troops. A number of the units authorised by the Act of 1920 were, however, in an inactive skeletonised status.

Training of Officers.—The officers are obtained mainly from the U.S. Military Academy at West Point, a limited number of the most capable graduates at the Military Academy being appointed to the engineers. Inasmuch as the curriculum at the Military Academy is directed to general military fundamentals, the graduates require additional instruction to fit them for service as subalterns in the Corps of Engineers. For the special training of its younger officers, and for the development of enlisted specialists, a military engineering school is maintained at Fort Humphreys, Va., near Washington, D.C. The instruction embraces subjects of a general military nature, as well as those pertaining to the application of engineering to the functions of the Corps of Engineers both in war and in peace.

During the first three years of a young officer's career he is assigned for one year to duty with troops, and spends one year as student at a selected civilian technical institute, where he receives a degree in some branch of engineering, and one year at the Army Engineer school, where he pursues the "company officers' course." A few officers are appointed to the corps from civil technical institutions and these are assigned for two years with troops and then to the Army Engineer school to take the "company officers' course." Eventually the education of the appointees derived from the two sources is reduced to a common denominator, and no subsequent distinction is made between them in respect of duty or promotion. Their technical schooling is supplemented by assignment as junior assistants to officers engaged in public works, where their training is continued in accordance with programmes formulated in the office of the Chief of Engineers.

The practice of appointing the graduate of the Military Academy to civilian institutions for technical training has many advantages, in that it gives the young officer the benefit of the complete educational plant and specially trained staff found only at large institutions, and his professional education is attested by a scholastic degree of known merit; as a student he comes into competition with young men who will subsequently practise engineering in civil life, and he and his civilian fellows thus obtain a mutual knowledge of and respect for one another's ability. The young officers become members of the fraternal societies and alumni associations of the various institutions, which circumstance promotes a knowledge of the regular army and an interest in national defence on the part of the civilian practitioner. This is particularly advantageous in view of the traditional military policy of the United States which places its reliance on a citizen soldiery. (G. A. Y.)

ENGLISH HISTORY (*see* 9.466).—The history of England from 1910 falls obviously into three main divisions, the years before the outbreak of the World War, the years of the War, and the period that began with the armistice, 1918. For convenience the third period may be sub-divided, the end of the Lloyd George Ministry being taken as the line of demarcation.

I. FROM THE KING'S DEATH TO THE WAR

The truce which the death of Edward VII. (May 6 1910) imposed upon political warfare was not of long duration, and the conference in which the opposing parties sought a negotiated peace over the veto of the House of Lords broke up on Nov. 10 1910, with the announcement that it was unanimously of the opinion that no information could be given on the nature or causes of its disagreement. The general election which followed in Dec. was fought specifically over the Parliament Bill, Mr. Asquith having announced in the previous April that Ministers would not advise a dissolution except on such conditions as would enable them, if successful at the polls, to place that bill on the statute book, despite the resistance of the House of Lords.

Tariff Reform and the referendum were pressed on the other side as alternative issues; Mr. Redmond's return from America with $200,000 for Home Rule provoked the cry of "dollar dictation," and woman suffragists, in default of the vote, exercised some physical force against prominent ministerialists and public property. But these diversions, while attracting some votes and repelling others, hardly affected the main issue. It was generally expected that Ministers would be returned to office, but with a diminished majority, and it was contended that the loss of half a dozen seats on balance would be sufficient to deprive them of that "adequate" majority which they themselves regarded as an essential justification for invoking the royal prerogative of creating peers in order to pass the Parliament Bill. Even that modest hope was frustrated. The Government came back with a nominal following of 398 against 272 in opposition, having thus increased their majority by four.

The Parliament Bill.—The Parliament Bill was accordingly re-introduced on Feb. 22 1911. Objection to its preamble, which accepted the principle of a second chamber and foreshadowed a reform of the House of Lords, was taken by Labour members and some Radicals; but the Bill passed its third reading in the Commons on May 15, after a few modifications in committee, by 362 votes to 241. The House of Lords had meanwhile been seeking to ward off the blow by considering various plans for its own reformation. They all contemplated a drastic reduction of the number of hereditary peers and the reinforcement of the House by nominated or elected members, the proposed electoral bodies varying from the peerage itself to comparatively popular constituencies. But there was little agreement, and Lord Lansdowne's bill, which was given a second reading without a division on May 22, proceeded no farther.

More urgent than the reform of the House was the defeat of the Parliament Bill, and the proposal which commended itself most to the majority, but not all, of the Unionist peers and members of parliament was the adoption of the referendum. Mr. Balfour accepted it on behalf of the party and even, in response to inquiries from his free trade opponents, undertook to submit tariff reform to this "poll of the people." Advanced tariff reformers suspected this acceptance as a concession to free trade. Unionists and resented it as an evasion of their attempts to pin their leader down to what they regarded as the most important and popular plank in their platform. Nor was it made at all clear in what form the referendum could be applied to such a question, nor how it could be reconciled with the financial control of the House of Commons; the more general opinion among tariff reformers was that finance must be excepted from its operation.

Meanwhile the Parliament Bill demanded the Lords' attention. Tactical reasons dictated a second reading without a division on May 29, and then the preparations for the coronation of the King and Queen (June 22) and the prolonged festivities connected therewith interposed a truce. Parliament reassembled on June 26 and Lord Lansdowne produced his amendments; if successful they would not only have wrecked the Bill, but have made it impossible for the Government to carry any other principal item in its programme without either a second, if not

a third, general election, or the adoption of the referendum for any bill proposing a change in the constitution; the adoption of this change in the constitution would obviously itself have to be submitted to a referendum. On July 5 the principal amendment was accepted by 253 votes to 40, and of that minority 27 had been created peers by the existing Liberal Government. "The referendum," said Lord Selborne, "had come to stay."

On July 20 the Lords completed their remodelling of the Parliament Bill and sent it back to the Commons. On the same day Mr. Asquith wrote to Mr. Balfour informing him that "should the necessity arise, the Government will advise the King to exercise his prerogative to secure the passing into law of the Bill in substantially the same form in which it left the House of Commons, and his Majesty has been pleased to signify that he will consider it his duty to accept and act on that advice." This intimation produced a sharp division in a meeting of Unionist peers held on July 21 and in the party generally.

The advocates of resistance, "die-hards," as they were called, were in a minority, but were very determined; their figure-head was Lord Halsbury, but they were led by Lord Milner, Mr. Austen Chamberlain (with the full support of his father) and Sir E. Carson. They included the Duke of Bedford, the Marquess of Salisbury, the Earl of Selborne, Lord Willoughby de Broke, Sir Edward Carson and Mr. George Wyndham. The younger Cecils were more dubious in their attitude, while the responsible leaders of the party, Mr. Balfour, Lord Lansdowne, the Duke of Devonshire, Lord Curzon and Viscount St. Aldwyn, thought discretion the better part of valour. The "die-hards" themselves were firm in their convictions, but many believed that the threat to create 500 peers was little more than bluff. The discovery that the Government was in earnest and possessed the means to carry out its policy provoked a furious resentment; and when on July 24 the Prime Minister rose in the House of Commons to amplify and justify his communication to Mr. Balfour, he was greeted with 40 minutes' organised and premeditated uproar which even the Speaker was unable to check. Next day Lord Lansdowne and Mr. Balfour appealed to their respective followers in the two Houses to desist from further resistance to the Parliament Bill, but their advice was rejected by the "die-hards".

On Aug. 8 the Lords passed, by 282 votes to 68, a vote of censure on the Government which the Commons had rejected by 365 to 246 votes on Aug. 7; and on Aug. 9 and 10 they debated what they should do with the Parliament Bill once more sent up by the Commons with the Lords' amendments deleted. The division was taken on Aug. 10: 37 Unionist peers, the two archbishops and 11 bishops voted for the bill, while the majority abstained; it was carried by 131 to 114 votes, but eight "die-hards" were accidentally prevented from reducing the majority of 17 to even more exiguous dimensions.

The Position Analysed.—Probably the moderate Conservatives, by their action and inaction, conserved a good deal more than their extremer colleagues would have done had their resistance succeeded. Yet it is not so easy as it appears on the surface to strike a balance of ultimate advantage between the rival tactics. The rejection of the Parliament Bill would undoubtedly have been followed, as Lord Crewe had intimated, by the creation of enough peers to outnumber any possible opposition; but that vast creation would surely have hastened the reform of the House. No doubt the Government would see to it that the new peers were also sound on Home Rule, if not on Welsh Disestablishment as well; and that would have meant Home Rule in 1912 and Disestablishment in 1913 instead of two years later. Home Rule in 1912 might have involved a rebellion in Ulster, but it would surely in that case have prevented a Sinn Fein rebellion in 1916 and the civil war of 1920–2; the Home Rule Bill which was frustrated in 1913–4 was conservative compared with the Irish treaty adopted by the Coalition in 1922; and the implementing of the preamble to the Parliament Act, which the creation of 500 peers would have made feasible within the lifetime of the 1910 Parliament would, whatever its details, have seemed a conservative measure 10 years later.

National Insurance.—The Parliament Act was only the most striking legislative incident in a year singularly fertile in political sensations; and during the intervals in which the Lords were perpending the Parliament Bill, the Commons were engaged upon a vast and novel scheme of National Insurance. It was introduced by Mr. Lloyd George on May 4 amid a chorus of approval which might well have reminded him of the warning of woe when men speak well of apostles and prophets. The scheme touched many interests and classes, and the sections proceeded to discuss it in the light of how much each would put in and how little each would get out of the common welfare. The British Medical Association seemed to be the most class conscious; doctors, it said, would be ruined, or at least inadequately paid. The Friendly Societies took the view that they would be the principal sufferers. The Chancellor of the Exchequer at times implied that he was giving the people 9d. for 4d.; labour thought it should get the 9d. for nothing; other friends of the people contended that they would be paying 9d. for 4d.; and *The Daily Mail* collected 10,000 mistresses and maid servants in the Albert Hall, London, to protest against the prospect of "licking stamps" for the sake of Mr. Lloyd George.

The bill was taken in intermittent stages between May and Dec., by which time Unionist approval had turned mostly into violent condemnation, tempered mostly by conviction that the enormous burden the Act would put upon industry would create an imperious demand for tariff reform. Attempts were made to separate the parts dealing with invalidity from that dealing with unemployment, and a good many details were altered by Mr. Lloyd George himself as a result of his numerous conferences with the rival interests. The result showed a remarkable triumph of common sense over sectional clamour and political faction. Only 21 members voted against the third reading in the Commons; the Lords adopted the Bill without protest, and its main principles have been universally accepted as sound and beneficent, capable of modification and extension but not of repudiation.

Payment of Members.—Another change, almost equally resented in certain quarters but easily effected because it did not require legislation, was the adoption of payment of members by resolution of the House of Commons. Members had been paid from the days of Edward I. to the end of the 17th century; but while the Government fixed the rates, the wages were levied by the constituencies, which often paid less and sometimes more than the standard rates. The stipend was now made uniform and paid out of the national exchequer; the £400 a year at which each member's salary was fixed was, considering the greater length of sessions and the fall in the value of money, far below the rates which obtained in the Middle Ages. The Commons also rejected the old standing order which denied the right of peers to vote, or otherwise participate in elections to the House of Commons; it was not for the Commons to maintain, in the year of the Parliament Act, that any class should be unrepresented therein.

Other enactments affecting very different sections of the community were the Shops Act, restricting the hours of attendance of employees to 60 a week, and the Copyright Act extending protection for that form of property to 50 years after the author's death. A Trade Unions Bill designed to modify the effects of the Osborne judgment and to enable unions to raise voluntary levies for political purposes passed its second reading on May 30 by 219 to 18 votes. A limited Women's Enfranchisement Bill also passed its second reading in May by 255 to 88 votes. But enthusiasts for women's suffrage were infuriated by Mr. Asquith's announcement in Nov. of a bill to be introduced embodying the principle of adult male suffrage, and the close of the year was marked by an outburst of window breaking and other manifestations of suffragist militancy.

Resignation of Mr. Balfour.—These were the pin pricks of politics. More serious anxiety was caused by a series of railway and other strikes during the summer, for which its excessive heat and unusual length, the rise in prices and the unbending temper of employers were variously blamed. The strength of

the Government's position seemed, however, hardly to be affected except by one or two by-election losses attributed to the Insurance Act, while on the other hand the Opposition was deeply divided by the die-hard schism and dissatisfied with its leadership. Tariff reformers resented Mr. Balfour's pledge to submit their policy to a referendum, and on Nov. 8 Mr. Austen Chamberlain said that a Unionist Government would embody it in a statutory form "without any further mandate, sanction or approbation." Mr. Balfour had resigned a few hours before, pleading advancing years and insufficient vigour to manage another administration.

The two most obvious candidates for the leadership were Mr. Austen Chamberlain and Mr. Walter Long, one representing the commercial and industrial elements in the party, the other its landed and aristocratic traditions. A contest was, however, avoided by the withdrawal of both in favour of Mr. Bonar Law, a Glasgow ironmaster whose membership of Parliament only went back to 1900 and whose experience of office was limited to the under-secretaryship to the Board of Trade from 1902 to 1906. Apart from his personal qualities, he probably owed his choice largely to his Canadian birth and education and to the fact that Canada's emphatic rejection of Laurier's Liberal Government and its tariff reciprocity with the United States at the general election in Sept. had given British tariff reformers greater cause to rejoice than any recent event in domestic politics.

Their other principal cause for satisfaction was the refusal of the House of Lords, by 145 to 53 votes, to give a second reading to the Naval Prize Bill, based on the Declaration of London. It had only passed the House of Commons by less than half the Government's normal majority (172 to 125), and although the Imperial Conference then sitting had, Australia dissenting, approved its principles, the proposal created great alarm as likely to endanger Great Britain's food supplies in time of war; and the action of the House of Lords saved the Government three years later from having to revoke a law in addition to acting against its principles.

The proposed reference to an international court at the Hague was in keeping with the movement towards arbitration expressed in treaties being negotiated with the United States; but these were eventually rejected by the Senate, and the omens were beginning in 1911 to point less towards the peaceful settlement of disputes than the arbitrament of war. In defending the naval estimates in March, Sir Edward Grey had deplored the increase in armaments which, if it went on, must in the end break down civilisation, though he thought it might be ended, not so much by war as by the revolt of the masses of men against taxation. He welcomed President Taft's pronouncements in favour of arbitration, and thought that public opinion might rise to it under the increasing pressure of armaments, that armies and navies might survive only as the police of the world, and that law might take the place of force. But no one nation could stop the race for armaments by simply dropping out, which would give a spurt to expenditure somewhere else. The First Lord of the Admiralty, Mr. R. McKenna, opined that the new naval works at Rosyth might be completed by Sept. 1914, and the discussion turned on the probable distribution of naval strength about that time.

The Agadir Crisis.—The crisis threatened to come earlier. In May the disorder in Morocco induced the French to occupy Fez and on July 1, Germany announced the dispatch of a gunboat to Agadir. After a Cabinet meeting on May 5, Sir Edward Grey informed Count Metternich that the British Government could not disinterest itself in Morocco, and that until Germany's intentions were made known their attitude must remain one of reserve. There intervened "the period of silence" during which Germany said nothing to England but continued to bring great pressure to bear on France. On May 21 Mr. Lloyd George took the occasion of a speech at the bankers' annual dinner in London to make it plain, in diplomatic language, that if Germany meant war, she would find Great Britain on the side of France. Coming from the leader of the least imperialist section of the Cabinet, the speech produced a great impression. "The accession of Mr. Lloyd George," writes Mr. Churchill, "in foreign policy to the opposite wing of the Government was decisive. We were able immediately to pursue a firm and coherent policy." On May 25 Sir E. Grey received a communication from Germany "so stiff that the Fleet might be attacked at any moment;" the German Government refused to explain its intentions, and the British Mr. Lloyd George's speech. On Aug. 23, after Parliament had risen, the Prime Minister convened a secret and special meeting of the Committee of Imperial Defence. It sat all day and at its conclusion Mr. Haldane informed the Prime Minister that he could not continue to be responsible for the War Office without a new Board of Admiralty which would begin to organise a proper Naval War Staff and co-operate with the War Office. Mr. Churchill had already on May 13, while Home Secretary, drafted a sketch of the probable course of a war between Germany and Austria on the one side and France, Russia and Great Britain on the other which was accurate enough for him to reprint it in Sept. 1914; and in Oct. Mr. Asquith invited him to become First Lord of the Admiralty, Mr. McKenna taking his place at the Home Office.

Mr. Churchill was always a good barometer, though sometimes inclined to rise too fast. He subsequently admitted that probably Germany had no thought of war at that time; her Government made a "very friendly" communication to Sir Edward Grey on July 27 and considerable concessions to France during the Morocco negotiations. The incident, however, reverberated in war preparations, both naval and military, and in war scares throughout the autumn and provoked a good deal of criticism from the Labour and Radical benches when Parliament reassembled.

The critics found other, and perhaps more substantial, grounds for complaint in the effects of the Anglo-Russian agreement in Persia, where co-operation seemed to be turning into a dual control, destructive of that "integrity and independence" of Persia to which the two Powers were pledged by their agreement of 1907 and fraught with evil influence on the Mesopotamian campaigns of the World War. The atmosphere was not improved by Italy's sudden attack on Turkey and invasion of Tripoli which Turkey, having no navy, was in no position to defend; more pregnant with future problems was Italy's seizure of islands in the Aegean which the outbreak and consequences of the Balkan wars accidentally enabled her to retain. Meanwhile, in July, the Anglo-Japanese treaty was renewed till 1921, and Kitchener was appointed to succeed Sir Eldon Gorst in Egypt; and on Nov. 11 the King and Queen sailed to India to hold their coronation Durbar at Delhi in Dec. and there to announce the transference thither of the capital from Calcutta.

Early Events of 1912.—Exit annus mirabilis was *Punch's* legend on its last cartoon of 1911. Its first, in 1912, depicted the infant year being dragged into a dark wood haunted by goblins of Home Rule, Welsh Disestablishment, and Manhood Suffrage. It would have needed a more prophetic soul to descry the heroic tragedy of Captain R. F. Scott's Antarctic expedition, after discovering the South Pole on Jan. 18, the strike of coal-miners in the spring, the "Titanic" disaster in April, the worst summer, from the climatic point of view, on record, and the outbreak of Balkan War in the autumn.

Mr. Bonar Law's Speech.—The new Unionist leader made his first appearance as such on the platform at the Albert Hall on Jan. 26, and signalised the occasion by what his opponents called "the new style" of political debate. His speech was a comprehensive denunciation of the Government, all its members and all its works. Mr. Churchill and Mr. McKenna had, he said, exchanged offices, probably to escape the consequences of failure. Mr. Haldane's army policy had been unsuccessful, and Mr. Lloyd George's speech on July 21 had roused enduring ill-will in Germany; the Government as a whole had introduced into England a "spoils system" from America, and the shock to public confidence was shown by the flight of capital. Uncompromising as the utterance was on domestic politics, the censure of Mr. Lloyd George's warning to Germany implied a desire for

more friendly relations with that country, and the first few months of 1912 were marked by a reaction against the war talk which followed on Agadir.

Naval Rivalry.—This feeling was expressed by a meeting on Jan. 27, called by the Lord Provost of Glasgow, addressed by Sir Frank Lascelles, late ambassador to Germany, and blessed by Lord Rosebery. Similar sentiments were enunciated by the Bishop of Winchester at a diocesan conference on Jan. 31; and on Feb. 7 Mr. Haldane started on a mission to Germany on which he published a volume after the War. Two days later, Mr. Churchill, having, in defiance of threats which led to the concentration of 4,000 troops in Belfast, addressed a successful meeting in the Irish quarter of that city, crossed over to Glasgow and defined Anglo-German relations in terms which pleased his Unionist opponents as much as his Belfast speech had gratified his Home Rule friends.

Naval power was, he said, a luxury for them; to us it meant existence, to them it meant expansion. Great Britain could build ships faster, more cheaply and on a larger scale than any other Power. Whatever happened abroad there would be no signals of distress in Great Britain, but she would be the first Power to welcome and respond to any slackening of naval rivalry. The speech had not the remotest effect on Mr. Haldane's mission; this came to nothing, as he has explained, because the German Government demanded as the price of any agreement "a covenant of absolute neutrality" in case of war between Germany and France, from whatever cause it might arise; and all that he brought back on Feb. 12 was a confidential draft of a new German naval law containing a programme of construction and personnel far in excess of the rumours which had reached the British Cabinet.

The determining cause of this uncompromising attitude had been the German general election on Jan. 11, which had resulted in the return of the Socialists as by far the largest party in the Reichstag and in the first serious threat to the continuance of the form of government established in Germany by Bismarck. For, in spite of its manhood suffrage, Germany's administrations were responsible to the Kaiser and not to the Reichstag; and hitherto a bourgeois Reichstag had acquiesced in its subordinance. The effect of Socialist victories on the Government was therefore to cause it to react not to but against democratic opinion and to strive in the interests of self-preservation to improve its chances of success in war by which alone it thought it could postpone, if not avert, domestic revolution.

There was therefore no response to Mr. Churchill's suggestion for a slackening in naval armaments, and in introducing his naval estimates on March 18 while repeating his offer, he insisted upon the danger to the world of one nation adding a predominant fleet to an overwhelming army and upon the necessity to Great Britain of a fleet adequate for protection against the risk of defeat. His argument came in short to this; no naval superiority on the part of Great Britain could threaten Germany with invasion, while a German naval victory would paralyse the British Empire and expose Great Britain itself to conquest. It fell on deaf ears in a Germany which was not content with security, but regarded an overseas empire as its place in the sun.[1] In the same month, March 7, the Anglo-American and Franco-American treaties of arbitration were rejected by the Senate of the United States.

Strike of Miners.—Meanwhile the King and Queen had returned from India (Feb. 4), Sir Edward Grey had received the Order of the Garter, conferred on only four commoners before Feb. 13, and Parliament had been opened on the 15th. But it had barely disposed of the address when its attention was diverted from estimates and its legislative programme by a strike of coal miners which began on Feb. 27, and lasted for over six weeks. There had been a good deal of labour unrest for some time, due probably to the rise in prices, which itself was partly caused by additional taxation required to finance the Government's social reforms; the Chancellor had to budget for over £187,000,000 in 1912, double what it had been 20 years earlier.

The demand of the miners, now that hours of labour had been fixed at eight, was that wages should not fall below a minimum fixed by law. The coal owners adhered, on the other hand, to the principle of payment for work done, a principle which does not obtain in the Civil Service, the clerical and scholastic professions or even in most fields of labour. By March 4 about 1,000,000 miners had ceased work, and another 1,000,000 in other industries were threatened with consequential unemployment. On Feb. 28 the Government had proposed acceptance of the principle of minimum rates of wages varying according to districts and conditional upon safeguards against a diminution of output. Some of the coal owners still held out, while the inconvenience and, in some localities, distress increased; and on March 19 the Prime Minister introduced a Minimum Wage Bill on the lines he had already indicated. It was opposed as panic legislation and on a party division the second reading was carried by 348 to 225. A new conference failed; by the end of the month the Bill got through its remaining stages in both Houses without much opposition, and gradually the miners returned to their work.

The Suffragists.—The remedy of any grievance before their own was regarded by the militant suffragists as an additional grievance and insult; and the Government's acceptance of the minimum wage for miners on Feb. 28 was followed on March 1 by a feminine onslaught on the shop windows of the west end of London. Arrests and sentences to imprisonment were followed by further raids, and the raids by a weakening of support for the Conciliation Bill in Parliament. This was defeated on its second reading, March 28, by 222 votes to 208. Further outrages occurred, and on May 22 Mr. and Mrs. Pethick Lawrence and Mrs. Pankhurst were convicted at the Central Criminal Court of conspiracy and sentenced to nine months' imprisonment in the second division; they were, however, released in little more than a month on the ground of ill-health. The militant campaign continued in various forms, personal assaults on Ministers, attempts to burn churches and pose as martyrs and hunger strikes in prison; but its effect was to postpone the adoption by Parliament of any measure of women suffrage until towards the end of the War.

The Home Rule Bill.—Diverted by these episodes, it was not until after Easter that the first item in the Government's legislative programme, the Home Rule Bill, was introduced. Inasmuch as it never came into operation and, even as a proposal, was entirely superseded by the more radical Irish treaty of 1922, the third Home Rule Bill has merely a historical interest. Substantially the difference between it and the Irish treaty was that its constitutional arrangements were based on the relations between a Canadian province and the Dominion of Canada, whereas the treaty established between Southern Ireland and the United Kingdom the relations existing between the latter and the Dominion; in other words the Home Rule Bill treated the whole of Ireland as a province, while the treaty recognised part of Ireland as a Dominion. It was none the less fiercely resisted for that; and nothing would appear more irrational than the two years' turmoil over the bill contrasted with the ease and rapidity with which the treaty obtained Parliamentary sanction. The War and the Coalition, bitter experience and increasing wisdom do much to account for the contrast.

But there was a further reason inherent in the difference between the proposals. Ulster was excluded from the Ireland of the treaty, but included in the Ireland of the bill; and that attempt to force Ulster into a united Ireland was as fatal to the bill as it was illogical in a policy based on the impossibility of retaining Ireland within the United Kingdom. It was inconsistent with the Canadian precedents both for the bill and the treaty; the union of Upper and Lower Canada in 1841 had proved unworkable and had been abandoned, and no Canadian province that desired to keep outside the Dominion in 1867 was forced within its jurisdiction. The lesson was learnt in the end that Ulster, like Newfoundland, must be left, if she liked, to contract

[1] *Cf.* B. Pascal, *Pensées* xxv., 34: "*Ce chien est à moi,*" *disaient ces pauvres enfants; "c'est là ma place au soleil. Voilà le commencement et l'image de l'usurpation de toute la terre.*"

out of a Dominion; but the refusal to admit the force of the argument in 1912–4 brought a disunited Ireland and a disUnited Kingdom perilously near the argument of force.

Other Measures.—For eight months, on and off, sterile debate on the Bill occupied the time of Parliament and the energies of rival demonstrations in the country. Introduced on April 11 it was read a second time by 372 votes to 271 on May 9. It was not through committee until the second week in Dec., and the autumn session had to be prolonged into the new year for the report stage, third reading and rejection by the House of Lords. The intervals were partly occupied by discussion of the Welsh Disestablishment Bill, which had, at least, the merit of ultimately becoming law and causing less harm and friction than its critics had foretold. It was introduced by Mr. McKenna on April 23 and passed its second reading by 348 to 267 on May 16. The diminution in the Government's normal majority was due to the fact that, outside Wales, there was no great enthusiasm for it, and a number of Liberals disliked, not so much the disestablishment as the disendowment, of four dioceses of the church which assuredly were not rich. They had, however, little sympathy with the charge of sacrilege urged most vehemently by owners of lands which had once belonged to the church in England. The committee stage was not begun until Nov. 29 nor concluded till the following year. Similarly, the third Government bill of the session, proposing to abolish plural voting and university representation, was, after receiving a second reading on July 12, postponed with its committee stage and women suffrage amendments until 1913. Some days in July were also spent over Mr. Churchill's supplementary naval estimates, the foreign situation, and the causes of the "Titanic" disaster. Mr. Haldane meanwhile had left the War Office to become Lord Chancellor in succession to Lord Loreburn and had been created a viscount, while his under-secretary, Colonel J. E. B. Seely, succeeded to the headship of the department.

Outside Parliament a fusion was effected of the Conservative and Liberal Unionist organisations in May, and a serious strike of dockers began which lasted until August. Protests against the impending coming into force of the Insurance Act continue. The rank and file of the medical profession threatened to boycott it; the Albert Hall, London, was more than filled for a second time with indignant mistresses and maids on June 27; and the agitation only ceased when the agitators began to realise through practical experience what the Act was really like. The House rose on Aug. 8, and the vacation was principally marked by denunciation of the Home Rule Bill, and by the more impressive adoption of the Ulster Covenant in September. Mr. Bonar Law had justified resistance at a Unionist demonstration on July 27, and missiles were thrown by members in the House of Commons itself in a disorderly scene on Nov. 13. The pertinent comment was contained in a letter from Miss Christabel Pankhurst claiming that members could no longer deny to militant suffragists the right to assault Ministers and drown their utterances by vocal protests.

War in the Balkans.—But graver events than speeches or even missiles in the House of Commons disturbed the peace in the autumn. On Oct. 8, Montenegro suddenly declared war upon Turkey, which was still at war with Italy, and in a few days Serbia, Bulgaria and Greece followed suit. (*See* BALKAN WARS.) There had been careful premeditation, and in a rapid, combined and unexpectedly successful campaign the liberated Balkan peoples showed that they were masters of their fate, provided they were masters of their temper. The Turks were everywhere defeated until, in Nov., the Bulgars reached the Chatalja lines and confronted the problem of Constantinople and a forbidding concert of Europe. The Great Powers had helplessly threatened, before the Turks were beaten, to recognise none of the victors' accomplished facts.

They did not now propose to keep their word, but they proceeded, at the Conference of London in Dec., to inflame enmity among the victors lest their united advance should inflame it among the Great Powers themselves. None of them, with the possible exception of Great Britain and France, was prepared to see Constantinople in the hands of the Balkan League and the Adriatic dominated by Jugoslavs; and the restraint of these ambitions precipitated a conflict among the Balkan allies over the remnants of their spoils. It was a dubious credit to British diplomacy that it should, with Germany's hearty co-operation, have in London secured a brief prolongation of peace at the cost which was later paid in the course of the World War.

Domestic Politics Again.—New Year's day 1913 found the House of Commons engaged on the report stage of the Home Rule Bill. Sir Edward Carson's motion that Ulster be excluded from its operation was rejected by 294 to 197 and the third reading was carried on Jan. 16 by 367 to 257. On Jan. 27 its consideration was begun in the House of Lords, which rejected the motion for its second reading by 326 to 69 three days later. On the same day, by a singular coincidence, Londonderry city was won at a by-election by the Home Rulers from the Unionists, thus giving Home Rule 17 seats in the province of Ulster against 16 held by Unionists. Meanwhile, the Welsh Disestablishment Bill reached its report stage on Feb. 3 and passed its third reading by 347 to 240 on Feb. 5. It was discussed for three days Feb. 11–13 in the Lords and then rejected on its second reading by 252 to 51.

The Lords, however, passed the Trade Unions Bill, which had been for two sessions before the House of Commons; and, though the Scottish Temperance Bill was lost, it was rather through inadvertence than deliberate hostility. The Franchise Bill encountered a fiasco in the House of Commons; undertakings had been given that the Government as such would not resist amendments incorporating in the bill some form or other of women suffrage; but, when the first of these amendments came to be moved, the Speaker intimated on Jan. 27 that he must consider a bill so radically amended as a new measure, which could not be taken without a fresh introduction. The bill was accordingly withdrawn. The Commons adjourned on Feb. 14, and on March 7, Parliament was prorogued, to meet again for another session three days later.

Outside its walls the principal controversies related to Tariff reform, national service and woman's suffrage. On Jan. 2 a Lancashire deputation had pressed upon Mr. Bonar Law the Unionist objections, in that part of the country, to any taxes upon food, and after consultation with Lord Lansdowne he announced that it was not now the policy of the Unionist party to impose such duties "until they have been submitted to the people of this country at a general election." Tactically the decision was wise, but it was deplored by an influential section of the party, led by Mr. Austen Chamberlain, which regarded the taxation of food as the very foundation of any effective measure of Imperial preference, protection or relief from the burden of direct taxation; from that source, too, they looked for the revenue to promote social reform, which Conservatives would not support if it depended upon a heavy income tax.

This domestic controversy lasted throughout the year and materially impaired the power of the Unionist party to combat effectively the legislative proposals of the Government. Another topic on which Unionists were more divided than Liberals was national service, in the interests of which Earl Roberts conducted a six months' campaign. His great services and popularity neutralised to some extent the objections to his plan, namely that it contemplated only home defence, which necessarily depended upon the navy, and made no provision for expeditionary forces; Lord Roberts' own belief that an army, compulsorily raised for home defence, would volunteer for foreign service, could hardly be used as an argument without provoking the retort that his proposal was really to provide an army for foreign service out of the need for home defence.

The Suffragists Again.—The fiasco over the Franchise Bill not unnaturally infuriated the militant suffragists, who felt that they had been betrayed; and there followed at once a renewal of the campaign of outrage which grew more intense as time went on. It was logical enough as a retort to the arguments that women should not vote because they could not fight and that government in the last analysis rests on force as its foundation. The outrages on property and persons were followed by

arrests and imprisonment; to this the militants responded by hunger striking, and the Government replied by forcible feeding, an expedient which disgusted a number of its supporters.

To meet the difficulty the Home Office devised what came to be known as the " cat and mouse " bill; prisoners whose health was impaired by hunger striking might be released on conditions by the Home Secretary, and then rearrested without further warrant or trial if they broke the conditions and resorted to outrage. The bill was passed by overwhelming majorities (296 to 43 on its second reading) in April, but it had apparently little effect in diminishing or even retarding the development of the campaign; and the day after the second reading Mrs. Pankhurst was sentenced to three years' penal servitude for inciting a bomb explosion which wrecked Mr. Lloyd George's unfurnished house at Walton Heath in Surrey.

A fresh impetus, indeed, was given it by the rejection on May 5, by 267 to 219 votes, of the Women's Suffrage Bill, which had been introduced as a separate measure to repair the fiasco of the amendments to the General Franchise Bill in January. It proposed to enfranchise 6,000,000 women, and its liberality was no doubt responsible for the fact that the minority in its favour consisted mainly of Liberal and Labour members, while the majority against contained twice as many Unionists as Liberals. The issue was really decided by the 54 Nationalists who voted against the Bill from motives quite unconnected with its merits. On the following afternoon one of the finest of South London churches, St. Catharine's, Hatcham, was destroyed by militant incendiarism, and a bomb was found under the bishop's throne in St. Paul's Cathedral.

Important Legislation.—Most of the legislation promoted in the session of 1913, which began on March 10, proved equally abortive. The Home Rule Bill was reintroduced on May 7 and read a second time, by 368 to 270 votes, on June 9. The committee and report stages were, in order to secure the benefit of the Parliament Act, reduced to mere formalities and the bill passed its third reading on July 7. The Lords debated its second reading for two days, and then declined, on July 15 by 302 to 64 votes, to proceed any further with the bill " until it has been submitted to the judgment of the country." The Welsh Disestablishment Bill followed it through the same ritual to the same sacrifice, a week later, July 22. The Plural Voting Bill was slaughtered on a somewhat different plea: after an attempt to preserve a second vote for university graduates had been defeated the bill was read a third time in the Commons on July 14 by 293 to 222 votes.

The House of Lords on July 24 refused by 166 to 42 votes to proceed with it, not until it was submitted to the judgment of the country, but on the ground that it dealt with only one electoral anomaly when there were so many others. The policy, if any, underlying this discrimination was not very obvious unless it implied a claim by the Lords to refer to the country whatever bill they thought might thus be defeated, and to defeat by their own authority whatever bill might pass the popular test. The Scottish Temperance Bill, however, which had also been reintroduced and passed by the Commons, was accepted, after some modifications, on July 31 on the ground that it was a local measure and was apparently desired by the Scottish people.

The Budget.—The Budget was slightly delayed by a judgment obtained from the Court of King's Bench to the effect that the resolution of the House of Commons, in virtue of which new duties were usually collected pending the passing of the Finance Act, was not sufficient authority for the collection of income tax; and a Provisional Collection of Taxes Bill, which did not, under the Parliament Act, require the assent of the House of Lords, had to be passed to remedy the defect before the Budget was introduced. It imposed no fresh taxation although the estimates had risen to £195,000,000. The past year, claimed Mr. Lloyd George, had been the most prosperous British trade had ever known, despite the coal strike, the bad harvest and the Balkan War; and he looked to a further increase in the revenue to counterbalance the increased expenditure.

The Marconi Episode.—The Budget provided little material for party warfare compared with the Marconi episode, which bulked so large in the public eye during the summer of 1913 that one of the most moderate of Unionist journals lamented that so much time had been spent over the insurance agitation which should have been devoted to the Marconi " scandal." The gist of the charges in some Unionist journals was that Ministers, notably the Attorney-General (Sir Rufus Isaacs) and the Chancellor of the Exchequer (Mr. Lloyd George) had been guilty of corrupt practices in connection with the Government contract with the British Marconi Co., the managing director of which was the Attorney-General's brother. The editor of *The New Witness* was condemned in an action for libel, but the legal proceedings covered but part of the ground occupied by the fertile weeds of suspicion; and a committee of the House of Commons spent many months examining witnesses and probing the charges, only to produce four more or less discrepant reports and some inconclusive debates in the House. One at least of the Ministers had indulged in a " flutter " which was indiscreet in a Chancellor of the Exchequer, but their dealings had been in the shares of the American Marconi Co. which had no connection with the British Company and no contract with the British Government. All the committee's reports declared that the charges of corruption were false, and none accused the Ministers of anything worse than indiscretion in act and reticence in speech, which they admitted themselves. The best answer lay perhaps in the subsequent careers of Sir Rufus Isaacs as Lord Chief Justice and Viceroy of India, and of Mr. Lloyd George as Prime Minister and head of a Coalition which included opponents who had viewed his conduct unfavourably in 1913.

National Insurance.—Both the Chancellor of the Exchequer and his critics might congratulate themselves on the comparative ease with which his National Insurance Act was amended before the end of the session. The amendment took the form of extension in two directions: full benefits for employed contributors were extended from 50 to 70 years of age and full medical benefits for all insured persons to the end of their lives; and additional grants were provided for medical service. These emollients hastened the decease of the medical boycott, and the amending bill, which had been referred to a standing committee, passed its report stage on Aug. 6 and was accepted by the House of Lords before Parliament was prorogued on Aug. 15.

A Proposed Naval Holiday.—In introducing the naval estimates in March Mr. Churchill had asked why all the Powers concerned should not take a " naval holiday " in construction for a year, but Germany regarded the suggestion as impracticable since Great Britain, being able to build a warship in two years while it took Germany three, could make up arrears a good deal faster; and in July Mr. Churchill announced an acceleration in British construction, attributing it, however, to the defeat in May of the Canadian Naval Aid Bill by the Canadian Senate, a Liberal second chamber which had not yet been affected by Mr. Borden's Conservative victory at the Canadian general election in the autumn of 1912.

Another of Mr. Churchill's announcements related to the substitution of oil for coal as the fuel for the British Navy, stimulated partly by the coal strike of 1912 and the determination of the Admiralty to become ultimately the independent owner and producer of its own supplies. For the time being it must rely to a large extent on Mexican oil, in which Lord Cowdray was largely interested and to which the chief Liberal whip (Lord Murray of Elibank), after resigning that office, devoted much of his attention. The policy subsequently had its reverberations in Mesopotamia.

Foreign Relations.—International relations were less strained apart from the Balkans, than they had been in 1911–2. In May the King and Queen visited Germany on the occasion of the reconciliation of the Guelph and Hohenzollern feud by the marriage of the Kaiser's only daughter to Prince Ernest Augustus of Cumberland, and in June President Poincaré had a notable reception in London. Lord Haldane's visit to Canada in Aug., to address the annual meeting of the American Bar Association at Montreal, necessitated the unusual step of putting the Great

Seal in commission and illustrated English speaking friendliness; but the visit in Nov. of the heir presumptive to the Austrian Empire, the Archduke Franz Ferdinand, and his morganatic wife, attracted less attention that it would have done had people known what the future had in store.

The Balkan situation was ominous enough, and it would have seemed more so had it been known that Austria sought the connivance, if not the co-operation, of Italy in an attack upon the too-triumphant Serbia. The Peace Conference of Balkan States in London broke down on Feb. 1, and the Balkan War began again. The Crown Prince of Greece occupied Yanina early in March and King George of Greece was assassinated at Salonika on March 18. The Bulgars got to Bulair, on the Sea of Marmora, early in Feb. and captured Adrianople, with 30,000 prisoners, on March 25. Scutari (Skodra) alone held out, and that was because it was neither Turkish nor Yugoslav but Albanian, and the Powers were bent on applying the doctrine of self-determination to the extent of creating an independent Albania. A naval demonstration gave point to their determination, but Scutari, nevertheless, capitulated to Montenegro on April 22.

A second London Conference opened on May 20, but it could not restrain the animosities which broke out among the Balkan victors. Bulgaria, threatened with the loss of much of her spoil, took the offensive against Serbia; Greece and Rumania took the Serbian side, and even Turkey rejoined the fray in July. Bulgaria was hopelessly outmatched and had to submit to a settlement by which she lost Adrianople and Macedonia and acquired a grievance which led her to intervene with disastrous results in a greater war two years later.

Trouble in Ireland.—War seemed to threaten nearer home than the Balkans in the autumn of 1913. Arms were being stealthily imported from Germany into Ulster, and a provisional government for that province was organised in September. The intention was not to resist the establishment of a Home Rule government in Dublin, but to resist its authority over Ulster, and the leaders of the movement had some grounds for their conviction that in such a conflict no British Government could coerce them. Lord Loreburn, the Liberal ex-Lord Chancellor, issued an appeal that month for a conference on Home Rule, and on Dec. 17 Sir Edward Grey said, at Alnwick, that the door was still open for a settlement by consent as regarded Ulster; behind the appearance of no-compromise on both sides, both parties came down in the following year to disputes over the frontier of the Ulster that was to be exempt from the Irish parliament. Mr. Lloyd George meanwhile was concentrating his energies on a fresh land campaign in view of the dissolution, which would normally come not later than the winter of 1914–5, and of the very mild proposals which Lord Lansdowne had put forward in July.

The session of 1914 did not, however, open until Feb. 10 and Jan. oratory had thrown cold water on the prospects of Irish accommodation, Mr. Redmond declaring that Ulster would make no concession and Mr. Bonar Law asserting that the conversations had come to nothing. The King's Speech, indeed, admitted that they had "so far not succeeded." An identical amendment to the Address was accordingly moved in both the Houses declaring that it would be disastrous to proceed further with the Home Rule Bill until it had been submitted to the judgment of the people; it was carried in the Lords by 243 to 55 and rejected in the Commons by 333 to 255. Five days later a similar amendment to the address was moved with reference to Welsh Disestablishment and defeated by 279 to 217.

On the second reading of the Home Rule Bill (third time of asking) Mr. Asquith explained the concessions the Government was prepared to make. Any Ulster county (Belfast and Londonderry being regarded as counties for this purpose) might, immediately after the enactment of Home Rule and before it came into operation, vote by ballot for its own exemption, such exemption to expire at the end of six years unless the Imperial Parliament otherwise determined. Mr. Redmond agreed to this proposal, but Mr. Bonar Law declined unless there were further concessions to follow, and Sir Edward Carson demurred to a reprieve which might last no longer than six years. Nevertheless, the difference between the two parties seemed to be reduced to a narrowness incommensurate with the agitation, anger and anxiety which followed; and it appeared, from the speeches on the vote of censure moved by Mr. Bonar Law on March 19, that the main concern was less to exclude the Ulster counties from a hypothetical future incorporation in a united Ireland than to exclude the accumulated legislation of the Government from the impending benefits of the Parliament Act, for his suggestion was once more that not only the new proposals but the bill should be submitted to a referendum; and it was obvious that, if this argument and the threat of forcible resistance were admitted with reference to Home Rule, it could and would be applied to the other bills awaiting enactment without the consent of the House of Lords. The motion was rejected by 345 to 252 votes; Sir Edward Carson went off to Belfast, and on March 21 the Chancellor of the Exchequer attacked at Huddersfield the whole idea of Ulster exclusion.

The Affair at the Curragh.—Two days later it was announced that a number of army officers stationed in Ireland at the Curragh had tendered their resignations rather than face the duty of executing orders which they feared might be given them. Measures, both naval and military, had in fact already been taken to protect military stores against possible raids by Ulster Volunteers, but the resignations seem to have been tendered under the impression that these measures were designed to initiate military operations against Ulster rather than to maintain order, a duty which the officers were prepared to accept. When they were reassured they returned to their posts.

But this reassurance alarmed the civilian mind. The Labour party at once pointed the moral by the syndicalist appeal to troops to refuse to obey orders to suppress a strike; and Mr. J. H. Thomas declared that, if the Opposition doctrine held good, it would be his duty to tell railwaymen to organise their forces and spend their capital in the purchase of arms and ammunition. The alarm was increased by the publication of a minute of the Army Council initialled by Col. Seely, Sir John French and Sir Spencer Ewart, implying a discretion invested in officers as to what orders they should obey. All three resigned, and Mr. Asquith evoked great enthusiasm from his supporters by taking upon himself the vacant Secretaryship for War and vindicating thus the subordination of the military to the civil power. His appointment vacated his seat, but he was returned without a contest by his constituents on April 8.

The Home Rule Bill.—The second reading of the Home Rule Bill was taken during Mr. Asquith's absence, and Sir Edward Grey, who led in his place, while refusing to go beyond the six years' exemption, suggested the possibility of a federal solution. The bill was read by 356 to 276 votes on April 6. After the Easter adjournment, the second reading of the Welsh Disestablishment Bill was taken on April 20–21 and carried by 349 to 265. During the next three days the King and Queen returned President Poincaré's visit and had an enthusiastic reception in Paris. The Plural Voting Bill was read a second time on April 27, and on April 28 the Unionists moved for an enquiry into "the plot to coerce Ulster."

The point of the motion was somewhat blunted by the news that 35,000 rifles and 3,000,000 cartridges had been landed at Larne on the night of April 24–25 and distributed by motor lorries and motor cars throughout Protestant Ulster. In spite of mutual recriminations about the rival "plots," conciliatory speeches were made by Mr. Churchill, Sir Edward Carson, Mr. Bonar Law and Mr. Asquith; but on May 12 Mr. Asquith announced that any settlement with Ulster must take the form of a separate amending bill; for, of course, the Home Rule Bill by amendment would lose the benefit of the Parliament Act; and, further, the idea was to make the government of Ulster "Home Rule within Home Rule," a subordinate and not a co-ordinate part of their scheme. The bill was reported on May 21 and read a third time by 351 to 274 on May 25.

The Lords gave it a first reading on June 7, but refused to proceed further until the amending bill was produced. This was

introduced by Lord Crewe on June 23, and, no agreement having been yet reached, it simply embodied the Prime Minister's offer on March 9 of allowing Ulster counties to contract out. The Lords, however, gave it a second reading on July 2—the day on which Mr. Joseph Chamberlain died—and on July 8 began to amend it by excluding the whole of Ulster, without any ballot, from the operation of the Home Rule Bill; other amendments transformed the amending bill which was read a third time on the 14th. On July 20 Mr. Asquith announced that the King had summoned a conference of eight delegates, with the Speaker as chairman, at Buckingham Palace. The locality protected the Conference from the intrusion of the Press; nevertheless, after four meetings, the Speaker reported that it had been unable to agree either in detail or principle. The further prosecution of the quarrel was interrupted by Austria's declaration of war upon Serbia on July 28, which put into some sort of perspective the parochial nature of the Irish dispute.

Parliament in July 1914.—Meanwhile, the Welsh Disestablishment Bill passed the Commons for the third time on May 19, and on June 25 the House of Lords delivered its last blow at the measure; it took the interesting form of a refusal to proceed pending the report of a select committee into the historical question whether the constitution of the Convocations of the Church of England had ever been altered by Act of Parliament without their own consent; but the implication that Parliament was precluded from passing any measure which it had not passed before was not a convincing political argument. On July 15 the Plural Voting Bill came before the Lords: its second reading was postponed without any periphrasis, for, unlike the Home Rule and Welsh Disestablishment Bills, it had not yet come to its third time of asking.

The Budget of 1914.—The Budget was interesting as the last before the World War, and the lightest that generation was likely to see. That did not prevent some of its taxes from being heavier than ever before, nor preclude the taxpayers from lamenting, in *Punch's* words, that this was "not milking, but murder." The revenue had expanded beyond even the Chancellor's expectations, the increase amounting to over £9,000,000; but he had supplementary estimates to meet, and further demands would be made by the reforms he proposed. The total required was nearly £206,000,000, and increased taxation would be needed to relieve municipal rates of some of the burden in which municipal authorities were involved by the fresh duties Parliament had put upon them; the education grant was to be reconstituted on the principles recommended by the Kempe committee which had reported in March.

The tax on incomes between £1,000 and £1,500 was therefore to be raised to 10½d., on £1,500 to £2,000 to 1s., on £2,000 to £2,500 1s. 2d., and over £3,000, 1s. 4d.; the highest rate of supertax was also raised to 1s. 4d., though reduced in committee to 1s. 3d. The Speaker, however, ruled on June 22 that a finance bill must be limited to the imposition of taxation, and the bill was therefore divided into two parts, with the result that the temporary grants to local authorities were not made that year. The Finance Bill passed on July 31; the Revenue Bill was postponed until the new session. The naval estimates had risen to £51,550,000, an increase of 70% during the Government's eight years' tenure of office; criticism of this expenditure was effectually silenced before the session ended.

II. THE WAR PERIOD

The Great War came as a thief in the night upon the country at large. The murder of the Archduke at Sarajevo on June 28 had not greatly disturbed men's minds, and even the Cabinet had no thoughts of immediate danger from that source until, at the conclusion of its meeting on Friday, July 24, news came of Austria's ultimatum. Sir E. Grey's efforts to promote a pacific settlement of the dispute belong to the history of Europe and of the World War (*see* EUROPE). The precaution was taken during the week-end by Mr. Churchill and his First Sea Lord, Prince Louis of Battenberg, of countermanding the dispersal of the fleet assembled for a great naval review at Spithead on July 18, and on July 27 it proceeded quietly to its war stations in the North Sea, the German fleet having withdrawn from the Norwegian fiords on the previous day.

But even after Austria's seizure of Belgrade on July 28 there was little idea in the popular mind that anything worse than another Balkan war was afoot, and the Russo-German declarations of war on Aug. 1 did not reveal to the British public the western implications of the conflict. That came with the crossing of the frontiers of France and Luxemburg by German troops on Sunday, Aug. 2, and the dispatch that afternoon of mobilisation orders to British naval reservists. The Cabinet itself was still undecided, a circumstance which might be alleged to prove that England's hands were still free. In point of fact no country's hands are free; its action depends upon that of others, and it was Germany's action which made up the mind of the British Cabinet and people and determined the issue of the War before it was begun.

Britain at War.—Late that evening Germany informed the Belgian Govt. of her intention to violate Belgian neutrality, and at 7 A.M., on Monday Aug. 3, Belgium appealed to Great Britain. There could be but one reply, and there never has been an answer to King George's question to Mr. W. H. Page, the American ambassador: "Good God, sir, what else could we do?" Whether Great Britain would have intervened in the War had Belgium been left at peace is another matter; but there can be little doubt that, had Germany confined her attack to Russia and stood on the defensive in the West, she would have won the War with comparative ease. If France had attacked her, Italy would have been bound by the Triple Alliance to side with Germany and assuredly would not have come into the War on the other side; nor would the United States, while Great Britain, if she intervened at all, would have done so under another Government and with a mind so divided as to destroy her best chance of success.

It was Germany's subordination of moral principle to military advantage that set the world against her from the start; and serious division in the British Cabinet was solved by her attack on Belgian neutrality, which she, as well as Great Britain, was pledged to observe. Lord Morley, whose retirement could not have been long delayed in any case, resigned, as did another Cabinet Minister, Mr. John Burns and Mr. C. P. Trevelyan, secretary to the Board of Education, for different reasons. Some Radicals and Labour M. P.'s remained unconvinced because they hated war in general; but that was no answer to the specific question put by the Belgian Govt., and Sir E. Grey, in a speech described by Lord Lansdowne as one of "rare courage," carried the vast majority of the House with him on Aug. 3. The Unionist leaders assured the Government of their whole-hearted support. Germany invaded Belgium on Aug. 4 and Great Britain declared war that night.

With the outbreak of war, party differences ceased and political history shrank to a tenuous stream. The truce was illustrated by the appointment, amid universal acclaim, of Lord Kitchener as Secretary of State for War; he could not be expected to commit himself on such questions as Home Rule and Welsh Disestablishment, and it would have been more in accordance with the fitness of things had the Government refrained from insisting on placing those measures on the statute book under the Parliament Act in September. Their execution was, however, postponed till the end of the War by a suspensory Act which simultaneously received the royal assent; and the World War was undisturbed by the domestic dissensions which had marked the war with revolutionary and even Napoleonic France a century earlier.

Early Days of the Struggle.—There was no organised British party pressing throughout for peace, and the pacifists were simply individuals, some of them distinguished, without an organ in the Press, or a platform in the country: even Mr. Ramsay MacDonald found little support in the party he had once led. Such agitation as arose was not for peace, but over the methods and means of carrying on the War. It might have been different had a gradually waning strength in the enemy produced an accommodating temper and afforded an opening for a nego-

tiated peace. But Germany resembled Oliver Wendell Holmes's "one-hoss shay," which was so perfectly organised and its parts so equal in strength that none broke down until the whole collapsed into a heap of dust; and Germany's position remained imposing and her Government intractable until complete ruin overtook them between Aug. and Nov. in the fifth year of the War. The military efficiency which betrayed Germany into war betrayed her also into ultimate collapse. She, too, learnt that under modern conditions, Governments, however autocratic, can maintain themselves in war only so long as success commends them to their subjects.

The reaction to ill-success was more rapid in more democratic countries, all of which changed their governments once or more during the War, England twice and France half a dozen times. There was a natural tendency to attribute individual mishaps to espionage or treachery and the postponement of victory to the incompetence of the Government; and as time went on popular psychology accepted the view expressed by a comparatively sober journal that in the case of mistakes soldiers were never, generals sometimes, but Ministers always, wrong.

The first serious criticisms, however, which affected the course of political history related to the inadequacy of munitions and the policy of the Dardanelles expedition. Men had been the first need of the War, but in the autumn of 1914 they were volunteering faster than they could be clothed or armed, and the demand for conscription met with little response. Nor was it the lack of rifles that produced the crisis over munitions, but a need which arose from the change in the War, after the failure of the German invasion of France, from one of movement to one of positions.

On the Western Front the opposing forces had come to a deadlock of lines stretching from neutral Switzerland to the British-commanded sea; and the Germans, with a forethought characteristic of them, spent the winter in constructing defences, novel in their intricacy of barbed wire and trenches, which could only be overcome by high explosives and heavy guns. The French took naval guns from their ships to meet the need and even criticised the British for not following their example when every naval gun was needed to maintain that command of the sea on which the fortune of the Allies depended. The problem was brought home acutely by the failure at Neuve Chapelle (March 10–12 1915) of the first deliberately planned offensive by the British, and it was natural, even for the commander-in-chief, to subordinate its other causes to the lack of adequate artillery preparation and that in its turn to inadequacy of munitions. This explanation was communicated to others in England besides the authorities, and by April the first serious political agitation against the Government during the War was in full swing.

The Dardanelles Operation.—This coincided with another dissension of which, however, little was known outside the Cabinet, though it had reference to a divergence of opinion which lasted almost throughout the War. The stabilisation of an impregnable front from the Alps to the sea inevitably suggested to strategical minds the idea of at least exploring the possibility of turning that front by means of the British command of the sea. Lord Fisher, whom Mr. Churchill brought back to the Admiralty as First Sea Lord to replace Prince Louis, who had been the subject of a campaign of calumny, had ideas of outflanking the land front by a naval incursion into the Baltic. The entrance of Turkey into the War (Oct. 1914) suggested to Mr. Churchill the feasibility of an attempt on the Dardanelles, and in Jan. 1915 he was actively engaged in an effort to convert or commit the Cabinet to his point of view.

There is now little doubt that, if the Allies had put into the Dardanelles campaign the forces and the energy they wasted on ineffective offensives on the Western Front during 1915, the Dardanelles could have been forced, Russia relieved, the Balkans brought solidly into the Allied scale, and Central Europe beleaguered on all sides. But the Cabinet was committed inch by inch, first to a naval and then to a military attack without being really converted to either. The real obstacle to, and criticism of, the strategy lay in the fact that the eyes of France were naturally glued on a front which lay almost wholly in France and not many leagues from its capital; and nothing would persuade her to risk her own defence by turning the speculation in the Dardanelles into a major operation.

The First Coalition.—Lord Kitchener, naturally more in touch with French military opinion than Mr. Churchill, was impressed by this objection; but the breach came between the First Lord and his expert adviser, Lord Fisher, who felt that he was being dragged by a politician where as a seaman he did not want to go. He resigned on May 15, and his resignation, coupled not only with the outcry about munitions and journalistic attacks on Kitchener, who was rewarded with the Garter, but with the threat of formal Opposition censure, convinced Mr. Asquith that the Government could not go on without broadening its foundations.

From the party point of view it would have been more prudent to resign and leave to others the conduct of the War, which would not have been materially abbreviated thereby, and the consequent burden of discontent with its leaden progress. But vital interests demanded a Coalition, and Mr. Asquith succeeded in enlisting all parties, save the Irish Nationalists. He remained Prime Minister himself, and Sir E. Grey Foreign Secretary: but Lord Lansdowne entered the Cabinet without portfolio, Mr. Balfour succeeded Mr. Churchill, who was reduced to the civilian sinecure of the Chancellorship of the Duchy of Lancaster, Mr. Bonar Law became Secretary for the Colonies, Mr. Chamberlain for India, Mr. Long President of the Local Government Board, Lord Curzon Lord Privy Seal, Sir Edward Carson Attorney-General and Mr. F. E. Smith, afterwards Earl of Birkenhead, Solicitor-General. Labour was represented by Mr. Arthur Henderson at the Board of Education, and Mr. Lloyd George took over the new Ministry of Munitions. Lord Haldane was sacrificed to popular clamour arising from the conviction that anyone who could speak German could not be an Englishman at heart; with the exception of Lord Fisher, he had done more than any other single man to arm his country.

The Question of Men.—The new Government, by its comprehensiveness, disconcerted the making of party capital out of the greater disappointments which followed in the summer and autumn, the rout of Russia, the failure of the Dardanelles campaign and of the French and British offensives on the Western Front, the entrance of Bulgaria into the War on Germany's side and the consequent over-running of Serbia; and the principal topic of civil dissension was the question of conscription. The idea of universal compulsory military foreign service was a complete novelty in English history, medieval military service being limited to those who held land on that condition in lieu of rent or other service, and the more general obligation to assist in keeping the peace and repelling invasion being limited to shires in which men lived. Even on the European Continent conscription was supposed to be limited to home defence; in Australia, where service at home was compulsory, similar service outside the Commonwealth was twice rejected on a referendum during the War, and it remained limited to the same extent in the Channel Islands. The Territorials, whose obligation was similarly restricted, had, however, almost all volunteered and been employed for foreign service; and the exigencies of the War led to the use of such arguments as that home defence involved the defence of Belgium and France as well as any part of the British Empire, and that the obligation could even be read into medieval precedents. The former argument was later on used by the French as a plea for cancelling their debt to England on the ground that they supplied the bulk of the forces fighting in France for England's defence.

It was, however, wisely recognised that the thing, if done at all, must be done by Act of Parliament, and, before resorting to that, Lord Derby was employed to obtain the maximum output from voluntary recruiting. His campaign in the autumn left too large a residuum of unrecruited men whose best justification was that they had domestic claims of which they could judge, while only the Government could judge the number of men required for service abroad, and therefore it was for the Government to take the responsibility by introducing conscription.

Conscription.—The first bill, which excluded married men, was introduced on Jan. 5 1916. Sir John Simon, the Home Secretary, resigned the day before, the Labour Ministers also tendered their resignations, and the Irish Nationalists avowed their opposition, notwithstanding the exclusion of Ireland. But on the second reading Mr. Redmond announced that they would not continue their opposition, the Labour Ministers withdrew their resignations, and the bill was carried by 431 to 39. It became law on Jan. 27, but did not satisfy military demands, and after a good deal of ministerial disagreement a fresh bill was introduced and discussed in secret sessions of both Houses of Parliament. It, too, proved unacceptable as a mere instalment, and on May 3 the Prime Minister introduced a third bill making all men, married or single, between the ages of 18 and 41, subject to compulsory enlistment. It was read a second time by 328 to 36 on May 4, and a third by 250 to 35 on May 16 and passed by the House of Lords within a week. Local tribunals were set up to determine claims for exemption on medical grounds, for family reasons, or on account of the national importance of civil work; most of the exemptions were granted for workers on the land or in munition factories.

Causes for General Uneasiness.—Dissatisfaction with the progress of the War soon found other grounds of complaint, and candidates began to appear at by-elections with unofficial newspaper backing against the Coalition Government. The principal objection to a Coalition is that it releases critics from the restraint and responsibility which a front Opposition bench normally imposes on its followers, and the principal motive for criticism was the insular pride which could only account for German success by the poor quality of British leadership. Hopes for the long-expected offensive on the Somme tempered this discontent for a time; but the Irish Rebellion at Easter, ambiguity about the battle of Jutland (May 31), whence the German fleet escaped with losses inferior to those inflicted on the British Navy, the loss of the "Hampshire" with Lord Kitchener on board (June 5), disappointment with the apparently meagre effects, in spite of the tanks, of the sanguinary fighting on the Somme (July–Oct.), and official reticence about the casualities provoked doubts of ultimate victory, which were reflected in views believed to have been communicated by Lord Lansdowne to his colleagues but not published until a year later in a letter to *The Daily Telegraph.*

Their existence was presumably responsible for an interview given by Mr. Lloyd George to an American journalist in Oct., in which he declared that Britain had only begun and that "the fight must be to a finish—to a knock-out." But the next episode was the ruin of Rumania (Nov.), the third little ally to be overrun by the enemy. Mr. Lloyd George termed it a "blunder" two months later without specifying whose; but the British public, having no other Government which it could call to account than its own, ascribed to it the failure of Russia to help a neighbour from which the other Allies were completely cut off.

The Crisis of Dec. 1916.—It was not, however, the public nor even the House of Commons which precipitated the political crisis in December. On Dec. 1 Mr. Lloyd George, who had succeeded Lord Kitchener as Secretary for War, intimated to Mr. Asquith that he could not continue unless the supreme direction of the War was entrusted to a new War Committee consisting of himself, Sir Edward Carson, Mr. Bonar Law and a Labour member, but excluding the Prime Minister. Mr. Asquith demurred; on Dec. 5 Mr. Lloyd George resigned, Mr. Asquith followed suit, and the King sent for Mr. Bonar Law, who found himself unable to accept the task of forming a Ministry.

Mr. Lloyd George as Premier.—It therefore fell to Mr. Lloyd George, who had already secured the co-operation of the Unionist leaders, except Lord Lansdowne, and gained that of most of the Labour party and some of the Liberals, to undertake the task; none of the Liberal members of Mr. Asquith's cabinet, however, transferred their allegiance at that time to the new Prime Minister, though all gave a general support to the new Government. It was a novelty in various respects, though the Prime Minister, now changed, remained at the head of the War Committee, which was reduced in number from seven to four, and all the four were politicians, with the possible exception of Lord Milner, and one of them, Mr. Henderson, was selected for purely political reasons. The radical change consisted in the supersession of the Cabinet by its War Committee, which became the War Cabinet without any sort of responsibility to other Ministers, and was at times expanded into the Imperial War Cabinet. The other Ministers were reduced to the position of heads of departments. The novel situation was clearly expressed by Sir Robert Borden in a speech delivered in London on April 3 1917, and quoted by the War Cabinet in its *Report for the year 1917* (*Cd.* 9005, p. 8).

> For the first time, he said, in the Empire's history there are sitting in London two Cabinets. . . . Over each of them the Prime Minister of the United Kingdom presides. One of them is designated as the "War Cabinet," which chiefly devotes itself to such questions touching the prosecution of the War as primarily concern the United Kingdom. The other is designated as the "Imperial War Cabinet," which has a wider purpose, jurisdiction and personnel. To its deliberations have been summoned representatives of all the Empire's self-governing Dominions.

This "Imperial War Cabinet" held fourteen meetings between March 20 and May 2 1917, but was then reduced to meetings which Mr. Lloyd George hoped would be "annual" in peace as well as in war, and eventually subsided into the Imperial Conference. The "War Cabinet," on the other hand, held more than 300 meetings in 1917; and, as it states in its *Report* (no other was issued than that for 1917), "this fact in itself indicates the great change which has taken place in the work of the Cabinet": when it refers thenceforth to "the Cabinet," it means the War Cabinet, its expanded session being designated as the "Imperial War Cabinet," and no other being mentioned. Its chart, "showing the administrative organisation of the British Govt.," represents "the War Cabinet sitting as a permanent body, the Imperial Cabinet meeting periodically and the Ministers with portfolios." Lord Curzon, the leader of the House of Lords, was included, but there was only a sort of liaison officer between this War Cabinet and the House of Commons in the person of Mr. Bonar Law, who occasionally attended the War Cabinet and led the House, from which Mr. Lloyd George as a rule absented himself.

Other important innovations consisted in having a Prime Minister who was leader of neither House, and heads of great departments who were not members of Parliament at all. The old Cabinet system ceased in fact to exist; the War Cabinet was a dictatorship, other Ministers became too numerous for any collective responsibility or activity and had little voice in general policy. As heads of departments, some of them achieved conspicuous success, notably Mr. R. E. Prothero (afterwards Lord Ernle) at the Board of Agriculture, and Mr. H. A. L. Fisher at the Board of Education.

Changes in Personnel.—Changes in the personnel of the Ministry followed one another with bewildering rapidity. The War Cabinet itself was increased to the number (seven) of the War Committee under Mr. Asquith's régime by the addition of Sir Edward Carson and General Smuts and the regular inclusion of Mr. Bonar Law; Mr. Barnes succeeded Mr. Henderson in Aug. 1917, and Mr. Chamberlain Lord Milner in April 1918. In the previous Cabinet positions Mr. Montagu succeeded Mr. Austen Chamberlain at the India Office, Mr. Churchill succeeded Dr. Addison at the Ministry of Munitions, and Sir Eric Geddes followed Sir Edward Carson at the Admiralty in July. In Aug. Sir Auckland Geddes followed Mr. Neville Chamberlain as Director of National Service, Mr. Hodge followed Mr. Barnes as Pensions Minister, Mr. Roberts followed Mr. Hodge as Minister of Labour and Mr. Wardle followed Mr. Roberts at the Board of Trade.

Outside the Cabinet, Mr. Stanley Baldwin became joint Financial Secretary of the Treasury in Jan., and other ministerial changes took place in June. In 1918, Sir E. Carson resigned from the War Cabinet in Jan. and Lord Milner left it in April to succeed Lord Derby at the War Office, and there were a dozen other changes among less important ministers before the War came to an end. Nor were the soldiers immune. Sir William Robertson was succeeded as Chief of the Imperial General Staff by Sir Henry Wilson in Feb. 1918, General Trenchard resigned

from the Air Staff, and Sir Douglas Haig was none too secure, there was not much stability in the strategy of the War until Foch's appointment as generalissimo of the French and British forces in April.

The War Narrative Again.—The public, however, thought, in Dec. 1916, that with the new British Ministry the Allies would not be long in winning the War. An emphatic refusal was given to the German invitation to enter a peace conference, and a Victory loan, calculated to last till about Aug., was successfully floated in January. For three months or so things went well enough; the fruits of earlier efforts were reaped in the German retreat from the Somme and Sir Stanley Maude's conquest of Baghdad in March. But the advance into Palestine was held up before Gaza; the Vimy campaign, after a striking initial success, subsided into trench warfare in April; the French attack on the Chemin des Dames was a ghastly failure and Russia was paralysed by the revolution of March.

The United States, indeed, declared war in April, but its intervention on the field of battle was delayed for more than a year, and the Allies were reduced to the defensive, modified by local gains by the French, a well-staged attack on the Messines Ridge in June, and a pitiless struggle for Passchendaele in the mud and the floods of Flanders.

Meanwhile, the battle of Jutland had been decisive enough to convince the Germans that their hopes lay not on but under the surface of the ocean. They concentrated on their submarines, which in April sank 25% of the merchant ships that put to sea, and bade fair to justify Mr. Prothero's anticipation, on taking office, that victory might be lost or won on the cornfields and potato lands of Great Britain.' Then followed the Italian disaster at Caporetto and the Bolshevik revolution (Nov.); Russia went out of the War at the peace of Brest-Litovsk; " defeatism " made its appearance in France, and Mr. Lloyd George only escaped suspicion of a leaning towards the Stockholm Peace Conference by ejecting Mr. Henderson from his Government.

The German Offensive.—What seemed to some a crowning disaster came with the German offensive in March 1918,' which swept away all and more than all the Allies had gained on the Western Front since the autumn of 1914. The British stood, as Haig said, with their backs to the wall, and their liaison with the French was nearly broken in front of Amiens. Things seemed far worse than they had been in Dec. 1916, and it looked as though another government might fall. The point of attack was the responsibility for the weakness of the extended front held by the V. Army under the command of General Hubert Gough, who was cashiered for his failure. It had been held at Versailles, in Jan., that the German offensive would fall on that front, and repeated demands for its reinforcement had been made and ignored. Mr. Lloyd George put the blame for the extension of Gough's front on the French Premier, M. Clemenceau; Sir Frederick Maurice, late Director of Military Operations, indicated, in a letter published on May 7, that the responsibility lay nearer home, and challenged the veracity of ministerial statements. He was placed on half-pay for his breach of discipline, but the Government offered a judicial enquiry into his charges. Mr. Asquith moved, on the other hand, for a select committee of the House of Commons, like that which inquired into the Dardanelles campaign. The Government treated this as a vote of censure, and it was defeated by 293 to 106 votes. The Liberal sheep who followed their leader were divided from the goats who supported the Coalition, and the party was rent in twain.

The United States in the War.—The War meanwhile had been won, not so much by the virtues of any particular British or other Ministry, as by the masses of troops which the United States, stirred at last by the threatened disaster to the common cause, poured into the Western Front during the next few months and by the unification of its command in the person of Marshal Foch. Two million American soldiers sailed before the end of the summer, relieving Foch of all anxiety about his reserves and middle-aged Britons of the military service imposed on all under 51 by the last of the Conscription Acts passed in May. With the prospect of an American army in France, larger than the British or the French, leadership in the diplomacy, which helped on the German surrender, passed to President Wilson, who had already, on Jan. 8 enunciated his famous " Fourteen Points "; and with Foch directing the strategy and Wilson the policy of the War, the Coalition Govt. entered smoother waters.

Electoral Reform and Education.—It had been far more happy in its projects of reform than in its conduct of the War; and in the spring of 1918 two measures of first-rate importance were placed upon the statute book. One related to electoral reform and the other to education. Before the fall of Mr. Asquith's Govt. the Speaker's Conference had been set up in Oct. 1916 to deal with the former problem, and on March 28 1917 Mr. Asquith moved for legislation on the lines of its report, indicating incidentally his own conversion to woman suffrage. The Prime Minister accepted the motion, subject to the qualification that proportional representation and woman suffrage would be left to the judgment of the House. Differences between members and between the two Houses turned mainly on these two points.

The chief proposals of the Representation of the People Bill, which was introduced on May 15 by Mr. Walter Long, were that no one should have more than two votes, one for his residence and the other for either his place of business or his university; that women entitled to the municipal franchise should also receive the Parliamentary vote on attaining the age of 30; that persons on war service should not be disqualified by non-residence; that all elections should be held on the same day and that there should be a redistribution of constituencies. The second reading was carried by 329 votes to 40; in committee, an amendment to omit the higher age limit for women was rejected by 385 to 55, and the clause adopted by 214 to 17. Proportional representation was rejected, except for universities, by 201 to 169 but the " alternative vote " accepted by 125 to 124.

The final stages in the Commons were deferred till the autumn session and the bill did not reach the Lords till Dec.; in Jan. 1918, an amendment against women suffrage was rejected by 134 to 71 and a proposal to submit it to a referendum by 90 to 62. The Lords then eliminated the " alternative vote " from the bill by 66 to 9 and inserted proportional representation by 132 to 42; and a brisk interchange of hostilities on these points ensued between the two Houses, each insisting on its own projects. A compromise eventually provided for a commission to set up a scheme by which not more than 100 members might be elected by proportional representation if constituencies desired it; no such desire has yet (1926) been expressed. The bill became law on Feb. 6.

The Education Bill.—Mr. Fisher introduced his Education Bill on Aug. 10 1917; but politics are always more urgent than education in the House of Commons because children cannot be educated as easily or as quickly as adults can be given votes, and the bill was deferred until March 1918. It proposed to abolish all exemptions between the ages of five and 14 and to require attendance at continuation schools until 18; no child under 12 was to be employed at all and none over 12 on school days except after school hours and before 8 P.M.; no fees were to be charged in public elementary or continuation schools; provision was made for nursery schools and various forms of physical training and recreation. Local education authorities were made responsible for the provision of all kinds of education in their areas, were released from the limit of their expenditure for higher education, and were guaranteed half the cost from the national exchequer. The bill was read a second time without a division, and the only hostile amendment in committee, aimed at the abolition of fees, was defeated by 157 to 51. The bill became law on Aug. 8.

The Budget of 1918.—Most of the time of Parliament was, however, devoted to legislation of a temporary character relating to the War, such as raising the military age, providing for the national service of civilians, the production and control of food and shipping, and war pensions; penalising aliens and conscientious objectors; and voting credits and taxation. The last budget of the war period was introduced by Mr. Bonar Law on

April 22. He estimated the year's expenditure at nearly £3,000,000,000 (£2,972,197,000) and the revenue at £774,250,000. The standard rate of income tax was raised to 6s. in the pound, the duty on spirits from 14s. 9d. to 30s. a gal., and on beer from 25s. to 50s. a bar., on tobacco from 6s. 5d. to 8s. 2d. a lb., and on sugar by an additional 11s. 8d. on the cwt.; an extra penny was put on cheques. The dead weight of the National Debt had risen from £651,000,000 on the eve of the War to nearly £5,000,000,000, and nearly another £1,000,000,000 was added during the year; the cost of its service, £22,000,000 a year in 1914, had risen to £189,000,000 by April 1918, and rose to £315,000,000 a year during the next 12 months.

End of the Long Parliament.—The first Parliament elected under George V. met for its last session on Oct. 15 1918. It should, under the Parliament Act passed by itself, have been dissolved in accordance with the five-year limitation, not later than 1915. But, just as the first Parliament of George I., elected under a Triennial Act, extended its own existence by its own authority to seven years, so this Parliament superseded its own Parliament Act in order to prolong its own existence from five years to eight; as if to atone for this excess it was before long dissolved without its consent in each of three successive years by the royal prerogative at the behest of three different Ministers. The autumn session of 1918 lasted for little over a month, and its chief decisions were to pass an Act qualifying women for election to Parliament and to reject a resolution moved by the Irish Nationalists demanding Home Rule before Great Britain entered a peace conference to settle Europe on a basis of "self-determination." The Chief Secretary (Mr. Shortt) resisted the motion, although he warned the House of the probability of another Irish rebellion; and Mr. Bonar Law declared that Ireland was purely a domestic question for the British Empire. Mr Asquith asked that it might not, "at this eleventh hour," be left as a standing reproach, but the resolution was rejected by 196 to 115 votes (Nov. 5) and the Irish settlement was left until very late in the eleventh hour of the Coalition and of the new Parliament, for which the election was already being prepared before the Armistice on Nov. 11.

The General Election of 1918.—Never had a government better excuses for taking its opponents at a disadvantage. The very fact that they were hardly in opposition, but had supported and served in the War, deprived them of putting before the electors any clear-cut alternative policy and any counter-attraction to the roseate prospect of homes fit for heroes, woes fit for Huns and indemnities to pay taxation, dangled before the popular gaze. The Independent Liberals, as they came to be called, demurred to an immediate general election; but, as the Prime Minister urged, Parliament had long outlasted its term, it had no mandate for peace and it was necessary that British Ministers should go into the peace conference with the confidence of the country at their back, although France, Italy and Belgium managed without general elections until peace had been signed.

A more acute and legitimate question was whether the Coalition, formed in and for the War, should prolong its existence for the purpose of peaceful reconstruction. Ministers had or expressed no doubts at the time, and Mr. Lloyd George was apparently convinced that Ministers who had won the War, or been in office when it ended, were entitled to build the temple and garner the fruits of peace; the "old mismanagement," if any in office were guilty, could be avoided by a general confession that all had made mistakes. The election test, he wrote to Mr. Bonar Law on Nov. 2, "must be not, as in the past, a pledge to support the Government in the prosecution of the War, but a definite pledge to support this Government." To what and how far Ministers pledged themselves, beyond mutual admiration, was prudently concealed.

The Results.—The Labour party refused to concur in this Napoleonic plebiscite, and to its decision in Nov. 1918 it owed its accession to office in Jan. 1924; it severed itself from the Coalition, though some Labour Ministers continued to support the Government and some became Coalition Liberals and one or two Conservatives. The Liberal party was incapable of action as a whole and followed the divergent lines drawn by the schism of Dec. 1916 and the division in the House on May 7 1918. The Independent Liberals refused the Coalition pledge, and a number of Unionists did the same. Parliament was prorogued on Nov. 21, dissolved on Nov. 25, and the election was fixed for Dec. 14, though the votes, for the sake of voters on active service abroad, were not counted till Dec. 28. The results exceeded the most optimistic hopes of the Coalition: 484 of its supporters were returned, made up of 338 Unionist, 136 Liberal and 10 National Democratic, and there were also 51 Independent Unionists. Labour secured 57, against 38 seats in the previous Parliament, but the Independent Liberals were reduced to 26 and all their leaders were defeated. The Irish Nationalists, however, suffered worst of all: they lost 70 out of 77 seats, while the Sinn Fein members rose from 7 to 73; but the latter were pledged to abstain from taking their seats at Westminster and their absence increased the colossal majority for the Coalition. Excluding them, and also the Independent Unionists, the Coalition had in the House 484 members to 85 Labour and Independent Liberal members combined, a majority of more than 5 to 1. It bore not the remotest relation to voting strength in the country, which gave just over 5,000,000 votes to the Coalition, but nearly 3,700,000 to Labour and the Independent Liberals, not to mention the Independent Unionists and Sinn Feiners. In view of the subsequent rise of the Labour party in Parliament it is well to note that in 1918 it polled almost as many votes as the Coalition Liberals and Independent Liberals combined and two-thirds as many as the Coalition Unionists.

The Lloyd George Programme.—It was impracticable to fight a general election on the principle of "least said, soonest mended," but rarely have Ministers been more embarrassed and impeded than was the Coalition by platform speeches and a programme which Mr. Lloyd George summed up on Dec. 10 as consisting of (1) trial of the Kaiser; (2) punishment of those responsible for atrocities; (3) fullest indemnities from Germany; (4) Britain for the British, socially and industrially; (5) rehabilitation of those broken in the War; and (6) a happier country for all (see *Annual Register*, 1918, p. 163).

There was, however, little novelty in the Cabinet burdened with these ambitions, and the arguments for the maintenance of the Coalition were not extended to the War Cabinet, which abandoned its war exclusiveness and resumed its previous distended size. It consisted of 21 members (Jan. 10); Mr. Chamberlain became Chancellor of the Exchequer, Mr. Churchill went to the War Office, Mr. Long to the Admiralty, Lord Milner to the Colonial Office and Mr. Shortt to the Home Office; Mr. Bonar Law continued to lead the Commons as Lord Privy Seal and Mr. Lloyd George, in view of the Peace Conference, retained his independence of departmental duties and of regular attendance in the House. Of the 77 Ministers, all but ten had been in the old Government, and the chief novelty was that Sir F. E. Smith became Lord Chancellor and Baron Birkenhead. The Labour party, as larger than the Liberal, claimed to be the official Opposition, and chose as its leader Mr. William Adamson, who had been a Perthshire miner, while the remnant of Independent Liberals chose Sir Donald Maclean.

III. FROM THE PEACE CONFERENCE TO THE FALL OF MR. LLOYD GEORGE

The Peace Conference.—The centre of interest, however, lay not in Parliament, which was opened on Feb. 11, but at Paris, where the Peace Conference gathered early in Jan. and held its first plenary session on Jan. 18. The delegates for the United Kingdom were Mr. Lloyd George, Mr. Balfour, Mr. Bonar Law and Mr. G. N. Barnes, all representing the Coalition, for which not much more than half of an electorate, already beginning to change its mind, had voted. It was felt in some quarters that the responsibility in England, as well as in the United States, might more wisely have been shared with parties not in power, and that there might in that case have been less of a burden to distribute. Mr. Lloyd George, however, was among the first to react from the mood of 1918, and on April 7 *The Times*, of which

Mr. Wickham Steed had succeeded Mr. Geoffrey Dawson as editor at the end of Feb., accused him at Paris of "thinking of his position at home all the time." On March 14 an Independent Liberal had won a seat from the Coalition by over 2,000 votes; another seat was lost by the Coalition on April 11 where the Coalition majority in Dec. had been over 10,000; and a third followed on the 30th.

Mr. Lloyd George was suspected of trimming his sails and of weakening on the question of German indemnities and the punishment of war criminals; and an indignant protest, originating in Lord Northcliffe's entourage, was eventually signed by 370 Members of Parliament. The Prime Minister replied that he would keep to his pledges, and an interview attributing to him more liberal sentiments was repudiated, but avowed and republished three years later as a vindication of his foresight. For the time he was tied by his immediate past, and the peace that was ultimately made (*see* PARIS, CONFERENCE OF) was dictated more by the sentiments of Dec. than by second thoughts in June. These were best expressed by General Smuts, who, while subscribing to the treaty, protested against its spirit and declared that real peace would be found not so much in its terms as in the means it provided for its own amendment when time had toned down the passions and products of war (*see* LEAGUE OF NATIONS). In presenting bills on July 3 for carrying out the treaty, Mr. Lloyd George announced that an Inter-Allied tribunal would sit in London for the trial of the ex-Kaiser, and that Germany had acknowledged her liability for all the costs of the War—some £30,000,000,000 sterling.

Russia.—The Government was still engaged in wars of sorts in Russia and in Ireland. In 1918 it was a nice question which of the two the average Briton hated more, the Germans or the Bolsheviks; in 1919 Moscow supplanted Potsdam as the root of all evil in ultra-British eyes, and forces intended to help Russia against Germany were perverted to the purpose of collecting British debts from Bolsheviks. It was a moot point, which continued to engage the attention of the United States, whether "self determination" entitles a people to determine how much of its debts it shall pay; but if there is anything that makes invasion unpopular it is the conviction that the invader comes in the guise of the sheriff's officer, and the half-hearted and surreptitious assistance given to Koltchak, Denikin and Judenitch did them far more harm than good, and incidentally weakened the Coalition in Great Britain. But only the failure of these successive efforts convinced the Government of the futility of attempting to impose upon Russia a policy borrowed from the Bourbon restoration.

Ireland.—Its task was formidable enough in Ireland, where on Jan. 21 a Sinn Fein congress adopted a Declaration of Independence after the fashion of the American colonies and established a provisional government modelled on that of Ulster in 1913; that such would be the result of an attempt to impose conscription on Ireland had been foretold when that Act was introduced (see *The Times*, April 11 1918). A fortnight later de Valera escaped from Lincoln gaol, and on April 5 was appointed president of the Sinn Fein executive; on May 9 Irish-American delegates were received in Dublin, and on July 12 Sir Edward Carson demanded the repeal of the Home Rule Act, which still remained an empty form on the statute book, and threatened to call out the Irish volunteers. Lord Birkenhead said that the Government had no sympathy with Sir Edward's attitude, Mr. Bonar Law that it had no ground for taking legal proceedings and Mr. Lloyd George that it had not prepared its plan for the settlement of Ireland; in Oct., however, a Cabinet committee began to draft a scheme.

Schemes of Reform.—Schemes were the order of the day, but Great Britain, like other countries, had incurred in the War debts too deep to be liquidated by Parliamentary bills, to be paid in a generation or to be redeemed by money transactions. "Homes fit for heroes" was but a symbolical expression of an aspiration which had been sincere enough in trenches and in hospitals where war had equalised mankind and almost abolished class distinctions; and millions at least had hoped that peace would no more revive those old inequalities than the old "mismanagement" which the Prime Minister deplored. The England for which they had fought was, as Mr. Kipling wrote of "The Return" from a smaller war, not "what England seems" but "the England of our dreams"; and the agitations of the first years of peace were efforts to realise dreams by Parliamentary statutes or action more direct.

Neither came up to expectation; Ministries of Transport and of Health were established by Acts passed in 1919; rents were restricted and evictions restrained; hours of labour in coal mines were reduced from eight to seven, and a commission, under Mr. Justice Sankey, was set up to consider nationalisation; a Housing Act was passed, and another to fix prices and check profiteering. But dreams cost much to realise, and Englishmen thought that no one but Germans should pay the cost. Prices continued to rise, in spite of Acts of Parliament; the nationalisation of coal was recommended by the casting vote of the chairman of the Sankey Commission which was equally divided between owners and men, but it was not adopted; and Housing Bills became hardy annuals which produced few houses but frequent defeats for ministers who proposed them. It was not until two or three years after peace had been signed that the Coalition realised the necessity of acting upon the truth that the only way of reducing a nation's debt is to raise its production above its consumption and to reduce its expenditure below its income.

The Budget of 1919.—Mr. Chamberlain's first peace budget was introduced on April 30. The national debt had risen during the year from £5,871,000,000 to £7,435,000,000; it had stood at £900,000,000 at the end of 22 years' war in 1815, and had been reduced in a century by about £240,000,000. The increase during 1918–9 had, however, been enhanced by loans to Allies and Dominions, whose indebtedness to Great Britain now amounted to £1,739,000,000. On the other hand, to this dead weight of national debt had to be added a floating debt of £1,412,000,000. The cost of its service amounted to £400,000,000 and the total expenditure for 1919–20 was estimated at £1,435,000,000, subsequently raised to £1,642,000,000, and the revenue at 1,201,000,000, afterwards reduced to £1,168,000,000. The death duties and duties on beer and spirits were largely increased; but the excess profits duty was reduced from 80% to 40%, the proposed luxury tax was not adopted, the duties on land values were abandoned as unworkable, and a beginning was made in Imperial Preference by reducing the duties on certain articles of colonial manufacture. With the income tax left at 6s., the deficit was estimated at £234,000,000 and afterwards raised to £473,000,000, and expenditure in the autumn still averaged over £4,000,000 a day, while it was calculated that the total debt would amount by the end of the financial year to over £8,000,000,000. It was little wonder that even Mr. Bonar Law began to consider the merits of a capital levy, or that opposition was raised to the bill prolonging conscription until April 30 1920.

England, declared the Prime Minister on the eve of the adjournment in August, was not paying her way: so far from reducing her debt, she was producing less and consuming more. Nevertheless, when Parliament reassembled in Oct. its attention was mainly devoted to a bill which provided that every former enemy alien should be deported unless licensed by the Home Secretary to remain. Old age pensions, in view of the rise in prices, were raised from 7s. 6d. to 10s. a week, and a bill establishing industrial courts was passed. The Government of India Bill, giving effect to the Montagu-Chelmsford reforms, received the royal assent on Dec. 23. Dr. Addison admitted that the actual amount of building under the recent Housing Act was trivial, and proposed to stimulate it by a subsidy of £130–£150 a house. Lady Astor, the first woman M.P., took her seat on Dec. 1, and a bill to remove the sex disqualification for the bar and the judicial bench was passed, the House of Lords debating a clause to open its doors equally wide. No less a novelty was the Act establishing a National Assembly for the Church of England, and enabling it to legislate within limits for itself: hitherto the highest church assemblies had been provincial, and they had possessed no independent right of legislation. The

Welsh church had earlier in the year received a more extensive independence in the form of disestablishment and disendowment (April 19); Lord Robert Cecil had resigned from the Government because of disagreement with the measure on Nov. 23 1918.

Thus passed one of the three measures which had created so much controversy in the years before the War. Another, the Plural Voting Bill, had been compromised in the Reform Act of 1918. Home Rule remained, and on Dec. 22 1919 the Prime Minister outlined his proposal for two Irish parliaments, one for Northeast Ulster at Belfast, the other for the rest of Ireland at Dublin. The bill was not introduced until the new session which began on Feb. 10 1920, after the remaining Labour Ministers, Messrs. Barnes, Roberts and Wardle, had resigned; it was debated for three days at the end of March. Mr. Clynes moved its rejection, and Mr. Asquith, who had returned to the House as member for Paisley on Feb. 25, declared that no one in Ireland wanted two Irish parliaments, and urged that Ireland should be given the status of a dominion—a step that was taken, after infinite troubles, three years later. Sir Edward Carson said that Ulster did not want the bill, and before it was passed the Government was asking for emergency powers to supersede the civil courts in Ireland and deal with a civil war (*see* IRELAND). The King's Speech had been optimistic in other respects; it promised bills to acquire mining royalties and reform the House of Lords, while the Prime Minister made the bold assertion that the Government was effecting the strictest and most relentless economy in every department of state.

Another Budget.—The budget, however, estimated expenditure for the second year of peace at £1,177,000,000. Revenue was, indeed, put at £1,341,000,000, leaving a surplus of £154,000,000 for the reduction of debt. This Mr. Chamberlain considered insufficient; and, the land taxes being definitely repealed as unproductive, the minimum cost of letters was raised to 2d. and of telegrams to 1s., the duty on spirits by a further 22s. 6d. a gallon, and that on beer by 30s. a barrel. The Excess Profits Duty, which had been reduced in 1919 from 80% to 40%, was raised again to 60%; and a corporation tax was imposed on limited liability companies. Mr. Clynes's motion for special taxation on war fortunes was, however, rejected by 244 to 81 votes on June 8. The Finance Act passed without difficulty in the House, but the loss of safe Unionist seats at by-elections to "anti-waste" candidates showed that electors wanted the reduction of expenditure rather than the increase of taxation.

Other measures dealt with rents, attempted to render the Profiteering Act more efficacious, and made further provision for health insurance. Instead of the nationalisation of the mines, Sir Robert Horne proposed a Ministry of Mines and the establishment of district boards to adjust the remuneration of miners to the profits of the industry in the different areas; the House of Lords reduced the minister to an under-secretary of the Board of Trade. The Indemnity Act, necessary after every war, was passed almost automatically. These measures seemed very inadequate to a public more impressed by 2d. postage, the increase of railway fares in Aug. by 25% in addition to the 50% of the War period, by the rise of the bank rate, which had been 5% during the War, to 6% in Nov. 1919 and 7% in April 1920, and by the steady mounting of prices which in Nov. were 176% above those of July 1914.

The Irish Bill.—The autumn session was mainly concerned with the Government of Ireland Bill, the problem of unemployment, emergency measures during strikes and agriculture. The condition of Ireland was going from bad to worse, and outrages were growing into raids and ambuscades and military operations hardly distinguishable from a state of war, or at least of revolution. Speaking in London at the Guild hall, Mr. Lloyd George declared that the Government "had murder by the throat," and two days later he said in the House of Commons that Great Britain could give to Ireland no powers which would endanger the integrity of the United Kingdom, of which Ireland was part. The latter remark referred to the proposal to give Ireland the status of a dominion, which had met with growing support since its suggestion by Mr. Asquith in March. Few seemed to have much confidence in the bill before Parliament as a solution of the problem; and, considering the size of the Coalition, the majorities by which it was passed, 131 in the Commons and 86 in the Lords, were small.

The problem of unemployment, due to demobilisation and trade union resistance to the dilution of labour by "hands" which were "unskilled" because of their service in war was hardly less disturbing than the Irish situation; and on Oct. 18 there were riots in Downing street, London, which led to its being barricaded against the public. The two bills passed to deal with the subject in Dec. only touched the surface of a fraction of the problem. The Agriculture Bill was more comprehensive; it aimed at guaranteeing prices for the farmer by perpetuating the corn production legislation of the War, and at insuring a minimum wage for the labourer; a further instalment of protection was effected by a bill to safeguard the manufacture of dyestuffs in the country.

Weakening of the Coalition.—The year 1921 marked the turning point in the history of the Coalition and the reversal by itself of the policy for which it existed. The first Coalition of May 1915 had been created in order that the nation might present an organised and co-ordinated front to the dangers with which it was beset. The second Coalition of Dec. 1916 had been called into existence to develop that organisation by increasing state activity and control over all the nation's powers of production, defence and attack; and the result was, in fact, though the phrase was eschewed, a gigantic experiment in state socialism. This was one of the subtle causes which made the Labour party more wholehearted as a rule than Liberals in support of the Coalition. In Nov. 1918, the leaders of the Coalition came, for various reasons, to the conclusion that reconstruction must be pursued by the methods which, it was thought, had led to success in the War; that is to say by the employment of supermen to exercise supercontrol of national energies, rather than by reliance upon the initiative, energy and productiveness of the individual.

There was much to be said for this view; millions of men drilled for military service, trained to look for orders, and accustomed to depend upon a sustenance that was provided for them by an industry to which they had never been accustomed, or from which conscription had cut them adrift, would not find it easy, without direction and assistance, to discover or resume their place in a community dislocated by the consequence of War. Ministers themselves found the transition from war to peace as difficult as that from peace to war, and the painful stages by which the nation worked up to efficiency in war were reproduced in the lagging steps by which it was brought back to normal conditions of peace. "Business as usual" had been the cry in the first few months of war; control, if not conscription, as usual, seemed the main business of the first few days of peace.

Finance and Decontrol.—The tax collector was, as ever, the main factor in the political education of the country, and the cost of control by supermen with Napoleonic ideas provoked in 1920–1 a movement which convinced even the supermen themselves of the evils of superfluity and converted them to the virtues of the economical axe. Decontrol became the order of the day; and railways, mines, food and drink, prices, agriculture, the Civil Service and other organised activities were subjected to the processes of pruning or liberation. In some the reversal of policy was distinctly precipitate, and the Minister, who in Dec. 1920 had secured an Act for guaranteeing prices for farmers and wages for agricultural labourers, obtained its repeal and the abandonment of its principles in July 1921.

The railways were decontrolled by another bill introduced by Sir Eric Geddes, and resisted by Mr. Clynes on the ground that it failed to provide for public ownership and control. The bill to decontrol mines was introduced on March 4 and passed with great rapidity three weeks later. The Labour protest against it took the form of a miners' strike at Easter, which provoked the powers granted by the Emergency Act of the previous session. The reserves were called out and a defence force was established in April; but on June 28 Mr. Lloyd George announced terms of settlement, which he claimed with inveterate optimism would

open a new era of co-operation in the industry. Peace was bought by a subsidy of £10,000,000 out of the public purse. On the other hand, decontrol coincided with a steady fall in prices and a reduction in the bank rate from 7% to 6½% on April 28, to 6% on June 23, to 5½% on July 21 and to 5% on Nov. 3. Prices, which had averaged 176 points above the pre-War level in Nov. 1920, had fallen to 133 in April 1921, and fell as much again to 92 by the end of December.

Resignation of Mr. Bonar Law.—The new policy also coincided with important ministerial changes. Lord Milner resigned in Feb. 1922; Mr. Churchill took his place at the Colonial Office; and Sir L. Worthington-Evans followed Mr. Churchill at the War Office. Mr. Long simultaneously resigned the Admiralty and was created a peer, his place at the Admiralty being taken by Lord Lee of Fareham. A greater disturbance was caused on March 17 by the resignation of Mr. Bonar Law on the ground of ill-health. This created a vacancy in the leadership of the Unionist party and of the House of Commons. Mr. Chamberlain was unanimously elected to the leadership of the party, and the Prime Minister thereupon invited him to lead the House of Commons; he also took Mr. Bonar Law's post as Lord Privy Seal. Sir Robert Horne succeeded to Mr. Chamberlain as Chancellor of the Exchequer, and Mr. Baldwin to Sir R. Horne as President of the Board of Trade. Dr. Addison resigned the Ministry of Health in April because the axe had been laid at the root of his housing policy, and was succeeded by Sir Alfred Mond. In the same month Lord French resigned his lord-lieutenancy of Ireland and was succeeded by Lord Edmund Talbot, who was created Viscount FitzAlan; his chief secretary, Sir Hamar Greenwood, was included in the Cabinet, to which Sir. L. Worthington-Evans, Sir Alfred Mond and Sir A. Griffith Boscawen were also admitted in the place of Lord Milner, Lord Long and Dr. Addison. Minor official changes followed, and in Oct. Sir Eric Geddes retired from the Ministry of Transport and from politics. Politics, however, had nothing to do with the retirement of Mr. Lowther from the Speaker's chair in April; he had occupied it for the almost unprecedented period of 16 years. He was succeeded by Mr. J. H. Whitley, and was created Viscount Ullswater. Promotion, however, could be earned by other means than resignation, and in June Earl Curzon was made a marquis and Lord Birkenhead a viscount.

Political reasons may have had something to do with the elevation May 24 of Sir Edward Carson from Irish politics into the serener atmosphere of a judicial seat in the House of Lords. The substitution of Lord FitzAlan for Lord French, interviews between emissaries of the Prime Minister and Sinn Fein leaders in Mountjoy Prison at which Dominion Home Rule was discussed, and between Sir James Craig and Mr. de Valera, all indicated that the ideas of the Government were getting beyond the grasp of " murder by the throat " and following the lines of decontrol. The elections, a few days later, to the paper parliament for Southern Ireland provided a remarkable justification for this intelligent conversion; apart from the University of Dublin hardly a candidate, Nationalist or Unionist, was forthcoming to withstand the nominees of Sinn Fein, many of whom enjoyed the credentials of imprisonment; out of 128 seats they secured 120 without a contest. The approaching Imperial Conference in London eased the approach to conferences between General Smuts, Mr. de Valera, Sir James Craig and Mr. Lloyd George. In July a truce was arranged, and conversations led to a conference which, in the autumn, produced the Irish treaty and a far more radical solution of the problem than the Home Rule Bills of 1886, 1893 and 1912, which, backed by nothing but argument, had encountered an opposition which disturbed and dominated British politics for a generation.

The Budget of 1922.—Meanwhile the budget had been introduced on April 25 by Mr. Chamberlain, because his successor, Sir Robert Horne, was absorbed with the coal strike and industrial unrest. Comparison with previous budgets was complicated by the distinction now first made between ordinary and extraordinary revenue and expenditure. The ordinary revenue for 1921–2 was estimated at £1,058,000,000; the extraordinary, arising from the realisation of war assets, at £158,000,000. The ordinary expenditure was put at £974,000,000, and the extraordinary at £65,000,000, thus leaving a combined surplus of £176,000,000. The disconcerting facts were that the National Debt stood at £7,831,000,000, and that, while the total expenditure for 1921–2 was put at £138,000,000 less than in 1920–1, the revenue was also £125,000,000 less, even including £158,000,000 accruing from the disposal of war assets. There seemed therefore to be no justification for the abolition of the excess profits duty, except the assumption (fatal to the policy of its imposition) that the removal of this tax would enable trade to make up the deficiency through more ordinary taxes. The other changes in taxation were unimportant; the income tax was left at 6s., and presumably the Government was looking for relief to the prospect of extracting fresh revenue out of its plans for safeguarding British industries.

Resolutions to this effect were moved by Mr. Baldwin on May 9. Duties to the extent of 33⅓% of the value were to be imposed for five years on specified articles in key industries, and also upon imported articles sold below the cost of production in England. Other birds, it was hoped, might be killed with the same stone; the exchange with New York, which at the end of 1920 had sunk to $3·54 to the £, might be restored, dumping might be defeated and the figure of unemployment, which rose to 2,044,655—its highest point—on June 21, might be reduced. But food, drink and raw materials were exempt. The bill framed on these resolutions was actively resisted in the House of Commons, but was carried by 312 to 92 votes, and the Speaker ruled that it was a money bill within the terms of the Parliament Act and could therefore not be amended by the Lords; a motion for its rejection was nevertheless only defeated by 68 to 43. Something was also hoped from a bill passed in March to collect German reparations by taxing, up to 50% of their value, imported German goods.

The autumn session was the shortest in modern times. It began on Dec. 14 and ended five days later. Its sole purpose was to give parliamentary sanction to the articles of agreement concluded between the Government and the Sinn Fein delegation. Lord Morley emerged from his retirement to move the address in reply to the King's speech in the House of Lords, where the treaty, denounced by Lord Carson as treachery, was ratified by 166 to 47 votes, having passed the House of Commons by 401 to 58. The treaty, however, no more gave Ireland a constitution than the treaty of Vereeniging, in 1902, had given one to South Africa; and the first business of the new session, which began on Feb. 7 1922, was to pass a bill enabling the Provisional Government of South Ireland to convene a constituent assembly to frame a constitution. In moving the second reading on Feb. 16, Mr. Churchill declared that the Government would never recognise an Irish Republic. The bill met with some opposition from a small minority, but passed both Houses and received the royal assent by March 31. The final stage of giving the sanction of the Imperial Parliament to the constitution worked out by the Irish Assembly was not reached until the end of the year, when it had to be dealt with by a new British Govt. and a new British Parliament.

Troubles of the Coalition.—The Coalition, however, survived the session, and fell, as all British governments in the century had fallen, without any apparent or immediate reference to the confidence of the House of Commons. But the rift in the Coalition lute had produced audible discord from the earliest days of the year, and in Jan. the difference was over the date of the general election. The Prime Minister wanted it soon; the Unionists, or at least their expert tactician Sir George Younger, wished for delay until reform of the House of Lords had been achieved and there was some improvement in the industrial situation; the number of unemployed, after falling to about 1,500,000 in the autumn, had risen again to nearly 2,000,000. There was, moreover, serious doubt whether the two wings of the Coalition could present a united front to the enemy at a general election, and the preparations of the Unionists for standing alone were by no means complete.

Another grievance, which came out in public during the summer, created no little resentment. The distribution of rewards for political services was determined solely by the Prime Minister, though arranged by subordinates, some of whom exemplified the wisdom of the serpent even more strikingly than others did the innocence of the dove; and it was alleged, not without cause, that lavish benefactions to public and even to party funds earned little recognition unless they went into the particular party chest which Mr. Lloyd George controlled. Sir George Younger's objections were termed by the Lord Chancellor a mutiny of the cabin boy; but the election was postponed, and in July Lord Salisbury in the House of Lords and another Unionist in the Commons moved for a select committee of both houses to inquire into the actual methods of distributing honours. Lord Birkenhead and the Prime Minister moved and carried, after lively debates, in their respective houses, the circumlocutory substitution of a royal commission to advise on the procedure to be adopted in future to assist the Prime Minister in making his recommendations.

The Geddes Axe.—It was more difficult to evade pressure outside the tied Houses of Parliament, and the maintenance of taxes at a higher level in the fourth year of peace than they had reached during the War was producing a clamour for economy which would be fatal if it were side-tracked into mere inquiry. There was, indeed, little point in decontrol unless it led to economy; and in Aug. 1921, in response to representations by 170 Unionist members, a committee had been appointed, with Sir Eric Geddes as chairman, to assist the Treasury to discharge its proper function of containing expenditure within the limits of sound finance. The chairman was criticised on the ground that he had hitherto been concerned rather with spending than saving public money, but the report of his "super-axe" committee was found too drastic for the departments concerned, all of which resisted the reductions it recommended.

On its appointment, Sir Robert Horne, the Chancellor, had put the necessary economies at £130,000,000; the committee recommended £100,000,000; and on May 9 Sir Eric Geddes complained that the saving actually proposed in the estimates had been cut down to £52,000,000. The difficulty was that, while every one wanted economy, there was no agreement on the economies to be effected; the broad divergence was between those who wanted to cut down expenditure on the army, navy and air forces and those who wanted to reduce it on education and social services. The net result in the budget was an estimated revenue for 1922–3 of £910,775,000, against £1,216,000,000 in 1921–2, and an estimated expenditure of £910,069,000 against £1,039,000,000 in 1921–2, leaving a surplus of £706,000. Mr. Asquith criticised the remission of taxes out of so small a surplus, and Sir Donald Maclean the decision to suspend the reduction of debt. Some critics were placated by the reduction of income tax from 6s. to 5s., of letters from 2d. to 1½d. and postcards from 1½d. to 1d., and of the duties on coffee and cocoa.

Reform of the Lords.—The approach of a general election was also indicated by an attempt to reform the House of Lords. It was proposed to reduce its membership to 350 and to confine the strictly hereditary seats to peers of the royal family, though other peers could be elected by their fellow peers for a term of years; law lords and bishops were to sit as at present, but a considerable element, directly or indirectly elected, was to be introduced from outside. The proposals found little favour in the House of Lords, mainly because they assumed the permanence of the Parliament Act. The root of the difficulty was indicated by Lord Crawford when, replying for the Government, he remarked that there could be no repeal of the Parliament Act unless their lordships were prepared to accept an elected second chamber and the complete elimination of the hereditary principle, a dilemma which was long to defer the settlement of the question.

A Miscellany.—More serious differences of opinion in the Coalition cropped up from time to time. The indiscreet publication of a telegram by Mr. Montagu in March led to his compulsory resignation from the India Office, and to the revelation of strong Unionist dissatisfaction with the Indian policy of the Government. Affairs in Ireland caused greater disagreement, and Mr. Bonar Law declared in July that he would not now have given the vote he gave in Dec. for the Irish treaty. Lord Carson had already in March made a platform speech, for which he was rebuked by the Lord Chancellor, attacking the Coalition and saying it was time to return to the party system, and on April 5, Sir W. Joynson-Hicks moved in the House that in view of the Government's lack of coherent principle a new ministry should be formed upon that basis—he objected to the application of Liberal principles by a Government of which he was a supporter while Lord Hugh Cecil declared that no Prime Minister could be so bad as Mr. Lloyd George, and that the country had gone from bad to worse ever since the Armistice.

Members and even ministers were at loggerheads over the embargo on Canadian cattle, the mandates for Palestine and Mesopotamia, and the self-government of Egypt hardly less than over Ireland and India; while the failure in Aug. of the London conference on reparations and the increasing friction with France portended grave risk to the stability of European peace. A shock of a different kind was given by the murder of Sir Henry Wilson on his own doorstep near Belgrave Square, London, in mid-daylight on June 22; but more damaging to the Coalition was the buoyant speech of the Prime Minister at the adjournment of Parliament on Aug. 4[1].

Greece and Turkey.—The speech dealt principally with the situation in the Near East, which was afterwards described as being one of secret war between England and France openly waged by their respective pawns of Greece and Turkey. Mr. Lloyd George denied that Great Britain was giving Greece preferential treatment, but he said that the Greeks could take Constantinople in a few hours were it not for the allied occupation, and that he did not know of any other army that could have gone as far as the Greeks had gone in Asia Minor. The Greeks were wild with delight, and placarded the speech throughout their country. Within a month that army had been routed by Mustapha Kemal and driven helter-skelter to the sea; Smyrna was taken and pillaged, and the victorious Turks swarmed up to the limits of the neutral zone, where detachments of French and British troops guarded the approaches to the Bosporus and the Dardanelles. Mustapha denied all knowledge of a neutral zone, the French were friendly with the Turks, and their detachment withdrew across the Straits. At the end of September ministers believed that war was imminent; a semi-official manifesto was issued insisting on the necessity of defending the Straits and preventing a Turkish invasion of Europe, and the dominions were invited to send contingents to defend interests for which they had already made enormous sacrifices. But France remonstrated against the enunciation of an apparently bellicose policy without previous consultation; the dominions had similar cause for annoyance, and protests against a war which Great Britain might have to wage almost single-handed came from both the Labour and Liberal parties. Popular opinion was in this respect behind them, and the Government was constrained to rely, not on force, but on diplomatic suasion exerted by Lord Curzon on M. Poincaré in Paris, and on the tact and firmness employed by Sir C. Harington at the Dardanelles.

End of the Coalition.—The crisis passed with the convention which Mustapha Kemal signed at Mudania on Oct. 11, but it sounded the death knell of the Coalition and its Government. Mr. Chamberlain and Mr. Lloyd George strove manfully against the tide of disruption in speeches at Birmingham and Manchester on Oct. 13 and 14; but on Oct. 16 Lord Salisbury denounced what he called a new method of cabinet government and an exaltation of one-man rule which had proved to be disastrous, and declared that a Bolshevist bogey was the only excuse for maintaining the coalition. It foundered at a meeting of Conservatives held at the Carlton Club three days later. Mr. Chamberlain stoutly defended the coalition and its chief, but Lord Curzon stayed away, and the attack was led by Mr. Baldwin,

[1] The total failure of the Genoa Conference, which was to "settle Europe," played a very important part (April-May 1922) in weakening Mr. Lloyd George's position. (Ed. *E. B.*)

President of the Board of Trade, who said that Mr. Lloyd George had destroyed the Liberal, and was in course of destroying the Conservative party. Behind him loomed the figure of Mr. Bonar Law, whose retirement 18 months before enabled him to maintain a sphinx-like attitude until the last.

While the meeting was in progress, news arrived of a Conservative victory at Newport in a triangular contest with Liberalism and Labour; Mr. Bonar Law declared his opposition to a combination with either. Lord Balfour, on whom an earldom had been conferred in April, held that it was a principle of the Conservative party to act on the advice of its leaders; but the resolution to fight the general election as an independent party with its own leader and programme was carried by 187 to 87 votes. Resignations were at once dispatched to the Prime Minister, and in the afternoon he tendered his own to the King, who sent for Mr. Bonar Law. On Oct. 23 the new Prime Minister was unanimously elected leader of the Unionist party at a meeting consisting both of peers and members of the House of Commons.

IV. THE COURSE OF EVENTS SINCE 1922

This was something of an innovation in Great Britain, where the invitation to form a ministry from the Crown and success in forming it had hitherto determined the leadership of parties. Only when in opposition had leaders been elected, and then only leaders of the respective oppositions in the Lords and Commons. But the practice had long been in vogue in the Labour party in Australia, and the political earthquake which produced a purely Conservative administration in Oct. was curiously democratic in its operation. The movement came from below. Lord Salisbury on Oct. 16 had expressed a firm belief in the people, and the party repudiated Lord Balfour's advice to follow its leaders. Nearly all the Conservative ex-Ministers or ex-Conservative ministers, Mr. Chamberlain, Lord Balfour, Lord Birkenhead, Sir Robert Horne, Lord Lee, Sir L. Worthington-Evans and Lord Crawford, adhered to the Coalition, and Lord Curzon was the only Minister with any cabinet experience worth mentioning who conveyed the benefit of that experience from Mr. Lloyd George to Mr. Bonar Law in October. Sir A. Griffith-Boscawen had attained cabinet rank in Feb., Mr. Baldwin in April 1921 and Lord Peel in March 1922, while Lord Derby had been a minister under Mr. Lloyd George's War cabinet in 1917–8. The other members of the new cabinet were all newcomers, largely recruited from the under-secretaries in the old.

The General Election.—This disability, if any, hardly counted in the general desire to be rid of the Coalition, and Sir George Younger, who was created a viscount for his services, had made a remarkably shrewd forecast of the results of the general election which followed in November. The Conservatives, now united under the leadership of Mr. Bonar Law, secured 347 seats by their independent efforts, against 338 they had won in 1918 with the assistance of the Coalition Liberals; those Liberals were reduced from 136 in 1918 to 59 in 1922, while the Independent Liberals increased from 26 to 59 or 60, and the Labour party from 59 to 142.

But the advantages of unity, under the existing electoral system, were most strikingly illustrated by the fact that a single united party with 5,000,000 votes won 347 seats against 268 obtained by the 8,000,000 votes cast for the three sections of the opposition. In the rout of the Coalition Mr. Lloyd George was returned unopposed for the first time in his career; but Mr. Churchill was heavily defeated at Dundee by unconventional Labour candidates, and five other Coalition Liberals who had been cabinet ministers lost their seats elsewhere. Sir John Simon returned to Parliament and Mr. Asquith retained his seat at Paisley; but Mr. Runciman and Sir Donald Maclean were defeated. So was Mr. Henderson, but Mr. Ramsay MacDonald and Mr. Snowden returned to the House, reinforced by Mr. Sidney Webb and other Labour leaders. Two women alone were elected, Lady Astor and Mrs. Wintringham, both of whom had succeeded their husbands at by-elections to the previous Parliament.

The new Parliament met on Nov. 20 and Mr. Ramsay MacDonald was chosen leader of the Labour party by a majority of five votes over Mr. Clynes. The party outnumbered both sections of the Liberals combined, and there could be no doubt about its title to the front opposition bench. Divided though the opposition was, its combined strength left the Government with a majority of only 79, and the return to normal conditions was generally recognised as an improvement upon the last House, in which there could be no effective opposition at all.

The Irish Treaty.—It was the first Parliament of Great Britain and Northern Ireland; its members had been reduced to 615 by the exclusion of Southern Ireland, and its most urgent task was to implement the constitution of the Free State. The King had been moved to impress this duty on Mr. Bonar Law, and he had impressed it upon his party on his election to the leadership before the general election. In these circumstances opposition was almost out of the question; and when on Nov. 24 Mr. Law introduced two bills, one to sanction the constitution of the Free State and the other to make consequential alterations in that of Northern Ireland, the only objections came from the two singular Communists in the House; both bills received the royal assent on Dec. 5.

Hardly more serious was the opposition to a bill removing the embargo on Canadian cattle, and there was none to another providing a loan of £6,500,000 to set Austria on her feet again. There was more searching of heart over the unemployed, the numbers of which had fallen from 1,900,000 in Jan. to 1,318,000 in Sept., but had risen again to 1,400,000 before the end of the year. A Labour amendment to the Address was moved on the subject; the Minister for Labour announced that the Government's programme included proposals for relief and general work, unemployment insurance, and trade facilities and export credits; and a reduction of 350,000 in the number of unemployed was effected during the year 1923.

Foreign Affairs.—A crisis of considerable magnitude, however, arose in foreign affairs before Parliament met again. Mr. Bonar Law had announced, on his acceptance of office, that his foreign policy would be based on cordial co-operation and friendship with France; and on Dec. 9 a conference of the British, French, Italian and Belgian Prime Ministers began in Downing street to resume the discussion of German reparations which had been interrupted by the breakdown of the conference in August. The German Govt. had submitted proposals in a note which was laid before the conference and promptly denounced as not worth discussing by M. Poincaré, who declared that nothing would move Germany but the occupation of the Ruhr or some similar form of coercion. Some such measure had been contemplated and threatened by Mr. Lloyd George on May 5 1921.

The conference came to no decision in Dec., but adjourned the discussion until Jan. 2 at Paris; and on a debate on the subject in the House of Lords Lord Grey remarked that, if the January conference failed, it might mean a further step towards the collapse of Europe and the breach of our friendship with France. He doubted the wisdom of refusing to remit our debts to European allies merely on the ground that the United States declined to remit what Great Britain owed; he thought, however, that the strong measures recommended by France were more likely to produce the collapse of Germany than the payment of reparations. In the House of Commons a general who had been stationed in Germany expressed the view that the object of French policy was to break up Germany into small states, beginning with the separation of the Rhineland from the Reich. The general situation was rendered all the more difficult by the fact that Lord Curzon was at Lausanne endeavouring to place on a permanent footing the precarious agreement made with the Turks at Mudania; and a serious difference with France would at least prolong the unrest in the East.

The Prime Minister saw Lord Curzon in Paris before the conference opened on Jan. 2. No middle course was found between the English desire to give Germany, "purely as a business proposition," in Mr. Bonar Law's words, breathing time to

recover, and the French idea of compensating themselves for the absence of reparations and for the failure of the Anglo-American guarantee, proposed in 1919, by security through the dismemberment of Germany and the establishment of the Rhine as its frontier. The Entente Cordiale gave way to the "Rupture Cordiale," whatever that might mean, and France was left with a free hand to deal with a disarmed Germany without British assistance. Belgium supported France, but Italy's co-operation was purely formal.

Occupation of the Ruhr.—On Jan. 11 the occupation of the Ruhr began, many of the troops employed consisting of negroid auxiliaries which France had introduced into the heart of Europe to make up for her own declining birth rate. It required no little tact on the part of the British troops at Cologne to maintain the excellent relations which were said to exist between them and both the Germans and the French. If ever Great Britain was an arbiter, it was during 1923–4, but the arbitration had to be implemented by patience rather than by force; and it was by a year's patience and passive resistance that Germany convinced the French of the futility and folly of their enterprise.

The American Debt.—Meanwhile, Mr. Baldwin, the Chancellor of the Exchequer, had sailed for New York to negotiate terms for the funding of Great Britain's debt to the United States. This stood at some £963,000,000 sterling, all borrowed for the War, and some of it to be passed on to Allies to whom the United States had refused advances without a British guarantee. In Great Britain it was considered hard that she should pay interest, on that part of the debt especially, to the United States, which had profited enormously out of her neutrality during the greater part of the War, and where taxation was trivial compared with its burden in Great Britain, while Great Britain herself was receiving nothing from her European debtors. The ordinary citizen in the United States was, however, unacquainted with these facts, and more responsible persons to whom they were known were unfavourably impressed by the huge sums which the European debtors of the United States continued to spend on armaments. It was idle, they argued, to contend that these countries could not pay their debts while they lavished money on objects inconsistent with their professions as a League of Nations; and they felt that whatever they remitted as debt would go to increase armaments, which the United States had striven to restrict at the Washington Conference, and would have restricted further but for the opposition of their European debtors.

A partial reply to this reasoning was that European armaments were partly due to the refusal of the United States to implement President Wilson's proffered guarantee to France or to take its place in the League of Nations. But it was recognised that argument would not reconcile the conflicting points of view, and even British public opinion was fairly unanimous that any reasonable settlement, however onerous it might seem, would be better than none. Nor, regarded from a strictly business point of view, were the terms inequitable, and the city of London was strongly in favour of acceptance. Three per cent was to be paid for the first 10 years, and 3½% for the remainder of a period of 62 years, with an additional half of 1% as a sinking fund. The settlement materially added to Mr. Baldwin's reputation, and contributed to the restoration of British credit.

The Baldwin Budget.—The Chancellor's first budget, which he introduced on the April 16, was also well received. A revenue of £914,000,000 and an expenditure of £812,000,000 had produced a surplus of over £101,000,000 which went to the reduction of debt. Mr. Baldwin remarked that nothing would ease the finding of capital for industrial purposes so much as the steady redemption of public debt, and he proposed a sinking fund of £40,000,000, increasing to £45,000,000 the next year and to £50,000,000. The income tax was reduced from 5s. to 4s. 6d. and £1 a barrel was taken off beer. Mr. Asquith thought it should have been taken off sugar, Sir Alfred Mond preferred the lightening of taxation to the reduction of debt; Labour contended that taxation paid by the working classes should have been reduced rather than on income and property. But generally the Chancellor was thought to have been as wise in the disposal of his surplus as he had been fortunate in its inheritance.

The other legislation of the session was of a somewhat modest character. Mr. Neville Chamberlain did rather better than his predecessors with the annual Housing Bill, but modestly described it as being not a solution but the beginning of a solution of the problem. Some relief was also afforded to agriculture, and the Home Secretary had to be relieved of the legal responsibilities he had incurred under the Habeas Corpus Acts for deporting to Ireland prisoners over whom the Free State claimed jurisdiction.

Death of Mr. Bonar Law.—The great disaster to the Government was the resignation of May 20 of the Prime Minister, who died on Oct. 30 following. It was impossible to fill his place, and the choice of a successor caused his party anxious consideration. Lord Curzon had great claims and greater expectations; in ability and industry he had few equals and no superior. But his aloofness from the rank and file, his ambiguous attitude in the crisis of Oct., his friction with France, and his position in the House of Lords were serious obstacles to his selection; he attributed his failure to the last of these circumstances, and there was much significance in the fact that leadership of the House of Lords should be considered incompatible with the headship of what was almost a "die-hard" Government. Mr. Austen Chamberlain, who had been leader of the Unionists in the House of Commons, was ruled out by a Conservative clique for his fidelity to the Coalition; and that as well as advancing years and his peerage disqualified Lord Balfour.

Mr. Baldwin Becomes Premier.—This left Mr. Baldwin practically without a competitor, and no opposition was raised to his election as leader of the Party on May 28, six days after he had been entrusted by the King with the duty of forming an administration. He had, it is true, only two years cabinet experience, but Mr. Bonar Law had had none when he was elected leader of the Unionists in the Commons in 1911, and that experiment in novelty had been unusually successful. Mr. Baldwin had, moreover, taken a decisive part in demolishing the Coalition which, as he said in his first speech as Prime Minister, came only just in time to save the Conservative party from the disruption that had overtaken the Liberals. Other qualifications had been concealed by the absence of showier qualities; a man of sterling character and of more insight than was suspected, he had broad human sympathies not often associated with industrial capitalists, and he was the antithesis of the hard-faced profiteers who had compromised the Coalition by the fervour of their support.

A certain ambiguity, however, characterised the overture of his Government. He retained for the moment his Chancellorship of the Exchequer, but was known to be anxious to strengthen his Ministry and close the schism which excluded the Unionists, who had belonged to the Coalition. Mr. Chamberlain would have come to his assistance, but was barred from the Administration, as well as from the Premiership, and the only accession to the Cabinet was Lord Robert Cecil who became Lord Privy Seal. The Prime Minister, however, still hoped to secure as Chancellor of the Exchequer either Sir Robert Horne or Mr. R. McKenna, one of whom had held the office during the declining days of the Coalition while it had compromised the purity of its Free Trade principles, and the other under Mr. Asquith. The claims of business and of banking, respectively, given as reasons to the public for the refusal of both, were not exhaustive explanations; and it seems clear that Mr. Baldwin had not yet reached the conclusion that Protection afforded the only cure for unemployment.

Still, the financial orthodoxy of his Budget did not completely conceal or correct his leanings towards fiscal heresy; and it is possible that the alternatives of Sir Robert Horne or Mr. McKenna did not imply so much ambiguity as appeared on the surface. Conceivably Mr. Baldwin expected Mr. McKenna to take the same view as he did of certain duties which Tariff Reformers, in gentle retaliation for Mr. McKenna's refusal of office, insisted thenceforth on naming "the McKenna duties."

Those duties had been imposed while Mr. McKenna was Chancellor, after an Allied Conference at Paris in June 1916, and as an economic aspect of the war with Germany which some of their advocates hoped would outlive its other forms; and their idea was to provide for reconstruction and reparation after the War by means of tariffs, and also to provide against future wars by securing economic independence and control of key industries for the Allies by something like a Zollverein, the quaint assumption being made that enemies in the existing war would necessarily be enemies in the next. The immediate object of the duties was, however, to render Great Britain independent of enemy products during the War, and had nothing to do with unemployment which the War had practically extinguished; Mr. Long, indeed, declared in the House on July 11 1916 that it was non-existent.

Unemployment.—Unemployment was, however, a serious problem in 1923. The numbers had fallen during 1922 from nearly 2,000,000 on Jan. 1 to 1,695,000 at the end of the year, and a further reduction to 1,191,000 was effected by the end of June 1923; but in September they were rising again, and a change in the fiscal system might cure the evil, or alternatively might reap the credit for the amelioration in the industrial situation which some observers were beginning to anticipate as the result of slow but natural causes. While the figure rose to 1,246,000 on Oct. 1 it did in fact recede to 1,137,000 just before Christmas, its lowest point since demobilisation.

Imperial Conference.—Considerations other than the reduction of unemployment affected the imperialistic minds of some of Mr. Baldwin's younger colleagues. A tribunal of economists, appointed in Dec. 1922, reported in April in favour of "a cautious use of the power of the State to obtain for agriculture a somewhat greater measure of security than it had enjoyed for the past half century," and simultaneously the Prime Minister announced that, concurrently with the regular Imperial Conference, an Imperial Economic Conference would meet on Oct. 1. There was to be a great Exhibition of Imperial products at Wembley in 1924, and the Board of Education was to tune the schools to this imperial note; a circular was prepared requesting teachers to suspend their ordinary historical instruction in favour of a special six months' course devoted to the greatness of the British Empire. All this would provide an admirable setting while the House of Commons would be enacting a policy of Imperial Preference and Protection. The curtain was not to be raised at once; but before the end of July 1923 intelligent forecasts found their way into private conversations, and when Mr. Baldwin eventually divested himself of the Chancellorship it was announced on Aug. 28 that Mr. McKenna was unable to join the Government and that the mantle had fallen on Joseph Chamberlain's second son, Neville.

Relations with Russia.—Foreign affairs claimed attention before the *dénouement* of this domestic drama. In May Lord Curzon threatened a renewed breach with Russia, not so much on account of Bolshevik propaganda in the West as of its disturbing influence in Asia. It was dimly beginning to be perceived that Marxist Communism had proved a fiasco and made little appeal to any industrial community, but that the newer Bolshevik orientation was a far more serious and significant problem. Russia was, in fact, destroying the western façade which Peter the Great had imposed upon the country, and the Tartar in the Russian reverted to his original type. Bolshevik Russia lost all her western provinces, but easily recovered the Siberian conquests of the Tsars. The "war on heaven" was Russia's recantation of her whilom championship of the orthodox church against the Moslem and the Turk, and it paved the way for the Bolshevik assumption of the British part in Asia, which the Kaiser had challenged when he claimed to be the friend of Moslems all over the world.

But anything oriental was fish to the Bolshevik net: Chinese troops had been the most useful of their mercenaries, and Bolshevik influence overthrew the peace Lord Curzon dictated to Persia in 1919, penetrated into Afghanistan, played a large part in Chinese civil wars, and fostered discontent in India. But none of her new friends brought much grist to the economic mill of Russian destitution, and the "new economic policy" of 1922–3 recognised the need of western trade and capital and implied, perhaps, some doubt of the permanence of the new orientation. Krassin travelled by aeroplane to London in May to convey surprising acquiescence in Lord Curzon's somewhat dictatorial demands.

Relations with France.—With France relations were more and more strained as distrust of the wisdom of her Ruhr adventure grew into detestation of the methods employed, not so much to extort reparations as to dismember a disarmed country, to the integrity of which, as restricted by the Peace of Versailles, the Allies had pledged themselves. The worst was concealed by the Government out of consideration for French susceptibilities, but there was considerable indignation in Parliament and outside with the "wait and see" attitude of the Government and with the studied deliberation with which M. Poincaré, confident in his own methods, postponed the consideration of Britain's tardy efforts to find a practical solution.

The Cabinet was in fact divided, and the difference was somewhat strikingly illustrated by the discrepancy between Lord Curzon's note to France on Aug. 11 denying the legality of the occupation of the Ruhr, and the Prime Minister's statement, after an interview with M. Poincaré on Sept. 19, that there was no divergence between them in purpose or in principle with regard to Reparations. French intransigence was commonly attributed to M. Poincaré's knowledge of the support he enjoyed within the British Cabinet, but Mr. Baldwin did not expressly extend his approval of French purpose and principle to their methods, and in September there were extraneous reasons for avoiding disputes with France.

Greece and Italy.—A third crisis had been precipitated by M. Mussolini's hasty extension to other countries of the methods of the Fascisti. On Aug. 27 General Tellini and four members of his suite were murdered while engaged on a League of Nations commission to delimit the Greco-Albanian frontier. The outrage certainly occurred on soil that was claimed by Greece; but without waiting to ascertain whether the criminals were Greeks, M. Mussolini sent an ultimatum to Greece, and on Aug. 31 bombarded and seized Corfu. It was a repetition of Austria's action over the Serajevo murders, copied down to the phraseology used by the disputing parties, with this difference, that Tellini's mission was under the auspices, not of Italy, but of the League of Nations.

The incident produced a remarkably strong and unanimous expression of opinion by the League of Nations then in session at Geneva; but the Council of Ambassadors, which was still kept up, to temper with diplomatic caution the convictions of indiscreet humanity, intervened to secure the evacuation of Corfu, without compensation for its bombardment, and to impose a fine on Greece without waiting to ascertain who the murderers were. The credit of the League was thought to have suffered a shock; but Corfu was evacuated and it was the Conference of Ambassadors which disappeared. The general effect of the situation upon the prestige of the Government was indicated by Sir Robert Horne's assent to a remark by Mr. Asquith that Great Britain had almost ceased to count among the Great Powers of the world.

Mr. Baldwin and Protection.—Meanwhile, early in Oct., the British Dominions had met in conference and inspected the progress of the Wembley Exhibition; and on Oct. 9 Mr. Bruce, the Australian Premier, pleaded for a thorough Protectionist policy for England on the ground that it alone provided adequate scope for Colonial Preference. The Government at once indicated that it would go as far as it could within the limits of Mr. Bonar Law's pledge in Oct. 1922 not to introduce general protection during the lifetime of the Parliament then to be elected; and on Oct. 25 at Plymouth Mr. Baldwin announced that the only way of fighting unemployment was by protecting the home market, while his Chancellor of the Exchequer added that the Cabinet would have to seek release from Mr. Bonar Law's pledge.

The conversion of the Ministry and its announcement were hardly bolts from the blue to careful students of political meteorology. But the Prime Minister himself appears to have been surprised by the rapidity with which he was hustled towards a general election. He gave no hint of it in other speeches five and seven days later, and not until Parliament met on Nov. 13 did he announce that he had advised the King to dissolve it on Nov. 16. The wisdom of dissolution was not apparent, and a confession was read into his remark a year later that it was not often a man was given a second chance. He had an adequate majority over all other parties in the House; Parliament had still four years to run; unemployment, while serious enough, had been reduced by 25% or 30% in nine months without heroic measures, and Mr. Bonar Law had pleaded for a period of tranquillity. It seemed as though his successor was bent on throwing away substantial advantages for a delusive policy on which his party were not agreed.

To the feud between Coalition and anti-Coalition Unionists were added division between free traders and full protectionists and the alienation of both. Mr. Austen Chamberlain denounced the exclusion of wheat and meat from the proposed duties, and said it was a mistake to fight a great fight on a little issue, while Lord Derby and Lancashire inclined towards the view of *The Glasgow Herald* that Mr. Baldwin's policy was one in which the Unionist Party could not succeed without disaster to the country, nor fail without disaster to itself.

It succeeded, however, in averting one danger which Mr. Baldwin feared. He had remarked in his first speech as Prime Minister that the Coalition had been destroyed just in time to prevent the disruption of the Conservative Party; yet his succession to the Premiership had coincided with a vigorous effort, led by Mr. Churchill and Lord Birkenhead, to revive the Coalition under the name of a Centre Party in order to combat socialism. The revival of the free trade issue precipitated Liberal reunion, and enlisted the support of Mr. Churchill, who found his nearest approach to a Coalition among the Liberals. But while that reunion preserved Conservatism from the contamination of Coalition, it did not save the country from the experiment of a Socialist Government.

The General Election.—The general election took place on Dec. 6. Most Unionists had anticipated a reduced but still comfortable majority over all other parties. Their disappointment was due less to any great alteration in the distribution of the popular vote, than to the co-operation between the two Liberal sections and the restriction of contests between Liberal and Labour candidates to 52 seats. The Unionists lost about 75,000 votes, while Labour gained about 250,000 and the Liberals about 180,000 out of some 14,000,000 polled. But the Unionists lost on a balance 88 seats while Labour gained 47 and the Liberals 41. The result was that, instead of 346, there were only 258 Unionists in the new Parliament; instead of 144 there were 191 Labour M.P.'s; and instead of 117 there were 158 Liberals. Apart from eight Independents, Labour and Liberal members combined had a majority of 91 over the Government which had dissolved with a majority of 85.

Labour had again secured the place of the largest party in opposition, and would assuredly regard it as its duty to oppose; but it was not so clear that the Liberals would turn out Mr. Baldwin in order to install Mr. Ramsay MacDonald, nor, indeed, that the followers of Mr. Asquith and those of Mr. Lloyd George would take the same view of their duty in the matter. Mr. Baldwin, relying upon this ambiguity and upon the fact that he still had a bigger majority over Labour than Labour had over the Liberals, determined to wait in office and see what Parliament would do.

Historical Precedent.—The Christmas vacation was mainly occupied by a vigorous discussion of the political situation and its constitutional implications. There was no particular novelty in the existence of three parties in the House of Commons, no one of them possessing a majority over the other two combined. Daniel O'Connell held the balance of power between the Whigs and Tories in 1835 when his "Lichfield House compact" with the Whig Opposition turned out Peel and set "an evil precedent, pregnant with disastrous consequences." The Peelites themselves held the balance a few years later between Liberals and Conservatives. Liberals held office by virtue of Irish votes in 1886, 1892–5 and 1910–4, and a Conservative Government by Liberal Unionist votes, not represented, save by Mr. Goschen, in the cabinet, from 1886 to 1892.

The difference lay in the relative depth of the dividing lines; the stability of these recent Governments reposed upon the fact that one issue, Home Rule, overrode all others, and divided the Government from the Opposition more fundamentally than any division within their respective ranks. But in 1924 no two parties were bound together to pursue a specific policy. Nor was it easy to discover anything more fundamental in the division between a liberalism, not very clearly defined, and a socialism with many shades of meaning, than in that between liberalism and a tariff reform which might mean anything between a "whole hog" and a pork chop. To Sir John Simon's argument that the Socialist programme of nationalisation of the means of production, distribution and exchange meant the nationalisation of *all* these means, it might be replied that liberalism meant the nationalisation of none, and, therefore, implied the abolition of the Post Office, the repeal of a good deal of Liberal legislation, and the abandonment of several items in its programme. Free Trade was a clearer issue than most, and foreign policy came next; and the two together provided the basis upon which Mr. Baldwin was turned out and a Labour Government installed in office for the first time in English history.

The Position in Theory.—The constitutional argument turned on the question how far the leader of a party in a permanent minority could impose on the Crown an advice which depended for its authority upon the assumption that he enjoyed the confidence of a majority. Extreme doctrinaires held that the Crown must act on that advice even though it involved a dissolution of Parliament against the wishes of the Crown, the Commons, and the country, and envisaged a ministerial prerogative based on a purely Bolshevist theory of executive irresponsibility. But there were clearly practical objections to its adoption; according to it Mr. Baldwin might, instead of resigning on his defeat in the House, have plunged the country once more into another general election; Mr. MacDonald might, remaining in office after the general election of 1924, have done the same in Nov. or Dec. 1924; and a Government might theoretically maintain itself in office by a series of dissolutions. The best practical answer, however, to those who regarded absolute control over dissolutions as the sacred ark of ministerial prerogative, is perhaps the facts that no Prime Minister in the 20th century, except Mr. Asquith, has yet (1926) exercised it more than once, and that the more eager the claim to control the greater the penalty inflicted by the country for its exercise.

The first effect of the election was to provoke from timid minds an agitated appeal for another coalition of Conservatives and Liberals, and alternatively, either a Liberal agreement to support a Conservative Govt. or Conservative support for a Liberal Government. Mr. Asquith hastened to pour scorn upon this invocation of him as a saviour of society, and made no concealment of his intention to assist in the downfall of Mr. Baldwin's Government. Mr. Baldwin, whose supersession was one of the motives of the movement, could hardly have consented to a coalition in view of his action in Oct. 1922, and he somewhat easily weathered the attack on his position as Conservative leader.

Fall of the Baldwin Ministry.—He met Parliament on Jan. 8 1924 with a bold front and a programme shorn of Protection, but replete with proposals borrowed from Labour or the Liberals. The question was one of confidence, which a Labour amendment to the address denied in simple terms to Mr. Baldwin's administration. The amendment was supported by Mr. Asquith, who was the arbiter of the situation, and was accordingly heard with a respect which had not for nearly 10 years been paid to his words. Some of his nominal supporters did not relish his advice; 10 voted with the Government and six abstained; but the bulk

of the Liberals, added to the Labour vote, gave a majority of 72 for the amendment on Jan. 21, and for the first time since Mr. Asquith's own amendment on Aug. 11 1892, the House of Commons enjoyed the sensation of ejecting a ministry from office by a direct vote of censure.

Labour in Office.—Mr. Baldwin resigned, and Mr. MacDonald accepted office on the following day. He had already prepared his colleagues. There was necessarily a good deal of inexperience in the cabinet of a party taking office for the first time, and only three of Mr. MacDonald's colleagues had been in one before—Lord Haldane, who returned to the woolsack, Mr. Henderson, and Mr. Clynes. But there was a general desire to give the new Government a "fair chance;" and one or two Ministers, Lord Chelmsford, and possibly Lords Olivier and Parmoor, accepted office rather on the ground that the King's Govt. must be carried on, than from any particular zeal for Labour politics. Lord Olivier had, however, long been a member of the Fabian Society; Lord Parmoor, a prominent churchman and a Conservative M.P. from 1895 to 1914, had been attracted by Labour's devotion to peace; and there was particular need at the Admiralty for some one of Lord Chelmsford's experience and tact to bridge the hiatus between the senior service and the youngest of political parties.

Mr. Walsh, however, got on excellently at the War Office, though finding it a little difficult to be properly superior to his subordinate, the Earl of Cavan, chief of the Imperial General Staff. Probably the most effective of Mr. MacDonald's colleagues were Mr. Philip Snowden, who became Chancellor of the Exchequer, and Mr. J. H. Thomas, who went to the Colonial Office. Mr. MacDonald himself took the Foreign Office, too heavy a burden to combine with the leadership of his party and of the House of Commons. He was justified by the success of his dealings with France and Germany, and by the very favourable impression he produced at home and abroad; but overwork and strained nerves had a good deal to do with the abbreviation of his term of office.

France and Russia.—The European situation had taken a slight turn for the better before Mr. Baldwin resigned, owing to President Coolidge's intimation, in Oct. 1923, of America's willingness to participate in an inquiry into Germany's capacity to pay reparations and to M. Poincaré's consent in Dec. to the appointment of committees for the purpose; and by a tactful letter to the French Prime Minister on Jan. 26 Mr. MacDonald established a friendliness in personal relations which had been impossible under the Curzon-Baldwin diarchy. In response to this suavity or in intelligent anticipation of the French general election, M. Poincaré showed himself more accommodating on the Rhine. With regard to Russia, however, Mr. MacDonald reversed his predecessor's policy, recognised the Soviet Govt. on Feb. 1 and invited it to send plenipotentiaries to London to discuss existing treaties and the settlement of existing claims between the two Governments and their individual subjects. The Liberals warmly supported this policy, and still more warmly the Government's decision to abandon the project of a great naval base at Singapore. It was different with Mr. MacDonald's acceptance of his predecessor's plan of laying down five fresh cruisers, albeit his reason was peaceful employment rather than warlike preparation. This did not meet the Liberal plea for economy, and the Government had to rely on Conservative votes to save them from defeat.

Housing and Unemployment.—The most singular failures of Labour in office related to those domestic problems for which it was thought to have specific cures, namely housing and unemployment. The number of unemployed, which had risen during the last fortnight in Dec. to 1,280,000, had, indeed, been reduced by the end of June to 1,009,500, the lowest point since demobilisation; but at the end of Sept. it was up again to 1,215,000, and before the end of the year to practically what it had been at the beginning. This was worse than the modest anticipation of Mr. Shaw, the Minister of Labour, in May, that the figure would remain at about 1,000,000 for the next two years and in the third would not sink below 800,000. The most plausible defence was that of Miss Bondfield, the first woman minister, to the effect that the Labour remedy was the nationalisation of land, mines, railways and main roads, which was impossible till Labour obtained power as well as office. Mr. Wheatley was no happier, as Minister of Health, with his housing policy, the fundamental trouble both with it and with unemployment being the reluctance of the majority of workers who were employed to risk reduction of wages and dilution of labour for the sake of those who were not.

The Labour Budget.—The Labour Govt. seemed doomed to prosper by its liberalism rather than its socialism; and Mr. Snowden came to the rescue on April 29 with a free trade budget, which pleased the Liberals a great deal more than it did some of his colleagues, including his own Prime Minister. The internal debt had been substantially reduced, and the external, save that to the United States, wiped out; and the Chancellor estimated his expenditure at £790,000,000 and his revenue at £828,000,000. He proposed, therefore, to halve the duties on tea, coffee, cocoa and chicory, and to reduce that on sugar from 25s. 8d. to 11s. 8d. per cwt., thus taking, he said, "the greatest step ever made towards the near realisation of the cherished Radical idea of a free breakfast table." He also proposed to abolish the inhabited house duty, and, after June 30, the corporation profits tax. He announced that the Government were unable to endorse the resolutions of the Imperial Conference in favour of Colonial Preference, but proposed to retain the existing ones. The McKenna duties, however, were to be abolished after Aug. 1. This last proposal provoked the most discussion, but Mr. Baldwin's motion regretting it was defeated on May 12 by 317 to 252. The effect of the Budget as a whole was to increase the gap between the Conservatives and the Government and to diminish that between the Government and the Liberals; and Mr. Thomas's interjection during the budget debates to the effect that the Government had many more budgets to introduce implied an expectation of continued co-operation between the two parties. The co-operation had to be active because mere abstention by the Liberals would insure the defeat of the Government.

The French Election.—Meanwhile another stroke of good fortune befell the Government in the French general election in May. The failure of the Ruhr adventure to produce financial fruits, coupled with its cost, had forced upon M. Poincaré the unpleasant necessities of taxation and retrenchment. These were not at all the results which France had expected, and her obvious reluctance to meet her obligations started the franc on the downward path of the German mark; not till it had fallen to nearly 130 was its progress checked by American and British intervention, dictated by fear of the effects on French external trade. This assistance did not save M. Poincaré, who had gone so far as to sanction a breach of the French law requiring annual budgets, from electoral resentment; but, as in England during the autumn, the success of the Radical and Socialist parties was due rather to increased co-operation than to any great turnover of votes. The result was the same, namely to give a majority to a combination of left centre and left parties, which enforced the retirement (June 11) of the French President, M. Millerand, on the ground that he had improperly identified himself with M. Poincaré's policy, and substituted M. Herriot as Premier for M. Poincaré.

A European Agreement.—Semi-Socialist governments in the two countries could now discuss the Dawes plan and the Ruhr with greater cordiality and better prospects of agreement. On June 21–2 M. Herriot paid a visit to Mr. MacDonald at Chequers and Mr. MacDonald returned it at Paris on July 8–9; as a result invitations were issued to a conference of the Allies in London which opened on July 16. Mr. MacDonald presided with a skill which materially contributed to its striking success; and on Aug. 16 a settlement was reached, embodying the Dawes plan and an agreement between French and German delegates for the liquidation of the Ruhr adventure, which was ratified by the French Chambers and the German Reichstag. This, claimed Mr. MacDonald with some justification, was the first real treaty

of peace since the War, because it was made by agreement and not dictated by force.

Difficulties of the Government.—This was the climax of the Government's success, and already ominous signs were appearing of trouble in other directions. One was the refusal of Northern Ireland to appoint, as provided by the Irish treaty, a commissioner to assist in the delimitation of the Free State frontier; but this only caused a Conservative outburst, which the Government could afford to ignore so long as it retained Liberal support. It was, however, sore over the number of Liberal amendments it was forced to incorporate in its housing, unemployment insurance and agricultural wages bills; and on one occasion the Prime Minister angrily refused to "feed out of Mr. Asquith's hand."

The final breach, however, was imposed upon him by his left wing, inspired by Mr. Wheatley, whom it would have preferred as Prime Minister. The negotiations which the Government had initiated with Soviet Russia dragged on from April until Aug. 5, when an official announcement was made that the conference had broken down; late that night, however, some four or five members of the extreme Labour left succeeded, by secret diplomacy, in persuading the rival negotiators to meet once more,[1] and on Aug. 6 the Under-Secretary for Foreign Affairs informed the House that a treaty had been drafted and would be signed next day. The determining consideration was the suggestion of British capital to Communist Russia in return for an acknowledgment and partial satisfaction of British debts. Unofficial intervention of a secret character also determined the withdrawal on Aug. 12 of the Government's prosecution for seditious libel of Mr. Campbell, who was the acting editor of *The Worker's Weekly*.

The first of these incidents caused most of the political discussion in Sept., but it was the second on which the Government fell. The Conservatives had at once denounced the Russian treaty in the House, and Mr. Lloyd George joined in the attack on its loan proposal. He renewed his attack during the recess on Sept. 10, and defied the Government to proceed with its ratification. Lord Grey took similar objection in a milder way on Sept. 18, and on Sept. 20 Mr. Asquith followed suit in a letter, but not without a hint that some modification of the treaty might induce Liberals to acquiesce in its ratification. The cabinet met on Sept. 22, and seemed not altogether averse from the idea. On Sept. 27 the Prime Minister explained that the Government only proposed to guarantee so much to Russia as she could raise in the ordinary way in the money market, and that it would guarantee nothing until the conditions were fulfilled.

Simultaneously there appeared, in the second edition of his *Socialism, Critical and Constructive* (1924), a denunciation of Russian Bolshevism and British Communism. The path was still open to peace between Labour and enough Liberals to avert a defeat of the Government. Both parties were at one over the Irish Boundary Commission, and all parties concurred in Mr. MacDonald's prompt refusal of Zaghlul Pasha's demand that Great Britain should relinquish the Sudan to Egypt. The urgency of the Irish question, however, required the reassembly of Parliament on Sept. 30, instead of four weeks later. The Boundary Bill went through without opposition except from Conservatives who did not persist therein, but the meeting of Parliament provided facilities for a disruption which might have been postponed or avoided, had the combatants kept apart on their respective platforms instead of coming into contact in the House of Commons.

Defeat of the Government.—On Oct. 1 the Liberals put down a motion on the Russian Treaty, but that was not to come up until Nov. On Sept. 30 Mr. Baldwin asked for a day to discuss, when Parliament met again at the end of Oct. the Government's action over *The Worker's Weekly*. It is not easy to apportion the responsibility for the anticipation of the crisis, and it may have been inadvertence rather than the deliberate choice of an issue which led Mr. MacDonald, in replying to Mr. Baldwin, to suggest an immediate discussion of the Campbell case. When that motion appeared next day as a vote of censure, constitutional propriety required that it should not be left hanging over the Government for a month, and it would seem that the Conservatives, who were already convinced that they had most to gain by a dissolution, were least anxious to avoid it. Mr. Churchill had just come out as a Conservative candidate, and, apart from that accession of strength, he was ever the best indicator of the quarter from which the wind was going to blow. Conservative tactics were certainly on this occasion more skilful than those of other parties.

The Liberal motion on the Campbell case was for a select committee, which need not be treated as a vote of censure any more than were those for the Jameson Raid committee or the Marconi inquiry; and, put as an amendment to Mr. Baldwin's vote of censure, it would ensure the defeat of the latter. If Mr. Baldwin's contention had been correct that the Government wished to defeat his motion by means of Liberal votes and the Liberal amendment by Conservative votes or abstention, it would have absolved Mr. MacDonald from the charge of precipitancy which the Conservatives incurred by voting for the Liberal amendment to their own motion and thus defeating the Government on Oct. 8 by 364 to 198. It was difficult for Mr. MacDonald not to regard an amendment as a vote of censure when the majority, who voted for it, had a vote of censure in their minds and on the paper. Partly by accident and partly by design, the Liberals had been hoist with their own petard and made to appear as willing to wound but afraid to strike; and the dilemma in which they found themselves was prophetic of their disaster.

Another General Election.—The Government naturally preferred dissolution to resignation, though they forfeited the prospect of a year or two of office and of budgets by which they could have effected much, as well as the unpopularity of a third dissolution in two years. The Conservatives were even more willing, and a windfall helped them in the Zinovieff letter inciting British citizens to disorder in the interests of international communism. The Foreign Office regarded it as genuine, and Mr. MacDonald demanded an explanation from the Russian Govt., which denounced the letter as a forgery. The original had not been seen, but a copy had found its way into the offices of *The Daily Mail*. After the election a committee of the Labour Govt. was unable to come to a positive conclusion, but a subsequent committee of its Conservative successors thought the evidence for its authenticity conclusive.[2] The effect of the bombshell was more disastrous among half-hearted Liberals than wholehearted Labour voters, and the polling revealed a landslide in public opinion. It was a falling away from the Liberal party in both directions. It lost 1,250,000 votes: the Conservatives gained 2,000,000 but Labour also gained 1,000,000.

This result was, as usual, grossly exaggerated in the members returned; less than half the votes cast—7,864,402 out of 16,302,455—gave the Conservatives more than two-thirds out of the whole House—413 out of 615 seats; Labour, with just over a third of the votes, obtained 151 seats, less than a quarter of the House; and the Liberals with nearly a fifth of the votes obtained 40, or less than a fifteenth of the seats in the House. Mr. Asquith lost his seat at Paisley and was presently created Earl of Oxford, the latest, but, with the doubtful exception of Harley, easily the most distinguished holder of that historic title; and Mr. Lloyd George, Sir John Simon, Mr. Runciman, Mr. Fisher and Sir Alfred Mond were the chief survivors of a disaster which seemed to show that Liberalism had fulfilled its function in British politics. Labour, while driven from office, had succeeded in its more immediate object of defeating its rival for the succession.

[1] Mr. MacDonald stigmatises as a "common error" the statement that "half a dozen unofficial members of Parliament reopened the negotiations and drafted the agreement" (*The Observer*, (London) March 21 1925). This does not, contradict the statement in the text.

[2] See the text and comment in A. J. Toynbee's *Survey for 1924* (1926), pp. 246–50, 492–6; the matter is still involved in obscurity due to the ambiguity of the relations between the Third International and the Soviet Government.

The Second Baldwin Ministry.—In a sense it had done so by converting both its rivals. The King's speech, which Mr. Baldwin had drafted in Jan. 1924, marked an enormous advance in Conservative thought; the Labour party had repudiated its Communist wing and definitely committed itself to the cause of orderly progress, and not a few Labour and Conservative leaders had called themselves Liberals and retained much of the faith in which they had been brought up. In the long run it might seem to make little difference to the country whether it took alternate doses of rival prescriptions, or adhered consistently to a compound of both. One thing was certain; the country would not remain always content with the same advisers, and the need for an opposition was only second to that for a Government.

Mr. Baldwin's second administration was a great improvement on his first; the Coalition feud was healed, and the new Cabinet included most of the able ministers who had been banned in 1922. Mr. Austen Chamberlain went to the Foreign Office, from which it was Mr. Baldwin's painful duty to exclude Lord Curzon; Lord Cave returned to the woolsack, but Lord Birkenhead was given the India Office; Lord Balfour succeeded Lord Curzon as President of the Council on Lord Curzon's death in March 1925; Sir L. Worthington-Evans returned to the War Office; and Mr. Churchill received, in the Chancellorship of the Exchequer, the reward of intelligent anticipation. But the House was the poorer for the holocaust of Liberal critics, and Mr. Baldwin's huge majority deprived its proceedings of an essential stimulus to liveliness. The country did not exactly want to rest and be thankful; but it wanted to get along without being over-driven by supermen and without being governed by a perpetual series of general elections.

The Meeting of Parliament.—The new Parliament met on Dec. 2 to find some results of the general election already registered in the Government's repudiation of the Russian treaties, the revival of the Singapore naval base, and the claim for excessive reparations from Egypt for the murder of the Sirdar, Sir Lee Stack; the Italian press approved of the British demands on the ground that they justified Italy's action the year before over the assassination of General Tellini. The Government, however, was continuing Mr. MacDonald's policy in rejecting Zaghlul's claim to Egyptian control of the Sudan and in bringing to a successful conclusion the negotiations for a commercial treaty with Germany. Another reversal of policy, indicated in Mr. Baldwin's declaration that in the view of this Government the late Government's instructions to the attorney-general to institute no political prosecutions without the sanction of the cabinet was unconstitutional, was modified a few days later by his statement that the attorney-general should in such cases inform himself of the views of the Government or the appropriate minister before coming to any decision. The chief outstanding ambiguity related to the Government's tariff policy. Mr. Baldwin on Dec. 9 renewed his pledge not to introduce Protection into the new Parliament, but on Dec. 17 he announced that a bill would be introduced next year to give any industry which could prove itself to be substantial and efficient general protection against unfair competition from abroad. How far "efficiency" in an industry was compatible with failure to meet competition, and how far "unfair" was identical with successful competition were questions demanding careful consideration.

Mr. Churchill's Budget.—Before Parliament reassembled, on Feb. 10 1925, the Government had determined to drop the idea of a tariff bill, in order, said Mr. Baldwin, to restore the House of Commons to its constitutional position as the taxing authority; and the Government's proposals were embodied in the budget which Mr. Churchill introduced on April 28. There were certain "sumptuary duties" on natural and artificial silk, and a "nakedly protective" duty on imported hops; the McKenna duties were reimposed, and the preferences recommended by the Imperial Economic Conference of 1923 were accorded so far as they did not involve new or additional duties upon food. These sumptuary, protective or preferential duties in the budget were subsequently supplemented by bills, introduced after reports by Board of Trade committees in favour of special measures of protection; and lace, gloves, gas mantles and certain kinds of cutlery were granted.

An application on behalf of the steel industry was rejected, not apparently on the ground that it was illogical, or that foreign competition was fair, but because steel involved so many particular industries that their sum might infringe the pledge against general protection; some of the parts must be left out lest they should make a whole. These concessions to the protective wing of the party were balanced by a new scheme for old age pensions at 65 and pensions for widowed mothers, by sixpence off the income tax and increased allowances for earned and smaller incomes. The fly in the ointment of the budget was an estimate of expenditure, amounting to nearly £800,000,000, and soon to be increased, until, at the end of the year, the Chancellor was faced with the dilemma of revoking his boons or imposing drastic and comprehensive economy.

The Gold Standard Restored.—The soundest of Mr. Churchill's achievements was, perhaps, the restoration of the gold standard, though its beneficence was disputed by some economists and it had little apparent effect upon trade or unemployment. Most progress was made with housing, but the 150,000 new houses owed their existence to private rather than to state or municipal enterprise; rent control was continued, and the total number of unemployed was only reduced during the year from 1,307,140 to 1,251,900. Coal mining threatened catastrophe, and at the end of June the owners intimated that they could not go on without a reduction in wages, which the men would not even discuss; a disastrous strike was only averted on July 31 by the dubious expedient of a subsidy, put at first by Mr. Baldwin at £10,000,000, but more than doubled by the end of the financial year. A commission sat throughout the autumn and into 1926 to deal with a problem for which none of the party creeds provided a solution. Owners could see salvation only in increased hours of labour and reduced wages and railway expenses, while the community paid for German indemnities by maintaining British miners and spent in the way of subsidies to coal what it saved by using other fuel.

The Pact of Locarno.—The need of retrenchment at home ingeminated peace abroad, and the spirit of Locarno pervaded the political atmosphere of the autumn. The Government had, in the spring, rejected the League protocol, conceived on Wilsonian lines and supported by the sentiment of labour and America, after it had been accepted by the great majority of the members of the League, and had turned to the more restricted but feasible ideas embodied in the security pact which was initialed at Locarno in Oct., ratified by the relevant parties in Nov., and signed in London on Dec. 1. By it Great Britain, France, Germany, Italy and Belgium bound themselves, collectively and severally, not merely, like the famous "scrap of paper," to respect but to guarantee the existing frontiers between Germany and France and between Germany and Belgium. The treaty was only to become effective on the day on which Germany entered the League of Nations. Whether this condition was inspired by fear lest Germany should decline to enter, or lest other Powers should shut the door, the universal anticipation was that it would be fulfilled.

Some ill-grounded apprehension had been felt in May over the election of the veteran Hindenburg as German President on Ebert's death; but that event belonged to the same harmless national psychology as that which made Marshal MacMahon President of the French Republic in 1873; and just as that was followed by the German evacuation of France, so Hindenburg's election was followed by the French evacuation of the Ruhr and the British evacuation of Cologne. For his services in the negotiations Mr. Chamberlain received the Garter and the gratitude of the world. The decision to proceed with Singapore was followed within a year by another to reduce Rosyth and Pembroke to a care-and-maintenance basis.

The spirit of peace spread to southeastern Europe; and after Greece and Bulgaria had been constrained by the League to forego a frontier war in Oct., even the Balkans began to talk of a security pact for their own particular cockpit. The League also

decided at length in Dec., mainly in favour of Britain, the claim, disputed by Turkey, to Mosul, though the solatium which would induce the Angora Turks to acquiesce was left over until 1926 for arrangement between the parties.

The Irish Boundary.—How far peace was induced in Ireland by the threat of the Free State to refer its frontier problem to the League is a matter of speculation. The refusal of Ulster to appoint a boundary commissioner in 1924 had been followed by the appointment of a distinguished South African judge, and an unauthorised forecast of the commission's report in Nov. 1925 precipitated at first a revival of contention and then a settlement between the parties without recourse either to the commission's report or to the League of Nations. The existing frontier was maintained and consolation extracted from the British Exchequer in the form of relinquished British claims to indemnities for destruction during the hostilities of 1921–2. Whatever the friction between the north and the south, there was, it appeared, an Ireland united at least in this: no Irishman would obstruct another in any claim he might have against the British Treasury, and all would resist a peace enforced in Irish homes by intruders from outside.

Position at the End of 1925.—Great Britain was left at the end of 1925 freer than it had been for 15 years to contemplate its own domestic discontents; and, for the moment, there was even there an uncommon absence of violent disagreement. The evils were admitted, and the remedial principles only disputed on the ground that they did not go far enough. The complaint of the Liberals, as of the Whigs 60 years before, was that their clothes had been stolen while they were bathing or basking in a setting sun. Socialists echoed the refrain with the reservation that it was a rising sun in which they basked; and when a Conservative Govt., acquiesced in the Parliament Act and political levies by trade unions, cold-shouldered the reform of the House of Lords, maintained state control of rents and prices, proposed to hew a way through city slums, bestowed old age and other pensions on an unexampled scale, and lavished subsidies on coal and protection on efficient industries, it was difficult to discern a basic principle of differentiation between the parties.

Labour had in Sept. repeated and reinforced its repudiation of Communism; even Mr. Wheatley's left wing was all but excluded from the executive of the party, and Mr. MacDonald regained his restraining influence. The two major parties were, in fact, suffering or benefiting by a process from which no party and no cause is ever immune, namely a dilution of its principles inherent in the extension of its size and the increase of its popularity. Intensity is the perquisite of the few, dilution the property of the mass. Dilution had even to be imposed upon the land policy, which Mr. Lloyd George inaugurated in the autumn, before it commended itself to his party; and such loss of voting power as threatened the Government was mainly due to the intensification of its policies of protection and economy.

In the first half of 1926, what had been called "the Locarno spirit" was violently disappointed. Germany's expected entry into the League of Nations as a permanent member of the Council with the moral status of a Great Power was vetoed by Brazil. That country's action was disapproved too late by the British and French governments, but earlier they had countenanced opposition by Poland and Spain to Germany's unconditional admission. This sequel to the Locarno Pact was widely censured and nowhere more generally than in Great Britain. (A. F. P.)

The Coal Commission reported in March condemning the subsidy, but recommending an extensive reconstruction of the industry and some temporary reduction in wages. (*See* COAL.) Again negotiations between miners and owners broke down and government intervention failed. A general strike was then declared by Labour at the beginning of May. It was one of the greatest social crises by which any country had been shaken since the War but it only lasted nine days. Volunteers and motor-transport played a chief part in preventing the paralysis of communications by the Trade Unions. The struggle had been watched with breathless attention by the world. The calm firmness and competence of the British people as a whole raised them accordingly in the world's respect. The miners stood out alone and the coal strike dragged on into June 1926. In the early days of that month earnest efforts for a settlement were afoot. There were strong hopes that the "spirit of Locarno" would prevail after all, both in the industrial field and in foreign policy. (ED. *E.B.*)

BIBLIOGRAPHY.—The great bulk of the original material for English history during these 15 years is contained in Hansard's *Parliamentary Debates* and the even more numerous volumes of parliamentary and official papers, for which see H. B. Lees-Smith's useful *Guide to Parliamentary and Official Papers* (1924). One of the most important of these is *The War Cabinet: Report for the Year 1917*, Cd. 9005, published by H.M.S.O. (March 1918), which is valuable not only as a record of achievement but of the now forgotten ideas of that body; no other British Govt. has published a similar record of its work or revelation of its methods. These official sources have not yet been supplemented to any great extent by personal or private revelations: the interval is too short to have permitted the publication of the confidential papers, correspondence or memoranda of British statesmen, or of their biographies or memoirs. Such as have appeared have generally been fragmentary and partial, often eked out with gossip misleading in proportion to its indiscretion. Most of these volumes, moreover, relate to the War, and are dealt with elsewhere.

Pre-eminent among periodical publications are *The Times* for its fullness and general accuracy, and *Punch* for its happy and impartial reflection of the passing mood. A good deal of history can also be made out of or verified by such annuals as the *Statesman's Year Book* and *Whitaker's Almanack*, while the *Annual Register* provides a valuable half-way house between daily papers and history. The documents it contains, while important, are few, and its usefulness consists, so far as English history is concerned, mainly in the political summaries compiled from *Hansard*, *The Times*, and other periodical literature.

Some political history is contained in books dealing primarily with the genesis, history, or consequences of the War, such as Lord Haldane's *Before the War* (1920), an account of his mission to Germany in 1912; Mr. W. Churchill's *The World Crisis*, 2 vol. (1923), the first volume of which deals with the prelude to the War, and the second with its naval history until Mr. Churchill's resignation; Sir George Arthur's *Life of Lord Kitchener*, 3 vol. (1920); Mr. H. H. Asquith's *Genesis of the War* (1923), which is authoritative but scrupulously reticent; and, weightiest of all, Lord Grey's *Twenty-Five Years*, 2 vol. (1925). For the documents in any complete form we have, however, to wait for the completion of the task with which Dr. G. P. Gooch and Mr. H. W. V. Temperley were entrusted in 1925 when the Government consented to open its foreign archives for that purpose. Political history also intrudes to some extent into J. Buchan's *History of the War* (1921–2), published in 24 volumes during its course and re-written in four volumes after its conclusion, and also into A. F. Pollard's *Short History of the War* (1920).

Some English political history for the period after the War is to be found in Mr. H. W. V. Temperley's six-volume *History of the Peace Conference*, published under the auspices of the British Institute of International Affairs (1920–4), and in its even more valuable continuation in Professor A. J. Toynbee's *Survey of International Affairs 1920–3* (1925), *The World After the Peace Conference* (1925), and *Survey of International Affairs, 1924* (1926), all produced under the same auspices. But this is mainly international and diplomatic history. For domestic history we have to rely almost exclusively on parliamentary and official papers, periodical literature, and personal recollection or information. (A. F. P.)

ENGLISH LITERATURE (*see* 9.607).—It must remain for a remoter posterity to pass final judgment upon the English literature of 1911–26; to decide which (if any) of the authors then living were really great; to discern with certitude the trends and the characteristic colour of the age.

I. INTRODUCTION

Among those who lived through the period, it was a common opinion that it was not an age "of giants"; that the poets were not as great as Browning or Tennyson, nor any of the novelists as eminent as Dickens, Thackeray or Fielding. That opinion, as yet, can only be tentative; in the ultimate, reputations are decided by the permanent, as contrasted with the topical, appeal to the human mind and heart; and it may be that to posterity all the writers of the age will seem to have qualities and a tone in common which were not evident to themselves. It certainly does appear to us that there was a harmoniousness, a shared adventurousness, curiosity and delight, general in the Elizabethan age; that the Puritan, the Cavalier and the "metaphysical" groups may be clearly distinguished in the next age, all three having much in common; and that the reaction against religious,

political and aesthetic excess produced in the 18th century a set of compromises and conventions on the basis of which men worked easily, confidently, with agreed assumptions and agreed aims. Yet we see these things more positively than our fathers did, and we cannot be sure.

Tendencies in Literature.—If there is foundation for the general view that there is a defect of passion in the most recent English literature and a lack of major achievements, the reasons must certainly be found in the state of thought and of what passes for thought. Men's views about the universe, the purpose of life and the nature and destiny of the soul must profoundly influence their works of art, as well as their other actions, however frequent may be the antinomy between their proclaimed theories and their obscure but obstinate impulses. There can be no doubt that the period under review was, at least in what are called "intellectual circles," a period of confusion and conflict, of doubt manifesting itself here in energetic pessimism, here in fatigue and apathy, here in blind hedonism, here in a desperate search for new creeds, sometimes brutally pagan.

The monstrous calamity of the War forced the perennial problem of evil upon the attention of those who would have been disturbed by no lesser, or less spectacular, shock; evolutionary science and comparative mythology had continued to sap the foundations of popular religion and were as yet imperfectly reconciled by contemporary thought in what a bishop has described as "the provisional correlation" of Christian truth with the latest developments of knowledge or hypothesis; the social reforming enthusiasm and the belief in automatic progress of the Victorian age had weakened and in the reaction the imagination brooded upon the prospect of an ice age and the imperfectibility of man. Meanwhile, the mass of questions asked ever since the feudal and Catholic system broke up were reinforced by a new chorus disputing the fundamentals of traditional morality. "Why should I?" was the dominant note, accompanied by a subtler "Why shouldn't I?"; and often neither awaited an answer.

Those who dislike what they regard as the "pollution of pure literature" by didacticism, propaganda, controversy may well find subject for complaint in modern English literature. When a whole set of dogmas is generally accepted both artist and audience may take them for granted, whether forgetting them, building on them or artistically embroidering them. Artists in such an age may sing like birds; where all are in disagreement, or at least perpetually worrying, harshness will creep into the song. At best, argument has its day; even the great genius of Voltaire and Rousseau cannot keep the bulk of their works alive; and those moderns whose plays and stories are coloured by argument, which is negative rather than positive, are handicapped, not merely by the ephemeral nature of the argument, but by the lowering effect of their views upon their general temperament, their capacity for ardent joy, fierce passion and acute grief.

II. FICTION

Conrad and George Moore.—Politics, popularised science, psycho-analysis and their results are powerfully present in a large proportion of the most intelligent modern novels, and the novel, grown polymorphous, is the characteristic medium of the age. Just as the Pre-Raphaelites segregated themselves behind the arras in flight from the smoke of the first industrial age, so certain modern novelists have declined to be affected by the smoke of modern controversy. Amongst novelists, since Meredith and Stevenson died, Joseph Conrad and George Moore were signal examples of the kind of artist who can build a raft for himself and escape from the topical welter. Conrad had his religion and his morality, "a few simple maxims," a code of honour and fidelity. He did not shrink from the major problems either; he was perennially occupied with the difficulties of conduct, the mystery of evil, the veil over the face of Destiny. Yet, as an artist, he did not primarily set out a sublimated journalist, to mingle art with conversion or subversion, to add his word to the babel of tongues discussing property, sex, the multiple self and spiritualism. His views were manifest and set; so were his doubts; he wrote to record what he saw of magnificence, even in the form and visage of tempest and terror, in the most beautiful language he could find; he was an artist in characterisation, in construction, in his treatment of the visible and invisible world.

Of Conrad's last works, *The Rover* (1923) was a prelude to the posthumous *Suspense* (1925), the torso of what might have been a great book, set in the Mediterranean, with Napoleon in Elba a shadow imminent over the action. He died in 1924, a Pole by birth, a seaman by training, who had achieved miracles in a tongue not his own and left a long series of tales, from *Almayer's Folly* (1895) to *Suspense*, mainly concerned with the sea, particularly the East Indian seas (with the psychology of conspirators as a strong secondary interest), written with such scrupulous art, such power of description and suggestion, such a march of sound, such chivalry of spirit, that it is difficult to conceive of them as tarnishing with time.

George Moore, in his latest years, modified his manner and took new materials. His Irish trilogy, *Ave, Salve, Vale* (1911–4), might be classed, by some of the friends whose words and deeds it records, with "fiction"; at least it does indicate his aims. Politics and religion may be and are touched on here, but they are raw material for art, for witty, graceful and tuneful writing; and the desire to create a finely shaped and phrased work is never subordinate to a desire to inform the reader. In *The Brook Kerith* (1916) and *Héloïse and Abélard* (1921), Moore took historical events and settings and made of them stories like tapestries, in the evenness of their flow and the carefulness of their execution. A touch of Pre-Raphaelitism may be detected in them, and some affinity with Pater's one long story, but few artists have owed less, in an obvious way, to their predecessors than Moore, and the ease and translucency of his English, in its latest developments, was unique in our time. The prose flowed like conversation, but no conversation was ever so well shaped and worded.

Other Leading Novelists.—Apart from these, the outstanding novelists of their generation were H. G. Wells, John Galsworthy and Arnold Bennett. Ultimately, Wells is not likely to be thought of primarily as a novelist, and he himself has stated that he has dedicated himself to journalism rather than art. He was the Rousseau, as Shaw was the Voltaire, of his time; he used a great variety of forms to communicate his opinions about the problems of the day and the morrow, to inculcate his enthusiasm for the physical sciences and to awaken the human race to the great possibilities before it, should it but be infected with his ardour for racial reconstruction, a more heroic (or alternatively more comfortable) life, and for the exploration of the worlds around and within us. As a workman and a poet in prose, he never excelled his early short stories and "scientific romances," in which extreme assumptions led up to ingenious and seemingly inevitable chains of consequence. Nor did any of his later novels, in which sexual romance, contemporary politics, satire and Utopian preaching are mingled, betray quite the same care or contain quite such fine sustained passages of description as *Tono-Bungay* (1909).

But *Mr. Britling Sees it Through* (1916) was a remarkable record of the effect of the War upon one man's mind, and *The Undying Fire* (1919), a very striking and successful modernisation of the arguments canvassed in the *Book of Job* and *In Memoriam*. He was tireless as a tractarian and amongst the most astonishing by-products of his great energy and zeal was an *Outline of History* (1919–20), unique among such compilations for the raciness of its narration and the ingenuity of its summary of all the world's annals since the ball of fire first began to cool. *The Salvaging of Civilisation* (1921) was one of his titles; a man who believes that to be his mission and the dissemination of opinion on a variety of subjects the best means to the end, is too preoccupied to write great novels or careful prose.

The reforming, or at least the protesting, bias was strong also in the novels of John Galsworthy. *The Forsyte Saga* (1922), a collection of novels, early and late, about one respectable family, was the crown of all his work. For all his air of detachment Galsworthy could not help presenting the respectable and complacent incompletely; more humour might have led to more

truth; so even might a less acutely sensitive humanitarianism. But the achievement of his presentation of the *moeurs* of South Kensington and of country houses cannot be denied; much is there that must be recognised as very faithful record; his characters often lead an independent life, and his writing at its best, if uniformly quiet, is extremely good.

In Arnold Bennett the propagandist instinct was much weaker, though the reporting proclivity was strong. His later, like his earlier, novels varied greatly in importance. He was never slipshod and dull, but in some of his books the chief interest lay in brilliant journalistic descriptions of superficial aspects of "West-End life," some were light-hearted farces, and the best were long meditated and profoundly "understanding" stories about real human beings, stories in which all his talents were brought into play, but all kept subordinate to his genius. The chief of his later books, a worthy successor to *Clayhanger* (1910) and *The Old Wives' Tale* (1908) was *Riceyman Steps* (1923). In this book Mr. Bennett did for his physical and social background, Clerkenwell, what he had long ago done for the Five Towns. The place is known as a place long lived in; the pages are full of pictures ranging from the Hogarthian genre to the Whistlerian nocturne; yet all is seen through the eyes of the characters, the miserly bookseller and his wife and especially Elsie, the brave and lonely maid-of-all-work.

A Younger Group.—Among the younger novelists, Hugh Walpole, Compton Mackenzie, Rose Macaulay, E. M. Delafield, Sheila Kaye-Smith, Francis Brett-Young, Virginia Woolf and Margaret Kennedy were widely read. D. H. Lawrence, brooding like many of them over the mysteries of sex and expounding vaguely prophetic things, showed great descriptive power and a gift for sentences like lightnings. Walter de la Mare in *Memoirs of a Midget* (1921) wrote a long modern fairy tale, like a poet's wood, full of flowers and insects, with a candle-light window at the end of a path and the constellations glittering in the dark sky overhead. H. Belloc's *The Four Men* (1912) was remarkable for its Sussex walks, its gay dialogue and its songs. E. M. Forster's *A Passage to India* (1924) was the most notable book of a maturing and slowly-working novelist, a book in which the artist brooded over the whole surface of Indian and Anglo-Indian life, showing the general through the particular. David Garnett's *Lady into Fox* (1923) and Hugh de Selincourt's *The Cricket Match* (1925) were short books beautifully composed. Among short-story writers W. W. Jacobs lost none of his old cunning and Katherine Mansfield, cut off in her youth, came, in *Bliss* and *The Garden Party*, nearer to Tchekhov than any of his many disciples. May Sinclair, J. D. Beresford, E. F. Benson, Leo Myers, R. H. Mottram, Aldous Huxley, P. G. Wodehouse, Frank Swinnerton and many other names might be added to the list of the novelists who, during the period, produced novels competent or more than competent.

III. POETRY

It is conceivable that in later retrospect the War years and the years immediately preceding and following the War will be held in literature to be chiefly remarkable for their poetry. There may have been few long poems of great note, but a very large volume of good lyric poetry by a very large number of writers was produced.

Bridges and Hardy.—One of the most extraordinary phenomena of the period was the continued fertility of the older poets. When nearly eighty, the poet laureate, Robert Bridges, produced a new volume of poems, *October and Other Poems* (1920), a collection which showed no waning of his technical powers, experimental curiosity and gift of observation, and (more unusual still) no slackening of his emotional ardour. Perhaps the finest of all our landscape poets, and certainly one of the most careful and cunning artists who has ever worked with English words and English rhythms, he stands out conspicuously also by virtue of his perennial freshness and energy, an energy manifested, moreover, in these later years in the compilation of a noble wartime anthology, *The Spirit of Man* (1916), and of various papers on prosody and pure English.

As Dr. Bridges at Oxford, so Mr. Thomas Hardy at Dorchester continued to command the astonished admiration of his juniors. Mr. Hardy, turning to verse in his old age after a long, and nobly productive, servitude to the novel, did not attempt to emulate the vast enterprise of *The Dynasts* (1906), a panorama of the Napoleonic era, with the Fates and the Pities and the Ironies brooding over it. But he followed up his three earlier volumes of lyric and narrative poems, a series of volumes beginning with *Satires of Circumstance* (1914) and culminating in *Human Shows* (1925). Grim little tragedies, tender memories of the beloved dead and Wessex scenes long vanished, hard clear etchings of landscape, sea and shingle, down and puddled lane, bare tree and shivering bird; many of these written in extreme old age, surpassed the best of Mr. Hardy's previous work. These poems were marked by a great and seemingly spontaneous gift of metrical invention, a power of emotion which enabled the poet to incorporate the most unmanageable words in the movement of his music and a quick sensitiveness, a capacity for suffering and pure joy, rare in the old.

Doughty and Others.—Another prolific veteran was C. M. Doughty (d.1926), author of *Travels in Arabia Deserta* (1888), one of the greatest books of the kind in any language, who followed up his *Dawn in Britain* (1906), with a series of long poems. *The Clouds* (1912), *The Cliffs* (1909), *The Titans* (1916) and *Mansoul* (1920), epical dramas and dramatic epics in which archaism and topicality, naïveté and sublimity are strangely mingled, are interspersed with massive passages in which the imagination ranges over all time; and in which the tongue, albeit with something of the accents of Chaucer and Spenser, speaks with prophetic force of imagery; and with other passages which to any one but an idolator must seem bathetic.

Sir William Watson published one volume during, and one after, the War in which, whilst not equalling his major achievements, he showed that his talents for pithy yet magniloquent statement and for the careful polishing of verse remained unimpaired. Maurice Hewlett (d.1923) devoted his last years mainly to poetry. His *Song of the Plow* (1916), perhaps the finest of all his works and certainly one of the few memorable long poems of the period, was a racy, vigorous, picturesque summary of English history from the point of view of "Hodge." His *Village Wife's Lament* (1918), a very poignant ballad of the effect of the War on the same kind of community, was a pendant to it. Laurence Binyon, of the other poets of that generation, perhaps wrote the most impressive volume of War poetry, *The Four Years* (1919), in which the meditations and agonies and exaltations of the humanitarian and the patriot in face of the great calamity are expressed with power and dignity.

Noble poetry inspired by the War was also among the last work of Herbert Trench (d.1923) and Alice Meynell (d.1922), Mrs. Meynell's little book *A Father of Women* (1917) displaying rigid restraint, perfection of workmanship and concentrated emotion, which have been characteristics of her work, both in prose and verse, throughout her career. A similar frugality was manifest in A. E. Housman's *Last Poems* (1922), its author's first collection of poems since *A Shropshire Lad* (1896), of a generation before. A few of the new poems surpassed the finest of the old for beauty of imagery and cadence, and the book was received with enthusiasm by the larger public and with reverent admiration by Mr. Housman's fellow artists. Gilbert Murray continued to add to his beautiful translations from Euripides. One volume, which contained some excellent epigrams and some spirited poems of the War, was all that the period added to the poetical works of Rudyard Kipling.

There remain a large number of poets whose reputations were not fully established in 1911, or who emerged during or after the War. The most notable progress among the former was made by Walter de la Mare, whose early books were followed by *The Listeners* (1912), *Peacock Pie* (1913) and others, including a two-volume collection in 1920. This poet usually inhabits provinces which he has made his own: Woods haunted by fairies, midnight gardens and heaths haunted by ghosts, desolate shores haunted by memory. His imagination broods intensely over

these, making the least flutter, tap or bird's cry momentous; or it returns to the happy or unhappy places of childhood, to the aunt's placid parlour, the cobwebbed shrubbery, the nursery, the populous countries of Grimm and Andersen. The exquisite melody and felicity of his most typical work would give him a high place among English poets; yet what is called the "major" note is not absent from his work, in which one suddenly encounters some profound allegory of man's bewilderment in the universal struggle, or some casual flung phrase like:—

When music sounds all that I was I am
Ere to this haunt of brooding dust I came.

The slow, vivid, sunlit style of T. Sturge Moore was again seen at its best in *The Sea is Kind* (1914); G. K. Chesterton, with "Lepanto," the songs in *The Flying Inn* (1914) and a few comic poems intensified his readers' regret that he should find so little time for verse; Hilaire Belloc added a few beautiful lyrics, notably "Tarantella," to the small body of his serious verse; and W. H. Davies almost annually delighted his admirers with a little collection of nature lyrics, of which the best achieved a simple perfection, and the worst had a certain peculiar charm. Alfred Noyes, with the two first volumes of *The Torch Bearers* (1922–5), opened an ambitious epic of human intellectual development. These two "covered" astronomy and geology; both were very readable, no small merit in a long poem, and contained fine passages, as well as being permeated by a faith and resolution not common in these years.

Masefield and Brooke.—In 1911 there broke upon the world John Masefield's *The Everlasting Mercy*, a sensational story of conversion written in vigorous octosyllabics. It had, as lively narrative work usually has, a great success; and the author followed it up with a series of long poems on rural and marine tragedies. *Dauber* (1913) was probably the best of them, but there were good things in all, especially the *genre* pictures in *The Widow in the Bye Street* (1912). Of his shorter poems "Biography," a series of vivid pictures from memory and "August 1914," were notable.

Several of the best poets of their generation died in the War. Rupert Brooke (d.1915), by virtue of his beauty, radiant personality and talents, became, when his *1914 and other Poems* (1915) were published, the general symbol of youth that went into the furnace. His maturer work showed grace, wit, intellectual curiosity and a growing perception of the chief goods of life; his five famous war sonnets, his manifesto and testament, remain intact in their brightness and nobility, though perpetually quoted and even misapplied.

James Elroy Flecker (d.1915) died of consumption at Davos, cut off from home by a ring of battle-grounds. His *Collected Poems* (1916) show that he had outgrown early affectation and uncertainty, achieved a style, pictorial and euphonious, of his own, and secured his grasp upon his deepest loves and most personal dreams. The East, which fascinated and repelled him, inspired many of his best things; it was also the source of his posthumous drama *Hassan* (1922), which was produced at His Majesty's in 1923. This is an imperfectly constructed tale of Haroun and Baghdad, with elements of farce and romantic comedy interwoven with dreadful tragedy, against a gorgeously spectacular background of moonlight and minarets, Persian hangings, silver fountains, ballets and processions of torturers and troops. Wilfred Owen, killed in 1918, was unknown in life. His *Poems* (1920) were very interesting for their technical use of assonance; but his technical genius, however remarkable, was less so than the magnitude of his vision and the ardour of his spirit, which produced unforgettable pictures of physical battle and of the torture of man crucified in the trenches. Charles H. Sorley (d.1915) was another boy who was killed on the verge of greatness; and Julian Grenfell (d.1915), professional soldier and fine boxer, went to his death with the finest song of the War on his lips, *Into Battle* (1915).

Edward Thomas (d.1917) had had a strange career. Before 1914 he was known as a voluminous writer and journalist whose hackwork was scattered with fine descriptions of nature, but whom no one thought of as a poet. Under the stimulus of the American poet, Robert Frost, he turned, in his last two fertile years, to the making of poetry, nature poetry unique in its kind. He knew the south of England intimately; he had learned to love any sight a man may see leaning over a gate: trampled mud, a stack of sprouting swedes, a stone roller overgrown by nettles. Exact observation and record of landscape could go no farther than this; but his *Poems* (1920) would not be as fine as they are were it not for their faltering music and the positive, if quiet and melancholy, personality which suffuses them all.

Poets of the War Period.—Siegfried Sassoon, Robert Graves and Robert Nichols all came into notice during the War as writers of powerful and "realistic" poems describing it. Surviving, they all developed interestingly. Graves first wrote charming songs of a fanciful nature, then curious poems in which the ballad was (as it were) crossed by psycho-analysis; Nichols, in his later work, employed, on themes of nature and love, an eloquence from which most modern writers too fastidiously shrink; Sassoon, quietly experimenting, searching his own heart and noting the ugly, the pretty and the comic aspects of the human panoramas, actual and historic, prepared himself for what may prove a very interesting and significant future. Ralph Hodgson (*Poems,* 1917) was always a poet of slender production, but his "Song of Honour" (a successful competitor with C. Smart's *Song to David,* 1895), "The Bull" and "Eve" are among the best-loved poems of the time. Edmund Blunden, mainly a recorder of rural scenes in the tradition of Morland and Constable, showed a very individual talent, and John Freeman must be singled out for the beauty of his rhythms, his spiritual strength and his landscape;[1] D. H. Lawrence (especially *Birds, Beasts and Flowers,* 1923) for his hard graphic power and apprehension of the crude forces of nature. Amongst others who, in few poems or many, have beautifully registered moments and moods, have dreamed or reflected, are Lascelles Abercrombie, Gordon Bottomley, A. Y. Campbell, John Drinkwater, Edward Davison, Frank Kendon, Harold Monro, Edward Shanks, W. J. Turner, Dorothy Wellesley and Victoria Sackville-West.

The Irish poetical movement (*see* IRISH LITERATURE) begun in the previous generation by "AE" (George Russell) and W. B. Yeats, showed signs of exhaustion. "AE" wrote little; Mr. Yeats in his later poems escaped from "the Celtic twilight", abandoned the Celtic myths and discarded the languorous manner of his early triumphs for a hard, bare style in which, used for describing the outer world and the inner, he wrote poems often obscure but always full of thought, which many held to be his finest. Thomas Macdonagh and Joseph Plunkett, who died after the Easter Week rebellion of 1916, had written good lyrics; Joseph Campbell, Seumas O'Sullivan and a few others did as much; but the most notable "new" poet of the period was James Stephens, author of the delightful prose fantasy *The Crock of Gold* (1912).

It is impossible to close this survey, however, without a reference to certain deliberate "movements" conducted by poets who held a strong conviction that the main poetic tradition had petrified, as that of the 18th century petrified. It is doubtfully profitable for an artist to write in violent reaction against other artists; to determine to treat of "new" subjects because others are too conventional in their themes, or to produce something as unlike "regular" poetry as possible because others grind their organs too mechanically. Much of the "free verse" both in England and elsewhere has been marked by a cold-blooded intellectualism, a bookishness (though of a new kind) and an excessive preoccupation with the technique of expression that are adverse to the production of poetry. Great poets do not flaunt banners proclaiming themselves Imagists, Cubists, Vorticists or, for the matter of that, psycho-analysts; the technique of poetry is a means to an end, and propaganda or the conveying of information an incidental matter. Where such writers, undoubtedly gifted, as Richard Aldington, F. S. Flint

[1] Blunden and Freeman were awarded the Hawthornden Prize, founded by Miss Alice Warrender in 1919 for imaginative work by young writers, the other recipients during the period being Edward Shanks, Romer Wilson, David Garnett and R. H. Mottram.

and their American confrères succeed with their "free verse" there is nothing unorthodox about them: music is music, truth truth, accuracy accuracy, sincerity sincerity and some of *les jeunes* waste time throwing bricks at imaginary Aunt Sallies who maintain that poetry must rhyme, that line patterns must be "regular" and that aeroplanes and complexes are taboo in literature. It is not for us to decide which of our poets, if any, rank with the greatest. If there be a malady which prevents any of them from so ranking it will not be cured by taking thought, still less by incorporating chemical formulae into verse, or by innovations of technique or typography; as thinker, as religious or irreligious man, the poet is partly the child of his age; and whatever he be his strength must partly reside in the response that his age can give him.

IV. CRITICISM

The publication of works of pure scholarship, and new editions with critical apparatus, was seriously affected by the expenses of production during the War and post-War periods. Nevertheless, a considerable number of important standard editions, especially through the University Presses, were published, notably Prof. Grierson's *Donne* (Oxford, 1912), the first volumes of C. H. Herford's and Percy Simpson's *Ben Jonson* (1925), some volumes of the Cambridge *Shakespeare* (a new text embodying the results of the bibliographical researches of A. W. Pollard and J. Dover Wilson (1920) and R. W. Chapman's exhaustive *Jane Austen* (1923). The *Cambridge History of English Literature* (1907–16) was brought to a conclusion and Prof. Oliver Elton published his massive *Survey of Modern English Literature* (1912 and 1920). Prof. Caroline Spurgeon's *Five Hundred Years of Chaucer Criticism and Allusion* (1925), in three volumes, was an outstanding example of the specialised literary research work which is largely superseding the older kind of academic criticism.

Gosse and Saintsbury.—Among critical studies of a less encyclopaedic kind, the most substantial were done by the older men, notably Sir Edmund Gosse and George Saintsbury. Sir Edmund Gosse, enjoying an Indian summer, produced numerous volumes of collected papers in which he illuminated authors and movements, ancient and modern, English and foreign, incorporating anecdote and personal sidelights with incomparable ease and grace, and delighting his readers by the suppleness, wit and pictorial brightness of his clear and idiomatic style. Most memorable perhaps, were the essays in which, with consummate skill, he etched the appearances, manners and habits of thought of men and women, celebrities and oddities, whom he had known. The most important of his later publications was *The Life of Algernon Charles Swinburne* (1917), a model of brilliant portraiture, compact narrative and sane criticism.

Mr. George Saintsbury, who retired from his Edinburgh professorship in 1915, completed his edition of the *Minor Caroline Poets* (1905–21) added *A History of English Prose Rhythm* (1912), *A History of the French Novel* (1917–9) and the *Peace of the Augustans* (1916) to the prodigious pile of his historical works; and made delightful use of his vast erudition and full-stored memory in several miscellanies including two about wine. At Oxford Sir Walter Raleigh and at Cambridge Sir Arthur Quiller-Couch lectured brilliantly and published the best of their lectures. Standard lives of Keats and Byron were produced by Sir Sidney Colvin and Ethel Colburn Mayne; and theoretical treatises of a high order were Percy Lubbock's *The Craft of Fiction* (1921) and Geoffrey Scott's *The Architecture of Humanism* (1914). The death of Arthur Clutton-Brock, in 1924, prematurely removed one of the most luminous and sensible of the literary journalists, publishing short criticisms regularly in newspapers and periodicals, who abounded in the period. Others who did good critical work were Edward Garnett, a notable discoverer of talent, John Freeman, Lascelles Abercrombie, Harold Nicolson, Gerald Gould, R. Ellis Roberts, Arthur MacDowall, Robert Lynd, T. Sturge Moore, J. B. Priestley, Osbert Burdett, Lytton Strachey, Edward Shanks, Maurice Baring, Virginia Woolf; and, among critics of the drama, A. B. Walkley and Desmond MacCarthy.

V. MISCELLANEOUS LITERATURE

The essay flourished in the period, but mainly in a modern form. The old leisurely manner was practised with perfect success by Max Beerbohm in *Seven Men* (1919), *And Even Now* (1920) and other collections. A caricaturist and parodist of genius, Beerbohm wrote with an awareness that made him extremely careful to secure the last degree of accuracy and flavour in his language, to arrange the cadence of his sentences, to exhaust his subject as it presented itself to his mind, the mind of a humorous, witty and tender connoisseur of life and particularly of highly civilised urban life. Alice Meynell also wrote essays on the major scale, profound in thought, exquisite in phrasing, austere in temper yet iridescent in hue, which posterity cannot neglect. The majority of the essayists of the period entirely, or almost entirely, wrote under conditions which precluded a painstaking craftsmanship, free quotation, digression, amplitude of illustration and other qualities which are admired in the essays of Lamb and Hazlitt. The typical modern essayist wrote regularly every week to fill a column in a daily newspaper, or a page in a weekly: the remarkable thing is the merit of much of the writing done under these limitations of time and space by such men as G. K. Chesterton, Hilaire Belloc, E. V. Lucas and Robert Lynd, and, in his last years, Maurice Hewlett.

Vivid and powerful sketches of travel were written by R. B. Cunninghame Graham and H. M. Tomlinson; Francis Brett-Young, in *Marching on Tanga* (1919), wrote a narrative prose poem on the Africa he saw during the War. Works difficult to group are the *Earlham* (1922) of Percy Lubbock, a picture of childhood's memories of a place and people; L. Pearsall Smith's *Trivia* (1902–18), brief prose compositions full of wit, candour and pictures, and very melodious. *The Puppet Show of Memory* (1922) by Maurice Baring, one of the most versatile writers of his time, was an autobiographical work of great charm and interest, conspicuous among recent memoirs for its good manners. Max Beerbohm's *A Christmas Garland* (1912) was a masterly volume of parodies of modern prose writers. Among other parodists, Sir Owen Seaman having resigned the art, E. V. Knox (Evoe) was conspicuous; his work in *Punch*, together with that, both in prose and in verse, of A. P. Herbert, was a mainstay of the chief English humorous journal.

Historical Works.—Historical works, deserving the appellation of literature, were few in the period. G. M. Trevelyan completed his Garibaldian trilogy and Philip Guedalla wrote an amusing book about Napoleon III., *The Second Empire* (1922). John W. Fortescue's *History of the British Army*, concluded in 1920, more than 20 years after its inception, was a massive work written in excellent English. The most interesting work in biography was not to be found in the two or three volume political biographies, notably G. E. Buckle's continuation of W. F. Monypenny's *Disraeli*, excellent though several of these were, as in such works as Lytton Strachey's *Eminent Victorians* (1918) and *Queen Victoria* (1921), works tinged with irony and partial perhaps, but seminal books, because of their brevity, their concentration of the essentials of a great mass of material, the excellence of their portraiture and the impeccability of their epigrammatic and coloured prose. They reminded people that there was something possible in biography between the review-essay and the enormous repository of significant and insignificant facts.

Dramatic Literature.—The theatrical literature of the period is surveyed elsewhere (*see* DRAMA), but some reference may be permitted here to certain works which were widely read as well as acted. In 1911 the "realistic" movement in the drama, largely influenced by Ibsen, was in full swing. The word did not necessarily imply any approximation to reality, though it was meant to do so. What it really implied was the substitution of a novel set of conventions for a set of which people had grown tired. West-End drawing-rooms were replaced by the homes of suburban clerks; rosy sentimentalism was replaced by cynicism, a prophetic pessimism or a detached irony of presentation; speeches gave way to silences or pregnant ejaculations; "social problems" broke in upon a theatre which had ignored them. The public was invited to listen, not to the epigrams of mar-

quesses, the lofty declamations of forgiving husbands, the sighs of a Romeo or the guitar of a Juan, but to the muttered resolutions of captains of industry, the subdued complaints of oppressed sempstresses, the exhortations of auctioneers, the speeches of strike leaders and the outbursts of Suffragist daughters crashing, blue book in hand, through the conversation of respectability, where they had been stifled by cant, convention, mahogany, plush and Tennyson's works in morocco.

The born dramatist could work within this convention as within another, assuming the fashionable trappings, but relying, as he must, for his effect upon the audience, on his ability to excite and amuse them by surprise, to charm them by the presentation of "humours," to exalt them with passion and courage, to "purge" them rather than depress by the display of failure and pain; and, where a play of this school succeeded, it was not because it was arguing for prison reform, votes for women, better housing or better drains. The restrictions, however, could not endure; humanity craves in the theatre for more splendid language than it ever uses and more splendid scenes than it habitually lives among; and the end of the period saw ample signs of a return to the stage of poetry and eloquence, vivid colour and symbolism, to the universal and the particular as contrasted with the mere mundane and temporal generalisation which obscures individual character without connoting anything eternal.

Shaw and Barrie.—Chief among living British dramatists, Mr. Bernard Shaw was perennially active, moved with the times and remained obstinately himself. His method in his early plays recalled now Sheridan, now Ibsen; the wit, the paradox, the irony, the odd "angle on life" were his own. Of his last eleven plays, long and short, the most interesting were the last three: *Heartbreak House* (1919), *Back to Methuselah* (1921) and *Saint Joan* (1924). In the first picture of social recklessness, the influence of Tchekhov and the Russians was evident; in *Saint Joan* notable for the great trial scene of Jeanne d'Arc and the detachment with which both sides of the argument were presented, Mr. Shaw wrote a chronicle play, as John Drinkwater in *Abraham Lincoln* (1918), which ran for years at the Lyric Theatre, Hammersmith, had done before him. *Back to Methuselah*, a cycle taking five nights to play, was all his own; a prodigiously ambitious play which opens with Adam, Eve and the Serpent in the Garden and ends with human beings "as far as thought can reach," who live beautifully and very long and are born, mature, out of eggs. The earlier and later scenes contained fine, even poetical, passages; the middle was marred by political topicality.

Sir James Barrie in *Dear Brutus* (1917), *Mary Rose* (1920) and seven short plays continued to charm a large public with his peculiar vein of humour, sentiment and fantasy, and John Galsworthy, with *The Skin Game* (1920) and *Loyalties* (1922), also did effective work in his established manner. A greater development was noticeable in the work of W. Somerset Maugham, whose long series of witty social comedies culminated (1923) in *Our Betters*, the most effective, if the bitterest, of them all. Henry Arthur Jones and Sir Arthur Pinero, the dominant dramatists of the previous period, did little to modify their reputations; and H. Granville-Barker, who had shown great promise with *The Voysey Inheritance* (1909), was largely preoccupied, first with production and then with editing Shakespeare. Arnold Bennett's *The Great Adventure* (1913) was a delightful comedy; the comedies of A. A. Milne also had distinction. G. K. Chesterton's solitary dramatic work *Magic* (1913) was agreeably individual in manner.

The effort to restore the "poetic drama" to the stage from the "closet" was increasingly noticeable. Flecker's *Hassan* (1922) was written before the War; Rupert Brooke was making his first dramatic experiments when War broke out. A series of verse plays by Gordon Bottomley the best, perhaps, being *The Riding to Lithend* (1909) and *King Lear's Wife* (1915), though retaining traces of the "reading play" had considerable dramatic power; Herbert Trench's *Napoleon* (1919) was on the verge of greatness; and there was grace and charm in Clifford Bax's *Midsummer Madness* (1923), a ballad opera to which C. Armstrong Gibbs wrote music. Other dramatists conspicuous in the period were Noel Coward, Clemence Dane, St. John Ervine, "Ian Hay," John Masefield, Alfred Sutro and Israel Zangwill.

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(J. C. Sq.)

ENGLISH-SPEAKING PEOPLES, RELATIONS OF.—The preservation of good relations between the various sections of the English-speaking peoples and nations, not merely in Great Britain and the United States, but wherever the English tongue is the medium of social life and intercourse, is a great cause; perhaps the greatest of all causes at the present moment. But the greater the cause, the more necessary it is to take the utmost care in its development and maintenance. As was said by an English-speaking philosopher, "the greatest truths demand the greatest care and devotion in their handling."

Misunderstanding is the chief disintegrating force in human affairs. It is that which poisons and disturbs the body politic. It acts as sepsis does in the body natural. This is particularly the case with the cause of amity among the speakers of the English-speaking tongue. Misunderstandings, on both sides of the Atlantic, spring up like mushrooms, and with them arise distrust, suspicion, soreness and wounded pride. People with thoroughly good intentions use vague and infelicitous language. Their words are misrepresented, and have reactions, evil instead of good. They are suspected of selfish and sly propaganda! Yet, all the time, the supposed propaganda was launched in perfect good faith, and without a thought of taking advantage. But, naturally, the repelled well-wisher is deeply hurt to see himself what he calls "cruelly misunderstood." What is wanted is to make absolutely clear the aims of those who would improve the relations between the communities who speak the language of Shakespeare, Bacon and Milton, of Washington, Lincoln and Emerson.

The desires of those who in England and America have given themselves up to the cause are so simple and so entirely divested of mere national, and therefore selfish, interests that it is difficult for them to think that they can be misjudged. Yet misjudged they are, and will be, unless they use a discretion proportionate to their enthusiasm. They grow too zealously fierce in their good cause. But that is a sure way to create the friction of alarm.

THREE REASONS FOR MAINTAINING GOODWILL

Let one, who is a convinced and life-long supporter of Anglo-American amity and goodwill, set forth as lucidly as possible (1) what the true friends of good understanding between the English-speaking peoples want, (2) why they want it and (3) how they propose to get it.

(1) They want amity for no exclusive, or dominating, purpose. They do not want it in order to crush other races and to exalt their own. Their do not want to establish anything in the nature of an alliance, entangling or non-entangling, offensive and defensive, or purely defensive, between America and the British Empire. All they desire is to obtain so complete and so clear an

understanding between the Republic and the Union of free Commonwealths that the evil chance of war and all thoughts of aggression or of interference in each other's domestic concerns, shall be forever banished. In the link of language, and in that intellectual liaison which follows from it, they see a deeply moving opportunity for human betterment. That link is far safer, and far less likely to tempt a misuse of power than is the pride of unity of race and blood. Such unity involves the evil influences of privilege, repulsion and exclusiveness, and aristocratic pretension.

The unity of speech has no bad side of this kind, no barbed wire barrier which cannot be climbed. Birth and race have been described as "incommunicable things." That cannot be said of language. You can learn a language and attain its powers and inspirations as completely as if you had been "born-free" of its privileges. You cannot make yourself a New Englander, a Virginian, a Pennsylvanian, a Scot, an Irishman, an Englishman, a Cockney or a "native-born" member of any of the British Dominions. The inhabitants of Great Britain and Ireland, and the Dominions, have in them a score of racial and sectional strains. They are a mixed race. Yet they are all speakers of English, save for a few dwindling exceptions. The same fact is even more superlatively apparent in the United States. There came to the making of the American, not 20, but 100 different nationalities. They are more recently, but also more completely, mixed than those on the other side of the Atlantic. Further, the mixture is a different mixture. Yet all are either actual or potential speakers of English.

English-speaking peoples everywhere should be fully conscious of this awe-inspiring freemasonry. This should also realise the opportunity it affords and seize it. And they can, because both America and Britain have obeyed Bacon's wise apothegm and have been "liberal in nationalisation," *i.e.*, have freely admitted men of other nationalities into their community—have been comprehensive, not exclusive, in the matter of citizenship. Let it be always remembered that while both countries ask for a recognition of the tie formed by a common language, they are not ignoring, but recognising, the differences of blood and birth, and, instead, noting how they can be fused in one lingual culture. They do not ask only the men of Anglo-Saxon race and blood to get together, but all the men who themselves, or whose forebears, voluntarily adopted the English tongue. That is what they want.

(2) Why is it wanted? It is wanted for the reason that in an understanding between those who speak the English tongue is to be found the instrument that will save the civilisation which has been built up with so much toil and anguish, high hopes and high endeavour, from going the way of Egypt and Persia, of Athens and Rome and of a hundred noble races and mighty empires. If anyone thinks that this is tall talk, visionary and unpractical, let him consider for a moment how many fissiparous influences there are still at work, how many sources of war and conflict. We may quite conceivably abolish war or, at any rate, limit it to local scuffles, if there are enough people in the world determined that the final word shall be, not physical force, but justice. But if these people do not act together, then we may drift into a long series of wars which will sap the vitality of the white races and expose the civilised world, as we know it, to incursions from the barbarians of our epoch, which will be quite as devastating as those of Alaric, Attila and Genseric. A new Theodoric may overwhelm Rome and burn St. Peter's, or stable his horses in Westminster Abbey, and leave the Louvre a heap of calcined walls. In the last resort, then, all the English-speaking peoples must get together, and hold together, because they can save the rest of the civilised world by their help and goodwill. In Franklin's famous phrase, the civilised races have got to "hang together," or else they will hang separately. But the way to teach them to hang together is for the English-speakers to show the path, not by dominance or arrogant assertions of racial superiority, but by example.

(3) How to arrive at this goal? The answer here must necessarily be largely negative. In the first place, it is a question of what not to do. Nothing should be done and nothing should be said that will give any possible ground for alarm to those who should co-operate together. Just as zealous Englishmen have got to avoid the slightest appearance of wishing to catch and lead Americans, so zealous Americans must avoid the slightest appearance of wishing, as foolish people would say, "to drag John Bull chained at their chariot wheels." Similarly both must both make it clear to the whole world that they have no design to rule it, or protect it, or to do any of the other things which make men think that they are no longer to be their own masters. They must learn a system of propaganda different from that which made the French Jacobins liable to the taunt that they met other nations with the demand, "Be our brothers, or we will slay you!"

It is difficult to describe the exact methods by which this cause is to be spread, for admittedly it is a new thing, and to describe new things is the most difficult task in the world. Yet it can be done, and must be done. The river in front is not one which any man with a spark of spirit, or good feeling, can dare to say is unfordable. It can be crossed and it will be crossed if there is faith. Those who desire to improve the relations between the various sections of the English-speaking world must remember Tennyson's words, though they were applied to so different a subject,

> How pure at heart and sound in head,
> With what divine affections bold,

should be the men whose intent it is to make the English-speakers understand each other; not for their own glorification, but in order to get a similar and greater understanding throughout the human race. (J. St. L. S.)

ENNEKING, JOHN JOSEPH (1841–1916), American painter (*see* 9.647), died at Hyde Park, Mass., Nov. 17 1916.

ENTOMOLOGY, ECONOMIC.—Interest in the practical importance of insects in relation to agriculture, horticulture and forestry has increased quite considerably during the past few years, owing to several factors which are readily apparent on analysis. One of these lies in the increasing ease with which insect pests are distributed from one geographical region to another as commerce becomes more rapid and extensive. For reasons which we shall see in a moment, imported insects are almost invariably more destructive than native ones.

Another depends upon gradual changes in agricultural, horticultural and forest practice, which are continuously tending away from diversification and leading to the growing of some single crop. This is true not only of individual landholders, but extends over large areas which are devoted to the production of one of several crops in enormous quantities. Outside Europe this is particularly true; we need mention only a few cases as cotton, wheat, maize, apples and citrus fruits. Such conditions offer exceptionally favourable opportunities for insect pests to develop, on account of a practically unlimited and easily obtained food supply which is available without interruption. There seems every reason to believe that agriculture will never return to its primitive system of diversified farming, so that from this standpoint at least the annoyance and destruction caused by insects may be expected to increase rather than abate.

The most serious and extensive outbreaks of recently imported pests have occurred in the United States. The pink bollworm (*Gelechia gossypiella*) has become established in Texas, the European corn-borer (*Pyrausta nubilialis*) in several parts of the eastern states and a number of minor pests in various localities. Many tropical and subtropical countries have been invaded by a small fly, the Mediterranean fruit fly (*Ceratitis capitata*), which feeds within a great variety of tropical fruits, ruining them for human consumption.

This insect has attained an almost tropicopolitan distribution and has wrought great havoc in many of the warmer countries of both hemispheres. To prevent its appearance in the United States the importation of fruits from Hawaii and the Mediterranean region has been prohibited. To curb the spread of insect pests many countries have passed laws prohibiting the importation of living plants without rigid inspection at the port of entry, since the commonest way in which insects come is with the plants upon which they feed. By these means it is hoped greatly

to lessen the rapidity with which such pests otherwise become disseminated.

In spite of the great advances that have been made in the methods of controlling injurious insects, it is probable that about one-tenth of the products of agriculture go to feed insects, and are thus an utter loss. In some cases this amount is greatly exceeded, as for example in the case of cotton in India and Egypt and particularly in the United States, where there are four insect pests of prime importance, two native and two introduced. One of the latter is so far very much restricted in its distribution. Once well established it is well-nigh impossible to eradicate completely any species of insect that feeds upon an extensively cultivated crop plant, and after a few years any one will spread over vast areas if not stopped by some natural barrier. In one case, however, it appears that an introduced insect, the gipsy moth, a general feeder on deciduous trees, will actually be wiped out in one section of the United States. It is now established beyond all hopes of eradication in New England, but a few years ago a second centre of infestation was discovered in New Jersey involving several hundred square miles. After several years of heroic and very expensive work, this area has actually been so nearly freed from this species that it now seems probable that it will soon be exterminated.

Methods of Control

The present methods of controlling insect pests are of two general types. The first depends upon the application of insecticides. Some of these kill by their poisonous action when taken into the stomach with food, and others act by contact or by the effect of poisonous gases, which are applied directly or result from the decomposition of some non-gaseous material. Such methods are by no means new, but considerable advances have been made in their application and many new materials have come into use.

Heat and Fumigation.—The use of heat is a common method of destroying insects in granaries, flour-mills and similar places. Insects are readily killed by exposure for a short time, to a temperature of about 140° F., which may be easily obtained even in large warehouses by artificial heating during the warm season. The fumigation of plants and trees by means of hydrocyanic acid gas is extensively practised in greenhouses and in orchards where trees like citrus fruits are grown, which are too delicate for treatment with sprays for the destruction of scale insects. Hydrocyanic acid gas was formerly generated where needed by the action of an acid on sodium or potassium cyanide, but it is now marketed in liquid form for fumigation. By this method a number of loaded freight cars may be cleared of insects within a very brief space of time, and even bales of almost impermeable material like cotton may be successfully treated by subjecting them to a vacuum and then allowing the penetration of the poisonous gas.

Oil Sprays.—The use of oil sprays for the treatment of trees infested with scale insects has become very general. Heavy petroleum oils are emulsified by means of various agents such as soap or fish-oil soap treated with cresylic acid, and the resulting emulsions are sprayed in a finely divided state upon the trees, killing the insects by contact. These and other sucking forms cannot be destroyed by poisoning their food, since they obtain this as sap from the interior of plants, and no method is yet devised for rendering sap poisonous without injuring the plant.

Nicotine.—Highly concentrated solutions of nicotine are now available for the destruction of many soft-bodied insects on foliage and even of small insect grubs that mine within the tissues of leaves. These may be poisoned by the application of nicotine solutions to the surface of the leaves. For this purpose the nicotine is applied as a spray in very dilute aqueous solution to which soap is added. Very recently nicotine has been combined with oleic acid to form nicotine oleate, a soapy compound that is used in water at high dilution.

Paradichlorbenzene.—The introduction of a new material, paradichlorbenzene, which is a very powerful contact insecticide, has made it possible to destroy insect larvae that bore in the roots of trees and those which feed in the wood. For insects like the apple-tree borer (*Saperda candida*) and the peach-tree borer (*Aegeria exitiosa*) this substance is sprinkled on the ground near the lower part of the trunk where the larvae develop. As it is non-poisonous to man under ordinary conditions it is particularly suitable for destroying clothes-moths.

Lead Arsenate.—In the spraying of foliage for the destruction of leaf-eating insects lead arsenate has come to replace almost entirely the other arsenical poisons such as Paris green. This is used in enormous quantities for the protection of agricultural crop plants and orchard trees and even in some places upon woodland and forest trees. Arsenate of lead is also used in dust form to a large extent, commonly diluted with some non-active dust and applied to plants by special blowers or dusting machines. Recently the dusting of extensive fields has been accomplished by aeroplanes fitted with large power dusters which operate as the planes pass and emit the poisonous powder, which settles upon the plants like fine volcanic ash. For the poisoning of certain insects, as the Japanese beetle (*Popillia japonica*), which will not readily eat plants coated with lead arsenate, a method has been devised of coating the minute insoluble particles of the arsenate with a film of an insoluble soap, such as lead oleate. This is more readily accepted and increases the toxicity of the poison. Calcium cyanide is now also applied in dust form as an insecticide. In the presence of water or moisture in the air this substance is decomposed into lime and the powerfully poisonous hydrocyanic acid gas.

X-rays; Mercury.—It has been found that light of very short wave length is a powerful insecticide, and exposure to X-rays forms a satisfactory method of destroying certain tobacco-beetles, the development of which is prevented in cigars that are treated by exposure to these rays. One of the most surprising discoveries relates to the vapour of metallic mercury, which appears to destroy some insects at least, such as bean weevils and clothes-moths, when present in infinitesimal amounts at ordinary temperatures. A small vial of mercury left uncorked in a container will prevent the development of the insect.

Machinery.—There have been no radical innovations in recent years in the machinery for applying sprays or dust insecticides, but much larger power machines are now in general use. Those, for example, used in New England for the spraying of woodlands infested with the gipsy moth or in the western United States to protect apple orchards from the codling moth ordinarily carry a tank holding 500 gal. and a gasolene motor powerful enough to supply simultaneously half a dozen lines of hose each delivering spray at pressure up to 200 lb. per square inch. It has been shown in several cases that insects show an increased immunity towards certain contact insecticides, such as sulphur-lime and oil emulsions after continued sprayings over a number of years. This is probably due to the more rapid eliminations of the more susceptible parts of the population and has necessitated the adoption of other materials. Just how far such changes may affect future entomological practice is not yet to be predicted.

Parasites and Natural Control.—From a biological standpoint there have been many advances leading both to a better understanding of the relations of insects one to another and of insect pests to the plants which they infest. One phase of this matter which has received much attention and assumed great practical importance relates to the effect of predatory and parasitic insects upon the abundance of insects destructive to plants. It was early realised that parasitic and predatory insect enemies were very important in regulating and holding in check the multiplication of vegetarian forms. Aside from a shortage of food, such enemies are the major factors that maintain the balance of nature and prevent the vegetarian species from becoming unduly abundant. When agricultural crops are planted continuously from year to year, shortage of food does not occur and consequently these enemies assume the major rôle. Further, when foreign pests are accidentally introduced into new regions they are very generally freed from this restraining influence, as practically all parasites do not select their hosts indiscriminately. Thus, the world over, the introduced pest soon becomes excessively abundant.

To counteract these conditions the parasites of imported

insects are in turn imported to aid control work, and perhaps the most notable progress made in economic entomology during the past two decades relates to this method of "natural control." Among many projects of this kind the most extensive has been undertaken and carried on for the control of the European gipsy moth in the New England states. Investigations of this moth and other insects have shown that the natural control of any insect in its native land is due to a number of parasites and predatory insect enemies which feed at the expense of the several developmental stages of their hosts. Thus there are enemies that destroy the eggs of the gipsy moth, others that attack the larvae and still others that feed upon the pupae. Large numbers of a series of such enemies of this moth have been brought over from Europe, multiplied in the laboratory and put out or colonised in places where the gipsy moth is abundant. A number of species have become well established and have spread until they now greatly reduce the numbers of their hosts each season.

The same method is now being applied to many other pests with very considerable success, and it has the great advantage that, once under way, it continues without further expenditure of time or money, whereas spraying and other similar artificial measures must be repeated continuously. Incidentally these experiments have added much to our knowledge of the biology of insects and greatly stimulated research on parasitic insects.

Insect Carriers.—As in the case of insects which act as carriers of certain diseases of man and other animals (*see* ENTOMOLOGY, MEDICAL), some species have been shown to act as carriers of plant diseases. Some of these are due to fungi and bacteria, and a number, including the mosaic diseases, to filterable organisms (*see* FILTER PASSING MICROBES). Most of the insects concerned are aphids and leaf-hoppers, which feed upon the sap of the plants concerned.

Legislation.—Apart from its scientific aspects economic entomology has entered widely into the legislative field. Laws have been enacted by nearly all governments, most extensively by the Federal and State Governments in the United States, relating in various ways to insect pests, and agencies have been created to enforce these laws. Many relate to quarantine, and these aim at preventing the introduction of foreign insect pests. They provide for inspection of living plants, bulbs, seeds, etc., foodstuffs and the like, and usually convey the power to refuse entry, destroy or properly fumigate infested or suspected objects. In America the importation of certain kinds of plants is now forbidden except in very special cases of plants which cannot otherwise be secured. These regulations frequently work considerable hardship, but in the long run there seems to be no question that they will greatly delay the spread of destructive insects throughout the world. This is particularly evident from the vast numbers of harmful kinds that are continually intercepted where inspection is practised, and inspection for such small and secretive creatures can never be satisfactory or complete. As the proper enforcement of laws of this kind requires an expert knowledge of insects, a type of police duty has necessarily been imposed upon many official entomologists, making heavy demands upon their time and leading in some cases to the establishment of separate offices or laboratories for such routine work.

Research.—The establishment of a number of new bureaux and research institutions devoted entirely or in part to economic entomology has been a notable feature of the last few years, as well as the rapid growth and development of others already extant. In Great Britain the Imperial Bureau of Entomology is a large and efficient organisation correlating entomological work in all parts of the British Empire and aiding science throughout the world by the publication of a fine review which summarises each month the current literature of applied entomology. In the United States the Bureau of Entomology is the largest of its kind in the world. Its many workers are occupied in Washington and several subsidiary laboratories throughout the country, dealing with economically important insects, their behaviour, habits and practical control, as well as the application of established measures to eradicate or reduce the numbers of particularly serious pests, and to limit the spread of certain introduced species that enjoy so far only a limited distribution. On account of its wide agricultural interests and extensive forests, the Dominion of Canada has added an entomological bureau performing similar services in a less elaborate way.

In addition to the various governmental and public agencies throughout the world there are numerous semi-private or endowed institutions maintaining laboratories for research in economic entomology, often in connection with universities. In a number of these there are opportunities for students to secure special training in pure and applied entomology.

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(C. T. B.)

ENTOMOLOGY, MEDICAL.—Although medical entomology includes in its scope a number of venomous and parasitic arthropoda that inflict miscellaneous minor hurts upon the individual human body, its main concern is with those arthropoda which, either as the necessary intermediary hosts or as the fortuitous mechanical disseminators of other pathogenetic organisms, stand in the main line of causation of serious endemic and epidemic disease and so are a menace to the public health.

Manson's Discovery.—Such insect-borne disease, though from of old a topic of popular belief and even of rational speculation, was first clearly demonstrated by Manson, who discovered, in 1879, how the embryos of the worm that causes a common filarial disease of the tropics are extracted from one human host by a female mosquito and then pass through their larval development within that insect's body before they can find their way into another human host. The value of this discovery, however, was not generally appreciated until 1898, when Ross discovered how the parasites of the more formidable disease malaria, after an analogous dependence on the mosquito for transport and sustenance, are furthermore injected into their human host by the insect intermediary, it being, however, "Manson's theory, and no other, which actually solved the problem" of the mode of transmission of this disease.

In these and similar instances the insect is a go-between, safeguarding the transfer of a specifically "human" parasite from one human being to another. But many blood-making insects are normally infected with seemingly innocuous endoparasites of their own, and some maintain that such insects may inoculate their own parasites into the human body where they may not remain innocuous. This is within the bounds of possibility, but the evidence of its actual occurrence is not generally accepted. Surmise of the same still unsatisfied kind has been awakened by the recent discovery in the normal intestine of certain insects, particularly bugs and lice, of bodies similar to the minute Rickettsia-bodies isolated, in 1916, by Rocha Lima from typhus fever cases and regarded by him as specifically morbific.

Recent developments in medical entomology may be summarised thus:—

Diseases Specifically Attributable to Mosquito Agency.—To filariasis, malaria and yellow fever, the parasite of which last was in 1918 determined by Noguchi as a *Leptospira*, must be added dengue fever, shown to be transmitted in Australia (Cleland and others) by *Stegomyia fasciata* and in Syria (Graham) by *Culex fatigans*.

Diseases Specifically Attributable to Sandfly Agency.—In entomological company with phlebotomus fever will probably have to be placed oriental sore (Sergent brothers: Aragão), and also kala-azar, the natural history of which seems from studies now in progress in Calcutta to be definitely associated with *Phlebotomus argentipes* (*see* KALA-AZAR and SANDFLY FEVER).

Diseases Attributable to Gad-fly (Tabanidae).—The details of the post-embryonic development of *Filaria (Loa) loa* in the course of its transmission from man to man by *Chrysops dimidiata* and *silacea* were described in 1921 by Dr. and Mrs. Connal. (Tularaemia, a recently recognised septic fever of American rabbits, may be imparted from rabbits to man by *Chrysops discalis*, but merely mechanically, since the infection may also pass to man without any insect intervention.)

Diseases Specifically Attributable to Tsetse-fly Agency.—Besides the notorious *Glossina palpalis* and *morsitans* several other common

species of *Glossina* are now known to be intermediary in the spread of the trypanosomes of African sleeping sickness.

Diseases Specifically Attributable to Flea Agency.—Hirst, in Ceylon, and Cragg, in India, have produced good evidence that not all the three species of rat-fleas of the *Xenopsylla* genus are equally formidable in spreading bubonic plague, and that plague does not rage as an epidemic in places where *Xenopsylla astia* is the only flea infesting the local rats. The evidence of the intermediation of the dog-flea in the transmission of infantile kala-azar is still obscure.

Diseases Attributable to Bugs (Rhynchota).—The parasite of South American trypanosomiasis (Chagas's disease) is now known to be transmissible by several species of reduviid bugs—and also, experimentally, by other bloodsucking insects—and is believed to be imparted to man in the insects' excrement. An original natural source of infection is said to exist in armadillos and opossums.

Diseases Attributable to Lice.—In company with typhus and relapsing fever the War disease "trench-fever" is to be included. In all three instances the virus is inoculated by contamination. The lousy person as he scratches himself rubs the infective juice or excrement of the infected insects into the abrasions of his skin.

Diseases Attributable to Ticks.—Several species of *Ornithodorus* are now suspected of transmitting the spirillum of relapsing fever, and *O. talaje* in tropical America has been shown to be as dangerous in this respect as the African *O. moubata*. The virus of Rocky Mountain spotted fever, conveyed to man by *Dermatocentor venustus*, is declared by Wolbach to be a *Rickettsia*. Another tick of this genus, *D. andersoni*, has been found infected with the bacillus of tularaemia. In these tick-borne infections the parent tick, becoming infected, transmits the infection to its offspring.

Diseases Specifically Attributable to the Agency of Harvest Mites (Trombidiid larvae).—Besides Japanese river fever, the virus of which is inoculated by the *akamushi* mite, there seem to be other local and seasonal epidemic fevers that have a similar causation. Among them is the pseudotyphus of Sumatra.

Diseases Specifically Attributable to Crustacean Agency.—Small freshwater copepods of the genus *Cyclops* have been known from the time of Fedshenko to be intermediary hosts of the guinea-worm (*Dracunculus medinensis*); and in 1917 Janicki and Rosen discovered, in *Cyclops strenuus* and the near-related *Diaptomus gracilis*, the long-sought first intermediary hosts of the larval ribbon worm (*Bothriocephalus latus*). Recently Japanese workers have shown that several species of river crabs play an intermediary part in the post-embryonic development of the lung-fluke. (In a logical system, however, all these passive crustacean infections should be classed with water-borne and food-borne diseases rather than with diseases due to the malign aggressions of insects.)

Diseases Attributable to Fortuitous Insect Agency.—Outside the range of the specific insects, ticks and mites that severally play their definite and *necessary* part as specific intermediary host for a particular morbific parasite of man, there has still to be considered the odious assistance lent by ubiquitous domestic insects—houseflies, cockroaches, cellar-beetles, ants, fish-insects and by the ubiquitous fauna—moth and beetle-larvae, booklice, food-mites—of granaries, provision stores, warehouses, etc., in the indiscriminate and mainly mechanical dissemination of morbific material of various kinds. Houseflies are the most assuredly dangerous of these disturbers of the public health. Sambon seems to regard the cockroach as equally, but more painfully, dangerous. Impressed mainly by the experiments of Fibiger, who found that in rats infected with a filarial worm of the genus *Gongylonema*, through feeding on infected cockroaches, cancerous growths started from the lesions caused in the rat by the worm, Sambon concludes that cockroaches, especially where they swarm in particular houses, are one of the main links in the causation of cancer in human beings. Evidence that cockroaches infect human beings with *Gongylonema*, or anything attributable to *Gongylonema*, is, however, still lacking.

Dangerous to the public health as all the insects here very briefly reviewed are, it is beginning to be realised that the danger is conditional. In an environment unmodified by sanitation, such as prevails in extensive areas in the tropics, where the villages and even the suburbs of the towns are still under the domination of the jungle, these insects are a constant danger, and, at the present time, must be attacked with energy, and with resource based upon a finished study of their life-history, seasons and habits. But in countries having settled standards of personal and domestic hygiene and an efficient sanitary administration these insects find no comfort in the reformed human environment and have ceased to be a standing menace to the public health, as is exemplified by the history of plague, typhus and malaria in England since the establishment of a sanitary régime. See A. Alcock, *Entomology for Medical Officers* (1920).

(A. W. A.)

ENVER PASHA (1881–), leader of the Young Turks, was born at Apana, on the Black Sea coast, where his father was a bridge keeper and his mother followed the despised profession of laying out the dead. His father was Turkish, his mother Albanian and he had a Circassian grandmother. He entered the Turkish Army as a subaltern without money or influence but gained admission to the staff college at Constantinople, and thence went to Salonika, the headquarters of the Young Turk movement. He fought with Bulgarian and Greek guerrilla bands, coming meanwhile in contact with the representatives of the new ideas, and finding in Talaat, the minor telegraph official, a politician after his own heart. In 1908 as aide-de-camp of Gen. Hussein Hilmi, he, with Niazi Bey, imported the flag of revolution into the Macedonian mountains, originally with the object of restoring the constitution of 1876, which had been disregarded by 'Abdul Hamid, but also to save himself from a threatened arrest. 'Abdul Hamid professed to yield and Enver entered Constantinople as a fêted hero. But he realised that his time was not yet come. He went to Berlin as major and military attaché, and there, from 1909 to 1911, he pursued his military studies and enjoyed a social career as a ladies' favourite. His stay was only once interrupted, when, in 1909, he hastened to Salonika, and with Mahmud Shevket undertook a brief and victorious campaign against the reactionaries, who hoped to regain unfettered power under 'Abdul Hamid.

After taking the capital and deposing 'Abdul Hamid, Enver returned to Berlin. Having learned to speak good German, he took command at Benghazi in the Italo-Turkish War. He also wrote a book called *Tripoli*, dealing with this period.[1] The Peace of Lausanne brought his work in Africa to an end, and he returned to Constantinople to find Turkey in the midst of the war with the Balkan States. During the Dec. armistice, Enver, then a lieutenant-colonel, was made chief-of-staff of the X. Army Corps, of which he soon was virtually in command. His attempt at a landing at Sharköi (in the east of the Gallipoli peninsula), on Feb. 8 1913, miscarried, as indeed did all Enver's military enterprises. During the peace negotiations, when Kiamil, as Grand Vizier, took the wise course of deferring to the wishes of the British, Enver with his friends arrived in front of the Sublime Porte, shot the War Minister, Nazim Pasha, turned out Kiamil, forced himself upon the Sultan, and in collusion with the Young Turk Committee filled all the offices with Young Turks.

The new Vizier, Mahmud Shevket, was assassinated in June 1913, and this further enraged the Committee against the Old Turks and the Union Libérale. The body of the state was purged of all elements which would not blindly carry out the policy of the Committee. More than 1,200 officers, among them 153 generals and colonels, were dismissed by Enver in one day. Enver put himself at the head of the troops, and in July 1913 made a triumphal entry into Adrianople, which had already been evacuated by the Bulgarians. On Jan. 3 1914 he promoted himself major-general and Minister of War.

When the World War broke out, Enver began to cherish strategical ambitions. In the winter of 1914–5 he led an entire Turkish Army in the disastrous offensive in the snow-covered mountains on the Russo-Turkish border. With Liman von Sanders, the chief of the German military mission, his relations were strained, and the situation was not improved by certain Germans who flattered Enver and intrigued against Liman von Sanders. He became a megalomaniac to whom no one dared offer a word of advice. He had no share in the Dardanelles defense, but took all the credit for it. In internal politics he became, by degrees, the absolute ruler of the country. When the Turkish collapse came, he fled by way of Odessa to Germany. In 1919 he was condemned to death at Constantinople *in contumaciam*. In the same year, after a brief exile among friends in Germany, he fled to Russia. There at first he helped Denikin to maintain the independence of the Caucasus, but when the latter made a political approach towards the Entente, Enver left him, stayed for a short time in Azerbaijan, and was mixed up in adventures in Asia Minor. He was reported in 1920–1 to have been employed at Moscow as director of the Asiatic

[1] A German version was issued in 1918.

department in the Soviet Govt., and to have posed at the Baku Congress of Oriental Peoples as the leader of a great Socialist movement in the Middle East and north Africa.

The last heard of him was that he had turned against the Soviet Govt. and was leading an insurrection against them in the mountains of Russian Turkistan—a revival of the "Pan-Turanian" ambitions which he cherished during the War. In this insurrection (which was unsuccessful) he appears to have met his death, though the circumstances of it are obscure.

EÖTVÖS, ROLAND, Baron (1848–1919), Hungarian physicist, son of Baron Josef Eötvös, was born in Budapest July 27 1848. In 1872 he was appointed professor of physics in the University of Budapest. In the following year he was elected member, and in 1889 president, of the Hungarian Academy of Sciences. From 1894–5 he was Minister of Public Instruction. His first scientific studies were connected with capillarity; in 1885 he published the result of these investigations, which is known as *Lex Eötvös*. From 1890 onwards he examined the phenomena connected with the problems of gravitation and of terrestral magnetism. He constructed a number of magnetic instruments and also an extremely delicate instrument with which the variations of gravity in space can be quickly and exactly determined both in the laboratory and in the open. In 1898 he completed his first single-armed variometer; later he constructed the double-armed torsion-balance. This so-called Eötvös-balance became an essential instrument for the location of subterranean materials.

To commemorate his researches, physicists express the result of the measurements with the torsion-balance in Eötvös units (*see* 12.388). In a treatise which won him the Benecke prize from Göttingen University in 1909, Eötvös demonstrated with great exactitude that the attraction of bodies is independent of the quality of the substance. Towards the end of his life he studied the variations of the gravitation of bodies moving on the earth. He demonstrated by experiments that if a body moves towards the east it loses in weight. He died in Budapest April 8 1919.

EPIDEMIOLOGY.—In recent years more study has been given to that branch of the science of medicine which, under the name of epidemiology, displays the general factors which operate upon populations or aggregates, and lead to the outbreak of a sickness affecting several persons within a short interval of time. The unit of the epidemiologist is a population, while the unit of a physician is an individual.

The Spread of Epidemics.—Modern epidemiology is based on the collections of statistics which began half way through the 19th century, and on the associated information which was obtained as to the causation and course of epidemics by careful local inquiry into all the conditions. Even before this some countries, such as Sweden, published the figures of the deaths from numerous infectious diseases for series of years; but, though very interesting, these figures reflect more or less special conditions. Since about 1840, especially in Europe, India and America, carefully collected information exists respecting many epidemics and epidemiological conditions. Sufficient evidence is now available to examine any theory which may be offered to account for the facts. Advance has been made on a number of lines: on the modes of spread of infection; on the theory of the course, recurrence and size of epidemics; on the relation of epidemics to climatic conditions and the cause of these relations; on the knowledge of the life history of the organisms which cause epidemics; on the conditions of living which favour the spread of infectious disease.

Aetiology.—With the discovery of the organisms (*see* Bacteriology; Filter Passing Microbes; Parasitology) which cause disease, and with careful observation in the field as to the manner in which disease spreads from person to person, many new points of view have emerged. It is no longer sufficient to talk vaguely of fomites. Most diseases have their special forms of spreading which account for practically all the cases. Thus measles (*see* Infectious Fevers) and smallpox (*q.v.*) are exceedingly infectious from person to person. Enteric fever is nearly always carried by contaminated water or contaminated food. Cholera (*q.v.*) is spread by water and flies. Other diseases have been found to be practically non-infectious from person to person unless by means of an intermediate parasite. Thus typhus (*see* Infectious Fevers) and trench fever are carried by lice, while yellow fever (*q.v.*) and malaria (*q.v.*) require the intervention of the mosquito. The mode of spread of some diseases, however, is still obscure. Among these scarlet fever must be placed. While direct infection undoubtedly takes place, a satisfactory elucidation of the problems of its dissemination has not yet been arrived at.

Infectivity and Virulence.—Disease-producing organisms possess two qualities: one, the power of causing the disease; and the second the power of producing a severe attack of disease. The first may be termed infectivity and the second virulence. These qualities must not be confused. In point of fact, they are not constantly associated. In certain diseases the height of the epidemic seems to be associated with severe disease, in others with that of milder type. The former at least holds for a certain number of large epidemics of measles of which the statistics have been investigated. The latter is the case both in Glasgow and London in regard to the autumnal prevalence of scarlet fever.

Incidence.—That an epidemic might possess a definite form capable of calculation seems to have been advanced first by Farr. In 1840 he graduated the decline of the great smallpox epidemic in England to the normal curve of error, and obtained a very close representation of the facts. He promised further discussion, but seems to have given none till 1867. In this year he returned to the subject in connection with the cattle plague, writing a letter to *The Daily News*, in which it was stated that though in the popular conception plague was advancing with such rapidity that all the cattle of the country might be destroyed, in reality the force of the epidemic was spent, and that if the form of the epidemic curve up to that point were taken as a basis of calculation the future course could be foretold. The prediction proved to be very near the truth.

The theory of the course of the epidemic, however, as a guide to the solution of the problem has unfortunately not proved so fertile as might have been hoped. Some facts are quite definite. The curve of the epidemic is often found to be symmetrical, the fall corresponding closely to the rise, though in some diseases the ascent is more rapid than the descent, and in some the reverse. The equation of the curve which describes the majority of epidemics, as found by trial apart from theory, is

$$y = \frac{a}{1 + \frac{t^2}{b^2} n}$$

where y is the number of cases at time t, t being measured from the centre of the epidemic.

Curves closely resembling that given by the above equation arise on a number of hypotheses, of which two are discussed. First, the organism may be assumed to possess at the beginning of the disease a high degree of infectivity, which decreases as the epidemic goes on. If the loss of infectivity is according to geometric law, the normal curve of error already used by Farr is the result. It is sufficient to state that on various probable hypotheses regarding exposure to infection, etc., the normal curve may be so modified as to take the form found by observation. Secondly, a similar type of curve arises if we consider an epidemic dies out from lack of susceptible persons. It is not possible to distinguish statistically these hypotheses from the consideration of the epidemic form alone. In one case, however, the second hypothesis can be tested. If the form of the epidemic be calculated by assuming different degrees of infectivity on the part of the organism, an infectivity which remains constant during the epidemic, it is found that this curve becomes flatter and flatter the smaller the degree of infectivity.

Now with regard to plague in India, among brown and black rats living more or less in the same circumstances, it is observed that many more brown rats are infected than black. In such circumstances the form of the epizoötic should be different in the two species if the decline is due to lack of susceptible individuals. As a matter of fact it is nearly identical: a fact which tells strongly in favour of the hypothesis that the epidemic ends because of

loss of infectivity on the part of the organisms. This example would be crucial but for the fact that the flea on which the spread of the epizoötic depends has a law of seasonal prevalence of its own to which both the epizoötics must conform.

In many cases, however, the only feasible explanation of the course of an epidemic is that the organism loses the power of infecting as the epidemic proceeds. It is difficult to believe, for instance, with regard to the great epidemic of smallpox in London in 1901–2, that there were only 8,000 people susceptible out of a population of 6,000,000. As the course of this epidemic was typical, rising and falling in the manner found to be characteristic, it cannot be argued that the decline was due to the action of the health authorities; all they can have done was to limit the extent of the epidemic, leaving its course unchanged.

Periodicity.—The next point requiring consideration is the periodicity in the epidemics of infectious diseases. Taking measles as an example, the common explanation is that each epidemic ends from the exhaustion of the number of susceptible persons, and that it is only when a new population of susceptible children has accumulated that a further outbreak occurs. This explanation fails to account for many of the facts. Even after the very large epidemic of measles in Glasgow in 1906, it was found that nearly half of the children admitted to the fever hospitals immediately thereafter suffering from other diseases had not suffered from measles, so that there must have been, with the high infectivity of the epidemic, plenty of susceptible material. The disease subject to the most extensive inquiry hitherto has been measles. Using the method of the periodogram, the statistics of London and all the chief towns of the British Isles have been analysed. It is found that in almost no case is there only one period to be discovered. In London there are several, the chief of which is 97 weeks.

Periodicity in other diseases is well known. Thus in the city of Liverpool the epidemics of scarlet fever occurred at regular intervals of four years from 1850–78. On one occasion alone was there an exception, when the interval between two epidemics was three years in place of four. A similar periodicity of five years has been observed in Glasgow. There is one specially interesting example, namely, the occurrence of plague in Bombay. In many places, such as Hong Kong, the period between each epidemic is rigidly a year. In such a case the influence of the season of the year seems a sufficient explanation. But the case of Bombay is different. The first epidemic in 1897 had its maximum about the 40th day of the year. From this point until the last year for which statistics are available (1918) the date of the maximum of the epidemic has steadily advanced into the year, advancing about 80 days in 20 years, or an average of four days a year. The conclusion must be arrived at that while some periodicities of disease are strictly seasonal others are not so, and require some further explanation.

A further important application of mathematics to epidemiology has been made by Sir Ronald Ross in his studies on malaria (*q.v.*). Here the factors influencing the spread of the disease are numerous. Rainfall and temperature, the number of persons carrying the organism in their blood, the number of mosquitoes and the proximity of the breeding-places of the mosquito to the abodes of men, are all capable of quantitative measurement, and of furnishing guidance in the adoption of suitable administrative measures.

Climate and Weather.—The relationship of epidemics to climate has received much attention in recent years, though in many cases the cause of seasonal prevalence is elusive. Thus, why scarlet fever should be so regularly an autumnal disease is not at all clear. On many cases, however, much light has been thrown. The discovery, for instance, that malaria was carried by the mosquito elucidates the seasonal distribution of that disease. A temperature of a certain height associated with pools of water is necessary for the rapid development of the mosquito, and also a certain degree of temperature for the development of the parasite in the mosquito. In the same way the zone to which sleeping sickness is limited is a narrow region in which the climate and environment are suitable to the life history of one particular tsetse fly. Much light has been thrown on the epidemiology of plague by the discovery that it was carried to man from the rat by means of the flea. Humidity is necessary for the growth of the flea, and consequently epidemics of plague can hardly occur at seasons of the year when it is warm and dry. Thus the epidemics of plague in Bombay, which have advanced progressively later and later into the year, now occur when the flea is no longer at its greatest prevalence. With this change the number of cases and deaths has greatly diminished.

Effect of Organisms.—As to the relation of epidemics to the organism which causes them, why an organism should be capable at one time of causing a great epidemic and at another only a few sporadic cases of a disease has not yet been found out. That organisms do vary in the power of infecting in this manner is a truism to anyone who has administered in the health departments of a large city. At one time the merest contact with a case of smallpox, for instance, will give rise to a large number of cases. At another time a patient suffering from smallpox may even attend a theatre without giving rise to a case of infection.

A considerable amount of evidence has been accumulated that an organism having found a suitable host or succession of hosts may have its virulence unusually exalted, and if the virulence can be exalted in this manner, it is probable that some similar conditions may give rise to a great increase in the power of infection.

Environment.—While an epidemic may in many cases be chiefly or even wholly due to the active condition of the causal organism, it is to be remembered that the vitality and environment of the persons affected must also play a part. Thus, for instance, typhus fever introduced into a crowded slum in which lice are plentiful will almost certainly cause considerable havoc, but even here the havoc will be determined to a certain extent by the season of the year. If the weather be cold the people are crowded together on account of the demand for warmth, and the chance of infection is increased. In addition, in the winter, food is often scarce, and consequently vitality is low. If, on the other hand, the invasion of the organism takes place during the summer, a large epidemic will be unlikely. But though these factors act, yet if an organism has an exalted state of activity an epidemic of the disease may occur at any season of the year, even the most unlikely. Plague, for instance, especially in temperate climates, is essentially a disease of the warmer part of the year, yet it has been known occasionally to occur in large epidemics in the middle of winter, while epidemics of typhus of considerable size have been recorded in the summer time. The great epidemic of influenza (*q.v.*) in the autumn of 1918 is a striking example, such a season being a very unusual one for an outbreak of this disease. What rôle special susceptibility on the part of the population, due to change in vitality, had in this case is not known.

Some other influences also act. There is some evidence that fatigue predisposes to enteric fever, an army on the march drinking polluted water tending to have a larger number stricken than a similarly conditioned civil population. Further, it cannot be doubted that the accumulated effect of seasons may tend to depress health and increase susceptibility to certain diseases. The cumulative effect of winter cold may be perhaps traced in children in relation to death from whooping-cough, the average minimum temperature in the winter preceding the maximum number of deaths from whooping-cough by about six weeks, while the form of the two curves is very much the same. The deaths from whooping-cough are due very largely to broncho-pneumonia, yet the seasonal distribution of whooping-cough is not identical with that of the latter disease. Thus scarlet fever, being an autumnal disease and following the hot summer, might in the same way be ascribed to depression produced by continued hot weather, making certain persons more susceptible to the disease. But as scarlet fever is a disease almost absent in warm climates this explanation can hardly be complete, and some other factor must be necessary. None of these questions, however, have at present been sufficiently investigated to allow any dogmatism.

Carriers.—Another point of importance requires special reference, and that is the problem of "carriers," as individuals in-

fected with a disease and cured as regards themselves, but who yet continue to harbour and distribute the parasite, are called. Cholera follows the pilgrims' way, enteric fever the carrier cook, diphtheria the carrier school-teacher.

Experimental Verification.—Recently, investigators in several countries—Topley and his collaborators in England; Webster and others at the Rockefeller Institute, New York; Neufeld, Lange and others of the Robert Koch Institute in Berlin—have applied the experimental method to the study of epidemiological problems. The plan has been to study the course of an epidemic disease introduced into a herd of mice, its evolution under conditions better defined and more simple than obtain in nature. Greenwood and Topley, for instance, have watched the progress of a fatal infectious disease of mice due to an organism of the Pasteurella group in a population of mice replenished wholly by the addition of normal animals over a period of more than three and a quarter years—that is, through a period much longer than the length of an average generation of mice. They have shown that in these circumstances the prevalence of the disease exhibits wave-like movements, and that the intervals between successive exacerbations can be diminished merely by increasing the rate of immigration of normal animals. It has been demonstrated that in infections of this type the regular immigration of healthy animals is sufficient to maintain the disease indefinitely. In spite of the obvious objection that experimental work can only be used to explain the phenomena of naturally occurring epidemics in men with the help of analogical reasoning, there is little doubt this is a promising field of inquiry.

Prophylaxis.—In field epidemiology much work has been done in developing a method of prophylaxis against diphtheria, rendered possible by the discovery that certain persons exhibit a peculiar skin reaction (the so-called Schick reaction) after the injection within the skin of a small quantity of the toxin produced by the bacillus of diphtheria (*see* INFECTIOUS FEVERS). It is thought that such persons are especially liable to develop the disease when exposed to infection, and that an outbreak may be controlled or prevented by the immunisation of those who respond to this test. This immunisation is obtained by the injection of small doses of a mixture of toxin and anti-toxin. The method has now been employed on a large scale, particularly in America, and a majority of experts consider the results very satisfactory. It is, however, too early to express a decided opinion, since the statistical evidence which has been tendered has not always been free from ambiguity.

BIBLIOGRAPHY.—An excellent general account of the progress of knowledge is contained in Haeser's *Lehrbuch der Geschichte der Medizin und der epidemischen Krankheiten*, 3 vol., 3rd ed. (1882); English epidemiological history is fully related in Dr. Charles Creighton's *History of Epidemics in Britain*, 2 vol. (1894). A paper by M. Greenwood on the "Epidemiology of Plague in India," *Journal of Hygiene*, vol. 10, p. 349 (1910), gives examples of modern epidemiological methods; while his report "On the Rise, Spread, etc., of Epidemic Diseases," *Internat. Congress of Medicine*, Sec. 18, p. 49 (London, 1913), gives a full study with literature. Two papers by John Brownlee discussing "Theory of Epidemiology in Relation to Plague," *Proc. Roy. Soc. Med.*, vol. 11, p. 86 (1918), and the "Periodicities of Epidemics of Measles," *Proc. Roy. Soc. Med.*, vol. 12, p. 77 (1919), give an account of the statistical and mathematical methods which may be used. Sir R. Ross's *Prevention of Malaria* (1910) and Sir R. W. Boyce's *Yellow Fever and Its Prevention* (1911) discuss theory and practice in all their forms. For a summary of recent work on experimental epidemiology, see M. Greenwood and W. W. C. Topley's paper, *Journal of Hygiene*, vol. 24, p. 45 (1925). A complete account of recent work on diphtheria is given in *Diphtheria, Its Bacteriology, Pathology and Immunology*, issued by the Medical Research Council (1923).

(J. BRO.; M. G.*)

EPILEPSY (*see* 9.691), a disorder whose essential symptom is a recurring, abrupt loss or alteration of consciousness, includes many types of seizures, *e.g.*, convulsions, emotional explosions, irritable periods, vertigoes and psychic clouding. There are normal gradations of consciousness, as sleep, degrees of attentiveness or mental concentration, etc. Convulsions, because of their alarming appearance, early impressed mankind. This continued, preventing recognition of mental traits and important minor phenomena of the epilepsies. Symptomatic convulsions occur in other disorders, *e.g.*, uremia, diabetes, eclampsia, psychosis, and in infancy and childhood, especially at the onset of acute infections.

Facts pertaining to heredity are not established scientifically to formulate laws regarding transmission of epilepsies. Direct similar heredity in epilepsy is uncommon. Hereditary syphilis is infrequent, although it cannot be determined how much damage may be done to germ plasm by parental syphilis (*see* VENEREAL DISEASES). Infections and malnutrition during foetal life, infancy and childhood may damage vital systems and cause subsequent epilepsy. The relative value of assigned predisposing and exciting causes varies. The majority of epilepsies seem due to multiple factors. Injurious influences affecting the brain during early life may permit later of otherwise harmless influences exciting seizures. Without such predisposition, normal functioning of essential organs would withstand the influence which produces epilepsy. Paralytics surviving from birth injury usually become epileptic. Finer changes in the nervous system from birth injury often cause subsequent mental defect, epilepsy or both. In many epileptics the heart and large blood-vessels are abnormally small. There may be other organ inferiorities. Seemingly inhibition, not stimulation, of the cerebral cortex, resulting in loss of control over lower brain centres (decerebration) produces impairment or loss of consciousness with convulsive manifestations. In epilepsies there is faulty energy distribution. Regressive changes may result in lack of inhibitory control of the brain.

The gravity of a skull injury bears no relationship to development of traumatic epilepsy which sometimes follows comparatively slight head injuries. Only a small proportion of head injuries in children or adults result in epilepsy. In epileptics having frequent seizures, the brain at autopsy may appear quite normal, finer changes being found upon microscopic examination. In cases with marked abnormalities there may have been few seizures. Such brain changes are considered in some to have been predisposing, in others resultant or merely concomitant.

The immediate cause of epileptic phenomena is cerebral vascular disturbance with resulting nutritive upset and transitory oedema of parts of the brain. Such vasomotor disturbance in the brain cannot ordinarily be demonstrated in life nor found *post mortem*. It may be caused by insufficient or excessive activity of endocrines, protein sensitisation, passage from the intestines into the circulation of toxins which eventually reach the brain, toxic substances produced locally in the brain as a result of vascular disturbance in encephalitis, brain tumour, arteriosclerosis, brain scars with adhesions, etc. Faulty metabolism of foods may result in substances toxic to brain cells and cause seizures, although simple retention of ordinary waste products may not so act. Some investigators claim an acidosis, others an alkalosis, precipitates seizures. Attacks may be induced by excess or undue diminution of blood sugar, sudden lowering or increase of blood pressure, great loss of blood, increased intracranial pressure, etc. Some maintain a severe convulsion automatically adjusts faulty metabolism resulting in an interval of relatively normal health. Habit may act in causing recurrence of seizures. The importance of eyestrain, teething, worms, scars on extremities, abnormalities of sex organs, etc., as reflex causes, has been exaggerated. Apparently menstruation, pregnancy and menopause provoke some seizures. Up to 20 years of age the two sexes are equally affected, subsequently males exceed because of habits, occupation, etc.

Some describe the epileptic as one with inherited defect which causes various types of stress, ultimately psychic in character, producing reactions of unconsciousness, recurring periodically, which permits riddance of a particular, adaptive demand through regression to the unconscious, a state of peace and harmony, comparable to existence before reality had become part of the mental demand. Mentality of epileptics may range from normal to marked defectiveness. Deprivation, retardation and deterioration are factors acting in many. A number are highly intelligent, the majority living normally in their community,

never reaching institutions. In some, outstanding symptoms are ego-centricity, supersensitiveness, emotional poverty, self-satisfaction, superficial religious manifestations and abnormal fluctuation of attention.

Attacks may be classified as follows: motor seizures, with or without apparent loss of consciousness; sensory seizures; psychic disturbances, acute or chronic. All symptoms considered part of the disorder are modifications of one or all of these reactions. Automatism, a part of certain seizures, is frequently unrecognised, the individual unconsciously committing certain acts. Medico-legally such periods as well as psychic phenomena of epilepsy are of importance. Many present "epileptic optimism," *i.e.*, failure to appreciate the necessity for avoiding dangerous situations or assuming undue responsibilities. An epileptic may appreciate the onset of a seizure, but not recall it by lack of memory fixation. Numerous factors seemingly favour occurrence of seizure, *e.g.*, circulatory changes accompanying onset and cessation of sleep, puberty, dietary indiscretions, emotional reactions, atmospheric humidity, etc.

Minor attacks are often overlooked, as the person may not fall; simply pauses for an instant, looks strange, then resumes conscious life. He may fall and immediately arise, such seizure being mistaken for syncope, but distinguished by suddenness of onset and recovery. Ramsay Hunt suggests such attacks are due to sudden momentary loss of postural muscular control, associated with transient unconsciousness. Recurring mild attacks in children may be a forerunner of epilepsy or cease without mental impairment.

Cerebral apoplexy seldom occurs in severe convulsions, although minute haemorrhages without doubt do, causing recurrence of symptoms. Study of the seizure itself does not with certainty differentiate those due to organic disease from those due to psychic cause. Research has thus far failed to prove perversions of function of organs peculiar to the epilepsies. No drug is specific because essential epilepsy is not a disease, but a symptom complex resulting from unknown underlying conditions. The basis of treatment is to find and remove, at least minimise, factors that adversely influence the central nervous system.

The epileptic should be placed under proper guidance early, not necessarily public surveillance, but a physician or person competent to advise. In effecting readjustment of life, it is necessary carefully to analyse symptoms and individualise treatment possible to carry out. The mode of living cannot be entirely changed, let alone environment; nevertheless, many circumstances or habits which act injuriously may be diminished. The patient must be considered as a whole and not solely as presenting types of seizures. Reasonable restriction of diet, allowing for maintenance of normal nutrition, with exclusion of articles difficult to digest will accomplish as much as extreme methods of prolonged starvation. Some are benefited with increase of fats, some by other food groups, depending on chemical examinations of blood, urine, etc. Due care must be given to the elimination of waste products. The pathology being unknown, surgery has no specific place in the treatment. It is indicated in certain symptomatic epilepsies, *e.g.*, brain tumour and to relieve conditions lowering general health.

The longer the freedom from seizures, and the better the adjustment to ordinary environments, the better the prognosis. Carelessness in mode of life may result in recurrence of seizures. Remissions over more or less prolonged periods, irrespective of treatment, are not uncommon. Spontaneous arrest seemingly occurs in some. Expectation of life in epileptics is some 20 years less than in others. To effect material improvement there must be only disturbed function, not destruction, of portions of the central nervous system and related organs. Psychic-mal-adjustments, lack of adaptation of organs and the individual as a whole, *i.e.*, constitutional instability, the environment created by neurotic relatives or associates, or the ordinary environment to whose stresses the abnormal person cannot react properly are factors influencing epilepsy. An epileptic ordinarily presents the reactions common to mankind, a fact to be remembered in prescribing for him. Salts of bromine have been used with more or less success for 70 years. Sodium or strontium salts produce least irritation in the gastro-intestinal tract. If bromides are used, particular care must be given to elimination and avoidance of deleterious influence on the mentality. Favourable results have followed the use of luminal (phenyl-barbital) in diminishing frequency of seizures, especially of the severer type, or holding them completely in abeyance. Alleged "cure-alls" often do much harm. Marriage of epileptics should be discouraged because of possibility of transmission of the condition to offspring, incompatibility of temperament and difficulty of assuming responsibility. Educational work among younger epileptics is beneficial, *e.g.*, discipline should be inculcated, interests aroused and self-control developed. Too solicitous care forces invalidism upon epileptic children. Responsibility begets confidence. The epileptic should be allowed to participate in activities of his circle, permitting energy outlets. The feeling that he is a person set apart from relatives and associates has a bad influence on mental functioning and metabolism. Occupation inducing normal healthy fatigue is most beneficial. (W. T. S.)

EPISTEMOLOGY: *see* KNOWLEDGE, THEORY OF.

EPSTEIN, JACOB (1880–), sculptor, was born in New York Nov. 10 1880, the son of Russian-Polish parents. He received his early training at the School of the Art Students' League of New York, and in 1902 he worked for a time at the Ecole des Beaux Arts in Paris. He went to London in 1905, and three years later obtained the commission to decorate the front of the British Medical Association building in the Strand, for which he made 18 large figures. In 1909 he carved the large sphinx for the Oscar Wilde memorial, placed in the Père Lachaise cemetery in Paris in 1912. His next works—the marble group "Two Doves" (1913), the marble Venus (1914) and his interesting carvings in flenite belong to his period of experiment in "abstract" sculpture. The life-sized bronze figure of Christ, on which he was working between 1917–9, roused a storm of opposition, which has signalised the appearance of each of the sculptor's most important works.

His series of bronze portraits, in which he may be said to have obtained his greatest success, began in 1907 with the portrait of Mrs. McEvoy. This was followed by the portrait of Lord Fisher in the Imperial War Museum (1915), mask of Mrs. Jacob Epstein (1916), the half-length "Meum with a Fan" and the Duchess of Marlborough (1917), bust of Mrs. Jacob Epstein (1918), Hélène (1919), the "Girl from Senegal" and "Kathleen" and "Jacob Kramer" in the National Gallery of British Art (1921), the "Weeping Woman" and "Dolores" (1922), Ferosa Rastourmji, R. B. Cunninghame Graham and "Old Pinager" (1923), Joseph Conrad (1924), "Sunita" and Sybil Thorndike (1925). His Hudson Memorial in Hyde Park—a panel carved with a figure of Rima—was unveiled in 1925. Exhibitions of the sculptor's works have been held at the Leicester Galleries, London, in 1917, 1920 and 1924. (*See* SCULPTURE.)

See also Bernard van Dieren, *Epstein* (1920) and the volume devoted to the sculptor in the *Contemporary British Artists* series (1925).

EQUATORIAL AFRICA, FRENCH (*l'Afrique Équatoriale française* or A.É.F.), formerly French Congo (*see* 11.99). Its area is approximately 982,000 sq. m. and the population was reckoned at 4,300,000 in 1911 and at under 3,000,000 in 1921. The inhabitants suffered greatly, especially in the Middle Congo colony, from sleeping sickness, dysentery and other diseases. Europeans numbered 2,932 in 1921.

By a decree issued on March 17 1920 the Chad territory, until then a dependency of the Ubangi-Shari colony, was made a separate colony. It extends from Lake Chad across the central Sudan to and including Wadai (*see* 28.225). The administrative system of A.É.F. is the same as in French West Africa. In 1911 more than 100,000 sq. m. of A.É.F. were ceded to Germany as compensation for the acknowledgment of a French protectorate in Morocco. This area was added to German Cameroons, but was restored to France in 1919 under the Treaty of Versailles and again incorporated in A.É.F. An Anglo-French agreement

in 1919 settled the dispute as to the frontier between Wadai and Darfur and in 1923 a joint commission marked the frontier on the spot.

Transport and Communications.—Economically A.E.F. is the least developed of French African possessions, largely owing to lack of transport facilities. The Ogowe river system affords access to part of the Gabun colony and the port of Libreville on the Gabun estuary has periods of activity; but the trade of the Middle Congo and Ubangi has no outlet save along the (Belgian) Congo railway. River and lagoon feeder services are maintained by the Chargeurs Réunis. The construction of a railway, some 300 m. long, to connect Pointe Noire on the coast near Loango, with Brazzaville, on the Congo river at Stanley Pool, was begun in 1921, but the railway had not been more than half finished by 1926. The plans included the creation of a port at Pointe Noire and harbour works were in progress in 1926. Telegraph lines have been laid connecting Brazzaville with Bangi and Fort Lamy. The total length of line in operation in 1925 was about 2,366 miles.

Trade.—Timber, palm kernels and palm oil, rubber, ivory and cocoa are the leading exports. The system adopted of granting exclusive rights to concession companies was unsuccessful; the companies did, however, help to make known the natural riches of the country and assisted the organisation of transport on the Congo, Ubangi and Shari rivers. Cattle, sheep, camels, horses, asses and ostriches are raised in the Chad colony, which contained over 700,000 head of cattle in 1922, but facilities for exports are lacking. The value of external trade was approximately 57,840,000 fr. in 1913; it fell to insignificant proportions during the World War, but increased to 49,800,000 fr. in 1920 and 65,300,000 fr. in 1923. Between 1910 and 1920 French authority was made effective throughout the country, Tibesti and other Saharan regions being occupied. The slave trade was rigorously suppressed and, in view of the alarming decrease in the population, considerable attention was paid to hygiene. Educational facilities remained however very deficient.

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ERITREA, an Italian colony on the Red Sea (*see* 9.745), has an area of 45,734 sq. m. and a population (1924) of about 410,000, of whom 4,000 were Italians. Asmara, the capital, had (1921) 13,510 inhabitants (of whom 2,407 were Europeans), Massawa, the chief port, some 12,000 (of whom 360 were Europeans). Systematic efforts were made to develop the resources of Eritrea, though a project to settle large numbers of Italians as farmers in the highlands had to be abandoned as it was found that nearly all the suitable land was already occupied by the natives (Abyssinians). Means of communication were extended. The port of Massawa was greatly improved and the railway carried from it to the highlands. The section to Asmara, 75 m., completed in 1912, rises to 7,765 ft., the altitude of Asmara. An extension to Cheren, 65 m., was opened in 1922. Thence the railway was continued towards Agordat, a town on the Khor Baraka. A motor road was made to Aduwa in Tigré (Abyssinia). A Decauville railway was built (1917–8) from Port Fatima in the Danakil (Afar) country to serve the potash mine at Dolol, on the Abyssinian side of the frontier. From the port of Assab, further south, a road was built to tap the trade of central Abyssinia.

Trade and Industry.—Stock raising remained up to 1925 the principal and most valuable industry and skins and hides the chief export. There was, however, marked increase in the trade in vegetable ivory (the nut of the dum palms). Other leading exports were salt, potash, mother-of-pearl and linseed. The most promising new industry was the cultivation of cotton in the Khor Baraka and river Gash (Mareb) areas. Ginneries were built at Asmara and Massawa and a beginning was made with irrigation works in the Gash area in 1915. The Gash ends in an inland delta in the Kassala province of the Sudan and in 1925 an agreement with the Sudan Govt. regulated the use of its waters by the two countries. Owing to the World War the development of the cotton fields was at first slow, the crop in 1922 being little more than 1,000 quintals. By 1924, however, the crop had increased to over 20,000 quintals.

The trade returns of Massawa illustrate the progress made in industry. In 1911 the imports were valued at 17,100,000 lire, the exports at 8,800,000 lire and the transit trade at 3,350,000 lire. In 1924 the figures were imports 146,129,000 lire, exports 86,680,000 lire, transit 18,850,000 lire. In the same year (1924) the total trade of Assab was returned at 12,000,000 lire; in 1923 the imports by the land frontiers were valued at 38,000,000 lire and the exports at 29,470,000 lire.

Finance.—Although Eritrea had not become self-supporting the budget for 1924–5 showed that the colonial revenue (12,400,000 lire) approximated to ordinary expenditure (13,700,000 lire). The budget was balanced at 36,439,000 lire, the deficit being met by the Italian Treasury. The sum of 11,365,000 lire was debited to military expenditure. The Abyssinians of Eritrea make good soldiers and Eritrian troops were employed in the war in Tripoli (1911–2) and in the World War. Eritrian battalions are stationed in Tripolitania, Cyrenaica and Italian Somaliland. In 1919 the military force in Eritrea itself was 12,000 (including 3,000 Europeans). By 1924 it had been reduced to 134 Europeans and 5,000 natives.

The relations of Eritrea with its neighbours, Abyssinia and the Sudan, were of a friendly character and it was comparatively little affected by the World War. Its oversea trade is mainly with Italy, Aden and India. Economic development might have been more rapid had foreign capital been sought, but it was not, and Italian capitalists for many years showed a disinclination to invest money in the colony. Massawa is in wireless telegraphic communication with Italy and with Italian Somaliland.

See Tommaso Tittoni, *Italy's Foreign and Colonial Policy* (English trans. 1914); *Eritrea*, a British Foreign Office handbook with bibliography (1920); E. Vinassa de Regny, *Dancalia* (Rome, 1923); the *Rivista Coloniale* (Rome) and the *Bolletino della Societa Geografica italiana* (Rome). (F. R. C.)

ERNLE, ROWLAND EDMUND PROTHERO, 1ST BARON (1852–), British agriculturist and writer, was born at Clifton-on-Teme Sept. 6 1852. He was educated at Marlborough and Balliol College, Oxford, where he took his degree in 1875. From 1894 to 1899 he was editor of *The Quarterly Review*. Twenty years as chief agent to the Duke of Bedford greatly extended his experience on agricultural questions. In 1913 he was a member of the royal commission on railways, and sat on the departmental committees on the home production of food (1914) and the increased price of commodities (1915). Having entered Parliament for Oxford University in 1914, he was President of the Board of Agriculture under Mr. Lloyd George from 1916 to Feb. 1919. He resigned his office in 1919 and was raised to the peerage.

Among his works are *Pioneers and Progress of English Farming* (1888); *Life and Correspondence of Dean Stanley* (1893); *Letters of Edward Gibbon* (1896); *Letters and Journals of Lord Byron* (1898–1901); *Psalms in Human Life* (1903); *The Pleasant Land of France* (1908); *English Farming, Past and Present* (1912); and *The Land and Its People* (1925).

ERZBERGER, MATTHIAS (1875–1921), was born on Sept. 20 1875, in Buttenhausen, in the Swabian Alp. Having entered the teaching profession, he soon became interested in politics. He joined the staff of the Stuttgart Catholic paper *Deutsches Volksblatt* and was elected member of the Reichstag at the age of 28. The Centre party, to which he belonged, came into existence as a mainly religious association during the "Kulturkampf" (Bismarck's quarrel with the Catholic Church.)

When this particular dispute had been settled the Centre party gradually assumed a political complexion. Erzberger, being rather anti-bureaucratic by temperament, began his career as a severe critic of the Colonial Office, whose chief spokesman, Dr. Helfferich, later on became his violent enemy. His party did not enjoy his impetuosity, which sometimes savoured of

bad form. The dissolution of the Reichstag by Prince Bülow, when the Centre party insisted on parliamentary responsibility in colonial affairs, and the return of the party with undiminished numbers in 1907 rather justified Erzberger in his tactics. And when Prince Bülow's incongruous Conservative-Liberal coalition broke down and the Centre party again became a quasi-government party (1909), Erzberger had gained a leading position in its councils.

During the World War Erzberger quickly realised the importance of public opinion. He built up a big organisation to enlighten neutral opinion, addressing himself primarily to Catholics. His influence on them was by no means inconspicuous, for though he was a fervent believer in the authority of his Church in spiritual matters, in temporal affairs he was a democrat by training and by temperament. He elaborated all sorts of plans for the reconstruction of Europe, some rather illogically based on the right of self-determination of the people.

He did not openly oppose submarine warfare, though he greatly feared America's entrance into the war. In the summer of 1917 he realised that Austria was collapsing. He knew the famous Czernin memorandum (April 12 1917) and has even been falsely accused of having brought it to light. His insight into the Austrian situation and his disillusion about the submarine warfare made him take the initiative in bringing about the declaration of the Reichstag on July 19, which proclaimed Germany's intention to fight for a peace without annexations. He succeeded by his impetuous methods in overthrowing Bethmann Hollweg, who sympathised with the movement, and bringing in Michaelis, who was a supporter of the militarists and whose famous interpretation of the resolution destroyed such chances as the appeal might have had. Erzberger played a part in the unsuccessful peace efforts of the Vatican, turning with a wonderful facility from one scheme to another, never daunted by failure.

Erzberger's great political chance came in Sept. 1918, when Prince Max of Baden formed a parliamentary government. Erzberger had outlined the programme for this coalition of National-Liberals, Liberals, Centrists and Socialists. He became Secretary of State without portfolio. He was asked to lead the armistice commission when General Headquarters insisted on an armistice. He did not succeed in getting terms, based on the Wilson principles, which Germany had accepted. He has been held up to obloquy for this failure, his carelessness, his ignorance of French and his bad manners having been given as reasons. It may well be doubted whether the most brilliant owners of such qualities would have fared better at the hands of a victorious general.

When Erzberger came home, the old régime had gone. He remained head of the armistice commission but participated in the reorganisation of the Centre party, which gained 90 seats at the election of 1919. He entered the Cabinet, formed by Scheidemann, as minister without portfolio. When that government, influenced by Brockdorff-Rantzau and the German delegation, desired to reject the peace terms, Erzberger dissented, distrusting the capacity of the German people to stand another prolonged strain, and fearing greatly for German unity. He pressed his point with his customary energy and perhaps, too, with that want of tact he occasionally exhibited. He is supposed to have said quite openly that another government would sign the treaty, if Scheidemann refused, and it is quite possible that his utterances may have reassured the Allies of the small risk they ran when presenting an ultimatum (June 16). The government did resign, and Erzberger became Chancellor of the Exchequer in the Bauer Government, formed by Socialists and Centrists, which signed the peace.

Up to that time the individual States had owned the railways and drawn the direct taxes, especially the income tax; the Reich had to be satisfied mainly with indirect taxation. The wrangles between the states and the central authority had filled the pages of German history, the states always succeeding in holding their own. Erzberger took the railways for the Reich and established its control over taxation. He succeeded where Otto von Bismarck had failed. He organised an Imperial inland revenue service and introduced a system of income and property taxes which, though somewhat socialistic in its main features, was the first real system of Imperial finance Germany has had.

His activities during the World War, his participation in the Armistice and the peace negotiations, and his financial policy made Erzberger the best hated man in Germany. His feud with the bureaucrats was of old standing; the capitalist classes hated him for his confiscatory financial legislation; and to the Prussian Protestant he was the international Catholic, who spoke with a broad Swabian accent. The federalists loathed him on account of his centralising tendencies, and the militarists tried to make him the scapegoat for their want of success. All the enemies of the new order of things realised, however, that whatever his faults might be, he was a man of action and not a dreamer.

Karl Helfferich, a former Secretary of State whose financial War policy Erzberger had strongly criticised, fathered these attacks in a pamphlet *Fort mit Erzberger*, in which Erzberger was accused of all sorts of petty underhand financial misdemeanors and even of having committed perjury. Erzberger sued Helfferich, but did not succeed in clearing himself as completely as the facts of the case probably warranted. He immediatedly resigned. The verdict assumed that he had committed perjury, but the same court, inquiring later on whether the facts established should lead to a public prosecution, came to a negative finding. It was then considered that in some way or other Erzberger would be completely rehabilitated. The feeling against him was so intense, however, that an abortive attempt upon his life was made during the proceedings. A few months after, when taking a holiday, he was foully murdered on Aug. 26 1921, by Schulz and Tillessen, two members of secret associations, who got safely to Hungary.

Erzberger was probably the most gifted man of action German democracy has so far produced. He acted with the light-hearted impetuosity of a child: there was no situation to which he did not consider himself equal. He quickly saw the main point, and when he saw it, he acted, being quite free from those mental impediments which so often paralyse intelligent men. He very often did not visualise the ultimate consequences of his actions, but this did not trouble him as he was quite sure that he could deal with them when they arose. His jaunty manner equally antagonised the deep thinker and the well-bred bureaucrat. He was often careless and inaccurate in details, for though details interested him greatly, he had not always a just sense of "value." Being rather insensitive himself, he often failed to consider other people's susceptibilities, and being simple though very shrewd, he was not a good judge of men and did not understand complicated minds, nor the impression he made upon them. He was a man of the people and he looked like it. As such he was loathed by all to whom a statesman must be "decorous." He was almost a genius. But he lacked the magnetism and charm indispensable to a really great leader.

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(M. Bo.*)

ESCALATOR: *see* ELEVATORS AND ESCALATORS.

ESENIN, SERGIUS (1895–1925), Russian poet, was born Oct. 4 1895 in Constantinovo, since his death officially renamed Esenino, in the Ryazan province. A peasant by birth, he lived in his native village until he was 17 when he moved to Moscow. His first poems (1915) met with immediate success. In 1919 he founded the Imagist group. Esenin travelled in Persia and also visited America and France. He was married first to the American dancer, Isadora Duncan, from whom he soon parted, and secondly to a grand-daughter of Count Leo Tolstoy. He died by his own hand on Dec. 28 1925. Although he was a staunch sup-

porter of the Soviets, his meditative and purely lyrical talent was tragically out of touch with the active and matter-of-fact post-Revolutionary Russia.

Esenin has been considered the finest Russian poet of his generation and second only to Blok. His poetry reflects the mysticism of the old Russian peasantry with its ikons and its folklore, as in "Radunitza" (Day of the Dead), "Goluben" (Blueness); and in "Inonia" he depicts a religious Utopia and proclaims the advent of a "peasant Christ." All his poems reflect the same love for peasant Russia, its fields, thatched cottages, its trees and animals. He called himself "the last peasant poet" and deplores the invasion of the land by the town—"the iron guest." His town and tavern poems ("Moscow of the Taverns," "The Confessions of a Hooligan," etc.) telling the evil victory of the town and its allurements, are of a tragic and captivating sincerity. His poetic style is highly imaginative and his simple, transparent verse follows the classic Pushkin tradition.

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ESHER, REGINALD BALIOL BRETT, 2ND VISCOUNT (1852–), British politician and writer, eldest son of the 1st Viscount Esher (*see* 9.768), was born in London, June 30 1852, and educated at Eton and Trinity College, Cambridge. He entered politics, becoming private secretary to the Marquess of Hartington in 1878, and from 1880 to 1885 was Liberal member for Penrhyn and Falmouth. From 1895 to 1902 he was secretary to the Office of Works. He succeeded his father in 1899 and in 1901 was appointed deputy constable and lieutenant-governor of Windsor Castle. In 1902 he was appointed one of the commissioners who inquired into the conduct of the South African War. In 1904 he was chairman of the War Office Reconstitution Committee, and in 1905 became a permanent member of the Committee of Imperial Defence. He was chairman of the Territorial Force Assn. of the county of London 1909–13, and president, 1912–21. Lord Esher was selected by King Edward VII. as one of the editors of the *Letters of Queen Victoria*, which appeared in 1907, and he produced *The Girlhood of Queen Victoria* (1912). His other works include *The Influence of King Edward* (1915); *The Tragedy of Kitchener* (1921) and *Ionicus* (1923).

ESPERANTO: *see* UNIVERSAL LANGUAGE.

ESSEN (*see* 9.778), one of the largest towns in Prussia, Germany, had a population of 439,257 in 1919. A later estimate was 474,000. Alten Essen, Haarzopf, Bredenau and part of Vorbeck, with a total population of 114,000 were included in the city boundaries in 1915. Situated at the centre of great coalfields, Essen has developed rapidly. The Krupp works, to the west of the old town, now produce locomotives, agricultural machinery, etc., and were employing some 35,000 workers in 1925. The Exchange, opposite the railway station, was finished in 1924. In 1920 factories were occupied by Communists during revolutionary outbreaks, and were only retaken by Government troops after heavy fighting. Occupied by the French after the Armistice, Essen was evacuated by them on Aug. 1 1925.

ESTONIA (*see* ESTHONIA, 9.797) an independent Baltic republic (Eesti), founded in 1918, its area is 16,955 sq. m. and the population (1922), 1,107,059. It is bounded on the north by the Gulf of Finland; on the west by the Baltic Sea; on the south by Latvia; and on the east by Soviet Russia, the boundary running through the middle of Lake Peipus. The republic comprises the former Russian government of Estland, the northern part of Livland, parts of two districts of the Pskov and Petrograd governments together with the islands of Dagö (Hiiu Maa), Oesel Saare, Muhu and other small islands in the Baltic Sea.

Constitution.—The constitution adopted by the Constituent Assembly on June 15 1920, provides for a republican government, with parliament (Riigikegu), consisting of 100 members elected by universal and secret ballot on the proportional representation system. Provision is made for a direct exercise of power by the people through initiative and referendum. The Prime Minister is the head and official representative of the Estonian Republic.

I. POLITICAL HISTORY

The Russian Revolution.—Acting on the proposal of the Union of Estonian organisations, the Russian provisional government, formed on March 12 1917, ruled that the northern districts of the Gubernia (government) of Livonia (inhabited by Estonians) and of Estonia should become one State and be given a democratic local self-government. Since the revolution of 1905 Estonia had, like the other small states on Russia's borders, been working for autonomy. When the Russian provisional government of 1917 had been declared this could only be granted by the All-Russian Constituent Assembly. When, therefore, the Estonian Diet met at Revel (Tallinn) on July 14 1917, its first task was to prepare a Bill for this purpose.

The Bolshevik *coup d'état* changed the course of events. On the fall of the Russian provisional government the

Estonian Diet, on Nov. 15, declared its complete local independence. The Bolsheviks, however, dissolved the Diet; and although national regiments, amounting finally to a division, had been formed during the revolution, the fact that Revel was now being used by the Russian army as its sea base, and lay exposed to fire from Russian ships, made it expedient to avoid conflict. The "Baltic barons" of Estonia had meanwhile appealed to Germany for military assistance. Taking their stand on the Treaty of Nystad (1721), they declared themselves the authorised representatives of the country, and on Dec. 12 1917 formally broke away from Russia, and invoked the aid of German troops. In accordance with Germany's request the barons approached the Estonian Diet with the object of securing a joint appeal to Germany; but the Diet, well aware of their schemes for German colonisation and compulsory denationalisation of the country, decided, at the turn of the year 1917–8, to separate from Russia, but at the same time to declare the independence of Estonia.

De Facto Recognition.—The resumption of hostilities by the Germans had disconcerted the Bolsheviks, and advantage was taken of this fact to overthrow the Bolshevik rule at Revel and proclaim Estonia an independent republic on Feb. 24 1918. The resolution of the Diet had been laid before the allied governments; favourable replies were received from France on March 1 1918 and from Great Britain on March 20, the *de facto* recognition of Estonia by Great Britain, France and Italy following on May 3 May 13 and May 29 respectively.

The German occupation which followed was designed to turn Estonia into a Baltic duchy in personal union with Prussia, in conformity with the wishes of the Baltic nobility. To create the appearance of a national movement it was desirable to gain the consent of certain sections of the Estonian people. The representatives of the peasant-proprietors, however, when summoned to the Riga Assembly on April 10 1918, by the authorities of the military occupation, refused their consent. Nevertheless, Baron Dellingshausen, the leader of the Baltic nobility, forwarded Estonia's request for union with Prussia to Berlin, and received the German Emperor's consent through his Chancellor on April 21 1918. After the peace of Brest-Litovsk, Germany held only tem-

porary police powers in Estonia, and Soviet Russia renounced her sovereign rights over Estonia and Livonia by the supplementary agreement of Berlin on Aug. 27 1918. With the collapse of Germany in the autumn of 1918 the Estonian provisional government, consisting of representatives of all parties, including the Social Democrats, resumed its activities. K. Päts, the former President of the Diet, released from imprisonment by the Germans, became Prime Minister; and J. Poska, the former Commissar of the Russian provisional government, proceeded to the peace conference in Paris as Foreign Minister.

The Bolshevist Invasion.—The German troops had not been completely withdrawn before a new danger threatened from the east. Narwa had been invested by the Bolshevists, who now began to penetrate into Estonia (Nov. 28) aided by landings on the coast of the Gulf of Finland. Estonia's situation was rendered more difficult by the fact that the Germans had devastated the country and removed or destroyed all arms. Thus a state had to be created without money, a war begun without weapons. Out of the cadres of the Estonian regiments of 1917 Gen. Laidoner had begun to organise an Estonian army, while Capt. J. Pitka created a marine force of volunteers and students, forming shock-battalions and improvising armoured trains out of goods trucks. Assistance came first in the form of a loan amounting to 20,000,000 Finnish marks, a consignment of arms and a body of over 2,000 volunteers from Estonia's neighbour and sister-nation, Finland. On Dec. 12 1918, a British fleet under Admiral Sinclair arrived at Revel, which brought over a supply of arms and took the Gulf of Finland under its protection. Sinclair also captured two Russian destroyers and handed them over to Estonia. Later, some hundreds of volunteers from Sweden and Denmark made their appearance. On Jan. 4 1919, when the Bolshevists held half Estonia in their grasp, their offensive was broken, and by the beginning of Feb. the whole country was freed from the enemy. The Constituent Assembly was now elected. Meeting on April 23 1919, it voted unanimously for the renewed declaration of Estonia's independence, and formed a new coalition government from the bourgeois parties and the Social Democrats.

Throughout the spring, from Feb. till May, Bolshevik attacks continued. In May, however, the Estonians took the offensive and broke through the Bolshevik front, carrying operations over into Russian territory. The "Northern Corps" of the Russian White Army under Gen. Rodzianko, which had retired into Estonia from Pskov, now occupied Yamburg, the Estonians taking Pskov. As the result of an attack to the south in the direction of Marienburg-Jakobstadt along the Dvina, Northern Latvia was freed from the Bolsheviks, while Latvia received assistance in organising its regiments. In the neighbourhood of Riga an encounter occurred with Gen. R. von der Goltz's German volunteers, who had overthrown the Lettish democratic government at Libau and were endeavouring to get the whole of Latvia into their power. Gen. Sir H. Gough, as chief of the Allied military mission, had ruled, in support of the demand of the Estonians, that Gen. von der Goltz should not lead his troops northward against Estonia but eastward against the Bolsheviks; in defiance of this, von der Goltz broke the armistice and began to advance. On June 21–2, at the battle of Wenden-Ronneburg, his front was broken through and his army put to flight and driven out of Northern Latvia. By the intervention of the Allies a new armistice was concluded at Riga on July 3 1919. Von der Goltz was forced to evacuate the town, and the Lettish Govt. was again able to return to its functions.

Peace with Russia.—On Russian territory the Northern Corps of the White Army had been organised as an independent north-western army with Gen. Yudenich as commander-in-chief. The disputes between the various Russian generals went on steadily increasing until finally civil war broke out at Pskov. As neither the White Russians nor the Paris peace conference of the allies would acknowledge her *de jure*, Estonia, on Aug. 31, accepted the peace proposals made by Chicherin on behalf of Soviet Russia. On Dec. 5 1919, peace negotiations were opened between Estonia and Russia at Dorpat. In order to make their demands more impressive, the Russians concentrated their VII. and XV. Armies (upwards of 40,000 men) on the banks of the Narowa and threatened Narwa. An armistice was declared on Dec. 31, and peace was concluded on Feb. 2 1920. Russia agreed to acknowledge the independence of Estonia and to pay her 15,000,000 gold roubles (£1,500,000) from the Russian gold fund, but refused to return the funds, savings and money which had been removed. On the other hand, Estonia was released from any responsibility for Russia's debts abroad. Free transit to Estonian ports was conceded to Russia. This was the first peace treaty concluded between Soviet Russia and any of the border states.

Internal Legislation.—On Oct. 10 1919, while the War was still in progress, the Estonian Constituent Assembly had passed an Agrarian Reform Bill, by which manorial estates of more than 330 hectares, a type of holding which covered more than half of the whole agricultural area, were to be divided among those who had taken part in the war of independence in holdings averaging from 20 to 25 hectares. Thus the landless peasant population, which constituted one of the most important factors in the revolutionary movement, was satisfied. The last task of the Constituent Assembly before its dissolution was the adoption (June 15 1920) of a constitution which resembled in many respects the Swiss and the new German constitutions.

The two parliamentary elections of 1920 and 1923 showed a strong tendency towards the Right as compared with the Constituent Assembly. In the case of the Assembly, agrarian reform came first in importance, but in the new parliaments economic problems were predominant. The Conservative Agrarian Party was now the strongest; the Social Democrats, who had formed 40% of the Constituent Assembly, sank to 30% in the Riigikegu. Socialists rarely held office in the government.

When the civil war in Russia ended in victory for the Bolsheviks the Supreme Council of the Allies agreed to the *de jure* recognition of Estonia (Jan. 26 1921). On Sept. 22 of the same year Estonia was admitted to the League of Nations. Recognition by the United States followed on July 28 1922.

Foreign Policy.—Attempts to co-ordinate the foreign policy of the Baltic States had been made while they were still fighting for independence. At Warsaw, on March 17 1922, Estonia, Poland, Latvia and Finland signed a political agreement, which, however, did not come into force, Finland refusing to ratify it on the ground that it might be directed against Germany. That the Baltic states are working with a common aim is nevertheless evident from their attitude in the League of Nations and from the periodic conferences between the foreign ministers; at one of these conferences, in 1925, an agreement was reached for the establishment of a permanent court of arbitration. Estonia came to a final agreement with Latvia with regard to their common line of frontier on Nov. 1 1923, when a treaty of defensive alliance was concluded, war claims were settled and an economic agreement signed. The economic clauses, which established unified tariffs and duty-free transit of goods, marked the first step in the direction of a complete customs union. Other agreements in existence between Estonia, Latvia and Lithuania aim at rendering inter-communication between these countries easier by the elimination of passport visas and the introduction of an inland postal tariff.

Communist Agitation.—Communist agitation has been responsible for constant friction between Estonia and Russia. Estonian Communists have their headquarters in Russia, and their secret agents in Estonia are under Russian diplomatic protection; should anything happen to these agents, Estonians living in Russia are imprisoned as hostages and an exchange is then proposed between them and the Communists imprisoned in Estonia. But Communist agitation has obtained so small a hold in Estonia that no special measures have been taken with regard to it. Estonia was the last of the border states to declare the Communist party illegal; this was in the autumn of 1923, when, at the time of the riots in Germany, Communists in Estonia began to prepare for an armed rising there also. At Revel, a "putsch" was attempted early in the morning of Dec. 1 1924, when the proceedings against the imprisoned Communists had come to an end. About 300 conspirators, formed into shock troops and composed mainly of Russian red guards, had been smuggled over, and Russian transit workers in Revel, provided with arms secretly imported from Russia, made a sudden and simultaneous attack on the government and military institutions, but were immedi-

ately repulsed and soon after killed. The result of this revolutionary outburst was the closing of all Communist organisations and the founding of civil guards on the Finnish model, in which 30,000 men were enrolled.

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(E. L.)

II. SOCIAL AND ECONOMIC CONDITIONS

Population.—According to the census of 1922, Estonia's population of 1,107,059 included 87·7% Estonians, 8·2% Russians, 1·7% Germans, 0·7% Swedes, 0·4% Jews. The rights of minority nationalities were laid down by the Constituent Assembly, and on Feb. 5 1925 a special Act was passed which granted national and cultural autonomy to all minority nationalities with a minimum of 3,000 members, living in Estonian territory.

The principal towns are: the capital Revel (Tallinn), 130,000 inhabitants; the university town of Dorpat (Tartu), 50,000; Pernau (Pärnu) 18,500, on the gulf of Riga, and the manufacturing town of Narwa, 27,000.

Education.—The various national minorities have their own schools, where instruction is given in each mother tongue. Every individual, however, has to learn the Estonian language also. School attendance is compulsory by law, and Church and State are separated. Religious teaching in the State schools was established by Referendum in 1923. The proportion of illiterates (to be found chiefly on the Russian border) is 5·7%. Dorpat University was re-opened on Dec. 1 1919 as the Estonian national university. The number of students in 1922 was 2,398 men and 1,002 women. Revel has a Technicum (higher professional school) with 400 students. Lutheranism claims 78·6% of the population, and the Greek Church 19%.

Defence.—Military service is compulsory. The army is organised in three divisions, the peace strength in 1924 being 1,600 officers and 18,500 other ranks, and the full strength on mobilisation 90,000. The naval force consists of two destroyers, one gunboat, one torpedo boat and smaller craft.

The Problem of Reconstruction.—Before the War Estonia was one of the principal sources of St. Petersburg's food supply and Revel was one of Russia's main northern outlets to the sea. There had grown up at Revel in easy reach of foreign coal a considerable industry—shipbuilding, metallurgical shops, textile mills, etc.—designed to supply the Russian market and largely to meet the requirements of the Russian army and navy.

The problem of reconstruction with which the Government was faced after the Treaty of Dorpat was, therefore, extremely difficult. An agricultural revolution had been created by the expropriation law of Oct. 1919 and agriculture had lost its normal market. The big industries had no less lost their markets. They were destitute of floating capital after six years of inflation and proved at first rather an incubus to the State than an asset. During the previous years public expenditure had been covered largely by means of the issue of notes, and the whole machinery of Government and administration had to be built up from its foundations.

Agriculture.—The most essential task was the reorganisation of agriculture, the drainage, stocking, equipment and general capitalisation of the new small holdings, the training of the new peasant farmers and the establishment of agricultural co-operation societies, for the main source of Estonia's wealth is agriculture. About 40% of the total area consists of prairie and meadow, 23% is under plough and 15% under forest. With the assistance of these co-operative societies Estonian agriculture is now developing on the lines of specialising in cattle-breeding, dairy farming and flax productions. The export of butter is controlled by the State with a view to maintaining a definite standard of quality, and new markets have been found in England, Germany and elsewhere. The total exports of butter increased from 1,032 tons in 1922 to 6,443 tons in 1925, and the export of eggs at a not much inferior rate.

While material progress has thus been made in dairy farming and in the cultivation of forage crops which that system of husbandry necessitates in northern climates, the areas under cereals and average cereal crops are about the same as they were before the War, and Estonia remains a corn-importing country. The production of potatoes, on the other hand, for which the land is well suited, has greatly diminished (1910, 810,000 tons; 1925, 590,000 tons) owing to the lack of markets for potato spirit. The area under flax has grown steadily from year to year and is now nearly 20% greater than it was before the War.

Industrial Production.—In the first few years of Estonian history high hopes were still placed on the future of her larger industrial undertakings, and considerable sums were advanced by the State Bank, with the result that by 1923–4 the credit and banking situation of the country became highly critical and a considerable proportion of the gold reserve obtained from Russia under the Treaty of Dorpat was lost. Estonia, however, possesses certain raw materials, which may possibly constitute the basis of a new industrial development in the future. Of these, the most important are wood and oil shale. The shale, the deposits of which are roughly estimated at 3,500–5,000 million tons, is unusually rich in oil. It is already utilised to a growing extent in Estonian factories and on the railways in its crude state in place of coal, and a certain number of concessions for its more scientific exploitation have been granted to foreign firms.

The forests, which since the expropriation law of 1919 have remained under the direct control of the State, constitute an additional source of fuel and the raw material of the saw mills, three-ply, and paper industries. Since about 1921 the quantity of timber employed in the country by these three industries has steadily increased. Cement is another product the preparation of which is in no way dependent upon foreign raw materials. Of the industries which are dependent upon foreign raw materials cotton spinning has been the most successfully organised, the exports of cotton yarn having increased from 154 tons in 1922 to 758 in 1924 and 1,282 in 1925.

Trade.—The principal exports of the country in 1924 were:—

	Value in Estonian marks
Dairy produce and other foodstuffs of animal origin	1,191
Wood and wood products	1,752
Cotton fabrics	1,094
Flax, raw	1,690
Total exports	7,866

Although Estonia was the first " window into Europe " for Soviet Russia, neither Russian transit nor the traffic in goods attained the height reached before the War. Trade with Russia was heaviest after the great Russian famine of 1922, when, in consequence of the quantity of provisions sent into the country, Russian transit over Estonian railways amounted to 370,000 tons, providing one-fourth of the total revenue of those railways.

Currency.—The economic progress which the country has achieved may be judged from the growth of its total exports from 2,287 million Estonian marks in 1921 to 4,812 in 1922, to 5,712 in 1923, to 7,866 in 1924, to 9,665 in 1925. To some extent the increase in these figures is due to the depreciation of the Estonian mark and the rise of prices. Direct fiduciary inflation ceased in 1921, and the exchange improved slightly during the next two years. With the bank inflation of 1923–4 the exchange depreciated from about 340 to 460 (Aug. 1924) to the dollar. By the end of the year, however, the Central Bank, which is a Government institution, had succeeded in bringing down the rate to about 373 Estonian marks to the dollar, a rate which is equivalent to 100 Estonian marks to the Swedish crown. The exchanges were kept stable at this rate from Jan. 1925 onwards, and it is proposed to introduce a new currency, a Kroon, equivalent to 100 of the present Estonian marks. In June 1924 this Kroon was made a legal unit of account.

The measure of success with which Estonia has met her economic reconstruction, despite great initial difficulties, despite certain highly critical periods as in 1923, when the effects of a bad harvest and an unwise credit policy coincided, and despite inevitable errors, has been largely due to the fact that since 1921 she has managed to balance her budget. Indeed, not only has the budget been balanced, but the capital outlay incidental upon her economic reconstruction has been largely met out of current revenues. Her taxes have thus been to a considerable extent a form of forced savings. On the other hand, as indicated above, as a result of the losses incurred by the State Bank, this country has lived to some extent upon the gold received from Russia.

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ETCHING (*see* 9.804).—No feature of recent art history has been more remarkable than the extended practice of original etching and its widening appreciation among print collectors and the public seeking decoration for its home walls. To compare the art's present condition with that offered to the survey of Sir

Frederick Wedmore in the 11th Edition of *The Encyclopædia Britannica* is to realise that since 1911 etchers of importance have arisen who must be ranked with the masters, while the average standard of accomplishment is now so much higher, notwithstanding the great increase in the numbers practising the method, that changes in the comparative value of reputations are inevitable.

While, therefore, etchers already of world-wide repute, such as Forain, Bauer, Zorn, Brangwyn, Bone and McBey are now mentioned for the first time in these pages, there are names which must disappear, necessarily giving place to others of more representative distinction. Since the volumes of the 11th Edition were in the press, the three latest surviving protagonists of the modern revival of original etching have died; Sir Francis Seymour Haden in 1910, Alphonse Legros in 1911 and Felix Bracquemond in 1914.

The Influence of Short.—Even greater and farther reaching than Haden's has been the influence of his successor in the presidency of the Royal Society of Painter-Etchers and Engravers, Sir Frank Short, R.A., for, during his long direction of the famous Engraving School of the Royal College of Art, he has trained two generations of British etchers in the tradition of Rembrandt's vital line, which he has held always as a sacred trust. A master of every method of the copperplate, with freshness of vision and sincerity of expression, Short long ago added to the classics of the etcher's art, to name only such beautiful and masterly plates as "Low Tide and the Evening Star," and "A Wintry Blast on the Stourbridge Canal." His revival of pure aquatint, in other words, tone-etching, as an independent expressive medium, with rich and subtle development of its capacity for tonal gradation, has enlarged the scope of the etcher's pictorial utterance. This service to graphic art was scarcely less important than Short's restoration of mezzotint to its purity of practice, first in his completion of J. M. W. Turner's *Liber Studiorum*, and further in his own poetic plates, exemplifying its value for original landscape.

Sir D. Y. Cameron, R.A., another veteran of the copperplate, won a distinctive place among eminent etchers before he had established his fame as a painter. Always attracted by the romantic aspects of architecture and landscape, he gradually found, through the just inspiration of the masters, a graciously distinctive style of his own to interpret with impressive chiaroscuro the significant beauties of buildings of character, and the essential poetry of his native scenery of loch and mountain. There are masterpieces among Cameron's architectural plates too familiar to need naming here, yet, remembering the beauty of "The Meuse," "Ben Ledi," "Ben Lomond," "Strathearn," one may believe that in landscape he finds his most distinctively personal expression on copper as on canvas.

Work of Brangwyn and Bone.—Another eminent painter who has made also a great reputation as an etcher is Frank Brangwyn, R.A., though he has characteristically taken his independent way with the method, adapting it with boldly bitten line to his pictorial designs, conceived deliberately on an unusually large scale for wall decoration rather than for the collector's portfolio.

Extraordinarily varied in pictorial interest, many of Brangwyn's etchings are monumental in design and vigour of draughtsmanship, though the effect of their chiaroscuro often suffers from over-emphasis in the printing, Muirhead Bone has long been one of the most potent personalities in British etching, though it is with the dry-point rather than the etching-needle that he has expressed his linear mastery in the interpretation of architecture as an integral factor of social life. Always he has had a sympathetic eye for landscape, but it is with buildings in every variety of aspect and condition that his keen vision and magnificent, searching draughtsmanship have been chiefly concerned, and whether the structures are shown in progress, in course of demolition or actually functioning, the vital accent of human interest is never missing.

McBey and Other Masters.—Innately an etcher, with a vivacious wizardry of line and originality of vision, James McBey was already a master of his expression when, in 1911, he came from Aberdeen to London and surprised and charmed the connoisseurs. With brilliant versatility, his progress has been extraordinary, and it may be traced through a succession of accepted masterpieces, such as "Ovation to the Matador," "Night in Ely Cathedral," "The Torpedoed *Sussex*," "Dawn—Camel Patrol Setting Out," "Gale at Port Errol," and certain Venetian plates.

In England we have now, indeed, as never before, a number of authentic etchers, producing plates of genuine, sometimes even masterly quality, distinguished by original design, with a wide range of pictorial interest. In these, while fresh architectural and landscape conceptions are revealing their artistic superiority to the stale conventions of vision so long prevalent, aspects of human life and character are claiming a far more important share. This awakened consciousness among British etchers that human beings and their circumstances and activities may be even more emotionally interesting as subjects for etching than, say, cathedral doorways and old barns is one of the most notable and promising signs of the present condition of the art in the country.

No etcher is more distinctive in his treatment of the human subject than Edmund Blampied, who finds the happiest inspiration for his superb drawing in vividly suggestive line in the life and labours of the Jersey and Normandy peasants and their farm horses and cattle; E. S. Lumsden finds his in scenes of native Indian life, and some of his Benares, Rajputana and Tibet plates bear the hallmark of a master. Of etched portraiture Malcolm Osborne, A.R.A., is a masterly exponent, while few of his best landscapes and architectural etchings are not invested with human interest. Francis Dodd also is most distinguished in his portraiture, while a style all his own marks Gerald Brockhurst's strangely alluring studies of feminine personality.

In several wonderfully characteristic etchings, of chiefly portrait interest, the art of Augustus John, A.R.A., has expressed its vitality and simplicity of conception in a line of singular purity. F. L. Griggs, A.R.A., in exquisite etchings of elaborate accomplishment recalling somewhat the technical manner of Samuel Palmer, aims at an imaginative reconstruction of medieval England in its architectural aspect, as William Walcot's remarkable "Roman Compositions," with a very different technique and manner, revivify Imperial Rome. Henry Rushbury's brilliant architectural conceptions, on the other hand, depict with something of Bone's accent the actualities of places. Landscape etchers range far and wide, but the homely charm of English landscape with its bounty of trees has found no truer interpreter in latter days than W. P. Robins. Marine etching has been given a fresh impetus, with widened scope, by Arthur Briscoe's authentic visions of nautical activities on the high seas. The etchings of Walter Sickert, A.R.A., George Clausen, R.A., Oliver Hall, A.R.A. and E. J. Sullivan, although but side issues of their lives' work, are yet important enough to stand the test of time; while among the legion of contemporary British etchers are some notably sincere artists who show a "coming-on disposition" which stirs hopes.

French Etching.—The outstanding personality in modern French etching is J. L. Forain, and he is one of the world's great etchers. Whether depicting with dramatic irony scenes of Parisian life, in the law courts, the café, the studio or interpreting with pathetic beauty the religious emotion of the Lourdes pilgrimage or challenging Rembrandt himself in his great human conceptions of Christ's tragedy, with his magically expressive line and vital draughtsmanship, Forain has produced unforgettable masterpieces. Although Auguste Lepère won fame first as a wood engraver of excellence, his name in the story of French etching is of considerable importance. There was always a charming humanity about his work. With him in the orthodox school may be mentioned Steinlen, Besnard, Beaufrere, Beurdeley, Roussel, Béjot and Auguste Brouet; but the personalities of the *Indépendent* group of modernists may perhaps be more safely left to the time test.

Other European Etchers.—In the land of Rembrandt there has been one great etcher since the supreme master, and he is Marius A. J. Bauer. He has found all his inspiration in the Orient, Turkey, Egypt, Palestine, India and always a rich imagination with a magnificent sense of design has directed his pictorial vision. His genius is seen as expressively in the vitality and spontaneity of his early small plates as in such great impressive compositions as "The Holy Camel," "Benares" and "Elephants." In Anders Zorn, Sweden gave a master-etcher to the world. His line was thoroughly individual, and happily adapted to his preoccupation with light in his vivid pictorial conceptions of the human physiognomy or figure, especially in his studies of nude bathers. His "Renan" ranks with the great etched portraits of all time.

Etching. America.—In America, where interest in etching grows apace, the most distinctive personality is Frank W. Benson whose vital studies of water fowl in their native wilds, the great Canadian rivers or the Atlantic coast, in various aspects of flight chiefly, have given new motives to the art. The veteran Joseph Pennell was productive until his death, April 22 1926. Herman J. Webster has produced many accomplished plates. Donald Shaw MacLaughlan, a masterly etcher, is increasing his reputation, while among the younger men of promise are notably John W. Winkler, Louis C. Rosenberg, Arthur W. Heintzelman, Ernest D. Roth, and Roi Partridge.

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ETHER (*see* 1.292).—Whether space is a mere geometrical abstraction, or whether it has definite physical properties which can be investigated, is a question which in one form or another has often been debated. As to the parts which are occupied by matter, that is by a substance which appeals to the senses, there has never been any doubt; and the whole of science may be said to be an investigation of the properties of matter. But from time to time attention has been directed to the intervening portions of space from which sensible matter is absent; and this also has physical properties, of which the complete investigation has hardly begun.

These physical properties do not appeal directly to the senses, and are therefore comparatively obscure; but there is now no doubt of their existence, even among those who still prefer to use the term space. But a space endowed with physical properties is more than a geometrical abstraction, and is most conveniently thought of as a substantial reality, to which therefore some other name is appropriate. The term used is unimportant, but long ago the term ether was invented; it was adopted by Isaac Newton, and is good enough for us. The term ether therefore connotes a genuine entity filling all space, without any break or cavity anywhere, the one omnipresent physical reality, of which there is a growing tendency to perceive that everything in the material universe consists; matter itself being in all probability one of its modifications.

Many attempts have been made to state the properties of such a substance in terms of material analogies, and all these attempts have shown signs of weakness and may be said to have failed. The properties of the ether are too fundamental to be stated in terms of something else.

There have been tendencies at different times to invent ethers or effluvia with special qualities to account for specific phenomena. These attempts were long ago discarded, and are now regarded as absurd. But that space has physical properties is a definite fact of experience, provided experience is extended to include inferences and deductions and is not limited to direct sensual perception. What we perceive directly are length, breadth and height, modified here and there by a resistance or obstruction which we call matter, and combined with the element of time or duration, as exhibited and measured by the motion of matter, with speeds that can be directly apprehended.

But in addition to all that mass of common experience, the free unobstructed space is modified by the neighbourhood of matter; so that there exists everywhere a gravitational potential varying inversely with the distance from its appropriate portion of matter; the result of which is that matter tends to move from places of lower to places of higher potential, as if some force were driving the masses of matter together. Civil engineering is constantly concerned with this fact; and on this basis the whole of the older astronomy has been worked out in detail.

Atoms of Matter.—The atoms of matter are not quiescent, even when a mass appears stationary, but are in a state of rapid quivering motion; and these motions are not independent of each other, but are interrelated and connected by additional and special disturbances which they communicate to the space or medium in which they occur. And about these supplementary disturbances our sense organ, the eye, has given us a mass of indirect information. These disturbances, though generated by matter, are not conveyed or transmitted by matter. They travel at a rate depending on innate properties of space; or rather, as we feel bound to say, on the physical properties of the substantial reality which fills space; thereby telling us something definite about those properties, though in a form difficult of apprehension and one which is not fully expressible in terms of any of the familiar properties of matter.

Thus the different masses of matter, even though separated by great distances, are not isolated or independent of each other. They are connected gravitationally, and they are connected optically. The energies of the earth, of which we constantly make use, are derived from the sun, and have travelled across the intervening 92,000,000 m. of empty space at a perfectly known and definite rate, with which rate matter has nothing to do. There may be uncertainty as to what exactly it is that is travelling; but the fact that it is travelling energy is certain. All that matter does is to generate this radiant energy at one end and absorb it at the other.

Concerning the processes of generation and absorption a good deal is now known. Moreover not only is the speed of travel of the transmitted disturbance known, but also the fact that it is a periodic disturbance, expressible mathematically in exact analogy with a wave equation. Wherefore the disturbance may be spoken of without further hypothesis as ether "waves," the generic name for which is radiation, a small range of this radiation being visible light.

Radiation is generated by some cataclysm or collision or other violent and sudden disturbance in the atoms of matter. When radiation encounters matter (unless it be merely reflected or passed on) it can throw the multitude of atoms into the confused motion we call "heat," and produce other remarkable and chemical effects. Thus an ether is necessary for the purpose of transmitting what is called gravitational force between one piece of matter and another, and for the still more important and universal purpose of transmitting waves of radiation between one piece of matter and another however small and distant they be.

Electric and Magnetic Properties.—In addition to those two functions, other properties have been discovered, notably the properties called electric and magnetic. Atoms of matter are electrically constituted, and accordingly tend to attract each other with a force which is the source of chemical affinity; with the result that molecules and other aggregates are formed, of which the structure is studied in the science of chemistry. Moreover the molecules themselves attract each other by a residual affinity, giving the familiar shape of crystals and other solids, the particles of which are held together in regular packing across ultra-microscopic intervals by what is called cohesion, for which likewise the ether must be held responsible. For, as Newton forcefully said in other words, it is absurd to imagine one piece of matter acting mechanically on another at a distance, whether that distance be large or small, without some intervening mechanism. The continuous medium which fills space therefore is not only the vehicle of gravitation and light, but is also

the instrument for cohesion and chemical affinity and for electric and magnetic attractions and repulsions.

The intimate structure of the ether will probably be expressible and partially understood in terms of the phenomena of electricity and magnetism: for electric and magnetic influences which can be the subject of experiment are transmitted perfectly through vacuum, that is, across space empty of matter. They represent primarily properties of the ether, and are only made manifest to our senses by means of matter. It was in terms of electricity and magnetism that Clerk Maxwell was able to explain the phenomenon of light. A close study of electro-magnetism, that is, of the interaction between electric and magnetic disturbances, showed that they must combine into a wave equation, the waves being transmitted at a rate calculable from purely electric and magnetic considerations. This velocity turned out to be the velocity of light; and so in 1865 the true theory of light was born.

Not that it is anything like complete. We know too little of the electric and magnetic properties of the ether to be able to picture them exactly. What we do know is that light is an electro-magnetic phenomenon, and that it is entirely dependent on the properties of the ether. The ether involves or possesses properties expressible by two fundamental constants; one of them regulates the force of attraction between two electrified bodies, and the other the force of attraction between two magnets. Neither constant by itself is as yet known. But the value of the constants multiplied together is known: it was discovered by Clerk Maxwell, and is the reciprocal of the square of the velocity of light. In other words, the combination of the electric and magnetic properties of the ether enables it to transmit waves at a rate equal to the inverse geometric mean of its two constants.

So far we have been dealing with things which have been known for some time. But the subject is so fundamental and important that a recapitulation in other terms seemed advisable. It now remains to deal with the later progress which has been made in investigating the properties of this extraordinary non-material but physical substance. Perhaps "substance" is hardly the right term, for, though exceedingly substantial in one sense, it makes no appeal to the senses and is therefore unlike any substance we know.

In the 9th Edition of the *Encyclopædia Britannica* an attempt was made to estimate the elasticity and the density of the ether, on the strength of a certain hypothesis made by Lord Kelvin. In the 11th Edition (*see* 1.292) this estimate was repeated, and it was hinted that the hypothesis might be erroneous and the values obtained exceedingly wrong. Everything tends to confirm that conclusion. Strictly speaking the very terms elasticity and density, which are terms applicable to matter, may be inapplicable to the ether without re-definition; if used they must be understood in a formal sense. The properties of the ether are not likely to be expressible in terms of matter; but, as we have no better clue, we must proceed by analogy, and we may apologetically speak of the elasticity and density of the ether as representing things which, if it were matter, would be called by those names. What these terms really express we have not yet fathomed; but if, as is now regarded as very probable, atomic matter is a structure in ether, there is every reason for saying that the ether must in some sense be far denser than any known material substance. The densest known matter, or matter of highest inertia, is found in some of the stars; the barely visible companion of Sirius having been found, on converging grounds of evidence, to be more than 1,000 times as dense as lead. The ether must exceed even that startling amount; indeed there are sound arguments for regarding it as a million times denser. The fundamental substance is not likely to be filmy and unsubstantial.

Recent discoveries have represented the atom of matter as composed of minute electric charges, which fill hardly any of the space inside the atom, so that it is as porous as a solar system. The great bulk of an atom is occupied only by a few electrons; so that it is by no means impenetrable to particles, which if they fly through it at sufficient speed, can escape being entangled and absorbed. Matter therefore is comparatively a gossamer structure, subsisting in a very substantial medium. An estimate of the substantiality of the medium can be made from its magnetic energies, and it comes out almost incredibly large. If it is right to express it in terms of material properties (which is doubtful) its inertia comes out as of the order of 1,000 tons per cubic millimetre. While as to the elasticity, that is still more enormous, since it is equal to the density multiplied by the square of the velocity of light.

These values are barely conceivable, being so much higher than anything of which we have sensual experience. But still they are definite and finite, and are capable of being measured and expressed; so the ether is a physical substance, with properties which can in time be ascertained; and if the estimate above given of the source of the vast energies involved is wrong (as it is sure to be inadequately and incompletely worded) subsequent investigation can correct it. Meanwhile we may assume that there is some truth underlying these modes of expression, a truth which we cannot at present formulate any better.

The constants embodying the physical properties of the ether though so huge are not infinite, and it seems to have certain very simple and perfect properties. It is perfectly transparent, it dissipates no energy; otherwise the stars and the spiral nebulae could not be seen at their gigantic distances across space. There is no friction between matter and ether, otherwise a portion of matter isolated from the rest would cool down, and the planets would not continue forever in their courses unperturbed. The ether has nothing of what we call in matter viscosity or fluid friction. There is no real heat in the ether, nor any sound; nothing but one simple type of propagation of effects by waves goes on in free space, and that with a definite unchangeable velocity which is known as the velocity of light, the one fundamental and so to say absolute velocity in the universe.

The Velocity of Light.—The question arises as to what that velocity can be due to. The most probable surmise or guess at present is that the ether is a perfectly incompressible continuous fluid, in a state of fine-grained vortex motion, circulating with that same enormous speed. For it has been partly, though as yet incompletely, shown that such a vortex fluid would transmit waves of the same general nature as light waves—*i.e.*, periodic disturbances across the line of propagation—and would transmit them at a rate of the same order of magnitude as the vortex or circulation speed. There remains indeed a question of stability to be safeguarded, but in these days of quanta (*see* QUANTUM THEORY) stability considerations are apt to be deferred. Thus it appears possible that some day an extended hydrodynamics of a perfect fluid will explain all the physical properties of the material universe.[1]

This motion of a structure due to vortex circulation in a perfect fluid may be regarded by some as too material an idea, and it may have to be discarded; but it is the nearest approach that can be suggested to a pictorial image of the etheric constitution. Certainly no *structureless* fluid could transmit actual radiation. And certainly the ether is continuous and without viscosity or any dissipation of energy, and so in many respects is like an ideal fluid. More than that we cannot say, except speculatively, about its constitution.

Meanwhile we must assume that the ether has a substantiality and a wave-conveying structure beyond our present clear imaginings, with parts of it modified in an unknown way into electrons and protons; that of these the atoms of matter are built up; and that the whole of material activity consists in the interactions of these minute electric charges, connected as they are by their lines of force and by radiation.

These electric charges, and the aggregates which they have built up are subject to what we experience or recognise as locomotion. The ether itself is stationary. Whether it is really infinite in extent or whether though boundless, like the surface

[1] Lord Kelvin, "The Vortex Theory of Ether," *Phil. Mag.* (1887) and *Math. and Phys. Papers*, vol. iv. and passim. G. F. FitzGerald, *Proc. Roy. Dub. Soc.* (1899), or *Collected Papers*, pp. 154, 238, 472.

of a sphere, it is nevertheless finite, are questions which we cannot at present answer. There is no doubt that it extends beyond the farthest visible stellar object, and for all practical purposes is infinite. There is very little doubt that matter is not an alien substance, but is essentially composed of it, being built up of the electrons and protons whose constitution has not yet been ascertained, but which must somehow be constituted of ether, perhaps in some sense analogous to that in which a knot in a piece of string is constructed of string, or a vortex in air is composed of air, or the fibre of a muscle is still essentially flesh.

Einstein's Theory.—The theory of Relativity (*see* RELATIVITY) has led some people—not many of the leaders of thought—to doubt if the ether can really exist. It may be useful therefore at the present time in this supplementary article to explain in what way the equations connected with that theory are to be understood physically. Newton expressed the laws binding the planets and suns together in terms of a hypothetical force acting between them, the same kind of force as we experience when a weight is supported above the earth; which force may therefore be taken as a fact of experience. But though the force is a fact, it is not explained: any expression in terms of action at a distance is necessarily incomplete.

Einstein was led by considerations of relativity to formulate a law of gravitation, not in terms of force or of action at a distance, but in terms of something in space, that is, in the ether, which results in a tendency of bodies to approach each other. It might be called a warp in space, or it might be called by other names: the names do not matter. The thing that has to be expressed is that the presence of matter modifies its whole neighbourhood, causing a gravitational potential, as has been previously said. And, until we know more about its intimate nature, the action of this modification is best expressed in terms of a differential equation which seeks to formulate abstractly, without physical hypothesis, the essence of what is really happening. None of the arguments which necessitate the existence of a medium are affected, but no name for it need be used, nor need the idea of a medium be introduced, for mathematical purposes. Mathematicians are quite able to work with abstract equations about quantities without physical implications or conceptions, as long as they remain purely mathematicians. They can reduce even geometry to arithmetic.

In a complete expression for the enlarged geometric interval between two points, the element of time must be introduced as well as the element of space, because they may be moving points. In other words geometry must be enlarged into kinematics, in order to express activities. The interval or line element between two neighbouring points may be expressed in polar co-ordinates π,θ,φ thus: $ds^2=-dr^2-(rd\theta)^2-(r\sin\theta d\varphi)^2+C^2dt^2$, a mode of expression devised by Minkowski, an enthusiast for this kind of four-dimensional treatment, where the fundamental etheric velocity c is introduced as a coefficient able to turn time into imaginary space, $icdt$. The emphasis on c, as an absolute geometric constant, is perhaps the most remarkable part of the Einstein-Minkowski conception, as a preparation for the building erected upon it.

But Einstein took a further step, introducing the gravitation potential as something which would modify the motions of matter, and introduced it not only into the element of time (as Newton might have done if he had used that notation) but into the element of radial distance also; so that if the points are in the field of a mass of matter m the Minkowski equation is:—

$$ds^2=-\nu^{-1}(dr)^2-(rd\theta)^2-(r\sin\theta d\varphi)^2+\nu c^2dt^2$$

where $\nu=1-2P/c^2$, P being the gravitation potential at the place considered; which, if caused by a mass at a distance r, is $P=k^m/_r$, with k as the Newtonian gravitation constant.

Here the coefficient ν occurs twice. If it occurred in the t term only it would be a mode of stating Newton's theory of astronomy, in differential instead of integral fashion; but this ν occurs in the r term also, as a result of the isotropy of the fourfold medium contemplated in this gravitational theory. This equation when elaborated gives, strangely enough, the outstanding progression of the perihelion of Mercury, and it also gives the double deflection for a ray of light passing near the Sun (doubled because the co-efficient ν occurs twice), which has since been perhaps confirmed quantitatively by observation. It likewise gives the shift of the spectral lines emanating from an exceedingly massive body, which has now been confirmed beyond the reach of reasonable controversy by observations on light coming from the companion of Sirius, which Eddington has astonishingly proved to be by far the most compact and densest material body at present known to science.

The beauty of these results is overwhelming; but the idea that any mathematical scheme is more than a powerful method of exploration, and that a universe can be thus constructed in which physical explanations can be dispensed with, involves too simple and anthropomorphic a view of nature. The things calculated, and the things observed, cannot exhaust reality; an explanation is bound to be sought, and ultimately attained, in terms of the partially recognised but largely unexplored properties of the entity which fills space.[1]

Locomotion of Matter.—The locomotion of matter is perhaps the commonest fact of experience, and it seems strange that it should be in need of explanation. But since the atom of matter is composed of electric charges, the locomotion of those charges has to be considered more in detail. An electric charge in motion constitutes an electric current, and the path of every electric current is surrounded by rings of magnetic force. This magnetic field confers inertia or momentum upon the moving charge; so that mechanical impulse is necessary to start it moving; and also to stop the motion. If not stopped it will continue to move uniformly in a straight line until it encounters some deflecting or retarding agency.

But though locomotion can thus be stated and worked out electromagnetically, that cannot be regarded as an ultimate explanation of so familiar and apparently simple a thing. Moving matter is known to have kinetic energy; and the familiar expression $\frac{1}{2}mv^2$ is the type of its measure. But when we come to analyse this expression there are difficulties about it which the Theory of Relativity has brought out and emphasised. For when we try to specify the velocity of a body, in order to calculate its energy, we find it difficult to say what that velocity really is: we can only specify it with reference to something else, commonly with reference to the earth. But the earth itself is moving. Hence $\frac{1}{2}mv^2$ does not give the absolute energy, but only the energy relative to the earth or other frame of reference, as Newton implicitly recognised. What the velocity of a body is in space we have no means at present of ascertaining, having no universal standard of reference; and accordingly the usual expressions, though practically useful, are by no means ultimately satisfactory. Nor can a statement in terms of electromagnetism be considered as ultimate.

The fact is that locomotion does not seem to be a property of the ether, which appears to be affected by one speed and one speed only, namely, what we suppose to be the speed of its internal circulation and are familiar with as the velocity of light. How then can a particle of ether, however modified, move from one place to another? The analogy of a loose knot slipping along a string may be helpful.

An electron even at rest has intrinsic energy, its electrostatic energy of constitution, which can be expressed in various ways, and which, when expressed in terms of mass and speed, is m_0c^2, m_0 being its inertia at rest. Its static energy is thus expressible as equivalent to that of a particle of certain mass m_0 or $2m_0$, moving with the speed c—the speed of light. To assist ideas, it might be thought of as a spinning motion; at any rate not locomotion.

When the particle is moved, the natural idea would be that this velocity c is increased, or that some addition is made to it. But according to the doctrine of relativity that is impossible: the velocity c is constant. The thing that changes is not c, but m. And the energy of a moving body is m_1c^2, where m_1 is greater than m_0. And as the speed of motion increases, m_1 increases too; until at high speeds it is very great, and, as the speed of light is approached, tends to become infinite. So that when an identified portion of ether is in locomotion, it is not the speed that is changed, but the amount of modified ether associated with that identified moving portion. And what we observe as the kinetic energy of the particle is $(m_1-m_0)c^2$ or c^2dm. This is what we have hitherto recognised and called $\frac{1}{2}mv^2$, an expression which is relative, and which is not exactly applicable to great velocities, such as we encounter in vacuum tubes and in radioactivity generally.

[1] To avoid any appearance of dogmatism on difficult subjects, it may be well to say that some eminent mathematicians are still of opinion that the Einstein formulation is not quite satisfactory. For instance, Larmor, *Phil. Mag.* (1923) claims that it only gives half values, and expects that some slight modification of Newtonian and Maxwellian theory will be found able to cover the above slight experimental deviations from what was previously known. The rest of this article must be treated as a tentative attempt to indicate ideas that cannot be thoroughly expressed at the present date except by symbols.

Thus when we try to look at locomotion absolutely, we have to admit that varying speed means varying amounts of substance in the identified portion of matter we are attending to. If the earth were to move quicker it would be more massive: and this increase of mass would appeal to us as locomotion. It is as if the normal constitutional circulation trended or drifted in one direction, so as to constitute perceptible or available energy.

The same idea may be expressed magnetically by calling attention to the magnetic field surrounding a moving charge. At high speeds the magnetic field is strong; more substance is involved in it: and the additional spin (if that is the right term, for magnetism is usually thought of as a kind of spin) accounts for the additional energy. Why it should appeal to us as locomotion, and what the real meaning of locomotion is, are not so clear. This is only an illustration of the difficulty we experience when we come to probe the simplest thing to its depths. We have grown accustomed to certain aspects of the universe given us by our senses, but we do not fundamentally understand them. And when we come to probe the meaning of things deeply enough, we find ourselves up against difficulties of conception, toward the elucidation of which our senses give hardly any aid. What we are used to is mechanical movements; but the effort to explain things ultimately in that way is not easy, and may turn out to be not possible.

Meanwhile we take refuge in expressing these things in terms of electricity and magnetism; which is a step toward an explanation, and is useful in bringing out the difficulties which underlie every ultimate and absolute statement. The attempted absolute expression for static electric energy, mc^2 with the inertia m as the only variable, is a legitimate mathematical expression of electric facts. But the real meaning of c is, at present, a hypothesis: and what the real meaning of m is, must be regarded as still less known. Both these factors must have reference to the ether, and until we know more about the constitution of the ether we must be content to remain in a condition of provisional ignorance. We are led to regard the material universe as a substantial reality in various stages or varieties of internal activity. We may try to think of this activity as akin to a fine-grained vortex circulation in a continuous, incompressible, perfect fluid: beyond that we cannot at present go; nor are we clear about the exact meaning of these terms when applied to a medium of unknown constitution. When we understand the real and ultimate nature of electricity and magnetism we may hope to proceed further. Till then we must be content with proximate explanations. (O. L.)

ETHICS (*see* 9.808).—Since 1911 little new or striking work has appeared on the subject of moral philosophy. The more original and prolific writers have devoted themselves mainly to metaphysics, or especially to the theory of knowledge. This was perhaps a natural result of the philosophical situation; but, while the consequent progress in these studies has been valuable, the loss has also been serious. The temporary neglect of ethics, the branch most attractive to the average educated reader, has tended to lessen popular interest in philosophy and to make the style as well as the subject of philosophical writers more technical. Attention to the facts of the moral consciousness has value even for the special problems of epistemology.

Perhaps in revenge for the neglect of genuine philosophical reflection on morality, a large part of the work professedly upon the subject has not been strictly philosophical at all, but either didactic or anthropological. There has certainly been no decrease in the output of books aiming at edification by attempting to deduce particular practices, political, social or religious, from arbitrarily selected principles. In other words, during this period, between the stools of metaphysic and didactic casuistry, moral philosophy has fallen to the ground. In English H. Rashdall's work[1] still holds the field as the most adequate survey of the whole ground of ethical controversies, though the modified rationalist and altruistic utilitarianism of his own view would certainly not be universally accepted.

[1] *The Theory of Good and Evil* (Oxford, 1907).

English Idealism.—The traditional doctrine of English idealism, not yet affected by contemporary Italian idealists or by the revival of realism, is well represented by J. H. Muirhead.[2] The general character and difficulties of this view may be illustrated by a quotation: "There is no such thing as determination by pure reason. Apparent cases, as in the preference of duty to inclination, are cases of determination by a deeper inclination." Here the word "deeper" where, after "preference" we might have expected "stronger," seems ambiguous. "The humblest plant is free in a sense denied to the heavens. *A fortiori*, all this is true of beings who not only live but can make their life an object—who to adjustment to environment and to determination from within can add determination by the idea of self." A man is more free according as he "lives more habitually and consistently in his deepest purposes." He who sees what is reasonable must do it. "The essence of moral judgment is distinction of value between different forms of momentary and individual satisfaction."

A similar view is elaborated in greater detail and with a full discussion of objections by G. C. Field.[3] For him also the only possible motive to action is desire; and on this point he contrasts Aristotle favourably with Kant. A wise man's desires are directed towards an end which would fully and permanently satisfy him, and the only such end is love as embodied in Kant's *Kingdom of Ends*. Right action then is action which tends to produce such a state, or expresses such a state, or removes hindrances to it. It is hard to see that such theories really give any account of obligation, and particularly any real account of the obligation to justice.

The Realists.—The moral theory of a realist, S. Alexander,[4] is not so different from that of idealists as might have been expected. He describes goodness as being like truth and beauty, a "tertiary quality" or value which exists "in a physical fact" only "for a contemplating mind." "Good is the satisfaction of persons." But goodness is attributed to acts of will only when they possess "coherence," which is not their "quality" but a "property" belonging to them just "so far as the valuing subject appreciates it." "The reality which we produce is good in so far as it satisfies coherently the persons who bring it about." "Morality arises out of our human affections and desires which we seek to satisfy. Some of them are self-regarding, others are natural affections for others. . . . We sympathise or dissympathise . . . with certain impulses or tendencies of others. . . . The good wills are those which cohere with each other." "The good act is approved as pleasing the collective wills." "In so far as the individual is good he represents the collective wills of the society. His approbations whether of himself or others coincide with theirs. . . . So far as he is good he embodies the common judgment . . . he is the standardised man." "Self and others are claims which are antecedent to morality and are reconciled by the moral judgment itself. . . . Much suffering and heartburning may be endured in the social adjustment of claims and exaltation of what is approved of them into rights, till the individual has learned the difficult lesson of finding more pleasure in following the right than he loses from the sacrifice of his desires."

Idealism v. Realism.—The expected issue between idealistic and realistic ethics is, however, clearly raised by G. E. Moore[5] where he asks "Whether when we judge (either truly or falsely) that an action is a duty or a state of things good, *all* that we are thinking about the action or the state of things in question is simply and solely that (1) we ourselves or (2) others have or tend to have a certain feeling towards it when we contemplate or think of it." This question he inclines to answer negatively, on the grounds that (1) where two people differ in a moral judgment we cannot think both are right, and (2) in making a moral judgment we do not mean to assert that others agree to it.

[2] Author of *The Elements of Ethics* (1910), in his article "Ethics" in the *Encyclopaedia of Religion and Ethics*, vol. 5 (London, 1912).
[3] *Moral Theory* (1921).
[4] *Space, Time, and Deity* (1920).
[5] The last essay of his *Philosophical Studies* (1922).

Elsewhere the same writer,[1] after expanding this view, argues that what makes an action right is its consequences. He does not make clear whether he would consider there would be a difference of consequences if by my act an exactly similar satisfaction could be produced either in a stranger or in one to whom I was under some obligation. To the question of freedom he suggests the answer that we are free to do an act if we could do it if we willed it; but he is not decided whether it is ever true that we can will or not will an act.

H. A. Prichard[2] points out that nearly all moral philosophers from Plato downwards have taken for their function to prove that we ought to do what we take to be our duties (or what they take to be our duties) as against a reflective scepticism arising from our disinclination to do it. They have tried to demonstrate the obligation either of current morality or of some version of it amended in their own sense. The only ways of doing this were either (1) to argue with the hedonists of all types that such alleged duties were really our interest—which after all does not prove them our duty; or (2) to argue with Sidgwick and Rashdall that the alleged duties were really duties because they led to some end rationally judged to be good; but this cannot always be shown of an act of secret (and therefore not exemplary) justice; or (3) to base the obligation to the alleged duties on the goodness of the act itself. But in this last attempt "good" either means (*a*) right, and then we are only told that an act is right because it is right; or (*b*) moral, *i.e.*, done from a sense of duty, and then we are told that acts are right which are done because they are thought right; or (*c*) virtuous, *i.e.*, done from a good desire, and then we are told that acts are right if they spring from right desires; but to have a desire is not in our power. It would appear that there can be no such thing as moral philosophy if that means a proof of our immediate moral apprehensions. If these are subsequently questioned (on any ground other than ignorance of matters of fact) the only remedy is to replace oneself imaginatively in the situation and perform the moral judgment again. The only proper sphere of moral philosophy is to justify the immediacy of our moral judgments and so to defend them against the scepticism which may arise from the failure to find demonstration.

Influence of Croce.—Perhaps the strongest idealistic influence of an original character has been that of Benedetto Croce.[3] Unlike Rashdall, Croce would deny that the rightness of an act depends upon its being directed to an end rationally judged to be good. For him a good is merely the object of a desire. All rules of conduct are merely empirical generalisations from past moral acts. Every act has its utilitarian or, as he calls it, "economic" side; in order to be willed at all its doing must have satisfied the doer. Moral acts have this economic side; they satisfy the agent; but they, and they only, have also another side which he describes as "universal." They satisfy not merely the individual nature of the doer, but that universal spirit in which as an individual spirit he shares. To the question of freedom, whether it is in our power to choose to satisfy either the empirical individual self only or the universal spirit, Croce's answer is obscure. He denies determinism as being "the introduction of the methods of physical science into philosophy," but he also denies what he calls "arbitrary choice." On the whole, his view of freedom would appear similar to that of H. Bergson, whom he quotes with approval.[4] The *Pratica*, though brilliant in criticism, is too cursory and contemptuous in its treatment of difficult problems to be satisfactory. For instance, it is not clear whether the acts which are said to satisfy the universal spirit are right acts (perhaps not known to be so by the individual) or moral acts—*i.e.*, acts done because thought (perhaps falsely) to be right by the individual.

In spite of this, and of their very different starting-points, there are some remarkable points of agreement between Croce and Prichard, which, just because of that difference, may well be symptoms of the general trend of contemporary thought. They agree (1) that, as against Kant, we cannot think an act right unless we think it will originate some satisfaction; but yet (2) that, as against Sidgwick and Rashdall, the rightness of one of alternative acts cannot be determined by the greater satisfaction or greater good which it will originate; and indeed (3) that rightness cannot be determined by reference to any concept other than rightness itself. Further, consequently, they agree (4) that "the formula of means and end is irrelevant in morality" and (5) that what is called "proving the rightness of an act" is either (*a*) giving fuller information about the situation, or (*b*) giving fuller information about the act itself, *i.e.*, what we are originating. Croce's "universal act" or satisfaction of the universal self would perhaps be described by Prichard as originating the satisfactions which we ought to originate or which we think we ought to originate. (The ambiguity is Croce's.)

Pragmatist Theories.—Theories of morality in a pragmatist sense have been mainly developed in America by J. Dewey and others.[5] Much that is here insisted on would be accepted by moralists of other schools: that right conduct depends in part on a scientific knowledge of the results of action; that all action has social effects; that there is no one ascertainable "end of man" to which all right actions are directed as means; that rules of morality are only generalisations from the judgments passed on particular acts in definite situations. But some of the conclusions would be regarded as paradoxical by moralists of any school outside hedonism. For instance, along with other "ends" dismissed as fictitious, Dewey classes the principle of "obedience to rational consciousness of duty." "A remote goal of perfection, ideals that are contrary in a wholesale way to what is actual, a free will of arbitrary choice—all of these conceptions band themselves together with that of a non-empirical authority of Right and a non-empirical conscience which acknowledges it. . . . Why indeed acknowledge the authority of Right? That many persons do not acknowledge it in fact, in action, and that all persons ignore it at times, is assumed by the argument. Just what is the significance of an alleged recognition of a supremacy which is continually denied in fact? How much would be lost if it were dropped out and we were left face to face with actual facts? . . . We live in a world where other persons live too. Our acts affect them. They perceive these effects and react upon us in consequence. . . . They approve and condemn, not in abstract theory but in what they do to us. The answer to the question, 'Why not put your hand in the fire?' is the answer of fact. If you do, your hand will be burnt. The answer to the question, 'Why acknowledge the right?' is of the same sort . . . it signifies the totality of social pressures exercised upon us." The conclusion appears to be that the only meaning for "thinking an act right" is the doing it, from fear of punishment.

The most interesting endeavour to demonstrate the rightness of some particular kind of conduct from philosophical principles is made by V. Solovyof.[6] It is the most interesting both because the emphasis on asceticism is somewhat strange to the Western conscience and because of the psychological views involved. The basis of morality is said to be self-regarding, not social; it consists in the sense of shame, primarily sexual shame, peculiar to humanity, which is implicitly a sense of the duty to free ourselves from the dominion of "the body" and of its instinctive demands for racial or individual preservation. Closely connected with the shame of sex (or of subjection to racial preservation) is shame of fear (or of subjection to selfish preservation). Shame is developed by reason into conscience, which gradually extends its sphere of criticism from the self-regarding duties of chastity and courage (subjection of bodily impulses) to the social duty of pity for those similar but inferior to us and the religious duty of reverence for what is superior to us. These two duties are developed, unlike shame, from impulses natural to animals as well as men, since they begin in parental and filial affection. From these three impulses the writer develops an elaborate system of personal, political and religious ethics.

[1] *Ethics* (1912).

[2] *Mind* (Jan. 1912) "Does Moral Philosophy Rest on a Mistake?"

[3] *Filosofia della Pratica*, written in 1908 and translated into English in 1913.

[4] *Les Données Immédiates de la Conscience* (1889).

[5] *Creative Intelligence* (1917) and by J. Dewey in *Reconstruction in Philosophy* (1921) and *Human Nature and Conduct* (1922).

[6] *The Justification of the Good*, translated from the Russian in 1918.

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ETHYL CHLORIDE (C_2H_5Cl) (*see* 9.851), prepared from hydrochloric acid and ethyl alcohol, is a gas at room temperature, but is stored and sold under pressure in glass bottles fitted with trigger-controlled spray nozzles, as a colourless, mobile liquid with a characteristic ethereal smell and sweet, burning taste, which boils at 12·5°C. The vapour burns with a green flame. Chloryl and Kelene are trade names. Anestile is a mixture of ethyl and methyl chlorides.

Uses.—It is used (*a*) as a local anaesthetic for small incisions, tooth extractions and needle punctures, by spraying it on the surface of the skin or mucous membrane in a fine stream. Its rapid evaporation causes local freezing (−35°C. can be obtained). This method is unsatisfactory for many reasons. Only a very small area can be frozen at one time, it is difficult to puncture or cut the hard-frozen tissues, the freezing is very transitory, the thawing afterward is exceedingly painful, the frozen zone is so superficial that the smallest incision penetrates beyond it and is felt by the patient, and lastly it is not good treatment to produce acute frost-bite in living tissues.

(*b*) As a general anaesthetic, it is usually given in doses of 3–5 cubic centimetres in a closed inhaler. An ordinary ether inhaler will do perfectly well. As regards safety it is probably intermediate between nitrous oxide and ether. At one dental hospital it has been given nearly 100,000 times without mishap. Short administrations produce an anaesthesia similar in type to that of nitrous oxide with an equally rapid loss of consciousness, a quick recovery and slight after-effects. Like gas, it can be safely given in the sitting position. It is more convenient than gas, as the apparatus required is less bulky; it is more powerful and more reliable, gives a longer period of anaesthesia for dental work (90 seconds instead of 30), and does not cause cyanosis. Muscular relaxation cannot be guaranteed, especially in adult males, but it is as a rule more satisfactory than with gas.

Longer administrations approximate more to the ether type of anaesthesia, ethyl chloride being, like chloroform and ether and unlike gas, a lipoid solvent. For cases lasting more than a few minutes ether is preferable and cheaper. Ethyl chloride may also be used to precede ether anaesthesia by the open or closed methods and is more humane as quicker, less irritating with a less unpleasant smell.

Clinically its effect on the circulatory and respiratory systems is slightly stimulating, causing flushing of the face, acceleration of the pulse rate by 10–20 beats per minute and a rise in systolic blood pressure of 10 to 20 millimetres, together with deeper and more rapid breathing. (*See* ANAESTHETICS.) (W. S. S.)

ETHYLENE (*see* 9.851), when inhaled is a general anaesthetic and was first used as such by Luckhardt and Carter in 1923. It is still in the experimental stage, however. Like nitrous oxide it is not a lipoid solvent. It is given with oxygen, of which 7–12% is needed. Caution is necessary because of the explosive nature of the mixture. Its efficiency is between that of gas oxygen and ether. Ether may have to be used with it to deepen the anaesthesia. (*See* ANAESTHETICS.) (W. S. S.)

EUGENICS (*see* 9.885), a name for any plan to improve the inborn qualities of the human races. The idea that such improvement might be made by deliberate selection of parents in accordance with the practices of animal husbandry, has doubtless often occurred to man from the earliest times to the present. The earliest extant expression of it in literature is probably found in Plato's *Republic*, written about 375 B.C. Plato recommended that, for the improvement of the quality of the citizens, matings should be arranged by the magistrates between the best of both sexes.

Toward the close of the 19th century Sir Frances Galton, from studies described in *Natural Inheritance* (1889) and *Hereditary Genius* (1869) concluded that improvement of the human stock was not only conceivable but practicable. At his death he arranged for the continued study of the subject at the University of London, where Karl Pearson has since directed the work of the Galton Laboratory of National Eugenics. An important series of its publications deals with human heredity. (*See* HEREDITY.) Interest in that subject was further stimulated in 1900 by the rediscovery of Mendel's laws (*see* MENDELISM), now regarded as the fundamental laws of heredity in animals and plants as well as in man, though the laws were unknown to Galton himself, who formulated a different generalised law of heredity (Galton's law), a less accurate generalisation than Mendel's, as is now recognised.

Eugenics Record Office.—In the United States, the Eugenics Record Office was founded in 1910 by Dr. C. B. Davenport, at Cold Spring Harbour, N. Y., for collecting for study all data obtainable about family histories, with special reference to the inheritance of traits physical or mental. The public is invited to deposit at the Eugenics Record Office family records, whose privacy is guaranteed. By co-operation with the authorities, family histories are also obtained relating to the patients or inmates of institutions for the insane, epileptic and feeble-minded. Based on the study of such data, bulletins are from time to time published concerning the inheritance of traits such as insanity, epilepsy, feeble-mindedness, hair-colour, skin-colour, stature, body-build and hair-form.

Since the rediscovery of Mendelism occasioned the founding of the Eugenics Record Office, it is natural that results coming from this institution should have been formulated as far as possible in terms of Mendel's laws. Thus in certain of its early bulletins feeble-mindedness, insanity and epilepsy are described as recessive characters, while Huntington's chorea, fragility of bones associated with blue choroid of the eye, and violent temper are described as dominant characters. Possibly some of these and other results published by the Eugenics Record Office have been put into too simple and too rigid categories, and a strictly Mendelian statement of results has been adopted oftener than is justified by present knowledge of genetics.

Karl Pearson and his associates of the Galton Laboratory in London have gone to an opposite extreme in ignoring Mendelism in the interpretation of heredity. Both schools agree that insanity, for example, occurs oftener in some families than in others, and that the differences are too great to be due to chance. A predisposition to insanity must accordingly be an inherited character, but its manifestations in successive generations are too varied and erratic to be described as a case of simple Mendelian inheritance.

Developments in Various Countries.—The study of human heredity is being actively pursued at present in most countries where the genetics of other animals and of plants are being investigated. Britain, Germany, Sweden, Holland and the United States have journals, devoted to a greater or less extent, to publishing the results of studies of human heredity. A considerable portion of the published material is probably of small value, since it is uncontrolled by experiment and is based largely on uncritical data; nevertheless substantial progress is being made in our knowledge of human heredity. There is an inherited basis for differences between individuals, families, and races, as regards (*a*) colour of skin, hair and eyes; (*b*) stature; and (*c*) head-form; what a geneticist would call multiple factor differences, dependent upon more than one inheritance unit, as the results of racial crosses show. Cases of inheritance due to one-factor differences (simple Mendelian cases) are limited chiefly to physical abnormalities or peculiarities such as albinism, night-blindness, brachydactyly, syndactyly, and other digital malformations, colour-blindness, spontaneous bleeding or haemophilia, and alkaptonuria. Few of these are seriously

harmful characters or recur with alarming frequency in a normally exogamous population.

Mental Traits.—It is generally believed that differences in intelligence are inherited, that the children of highly intelligent parents are more intelligent than the children of low-grade parents. But as the intellectual capacity of the child is determined only in part by inheritance and in part by the environment, it is difficult to devise intelligence tests (*q.v.*) which will discriminate between effects of the two agencies. Also not all the children of highly intelligent parents are of the same character. Nor are all children of exceptional intelligence born of highly intelligent parents.

Clearly then, neither high intelligence nor mediocre intelligence breeds true. While this will be generally admitted, some hold that the lowest grades of human intelligence do breed true, in the sense that feeble-minded parents have only feeble-minded offspring. Such in general is the finding of H. H. Goddard, who made a study of the families of pupils in the Vineland, N. J., Training School for the Feeble-Minded. To this it has been objected that the class feeble-minded cannot be clearly defined, since there are all grades of human intelligence between the lowest and the highest. Individuals of the very lowest grade (idiots) do not become parents, and it is only the " feeble-minded " of a fair amount of intelligence (comparable with that of anthropoid apes) who do leave offspring. Whether, when both parents are feeble-minded, the children are all as low in intelligence as their parents cannot be stated with any certainty until more reliable tests of intelligence have been devised than now exist.

Effect of Infection.—Another element of uncertainty is the part played by infection, especially with syphilis, in the production of feeble-mindedness and other nervous disorders. Admittedly it is considerable; its exact extent is unknown. A true-breeding feeble-minded strain may in some cases be only a fully infected syphilitic strain. A great majority of the feeble-minded are produced by matings in which one or both parents are not feeble minded, and a certain percentage of these cases are admittedly non-genetic, being due to accidents or infections occurring before, at, or subsequent to birth. But when more than one case occurs in the same family history, a genetic agency is at once suspected, though perhaps quite unjustly. Since, in the case of the higher grades and of average grades of intelligence, it is evident that differences, when genetic, are due to multiple factors, it is doubtful whether a low grade of intelligence is in general inherited as a unit-character either dominant or recessive, though in a particular isolated and inbred family group, this may well be true.

Heredity and Eugenics.—Human heredity forms the only rational basis of a programme of eugenics. Such programmes have been outlined and are being advocated by national societies in England, Germany, France, Italy, Sweden, Norway, the United States and several other countries. Two international congresses on eugenics have been held, the first in London, the second in New York in 1921. A permanent international committee on eugenics has been formed. A state-supported eugenic institute has been established in Sweden.

The Foundations.—The philosophy or logical foundation on which eugenic programmes explicitly or implicitly rest may be stated as follows:—

1. The present stratification of society is in part due to differences in ability between its constituent strata. The abler individuals rise to positions of influence and authority, enter the learned or professional classes, or become captains of industry and acquire wealth. The less able work with their hands rather than their heads, since the latter are inferior, and must content themselves with lesser economic rewards.

2. Each grade of ability has a *tendency* to breed true, though there are numerous exceptions. Thus the average ability of children produced by the professional classes and wealthier industrial and business classes is greater than the average for children of the poor and labouring classes.

3. In all civilised countries at the present time the professional and wealthy classes are producing fewer children per family than the poor and the labouring classes (*see* BIRTH CONTROL). (This differential fertility of the classes appears to be a modern development; *e.g.*, in Britain it only originated shortly before 1850.)

4. As a consequence of 2 and 3 the average grade of intelligence of the populations in all civilised countries is at present declining, and this decline will continue until the differential character of the birth-rate is abolished or reversed.

5. In addition, it has been maintained that physical and mental defects are increasing in all classes.

Measures Proposed.—The practical measures proposed by eugenists to correct the supposed declining quality of the population are of two sorts.

1. Measures designed to discourage, decrease or prevent reproduction by the inferior elements of the population—negative eugenics.

2. Measures designed to encourage or increase reproduction by the superior elements of the population—positive eugenics.

Negative eugenic measures include (1) the dissemination of information (popular education) concerning the racial consequences of unfit matings, which will result in voluntary abstention from marriage, or birth control, on the part of those likely to transmit bad physical or mental traits; (2) legal prohibition of marriage to persons unfit to be parents—for example, members of families with a hereditary taint of insanity, epilepsy, feeble-mindedness or the like; (3) segregation during the reproductive period, or sterilisation of mentally defective or otherwise seriously unfit persons. Measures of the first-mentioned sort are the aim in part of publications such as *The Eugenics Review* (London), *Eugenical News* (Cold Spring Harbor, N.Y.) and of the published proceedings of congresses and conferences on eugenics. Laws which fall into classes (2) and (3) have been enacted in certain of the United States, but most of these have been rendered ineffective by court decisions. In support of positive eugenics, proposals have been made to offer economic inducements to fit parents to have large families, but the practical difficulty of determining who are " fit " or of putting into effect class legislation for their benefit has hitherto prevented such suggestions from taking concrete form.

Criticisms.—Those who decry or look with disfavour on the modern eugenic movement suggest that the philosophy of eugenics is faulty, in that (*a*) the basic assumption that social status is in any degree due to inborn qualities of the individual, not to accidents of environment or opportunity, requires proof; (*b*) that the supposed greater average ability of the children of the professional and wealthier industrial classes is another unproved assumption, and that their superior attainments, if real, may be due to superior advantages made possible by greater economic resources or by the smaller number of children in the family; that (*c*) unless both assumptions (*a*) and (*b*) are established, there is no reason to think that the differential birth-rate is dysgenic; and (*d*) that such negative eugenic measures as refusing a marriage license to a person on the basis of his pedigree, or subjecting him to bodily mutilation against his will, are unwarranted interferences with his liberty and personal rights; that (*e*) the eugenists are wrong not only in the basic assumptions of their philosophy but also in their general conclusion that the human race is declining in ability, since at no time within the historic period has mankind been progressing faster than within the past century in physical, mental and moral achievements.

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EUGÉNIE (1826–1920), sometime Empress of the French (*see* 9.885), died in Madrid July 11 1920.

EUPEN AND MALMEDY (*see* 9.892), two districts acquired by Belgium from Rhenish Prussia in 1919, with the small district of Moresnet. The latter, by an oversight in the Treaty of Vienna in 1815, was not assigned to either Belgium or Prussia, and part of it therefore remained neutral territory between the two countries. It comprised little over 3,000 inhabitants (census of 1910).

Eupen and Malmédy comprise 60,924 persons, of whom less than one-sixth are Walloon and French-speaking, and five-sixths German. It was contended, however, at the Peace Conference that these inhabitants had been systematically Prussianised since 1815. It seems true that the majority spoke French before that date, and were, in origin, Walloons. The Peace Conference in 1919 therefore declined to sanction a plebiscite, but the inhabitants were permitted to express their opinions in registers for six months after the ratification of the treaty Jan. 10 1920. The league, to whom the case was referred ultimately assigned the areas to Belgium.

The Allied Powers (reply to the German observations on the draft treaty, June 16 1919) based the fate of these areas on grounds other than those of self-determination. Eupen and Malmédy had been made a basis for German militarism, and had a close economic connection with Belgium. Moresnet, which had valuable woods, was assigned to Belgium "in partial compensation for the destruction of Belgian forests."

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EURHYTHMICS is the term applied generally to the use of harmonious bodily movement as a form of artistic expression, and specifically to Dalcroze's system of musical education, which is founded on a rhythmical discipline of bodily movements for the expression of time values. The present article is restricted to the latter sense. (*See* DANCING.)

History.—Emile Jaques-Dalcroze (b. 1865) studied music at the Geneva Conservatoire and under Délibes in Paris and Bruckner and Fuchs in Vienna. In 1892 he was appointed professor of harmony at Geneva Conservatoire. His experience as a teacher suggested to him that the conventional professional training of musicians was radically wrong in that it ignored the relation of technical training to the inner consciousness of the student. It was found that pupils, technically far advanced, after many years of study were unable to deal with the simplest problems in rhythm; that their sense of pitch, relative or absolute, was extremely defective; and that, while able to read accurately and to play pieces memorised, they had not the slightest power of spontaneous musical expression. Dalcroze, starting from the position that technique is but a means to art, argued that the student should begin, not by specialising on any instrument, but by developing his musical faculties as a basis for specialised study. Such a training could only be secured by awakening the sense—natural, though often latent—of the ultimate bases of music, viz.: tone and rhythm.

As the sense of tone can be developed only through the ear, Dalcroze gave special attention to vocal work; and then, noticing that when the students themselves beat time to their singing the work became much more real, he wrote a series of "gesture songs," which were performed by his pupils with surprising ease. This suggested the idea, which is the essence of the Dalcroze method, viz.: the training of the body in such a way as to make movement not merely an accompaniment of music but a means of expressing it. At first only the conventional arm movements of the conductor had been employed. The next step was to devise a series of arm movements that should clearly mark all tempi from two beats in one bar to 12 beats, including such forms as $\frac{5}{4}$ $\frac{7}{4}$ $\frac{9}{4}$ $\frac{11}{4}$, and a system of movements of the body and lower limbs to represent note values from any number of notes to the beat up to notes of 12 beats.

About 1905 Dalcroze began to consider the possibility of applying his method not only to the special education of musicians but as part of the general elementary education of children. Accordingly he worked out a system of pedagogic eurhythmics which has been widely adopted in schools throughout Europe and America. In 1906 the first training courses for teachers were started at Geneva, but in 1910, on the invitation of the brothers Wolf and Harald Dohrn, Dalcroze removed to Dresden, where a college for rhythmic training was established in the garden suburb of Hellerau. The college made rapid progress and did educational work of great value. Its activities, however, were abruptly terminated by the outbreak of the World War, and since 1915 its place as the head-centre of eurhythmics has been taken by the Institut Jaques-Dalcroze at Geneva. Central schools were founded in London in 1913 and in Paris in 1924.

Outline of the Method.—The Dalcroze method consists of three parts: (*a*) rhythmic movement, (*b*) ear training and (*c*) improvisation (practical harmony). Of these the first is the essence of the Dalcroze method and is fundamentally new. The second is closely linked with the first and necessary to the pupil. The third is necessary to the teacher, who must have the power of free expression on some musical instrument, preferably the piano.

In the system of exercises upon which the method is based *time* is shown by movements of the arms, and *time-duration, i.e.*, note-values, by movements of the feet and body. In the early stages of the training this principle is clearly observed; later it may be varied in many ingenious ways—for instance, in what is known as plastic counterpoint the actual notes may be represented by movements of the arms, while the counterpoint in crotchets, quavers or semiquavers is given by the feet. The system of beating time with the arms provides for all tempi from $\frac{2}{4}$ to $\frac{12}{4}$ including $\frac{5}{4}$ $\frac{7}{4}$ $\frac{9}{4}$.

In the series of movements to represent note-values the crotchet is taken as the unit—this is represented by a step; higher values, from the minim to the note of 12 beats, are represented by a step with one foot and a movement or movements with the other foot or with the body, but without progression, *e.g.*, a minim by one step and a knee bend, a dotted minim by a step and two movements without progression, a note of 12 beats by a step and 11 movements. Thus for each note in the music there is one step, one progression in space, while at the same time the note, if of greater length than a crotchet, is analysed into crotchets. Notes of shorter duration than the crotchet, *i.e.*, quavers, triplets, etc., are expressed also by simple steps.

When the movements corresponding to the notes from the crotchet to the whole note of 12 beats have, with all their details, become a habit, the pupil need only make them mentally, contenting himself with one step forward. This step will have the time-duration of the note, which will be mentally analysed into its elements. The latter are not individually performed by the body, but their images in thought replace the movements.

The whole training aims at developing the power of rapid physical reaction to mental impressions. These latter are more commonly obtained through the ear, chiefly from the music played; naturally, however, the teacher needs at times to give commands during an exercise. For this purpose he generally uses the word "hopp," chosen for its clear incisiveness. Before each exercise it is clearly stated what the word is to represent in that particular case, *e.g.*, omit one beat, omit one bar, beat time twice as fast with the arms, etc.; often the word will be used in series in an exercise, each "hopp" meaning some additional change. As the command generally falls on the second half of the beat preceding the one in which the change is to be made, very rapid intellectual and physical response is necessary, especially if the music be at all quick. Exercises of this class soon give the power of rapid muscular innervation and inhibition, and are of extraordinary value in education, quite apart from their purely rhythmic side. The educational value of Dalcroze's method of eurhythmics is becoming widely recognised. There exist many centres in Great Britain and Europe, and trained teachers are working in America, South Africa, Australia and New Zealand. (P. B. I.)

EUROPE (*see* 9.922).—In dealing with the general European situation during the years which intervened between 1909 and the outbreak of the World War, the historian is faced with the fact that the importance of this period lies in the conclusion. Always there is before us the problem: was the War with which it terminated the inevitable outcome of deep-seated causes, or was it an avoidable result of demonstrable blunders and crimes? A consideration of this problem makes it necessary to revert briefly to previous events. Much which in 1910 was obscure has been elucidated by later publications; much which was then a conjecture or hypothesis has been verified; and much which could then only be tentatively suggested can now be frankly said.

I. THE ORIGIN OF THE WAR

The Triple Alliance.—The chief characteristic of the first years of the 20th century is the rivalry of the two political groups into which Europe was divided. As we can now see, the establishment of the Triple Entente (England, France, Russia) was a necessary and inevitable counterweight to the Triple Alliance (Germany, Austria and Italy); for this latter alliance, so long as it stood alone, gave to Germany a preponderance upon the continent of Europe so great as to be a permanent check on the free diplomatic activities of other states, and possibly a danger to their independence. It is true that the original alliance between Germany and Austria in 1879[1] had been a method of maintaining peace and securing the *status quo*. At that time Germany under Bismarck was, as he said, a "saturated" state; all that it required was time and peace for the development of its internal resources. In order to secure this he had built up a complicated system of alliances.

We have first among these the Austro-German Alliance, which was repeatedly renewed and remained in force until the outbreak of the World War. This treaty, which was published in 1881 in an incomplete form, bound the two empires to help each other in case either was attacked by Russia; if either was attacked by a third Power, the other was to observe at least a benevolent neutrality, and if the attacking Power was supported by Russia, then to come to the assistance of its ally. Side by side with this treaty of mutual defence against Russia, in 1881 Germany and Austria entered into an alliance with Russia, the chief point of which was a mutual engagement to act together in all Balkan matters. This treaty was renewed in 1884 for three years.[2] It lapsed in 1887, and for it was substituted the secret "Reinsurance Treaty" between Germany and Russia alone[3] by which each party agreed to maintain benevolent neutrality towards the other in case of a war with a third Power. This was not to apply in the case of a war against Austria or France if this resulted from an attack against one of these latter Powers by one of the parties to the treaty. In addition, Germany recognised the rights historically acquired by Russia in the Balkan Peninsula, and particularly the legitimacy of her preponderant and decisive influence in Bulgaria and in Eastern Rumelia. There was to be no modification of the territorial *status quo* in the Balkans without previous agreement and the principle of the closing of the Straits was reaffirmed. This elapsed in 1891; but just when a Russian envoy came to Berlin to arrange for a renewal, Bismarck was dismissed. Caprivi, on the advice of the Foreign Office, refused his consent; he is reported to have said that it was too complicated for him.

In 1882, the Triple Alliance was arranged between Austria, Germany and Italy[4] the essential point to which was that Germany and Austria were to come to the assistance of Italy if attacked by France, and similarly, Italy to come to the assistance of her allies if either of them was attacked or engaged in a war with two or more Great Powers; a special protocol stated that this treaty could not in any case be regarded as being directed against England. In 1883 Rumania, by a separate treaty[5] with Austria, to which afterwards Germany and Italy acceded became attached to the group, the allies binding themselves to defend Rumania if she was attacked. This treaty was kept strictly secret; it was a personal act of the King of Rumania, and was communicated to no one except the prime minister. In 1887 the Triple Alliance was renewed and extended[6] and included an undertaking to support Italy in any action that she might take to safeguard her position, even to war with France. In 1891 the third treaty of the Triple Alliance[7] reasserted in a strengthened form the Mediterranean obligations to Italy; a new clause (VII.) determined that every advantage, territorial or other, obtained either by Austria or by Italy in the Balkans should be based on the principle of reciprocal compensations.

These four Powers formed a coherent group, but to it other states were more loosely attached. In 1887, when there were cordial relations between the British and the German Govts., Lord Salisbury, by an exchange of notes, came to an agreement with Italy and Austria[8] to maintain the *status quo* in all the eastern waters of the Mediterranean, while Italy undertook to support Great Britain in Egypt; Great Britain on her side expressing her intention to support the action of Italy in North Africa. Lord Rosebery in taking office in 1892 refused to recognise the existence of this agreement. There was also an agreement between Italy and Spain as to Morocco, and at this time Serbia also was attached by a separate treaty to Austria.

We see that this very elaborate structure of treaties and agreements was really approximating to a general European system into which in one form or another there were brought Austria, Italy, Rumania, Spain, Serbia, Great Britain and even Russia; the whole object was the isolation of France, and it served its purpose of securing to Germany full and peaceful enjoyment of all that she had gained by the war of 1870–1. The extension of this system to the Mediterranean was advantageous to Great Britain in so far as it tended to strengthen her position in Egypt. The pivot was Germany and the centre of gravity was the German Army; this it was which held the whole together. It was a system in which Europe could acquiesce only so long as the policy of Germany was passive; a reaction must inevitably arise if Germany began a policy of active expansion. With the accession of a new emperor and the resignation of Bismarck, the Triple Alliance, while unchanged in form, acquired a new meaning. The period of rest and recuperation in Germany was over, and the new empire, conscious of its strength, began to stretch out with great ambitions towards the other quarters of the globe.

The immense growth of German wealth, the skill with which the mineral and agricultural resources were developed, and the expansion of manufactures naturally led to an extension of foreign trade. German agents, supported by German bankers, were to be found in every part of the world; there was a great development of maritime shipping, and this naturally led to the acquisition of extra-European dependencies and the extension of political interests. The first years of the new Emperor's reign appear a tentative experiment; with the appointment of Herr (afterwards Count and then Prince) von Bülow, first as Foreign Secretary and afterwards as Chancellor, the new tendencies became the deliberate and conscious policy of the German Government. It was inevitable, even with the best possible intentions, that numerous causes of friction should arise with other nations, and especially with Great Britain, for there was no part of the world in which the expansion of German influence did not touch British interests.

Franco-Russian Alliance.—Germany could embark with full confidence on this great policy of expansion just because her essential security at home was so well guarded; hers was the only alliance on the Continent. But ever since 1870 acute observers had foreseen that, some day or another, France and Russia would join together in order to redress the balance of the Continent. This event took place in Aug. 1891. The agreement (which was formulated in an exchange of notes) was based on "the renewal of the Triple Alliance and the more or less probable adhesion of Great Britain to the political views of this alliance."[9] It contained two clauses: one that the two Governments would agree together on any question of such a kind as to endanger the general peace; and the other that, in case either party was menaced by an attack, they would agree together on the measures to be taken. Two years later, however, after long negotiations in which many difficulties were encountered, this was supplemented by a military convention (Dec. 1893–Jan. 1894): if either France or Russia were attacked by Germany, France or

[1] Pribram, *Die politischen Geheimverträge Oesterreich-Ungarns 1879–1914*, p. 6 (Vienna and Leipzig, 1920).
[2] Pribram, *op. cit.*, p. 11.
[3] *Die grosse Politik der Europäischen Kabinette, 1871–1914.* Vol. 5, p. 253.
[4] Pribram, *op. cit.*, pp. 24–8.
[5] Pribram, *op. cit.*, p. 29.
[6] Pribram, *op. cit.*, p. 42.
[7] Pribram, *op. cit.*, p. 64.
[8] Pribram, *op. cit.*, pp. 52–6.
[9] *Documents diplomatiques: L'Alliance Franco-Russe* (issued by Ministère des Affaires Étrangères, Paris, 1918).

Russia respectively would apply all her forces to attack Germany.[1] If the forces of the Triple Alliance, or one of the Powers of which it consisted, were mobilised, France and Russia would immediately mobilise. The number of troops to be employed was specified, and it was agreed that there should be joint action between the general staffs and interchange of all information relative to the armies of the Triple Alliance.

But even after this there was little real cordiality in the relations between Russia and France. Russia, moreover, was occupied with Asiatic affairs, and had come to a friendly agreement with Austria as to the Balkans which was confirmed by an exchange of notes on May 8 1897.[2] The internal dissensions of France (it was the time of the Dreyfus trial) weakened the influence of that country abroad. France indeed was protected against the danger of a new attack from Germany, but received little support from Russia in the normal discussion of diplomatic matters.

The essential change took place at the turn of the century. Up to this period Great Britain had held herself aloof from the continental system. The British occupation of Egypt had resulted in a continued estrangement from France, and on the whole there was a tendency towards a close understanding with Germany and the other members of the Triple Alliance. This understanding was now broken. The first serious differences arose out of South African affairs. The Krüger telegram of 1896 was a flash of lightning; no storm followed, but this and the intense animosity against Great Britain shown during the Boer War were symptoms that could not be neglected. By a large party in Germany the consolidation of British power in South Africa was regarded as the loss of a sphere which they had marked out for German expansion. Suggestions were made in Berlin for a joint European action against England; these, however, broke down, for Germany made it a condition that there should be a mutual guarantee of European territory. The French Govt. would in this way recognise and confirm the cession of Alsace-Lorraine.

Equally important was the altered attitude of Germany towards the Near East. The great and legitimate expansion of German commercial and economic interests was accompanied by a growing cordiality with the Porte, and during his visit to Damascus in 1897 the German Emperor proclaimed himself the protector of all Mahommedans throughout the world—an utterance which from anyone but him would have been justly regarded by France and Great Britain as an unparalleled provocation. There was also a serious conflict of interests in the Far East. The evidence which came from many sources was sufficient to make it obvious to every British statesman that a continued political isolation was dangerous. England must have friends, and friends on whom she could rely.

From 1898 to 1901 advances were repeatedly made to Germany by Great Britain, and the project of a definite understanding, nay even of a defensive alliance, was ventilated.[3] The suggestions were accompanied by warnings that if an arrangement with Germany was not reached, then recourse would be had to the opposed alliance. The offers were rejected; the warnings disregarded. To the German Foreign Office, to Prince Bülow and to the Emperor, it was an axiom that there could be no real friendship, as they said, "between the whale and the bear." They feared, or professed to fear, that an alliance with England would only mean that they would be used as a military advance post against Russia; in the case of war the brunt of the fighting would fall upon them, while Great Britain would gather up the spoils in Asia. "The danger was imminent that if Germany allied herself with England she would have to undertake the rôle against Russia that Japan assumed later single-handed." They believed that they could do better business by playing off the rival empires against one another, by refusing to commit themselves either to Russia or to England, and by using the rivalry to extend their own influence and possessions.

[1] *Documents diplomatiques: L'Alliance Franco-Russe* (issued by Ministère des Affaires Étrangères, Paris, 1918).

[2] Pribram, *op. cit.*, pp. 73-82.

[3] See *Die Grosse Politik*, vol. 17, chap. cix.

The German Navy.—But there was another influence at work. One of the chief tasks which the German Govt. had set itself was the building of a great war fleet. It was the considered opinion of German statesmen that, if they were to come to a friendly diplomatic arrangement with England, this would inevitably compel them to limit their naval development; they affected to think that a fleet built by a Germany friendly to England would be a fleet built under patronage and limited by the British insistence on superiority at sea. This they did not desire; they preferred, therefore, full freedom to build against England, trusting that it might be possible to avoid a serious conflict during what Prince Bülow calls the "danger period of construction." It was indeed the new naval ambitions, more even than the rejection of the British offer of an alliance, that conditioned the whole European situation. The building of the German fleet could only be compared to the similar work by which from 1857 onwards the Prussian army, after a period of comparative stagnation and inefficiency, was brought up to the highest point of perfection, and we know how this great instrument of war, when perfected, was used to further Prussian policy. There could be no doubt that the navy, when completed, would also be used for the same object, and in fact the responsible spokesmen of Germany took care to leave no doubt on this point. They wanted the fleet to support their diplomacy. In the memorandum which accompanied the great Navy bill of 1900[4] this was clearly stated. The navy must be such that, "even for the greatest sea Power, a war with it would involve such risks as to jeopardise its own supremacy."

It would be an error to suppose that the German Govt. were deliberately looking forward to forcing a war with England. Still more misleading to assume, as so many did in England, that the object was an invasion. The danger was of quite a different character, but it was none the less serious. The calculation was that if there was a fundamental difference between British and German policy, the possession of a great fleet would enable Germany to get her way, because England might be put in such a position that she would not dare to risk war. And what was the kind of point on which such a difference of policy might arise? It was the want of a fleet which, as he himself said, prevented the German Emperor intervening during the Boer War. It had become the avowed policy of the German Emperor to use his friendship with the Sultan as a means of winning the confidence of the Mahommedan world, and this—we have his own words for it—was an instrument which might in necessity be used to render impossible the position of England in Egypt or to arouse difficulties in Mesopotamia, in Persia, in India itself. It was the calculation that if any such controversy arose, Germany would not be alone; if she were allied to some other Great Power which possessed a formidable navy—Russia, France, Japan or the United States—the predominance at sea, on which the very existence of the British Empire depended, would be imperilled.

This menace was one which had to be met. No child could suppose that it would not affect the whole trend of British policy. The Germans themselves knew this well. What they feared was that England would attack while she still enjoyed her previous naval supremacy and before the German fleet had grown large enough to be dangerous. But this policy of a "preventive" war was never even seriously considered by responsible British statesmen. Their answer was the only possible one. In the first place the British fleet must be strengthened and its whole organisation altered. A fleet, like an army, must be found in the place where it is wanted. In the old days the North Sea had been empty of ships; it was in the Channel, in the Mediterranean, in the Atlantic, that the British fleet was placed. The centre of gravity was the Straits of Gibraltar. Circumstances were now changed, and so a great reorganisation was effected. Outlying stations were denuded of ships and the bulk of the fleet was in the North Sea.

The Mediterranean had also, however, to be guarded. Austria was increasing her fleet, and Italy was an ally of Germany. To meet this danger in 1912 it was agreed by England that France should concentrate the greater portion of her fleet in the Medit-

[4] Published by German Government.

erranean; in the event of a common war with Germany it would fall to the British Fleet to defend the northern and western coasts of France. In the same year a naval convention was concluded between France and Russia;[1] with the building of the Kiel Canal the importance of the Baltic in naval strategy had increased. In 1913 a further naval convention between the three Powers of the Triple Alliance was made[2] and in May 1914 proposals were made for naval conversations between Russia and Great Britain;[3] it is to be noted that at the end of June in the same year the enlargement of the Kiel Canal, by which the biggest ships could pass through it, was completed.

All this was not enough. The German plan was based on the assumption that Germany would be able to gain further allies in addition to those she already had. England also must have allies. Now that Germany was becoming the second naval Power, England could no longer afford to regard with equanimity German military predominance upon the continent of Europe. The success of the German schemes required one of two things,—either an alliance with other states against England, or such increase of German preponderance that they would become, for political purposes, subject to German will. It was necessary, for England to guard against either contingency, and she could do so only by entering into a firm understanding to join with them in resistance to any unprovoked act of German aggression.

These considerations were so weighty that alone they are sufficient to explain and justify the action of the British Government. The further information which has now become available completely substantiates them. We now know from the letters of the Kaiser to the Tsar[4] which were published after the Russian Revolution, that throughout the whole of the reign of Nicholas II. the German Emperor had been using the strongest personal pressure upon him to bring about an alliance between Germany and Russia, the point of which was avowedly directed against Great Britain, an alliance into which France would be forced to come; whatever the subject of the diplomatic negotiations at the moment might be—whether it was Armenia or Crete or South Africa or Egypt, neutrality during the Russo-Japanese War, or Morocco—always we see the same ambition. He hoped to create trouble in India by encouraging a Russian move on Afghanistan, and for this purpose to arouse the slumbering passions of Islam: "Remember what you and I agreed upon at Peterhof, never to forget that Mahommedans were a tremendous card in our game in case you or I were suddenly confronted by a war with a certain meddlesome Power." He encouraged Russia to give support to Turkey as against Great Britain in the Persian Gulf:—

> Last but not least, an excellent expedient to kill British insolence and overbearing would be to make some military demonstrations on the Perso-Afghan frontier . . . . Even should the forces at your disposal not suffice for a real attack on India itself, they would do for Persia.

All this culminated when on July 24 1905 he persuaded the Tsar to sign the Treaty of Björko,[5] a secret alliance against England which it was his hope would afterwards be joined by France. The treaty proved abortive, for the Russian Foreign Minister pointed out that it was inconsistent with the terms of the French Alliance, but it shows the method by which the Kaiser professed to be guarding the peace of Europe. The remark of King Edward made to a Danish diplomatist may be recalled: "I will admit this, that with a man of so impulsive a temperament as the German Emperor at the head of the greatest Power in Europe, anything may happen." This correspondence was secret, but in diplomacy there is no absolute secrecy, and the rumours of it must be taken into account if we are to understand the profound distrust felt for Germany during these years.

Franco-British Entente.—These were the circumstances in which a great change of policy took place. The first step was the British alliance with Japan.[6] In this it had originally been contemplated that Germany should be a partner. But Germany did not accept the opportunity offered her, and, in addition, German action over the Manchurian agreement seemed to show that no confidence could be placed in any German engagement. The alliance therefore was one between Japan and Great Britain alone. In 1904 a colonial agreement was reached between England and France,[7] by which the numerous points of friction between the two countries were settled. The essence was that France recognised the British position in Egypt. To do so was a bitter blow to most cherished French traditions and ambitions. In return for this Great Britain recognised the special position of France in Morocco and gave up to France her claims and interests. This agreement in its original inception had, at any rate in England, no special point directed against Germany. It was probably due chiefly to Lord Cromer, but his efforts were supported by Lord Lansdowne and King Edward VII. The object was merely to clear away the outstanding causes of controversy with France, but it was destined to have far-reaching results.

This agreement was quite unexpected and very unwelcome in Berlin. The whole basis of German diplomacy was cut away. Europe at once took on a new aspect. In the ordinary diplomatic negotiations Germany must look forward to a situation in which she was confronted no longer by disunited and antagonistic states, but by great Powers, acting in union and co-operation. Even the Triple Alliance itself was shaken, for it was obvious that Italy could not be depended upon in any serious conflict with both France and England. It must therefore be the chief object of German diplomacy to drive a wedge between England and France. For this reason, from this time onwards, every diplomatic incident, even of minor importance, at once reverberated throughout the whole of Europe. This is illustrated by the Morocco affair. Morocco was of great importance to France and Spain; it was essential to England that no hostile Power should be established on the northwestern coast of Africa; apart from this, Morocco was merely of trivial importance to the rest of the world, including Germany. But Morocco was made the test of the Entente. Germany, taking advantage of the temporary crippling of Russia by her military and naval defeat in the Far East and the internal disturbances which followed, brought the full weight of her military superiority to bear upon France, and thereby forced her into a conference and brought about the resignation of Delcassé. This action defeated its own object. It cemented the union between France and Great Britain, and as soon as it became obvious that France, by entering into this union, exposed herself to the threat of war, it was inevitable that England should take steps, if necessary, to protect her new friend. It was the threats by Germany which gave a military side to what had at first been merely a diplomatic arrangement.

No doubt the French handling of the whole matter was open to criticism, but there was a peculiarity about the arrangement of 1904, which placed Great Britain in a delicate position. England, while she gained definite rights which France surrendered to her in Egypt, gave in exchange only eventual rights in Morocco; France, in return for a definite surrender, got nothing but hopes; England acquired Egypt, France merely the prospect of acquiring Morocco. In these circumstances there was obviously an obligation on Great Britain to see to it that her support of France in Morocco should not be half-hearted; had this support been withdrawn simply because some of the subsequent details of French action were open to criticism, then the worst possible construction might have been placed on the good faith of the British Govt.; it would have appeared that, after having secured themselves in Egypt, they had seized on a subterfuge so as to avoid carrying out their side of the agreement.

Anglo-Russian Entente.—Not only did the German attempt to separate Russia from France fail, but in 1907 an arrangement was made by which the outstanding points of difference between Great Britain and Russia and Tibet, Afghanistan and Persia were

[1] *L'Alliance Franco-Russe: Documents Diplomatiques* (issued by Ministère des Affaires Étrangères, Paris, 1918).
[2] Pribram, *op. cit.*, pp. 308 seq.
[3] Grey, *Twenty-Five Years, 1892-1916*, vol. 1, pp. 283 seq.
[4] *The Kaiser's letters to the Tsar*—edited by N. F. Grant (London, 1921).
[5] *Die Grosse Politik der Europäischen Kabinette.*
[6] *State Papers*, vol. 95, pp. 83 seq.
[7] *State Papers*, vol. 97, p. 39, 1903-4.

settled.[1] The prime motive as in the agreement with France was a genuine desire to remove possible causes of war in Asia, but though there was no definite agreement, it naturally brought about co-operation in Europe. The approximation between the two empires, which had for so long been in a state of complete rivalry, was cemented by a meeting between King Edward VII. and the Tsar, which took place at Reval in June 1908. The chief and almost only subject of discussion was the state of affairs in the Balkans, and it was agreed that there should be common action for bringing about a reform in Macedonia.

The Turkish Revolution and the Annexation Crisis of 1908.—This meeting was immediately followed by, and perhaps precipitated the outbreak of revolution in Turkey and the overthrow of Abdul Hamid by the Young Turks. This again was followed at the beginning of Oct. by the Declaration of Independence of Bulgaria and the annexation to Austria of the provinces of Bosnia and Hercegovina, which she had administered since 1879. These events produced an acute crisis. The British Govt. was estranged by the contrast between this action and the language used shortly before by Aehrenthal, the Austro-Hungarian Foreign Minister, and the Austrian Emperor. Moreover, they foresaw how dangerous would be the effect upon public opinion in Turkey. Above all, they protested against the claim of a single Power to change the arrangements made by all the Great Powers in the Treaty of Berlin. It brought to a head the animosity between Christians and Moslems in the Balkans, to which all the wars which followed were due. M. Isvolsky, the Russian Foreign Minister, was bitterly offended; negotiations were in progress by which he hoped as a recompense for his assent to the annexation, to receive important concessions regarding the opening of the Straits, the main object of Russian policy, but Aehrenthal acted before he had had time to consult France and England. Isvolsky felt, therefore, that he had been duped. It aroused also most intense animosity in Serbia and the result was to ensure that henceforward the full support of Russia would be given to Serbia against Austria and that the Balkans would once more become the field for Russian diplomacy.

The annexation crisis is important, for in it is to be found the explanation of much which happened in 1914. Just when it seemed as though the very prolonged and acrimonious controversy might be reaching a conclusion, Count Pourtalès, the German ambassador, delivered to M. Isvolsky "a peremptory demand" that Russia should without conditions agree to the abrogation of Article 25 of the Treaty of Berlin, that is, should recognise the annexation; and it was intimated that if the answer was unfavourable, Germany would "*lâcher l'Autriche sur la Serbie.*" It is important to understand what this threat—for it was a threat—implied. A war between Austria and Serbia would have placed Russia in a most disadvantageous position; weakened as she was, she could not have come to the help of Serbia, because under the system of alliances Germany would, if necessary, come to the help of Austria. Before this, Russian resistance collapsed; they agreed to the German demand without even consulting France and Great Britain. The success was a notable one, but it was dangerous. It was one which could not be repeated. Russia had given way to threats once; she could not afford to do so a second time. It left an intense feeling of indignation in St. Petersburg, which persisted, and became one of the most dangerous factors in the European situation. Personally M. Isvolsky, who soon resigned the post of Foreign Minister and went to Paris as Ambassador, henceforward became the active partisan of an anti-Austrian policy, and was only anxious to revenge himself for the humiliation which had been placed upon him first by Count Aehrenthal and secondly by Germany.

Agadir.—The annexation crisis had occurred at a moment when the relations between France and Germany were comparatively friendly; an attempt had been made at establishing economic and financial co-operation in Morocco. An awkward episode (the German consul at Casablanca was inducing soldiers of the Foreign Legion to desert and was arrested) was settled by arbitration. But this co-operation did not last long. The ambitions of the Colonial party in Germany could not be reconciled with the complete political control which France aimed at. A new and very serious crisis arose in 1911. The French, in consequence of a civil war in Morocco, followed by the abdication of the Sultan, advanced to Fez. This appeared to show a desire to disregard the obligations of the Convention of Algeciras. Germany, in order to support her claim to be consulted, took a step which, as so often happened, could be interpreted as a threat. She sent a small ship of war to Agadir. It was of course assumed, not only abroad but in Germany itself, that this action meant that the German Govt. proposed to claim part of the western coast of Morocco and were even intending to land troops in order to enforce this claim. It seems probable that the German Govt. themselves had not at the moment really made up their minds precisely what they wanted. The obvious answer to this German move would have been the dispatch of a French or British warship—a policy which was strongly pressed by some of the French.

Eventually separate conversations were begun between Germany and France on the basis that Germany would agree to disinterest herself in Morocco completely, receiving in return territorial concessions in other parts of Africa. There were many anxious moments, for some of the German demands were excessive, but eventually an agreement was reached by which France surrendered to Germany important parts of her possessions on the Congo.[2] As in the previous Morocco discussions, the importance of the episode lay not so much in the immediate question at issue as in the attempt of Germany to separate England and France and to intimidate France. As before, this had the natural result of strengthening the union between France and England, and taking a stage further the military and naval accompaniments of this agreement.

Great Britain and Germany, 1909–14.—The final settlement of the Moroccan question led to an improvement in the relations between Great Britain and Germany. One of the first acts of Bethmann-Hollweg, who on the resignation of Prince Bülow became Chancellor in 1909, had been to make proposals which might bring about an amelioration of the relations between Germany and England, and for the next four years conversations with this object continued. The negotiations turned on two points: (1) a naval arrangement, the object of which would be to prevent the two countries continuing on an unlimited rivalry of armaments; (2) a general political understanding by which each country should be assured that the other would not join in attacking it in case of war. From 1909 to 1911 the discussions took the form of conversations of the ordinary diplomatic nature, interspersed with public speeches in the two Parliaments. They were broken off in the summer of 1911 owing to the Agadir difficulty, but after that had been surmounted, were resumed at the beginning of 1912, when on Feb. 9 Lord Haldane was, in consequence of a suggestion from Germany, sent on a special mission to Berlin. On neither point did these negotiations lead to any definite result. As to the naval agreement it seems clear that Bethmann Hollweg would have welcomed it, but that his support was not strong enough against the opposition of Tirpitz and the Emperor.

The proposals for a general political agreement, however, broke down because, as soon as a precise formula was put forward, it appeared that Germany would not be satisfied with any arrangements except one which would be so worded as to imply that Great Britain would be debarred from coming to the assistance of France if she were attacked. Anything of this nature was of course out of the question, for, as Sir Edward Grey said on Nov. 27 1911, "one does not make new friendships worth having by deserting old ones." None the less, the very fact that this attempt had been made, though it failed, left the relations between the two Governments less unfriendly; even more important was the practical illustration afforded by the subsequent Balkan troubles as to the importance of co-operation between them. Everything tended to show that the peace of Europe could be maintained if Germany and Great Britain, while each maintaining full loyalty to its own associates, were willing, when any

[1] *State Papers*, vol. 100, p. 555.

[2] *State papers*, 1911, vol. 104, pp. 948–964.

difficulty arose, to communicate frankly and freely with one another. By this means the two alliances might cease from their rivalry and gradually be merged in a general concert. This was a system which Sir Edward Grey deliberately adopted; his whole handling of political difficulties was based upon this, and so long as Germany acted in a similar spirit things went well. When the World War ultimately broke out, it was because Germany, in a very grave crisis, ceased this co-operation and in profound secrecy made herself the associate of schemes the success of which would have been most detrimental to one of the partners in the Triple Entente. Meanwhile, during 1913 and the first half of 1914, negotiations were begun and carried through to a successful issue by which the two chief outstanding points of controversy were in fact removed. A settlement was at last brought about with regard to the Baghdad railway and the reversion of the Portuguese colonies in Africa.

The situation in Germany was, of course, the subject of the most careful study by those who were responsible for directing British policy. Opinions were much divided in England; there was a belief, which was probably well founded, that neither Herr von Bethmann Hollweg nor Herr von Jagow desired anything but the best relations. On the other hand, it must remain a matter of comparative indifference whether in any particular year the German administration then in office was well disposed, Their position was at the best very precarious. All information, both from public and confidential sources, showed that a very large section of educated German public opinion was animated by feelings of intense animosity against England, and, although this party was at the moment in opposition to the Government, at any time they might come into office, all the more because of the very unreliable character of the Emperor, of whom the only thing that could be said with certainty was that no one could foresee what he would do.

Moreover, there was another factor to be kept steadily in mind. Good relations between Great Britain and Germany might possibly be valued, not for their own sake, but merely as a device for separating Great Britain from her associates. It was an obvious policy to encourage a spirit of conciliation, so that if there was a serious conflict with Russia, English public opinion would refuse support to Russia. To put it brutally, Germany had no reasons to fear a war if England stood out; according to all instructed German expectations the crisis of any great European war would be over in the first two months. All that was necessary then was to secure that England should remain neutral during the first stage; if once the essential victory in France were secured, then nothing else really mattered. Germany would quite well be able to acquiesce in an interference of Great Britain at a later stage, for, though this might be used to moderate the claims of the victors, it would not eliminate the fact of the victory. It was the consciousness of this which made it absolutely necessary that every advance to Germany should be accompanied by the clearest and most public intimation that the union of the Entente was not thereby weakened. So we get the key to British policy: the maintenance of the two alliances, but the frank and friendly discussion between Great Britain and Germany on each point of difference as it arose. This was the state of things when a new and quite unforeseen evolution began in the Balkans. (*see* SERBIA.)

The Balkan Wars.—It had been long agreed that to Italy should fall the reversion of Tripoli. The increasing disorder of the Turkish Empire, the obvious failure of the Young Turks to establish an orderly and civilised Government, made it appear that the time for action had come. In Sept. 1911, at the very crisis of the Agadir incident, without previous warning the Italian Govt. presented an ultimatum to Turkey, and three days later, on Sept. 29, declared war. On Oct. 4 an Italian force landed in Tripoli, which, during the next months, was occupied with the very difficult task of subduing the resistance both of the Arab population and of the Turkish troops. The fighting which eventually extended to the Aegean raised among the Balkan States hopes of finally expelling the Turks from the Peninsula.

In Feb. 1912 negotiations were begun under the deepest secrecy, between Serbia and Bulgaria, and on March 13 there was signed a treaty of friendship and alliance (*see* SERBIA), by which the two kingdoms mutually guaranteed to one another their political independence and the integrity of their territory, and agreed to support one another with all their forces if either were attacked by one or more states. More than this, they agreed to support one another if any of the Great Powers attempted to occupy any part of the Balkans which was at present under Turkish dominion, a clause which was obviously directed against Austria. This treaty was accompanied by a secret additional treaty and a military convention; the first of these was in fact in the nature of an offensive alliance against Turkey and was followed by detailed arrangements as to the disposal of any Turkish territory which might be acquired. The treaty was to be communicated to Russia, and all matters undetermined in the treaty were to be settled by the arbitrament of Russia. The military convention determined precisely the nature and character of the help to be given in the case of a war with Turkey or with Austria or Rumania. This treaty was in accordance with the agreement submitted to the Russian Govt., but they did not communicate it to their Allies. It was followed in May by a similar treaty between Greece and Bulgaria, the initiative to which was to a large extent given by Mr. J. D. Bourchier, the well-known correspondent of *The Times*.

The action prefigured in the treaties was hastened by the conclusion of the war between Turkey and Italy; negotiations were entered into during the month of August and were brought to a conclusion by the Treaty of Lausanne signed on Oct. 18,[1] by which Turkey surrendered Tripoli to Italy, the future of the Aegean Is. being reserved for later arbitration. It was necessary, if the attack on Turkey were to be made, that it should take place at once so as not to leave time for preparation. On Oct. 8 Montenegro declared war; on the 13th the three other Allied states presented an ultimatum demanding the immediate grant of autonomy to Macedonia; on the 14th the population of Crete declared themselves independent of Turkey, and formally joined Greece; and on the 17th the declaration of war was sent.

During the next three months the Turks were repeatedly defeated by the Allies; they evacuated the whole of Macedonia and Southern Albania, as well as Adrianople. It remained for Europe to determine its attitude towards these unexpected events. The danger was extreme that the Balkan might become a European war.

The Austrian Govt. was determined to put a barrier to Serbian ambition. The arrangements with Bulgaria were based on the assumption that Serbia should gain her reward by the annexation of the northern part of Albania and should thereby obtain access to the Adriatic. This Austria would not permit. She did not wish to see a Slavonic State having access to a sea which she looked upon as her own. In this matter she could depend upon Italian support. Austrian troops were mobilised; garrisons in Hercegovina were placed upon a war footing, and the situation was aggravated by numerous personal incidents, as for instance by stories which were put about that the Serbians had imprisoned and ill-treated an Austrian consul. War between Austria and Serbia was imminent, but if it broke out Serbia would be supported by Russia, and in answer to Austrian military preparations, Russian troops on the southwestern frontier were placed on a war footing. A war between Austria and Russia would, in consequence of the complicated system of alliances, inevitably bring in Germany and France, and thereby bring about the great struggle which everyone wished to avoid. The danger was averted by France, Great Britain and Germany, who worked together to bring about conciliation. It had been arranged that, side by side with the peace negotiations which were taking place in St. James's Palace, the ambassadors of the Great Powers in London should sit in conference under the presidency of Sir Edward Grey. It was agreed that France and Great Britain should give their support to Austria, and that Albania should be set up as an independent state. This removed the essential point

[1] R. B. Mowat, *Select Treaties and Documents* (Oxford Pamphlets, 1914–5).

of controversy, and in Feb. the Austrian Emperor sent Prince Hohenlohe on a special mission with a letter to the Tsar. It was agreed that the two Powers should demobilise, and from this time the extreme friction began to diminish. But the refusal of Serbian access to the Adriatic was to have unexpected results. It cut away the basis on which the division of the spoil had been arranged between the Balkan States.

The Serbian Govt. therefore demanded a larger portion of Macedonia than had been originally assigned to her. They based this claim also on the point that Bulgaria had not provided her due share of forces to fight in the western area, while Serbia had contributed more than she was bound in the struggle for Adrianople. Under these circumstances an appeal to the Tsar to arbitrate was enjoined. But before he had even received the appeal, a catastrophe took place. The old animosity against Bulgaria, which had been for so many hundreds of years traditional among the Greeks and Serbians, was again growing. The armies were in Macedonia still in closely adjacent quarters. The Bulgarian Govt. determined on a sudden blow, and on June 29 an attack in form was delivered by the Bulgarains against the Serbian forces. Immediately afterwards the Greeks in Salonika attacked the Bulgarians. This new fratricidal war had scarcely begun when two new champions entered the field. The Turks denounced the armistice and a fortnight later retook Adrianople. On July 18 Rumania, with a fresh army, entered the field, declared war on Bulgaria, and occupied the Dobruja. Before this great superiority of force the Bulgarians, who had lost so heavily in the war—the dead alone were 30,000 —had no course open but to capitulate. On the demand of Rumania a conference was summoned to Bucharest, which on July 30 arranged an armistice, and on Aug. 10 the Peace of Bucharest was signed.[1] By this Bulgaria had to surrender to Serbia the whole of Macedonia, to Greece a large part of the northern shore of the Aegean, while to Turkey she had to restore Adrianople and to Rumania to surrender the Dobruja.

The situation left by the Treaty of Bucharest was very precarious. It was obvious that Bulgaria would not willingly acquiesce in the loss of territory and prestige. The mutual animosity between Serbia and Austria continued, and the Prince of Wied did not show himself capable of coping with the very serious difficulties in Albania. There were acute differences between Turkey and Greece, and the renewal of war seemed imminent. But these mere local complications could doubtless have been overcome so long as no one of the Great Powers intervened; separate action by any one of them must almost inevitably bring about the great trial of strength between the rival alliances. It was the object of every responsible statesman to prevent this arising. The immediate danger arose from Austria and Russia. Austrian policy was inclined towards Bulgaria and desired to see the Treaty of Bucharest overthrown. In the summer of 1913 they proposed an immediate attack on Serbia; in this they did not have the support of Berlin. The German Govt. was clearly dissatisfied with the Austrian handling of the Serbian difficulty, and also with the unnecessary harshness with which the Hungarians treated the Rumanians. They rightly saw that an amelioration of the position must be found in an internal reform of the Dual Monarchy.

On the other hand, German ambitions were becoming a serious danger. Count Wangenheim, who had succeeded Marshall von Bieberstein as ambassador to the Porte, was with great assurance strengthening the German control at Constantinople. This was a development which Russia could not regard with equanimity. A crisis was reached during the winter, when Gen. Liman von Sanders was not only appointed to reorganise the Turkish Army, but was given actual control over the army corps stationed in Constantinople. This led to a strong protest from Russia, and was followed by very violent press polemics between Germany and Russia. It is clear that Russia was becoming impatient. It looked as though Germany, with the conclusion of the Baghdad agreement, and in other ways, would gain complete control over Turkey, military, political and economic. This, if achieved, would be a formidable impediment to the ultimate realisation of what had for so long been the permanent object of Russian policy—not only the opening of the Straits but the control of Constantinople. In Feb., as we now know, the situation was reviewed; it was agreed that these hopes could only be achieved as the result of a European war, and that it was necessary to prepare the scheme for landing troops on the Bosporus if the contingency arose. Russia did not take her Allies into her confidence. The most serious element in the situation was that more and more, the old rivalry between Austria and Russia, which had always been found manageable, was giving place to a direct conflict of interests between Russia and Germany herself. Moreover, the commercial treaty made between Russia and Germany in 1892 was running out; Germany had succeeded in imposing upon Russia conditions which subordinated Russian interests to those of Germany. Any negotiations for the renewal of the treaty must certainly react on the political situation. Already the anticipation of this had aroused all the strong national spirit in both empires. The Russians in particular were determined not to accept a renewal of the humiliating position in which they had so long been placed.

Meanwhile Russia was actively strengthening her diplomatic position and was working to build up a new Balkan alliance. The first step was to win over Rumania from the Central Powers; in this she was largely successful, being helped by the popular sympathy in Rumania for their fellow-countrymen in Transylvania. But the prospect of a new Balkan alliance necessarily aroused the greatest apprehension in Austria; it could have no *raison d'être* except hostility towards her, for a reconciliation between Bulgaria and Serbia would only be possible if Serbia relinquished part of the territory won in the late war and as a compensation was able to extend to the Adriatic. Her real ambitions were the annexation of Bosnia and Hercegovina and in the prospect of this she was encouraged by Russia. Moreover, the internal condition of the monarchy was becoming serious.

Apart from grave financial embarrassments the conflict of nationalities was growing. The German element, on the loyalty of which the very existence of the monarchy depended, was tending to fall under the influence of the pan-German party in the Empire; the chronic difficulties with the Czechs had reached such a stage that from March onwards it was necessary to suspend the meetings of the Reichsrat; there were constant disputes between the Rumanians in Transylvania and the Magyar Govt., and throughout the southern provinces the dissatisfaction of Serbs and Croats alike was growing; the gradually increased strength and reputation of Serbia was beginning to act as a dangerous magnet. Responsible statesmen in Europe were beginning to realise that now that the Turkish problem had been solved, they would soon be confronted by an Austrian problem. This again affected the political situation of Germany; she had now only one sure ally left; if there were to be a collapse of Austria-Hungary, she would be left alone. Confronted by the growing strength of Russia, her rulers began to look to the future with grave apprehension. The great danger to Europe lay in the rivalry of armaments.

[1] R. B. Mowat, *Select Treaties and Documents*, p. 121.

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II. THE OUTBREAK OF WAR

The Murder of the Austrian Archduke.—The preceding pages of this article describe the state of Europe when, on Sunday, June 28, the Archduke Franz Ferdinand, the heir to the Austrian throne, and his wife, while on an official tour of inspection in Bosnia and Hercegovina, were murdered at Serajevo, the capital. The two assassins were young men of 20 years of age, natives of Bosnia and therefore Austrian subjects. Such evidence as is available seems to show that the motive for the crime must be traced to the intense racial animosity which had existed in Bosnia since the time of the annexation, increased as it was by the growing discontent in Croatia, and by the rising tide of aggressive nationalism in Serbia. But the preparations had been made under the auspices of a secret society in Serbia known as the "Black Hand," the leader of which was Demetrivich, an officer of the Serbian General Staff. The Serbian Govt. itself was in no way an accomplice in the act, which they deplored, for at the moment they desired peace and recuperation after two wars. There is, however, evidence that they had some knowledge of what was intended and they were very remiss in not giving a warning to the Austrian Government.

Elsewhere, except among the comparatively few who really understood how precarious was the position in the Balkans, it was the personal aspect of this event which attracted attention. The general feeling was one of deepest indignation, and of the warmest sympathy for Austria and for the aged Emperor, Francis Joseph, whose life had already been so full of tragedy. In Austria the crime, which was no isolated act, was looked on as a blow at the very existence of the monarchy. The relations with Serbia had for long been the cause of grave disquiet, internal as well as external. There had in fact just been drawn up a very important Austrian memorandum for communication to the German Govt.; in it the Balkan situation was discussed, and stress was laid on the scheme attributed to Russia of creating a new Balkan league, which was to include Rumania and be used as an offensive weapon against the Triple Alliance.

In this scheme the disaffection in Bosnia and Croatia, fermented by the agitation from Serbia, would be a dangerous instrument. Against this it had been intended to propose a pro-Austrian anti-Serbian alliance with Bulgaria and Turkey, which could be used also to check the pro-Russian influences in Rumania. Count Berchtold and his colleagues now determined immediately to use this new opportunity so as to rid themselves once and for all of the menace to the monarchy caused by the Yugoslav propaganda and at the same time to restore the waning prestige of the monarchy. In this they were influenced by the advice of Conrad von Hötzendorf, chief of the General Staff, who had long held the view that a successful war was the only means of stopping the disintegration at home and rehabilitating the Empire abroad.[1] For this purpose it was essential that there should be war with Serbia; no diplomatic success would be sufficient and the war must end in the diminution of Serbian territory and in bringing the kingdom into such a condition of dependence upon Austria that it would practically cease to be an independent state, or to exercise influence in the Balkans.

[1] Conrad, *Aus meiner Dienstzeit*, vol. 1 and 2 *passim.*

Austria could not take action of this kind unless assured beforehand of German support, for she would certainly be confronted by the opposition of Russia. Count Hoyos was therefore dispatched on a special mission to Berlin, taking with him both the memorandum written before the murder and an autograph letter of the Emperor in which the situation was explained.

The Decision in Berlin.—This letter was delivered personally by Count Szögyény, the Austrian ambassador, on July 5 to the German Emperor, who was due to leave for his annual holiday in the North Sea on July 7. It was then that the decision on which so much was to depend was made. It was one for which the Kaiser was immediately and personally responsible. While explaining that he must, of course, consult the Chancellor on a matter of serious European importance, the Count was authorised to inform the Austrian Emperor that in this question he could "depend on the complete support of Germany." "This especially applied to Austrian action against Serbia." "In the Kaiser's opinion there must be no delay. Russia's attitude would certainly be hostile, but he had for years past been prepared for this; if it was to come to a war between Austria-Hungary and Russia she could be convinced that Germany would stand at her side with her usual fidelity. Moreover, Russia, as matters stood, was in no way ready for war, and would certainly consider before appealing to arms."

The Kaiser, after a brief and informal committee with his naval and military advisers, left Berlin for his visit to Norway, as arranged, on July 7. The official German answer, though more guarded, was in accordance with his language. In it the Chancellor explained that the view of the German Govt. was that the relations between Austria and Serbia were a matter within the competence of Austria alone; Germany therefore did not propose to claim any right to interfere. What this, of course, meant was that Austria received a free hand to couch her demands on Serbia in such terms as she chose; Germany already knew that they would be such as to make war very probable. But Austria had already been assured that, if this action led to war with Russia, Germany would be at her side. It is noticeable that no advice or warning was given that the demands on Serbia should be so modified as to avoid this danger. On the other hand great attention was given to the diplomatic preparation; everything was to be done to secure for a war with Serbia the support or neutrality of the neighbouring states. With this object the Kaiser, though strongly against his own personal inclination, agreed that the King of Bulgaria should be asked to join the Triple Alliance, and, in view of the great German interests in Turkey, negotiations with the same object should be entered into with the Porte. What above all interested them was the position of Rumania and Italy. The situation in Rumania caused much anxiety, for King Charles let it be known that he would probably not be able to bring the country with him into a war with Russia on the side of the Germanic Powers; all, however, was to be done to strengthen German influences in that country. As to Italy, it was agreed that its Government should not be informed beforehand as to the blow which was impending against Serbia, but Germany pressed very strongly that Austria should be prepared to offer to Italy suitable compensation for any gain in territory or influence in the Balkans which might accrue to her.

Analysis of the objects and motives of the German Govt. is all the more difficult because, in its political composition, it had no powerful personality such as Bismarck had once been, and its actions were the result of many conflicting influences, while decisions were always liable to be deflected by the impulsive and vacillating character of the Kaiser himself. There was in the first place genuine indignation at the crime of Serajevo, an indignation which in the Kaiser's mind took the characteristic form that there must be co-operation between all monarchical states against elements of disorder. This motive was one which, no doubt, it was hoped when the time came he would use with effect upon the Tsar. Politically there had long been dissatisfaction at Berlin with the conduct of affairs in Austria; the force and decision which were needed in an ally were wanting. It was hoped, therefore, that the opportunity would be used to remedy this defect.

But there were further and greater objects which would follow automatically; if Russia could be persuaded to stand aside while Serbia was overrun by the Austrian Army, it would become evident that Russian protection was of no avail to Serbia; Serbia would be pushed out of the way, and thereby the Germanic Powers would gain in fact the control of the Balkans and the road to the East.

It was an essential part of the scheme that Great Britain and France should be urged to use their influence to keep Russia quiet; if they did not do so then the responsibility for any extension of the war which ensued would seem to attach to them; if they did then the internal harmony of the Triple Entente would be weakened; Russia would feel that she had been deserted by her Allies. It was hoped that these results might be obtained without a European war. If, however, Russia was determined to meet the challenge and war resulted, it could be so arranged that the responsibility for the war should appear to fall on Russia and the Entente. The general condition of Europe was very threatening; it seemed probable that under any circumstances the " great war " must ensue shortly; it was believed that Russia would be ready in about two years. If there was to be a war the summer of 1914 seemed on the whole to be favourable to Germany. The Kiel Canal had been enlarged; the army was at the height of efficiency; the diplomatic situation seemed favourable; there were very serious labour troubles in Russia, serious parliamentary disputes in France, and it appeared as if there might soon be open rebellion in Ireland, with possibly something approaching mutiny in the British Army. It was indeed impossible to depend on Italy; but if Bulgaria and Turkey could be won over this would counteract the uncertainty of Rumania's action.

German support having been secured, the Austrian Govt. proceeded to prepare the text of the demands to be presented to Serbia. The great point was that they should be so drafted that they would be unacceptable; the object was not a mere diplomatic victory, but war; it was held that nothing would meet the situation and restore the authority and prestige of the monarchy short of an effective display of military strength. It was agreed, however, in consequence of the strong pressure used by Count Tísza, who alone was in opposition to the policy proposed, that the annexation of any part of Serbia, apart from a rectification of the frontier, should be repudiated; on the other hand, as a result of a successful war, portions of Serbia would be assigned to Bulgaria and Albania. On July 17, the final draft, having passed the Council of State, received the approval of the Emperor Francis Joseph, but it was determined to postpone its presentation till July 23; it would be better to delay until M. Poincaré, the French President, who was to visit the northern courts, had left St. Petersburg.

These arrangements were conducted in the greatest secrecy. All that was known outside was that Austria was contemplating some serious action against Serbia; this was naturally sufficient to cause apprehension and anxiety, but, during the days of waiting, the Austrian Govt. used its influence to damp down the very violent denunciations of Serbia in the Viennese Press, and in other ways tried to still the vigilance of the other Powers. As late as July 19 they assured the Russian ambassador in Vienna that nothing dangerous to the peace of Europe was being undertaken, and in consequence he went on a holiday. The British Govt. and nation, whose attention was preoccupied at the moment with the Irish problem, were inclined to regard the local dispute between Serbia and Austria as not being one in which they were vitally concerned. On July 16 the British ambassador, Sir Maurice de Bunsen, was able to give Sir Edward Grey a warning which was corroborated from unofficial sources. None the less, the belief that there would be a real danger of European war was slow in maturing in Great Britain, in spite of the anxiety felt in a few well-informed quarters. This attitude was based on a belief that, after all, the German Govt. would not support Austria in any reckless policy.

The Austrian Note.—The ultimatum was presented at 6 P.M. on Thursday, July 23, by Baron de Giesl to Dr. Patchou, as M. Pasic, the Serbian prime minister, was absent from Belgrade. The note had been admirably drawn up to fulfil the avowed object that it should contain demands which could not possibly be complied with. It required that Serbia should first of all officially publish on the front page of the official journal a condemnation of the Serbian propaganda against Austria-Hungary, regret for the part taken by Serbian officers and officials in this propaganda, and a promise of amendment in the future. There were in addition 10 requirements, which included, among others, the dissolution of *Narodna Obrana*, the suppression of any publication which incited to hatred and contempt of the monarchy, the elimination from public instruction in Serbia (including the teaching body) of anything that served as propaganda against Austria-Hungary, the removal from the army and the administration of officers and officials guilty of such propaganda whose names might be communicated by the Austro-Hungarian Govt., the collaboration in Serbia of Austro-Hungarian representatives for the suppression of the movement against the territorial integrity of the monarchy, and that Austro-Hungarian representatives should take part in judicial proceedings against all the accessories to the plot of June 28 on Serbian territory. A reply was required by 6 o'clock on the evening of Saturday, July 25.

As was immediately pointed out by everyone who read this document, it would be impossible for the Serbian Govt. to accept all these demands; no such requirements had ever been directed to a fully sovereign state—in particular the requirement that unnamed officials should be dismissed on the request of the Austro-Hungarian Govt., and that Austro-Hungarian officials should take part both in police and judicial proceedings on Serbian soil, was clearly one impossible to be granted. There could be only one conclusion, that Austria intended to force a war with Serbia and that in doing this she had deliberately prepared to meet the opposition of Russia. But it was clear that Austria could not have taken this step without the previous consent of Germany. It was therefore at once concluded that the two Germanic Powers had determined immediately to challenge Russia, and with Russia, France, to a great trial of strength.

This view was supported by a note which on the following day was delivered at St. Petersburg, Paris and London, in which the German Govt. announced that they considered the procedure and demands of the Austrian Govt. to be both equitable and moderate. (It is now known that these words had been written at a time when the German Govt. did not precisely know what the demands of the Austrian Govt. would be. It did not occur to anyone outside that the Government of a great state could be guilty of such unparalleled levity; it was naturally assumed that they had seen and approved the text of the Austrian note beforehand, and all their disclaimers were received with incredulity.) The German Govt. also emphasised their opinion that the questions at issue between Austria and Serbia should be settled by these two states alone, and lastly they intimated that interference by any other Power would be followed by incalculable consequences. This could obviously mean nothing except that Germany was backing up Austria, would support her even in a war with Russia, and that a threat was intended to France and Great Britain that, unless they put themselves on the Austrian side and brought pressure to bear upon Russia to withdraw her support from Serbia, a European war would result.

The news reached St. Petersburg just after M. Poincaré had left. The secrecy with which the ultimatum had been engendered, the misleading assurances, the absence of any warning to or consultation with other states, all seemed to point to a deep-laid plot. The reaction was precisely what was to be anticipated. The greatest indignation was expressed and the indignation was genuine. M. Sazonov at once asked for assurance that he should have the full support of France and Great Britain against this unparalleled act of aggression; the only method of avoiding war with Germany was, he said, that Germany should know that she would be confronted by the united forces of the Entente. At the same time Russian military preparations were at once begun; it was decided at a meeting of the Russian Council of State on July 25 that all preliminary steps should be taken and that Sazo-

nov should be authorised to give the signal for mobilisation as soon as it seemed to him necessary. Meanwhile, a public communiqué was issued that Russia could not remain indifferent to the fate of Serbia. Similar language was used in private and official interviews. From the beginning it was clear that Russia intended to resist the Austrian scheme, by war if necessary.

In these circumstances much depended on the action of Great Britain. During these days France could do little, for the President and the Foreign Minister were at sea. Russia and France both pressed Sir Edward Grey to declare himself. The situation was a difficult one. He clearly could not, as the Russians asked, give an unconditional promise to join with Russia if war ensued; by doing so he would incur the danger of increasing the influence of the war party which undoubtedly existed at St. Petersburg. Moreover, he would not have the full support of the Cabinet, nor apparently of the country. On the other hand, he could not give the promise of neutrality which Germany asked for, nor could he even press Russia too strongly to suspend her military preparations, for, by so doing, he would in fact be giving his support to an act of aggression against a State with which he was in the closest diplomatic agreement. He therefore saw from the beginning that the only possible means of avoiding a European war was to bring about some form of mediation or conciliation by which time would be gained; then some means might be found of settling the crisis in a peaceful way. For the next five days, supported by France, he pursued this path with energy and resource. In accordance with the practice of the last years he depended on the co-operation of Germany. To intervene directly between Austria and Serbia was out of the question; if Russia became involved the only remedy would be joint action of Great Britain and Germany. He knew that he had the support of Prince Lichnowsky, the German ambassador in London; he hoped for the co-operation of the German chancellor; he did not know how fundamental was the difference between the German ambassador and his Government.

His first suggestion was that Austria should give Serbia more time, and not, as was threatened, break off diplomatic relations if Serbia did not accept all the requirements of the ultimatum by 6 o'clock on Saturday, July 25. This proposal, which was supported by Russia, received no support in Germany, and in fact reached Vienna almost too late. It was at once rejected there. The Serbian answer was actually delivered at the appointed hour on July 25. It was very conciliatory. It went to the furthest possible extreme in compliance; every demand was granted with the exception of two, the dismissal of unspecified officials and officers and the co-operation on Serbian soil of Austrian officials. The Austrian minister, however, at once, in accordance with his instructions, left Belgrade. Sir Edward Grey now began to press for mediation, not between Austria and Serbia, but between Austria and Russia, by the four Powers, Great Britain, Germany, France and Italy. On July 26 he converted this into a firm proposal for submission of the points at issue between Austria and Russia to a conference of the ambassadors in London. This proposal was rejected by the Germans on the ground that they could not ask Austria to submit to what would in fact be an Areopagus of the Powers. They also would prefer separate conversations between Austria and Russia, which Sazonov had accepted.

The text of the Serbian answer to the Austrian note was received in London on July 27. Sir Edward Grey at once pointed out that this reply could surely be made the basis of negotiations, and pressed that, if Austria continued her intransigeant attitude, it would appear that she was deliberately aiming at war. These representations were fully reported to Berlin by Prince Lichnowsky, who warned the German Govt. that, if they continued their negative attitude, they would no longer be able to depend upon the neutrality of Great Britain. They were without effect. The German Govt. indeed on July 27 forwarded Sir Edward Grey's proposals to Vienna, but at the same time they informed Count Szgbyény, the Austrian ambassador, that they did so merely because they did not wish to alienate Great Britain, and in no way associated themselves with the proposals, which they did not wish to see adopted. The negative attitude of Berlin, the apparent refusal to do anything to restrain Austria, inevitably produced the conviction that Germany was no longer working for peace. If this were so there then remained only one means of avoiding war, that Great Britain should give a formal warning that in the event of war she would be found on the side of Russia and France. This was from the beginning strongly urged both at Paris and St. Petersburg; a first step in this direction was the order given to the British fleet (which had been assembled for manoeuvres) not to demobilise; this order was made public on July 28.

However, on the morning of July 28, some change became apparent in the German attitude. The Kaiser had returned to Potsdam from his North Sea cruise on the afternoon of July 27. There was at once laid before him the text of the Serbian answer, which, owing to very serious delay, for which the Austrians were responsible, had not reached Berlin until that day. He saw that it left to the Austrians no defensible ground for a declaration of war. "A brilliant achievement; this is more than could have been expected. A great moral success for Vienna, but with it every ground for war disappears, and Giesl ought to have remained quietly at Belgrade. I would never have ordered mobilisation." He therefore, on the morning of July 28, caused to be sent to Vienna a proposal that Austria should be satisfied with the occupation of Belgrade and a defined limit of territory, and should issue her demands from there. This would give to the military feeling of Austria that satisfaction which they might reasonably demand. As was pointed out: "If Austria continues her refusal to all proposals for mediation or arbitration, the odium of being responsible for a world war will in the eyes of the German people fall on the German Government. On such a basis, however, a successful war on three fronts cannot be started and carried through." The weakness of this proposal was that it was based on the assumption that war with Serbia would have begun; but as soon as war began, clearly Russia must mobilise. No settlement could be successful unless it provided for a mutual understanding as to the military measures to be taken on both sides. The Emperor's proposal assumed that while Austria began a war with Serbia, Russia should cease all military measures. This clearly was impossible.

Austrian Declaration of War against Serbia.—Russian mobilisation was in fact becoming imminent. The preliminary work had proceeded rapidly; reports came to Germany from all parts of the Russian Empire showing the activity of the preparations. The Russian position never changed. They would not proceed to the next stage until Austria took overt action either by a military advance or declaration of war. As soon as she took either of these steps, Russia would mobilise part of her forces. This contingency was realised on Tuesday, July 28. Austria had issued an order for the mobilisation of eight army corps on July 26, and now sent a declaration of war against Serbia in an open telegram to Belgrade. The Austrian Govt. had informed Germany of their intention to do this the day before, but no warning or suggestion that some delay would be useful was given. Germany in fact was now beginning to experience the results of the very ill-considered language used three weeks before; the Kaiser had insisted then on the necessity for rapid and vigorous action; to press now for moderation and delay would have exposed him to the charge of vacillation which on other occasions his actions had appeared to justify, and from which he had boasted that on this occasion he would be free.

As soon as the news of the declaration of war reached St. Petersburg it was decided that partial mobilisation must follow; the German and other Governments were immediately informed. This decision was confirmed when on the same day the Austrians broke off the separate conversations with Russia which Sazonov had suggested, giving as a reason the declaration of war with Serbia, an act for which they themselves were entirely responsible. Even now, however, there was a delay of 24 hours. The next morning news came that the Austrians had begun to attack and were bombarding Belgrade. Further delay seemed impossible. The military authorities, however, strongly urged that par-

tial mobilisation against Austria alone would have fatal effects. If there was to be war, Russia would certainly have to meet Germany as well as Austria, but if partial mobilisation had once begun, the change to general mobilisation would for technical reasons produce a complete state of disorganisation. The Tsar therefore apparently, on the morning of Wednesday, July 28, signed two orders, one for partial and one for general mobilisation. It was still left open which should be used. About 7 o'clock that evening Count Pourtalès called on Sazonov, and under instructions from the German chancellor warned him that any further military preparations or mobilisation would involve German mobilisation, and that German mobilisation meant war. This message was so worded that it seemed to prohibit even partial mobilisation against Austria. The German explanation is that it was meant as a friendly warning, but it was taken, not unnaturally, as something in the nature of an ultimatum.

Meanwhile there was great anxiety in Berlin. The Government were not well informed as to the intentions of Austria, and answers to telegrams were long delayed. There was also a serious divergence between the political and military authorities. The general staff were becoming very nervous. If there was to be war it was essential that it must begin at once in order that they might gain the advantage which came from their higher stage of military preparation. Every day that elapsed would have the result of enabling Russia to enter the campaign sooner than had been anticipated. On the other hand, from the political point of view, especially having regard to the effect on public opinion in Germany and in Great Britain, it was most important to avoid action which might appear provocative. Matters must be so arranged that the appearance of aggression would fall upon Russia. The whole situation appears to have been discussed in a council which met at the palace at Potsdam on the evening of July 29. There is no authentic record of the discussion, but it is clear that a demand was made by the general staff for immediate mobilisation, and was refused.

It was, however, determined to make a strong effort to avoid the danger, which was becoming more apparent, of active British intervention in the war; with this object, that very evening between 9 and 10 o'clock, the German chancellor sent for Sir Edward Goschen, the British ambassador, and made him a strong offer for British neutrality. In return for this Germany would be prepared to promise that in the event of a successful war no part of France would be annexed by Germany. This suggestion was, of course, the next day indignantly refused. Scarcely, however, was the interview over when a fresh telegram from Prince Lichnowsky was received, containing a friendly warning from Sir Edward Grey that, if war resulted, England would probably not be able to keep out of it. This produced something like consternation. The negotiations with Austria as to Italy had not been proceeding favourably, and all the information seemed to show that Italian support would *not* be forthcoming. The very same night three additional telegrams were dispatched to Vienna couched in the most pressing and urgent terms, exhorting the Austrian Govt. not to continue their refusal against all projects of mediation; if they did so they would be dragging Germany into a European war, in which Italy would not be on the side of the Triple Alliance and in which Great Britain would be among the enemies—a war, therefore, which would be fought under the most unfavourable conditions.

Russian and German Mobilisation.—Among the numerous other telegrams sent out from Berlin on this evening was one from the Kaiser to the Tsar, again impressing on him in the strongest terms the danger of mobilisation. In consequence the Tsar, about 9 o'clock, counter-ordered general mobilisation sent out about midnight. (The statement made in 1917 that the Tsar's orders were disobeyed by General Sukhomlinov, the Minister of War, was untrue.) This decision caused the most serious anxiety in military circles and at a meeting held the next day, July 30, after a long discussion they succeeded in persuading the Tsar, against his will, to reconfirm the decision of the previous evening that general mobilisation was to be proceeded with. The notices were put up throughout the Russian Empire during the course of the night, and on the following morning the fact was public. There was, however, some delay in communicating it abroad; the news does not seem to have reached either Paris or London until very late in the afternoon. It reached Berlin shortly after midday. The Kaiser at once left Potsdam for Berlin and ordered the proclamation of *Kriegszustand*, the first step before mobilisation; a telegram was also sent to Pourtalès that he should immediately call on Sazonov and inform him that unless the order for general mobilisation was recalled within 24 hours Germany would consider herself at war with Russia. No answer was given; German mobilisation was proclaimed the next day, Saturday, Aug. 1, and war was declared at 5 o'clock in the afternoon.

The Russian order for general mobilisation seems on all grounds to have been ill-advised; from the military point of view delay was advantageous to Russia. Politically it provided the German Govt. with the pretext which was essential to them: for the moment it appeared as if Germany was defending herself against a Russian invasion; the solidarity of the nation was secured and even the Socialists ceased their criticism and opposition. It was this which made the Reichstag, which assembled on Aug. 3, almost unanimous in its support of the war measures laid before it. It also destroyed any slender possibility of still avoiding war. The decision seems to have been due not so much to any deliberate desire for war, as to the state of nervous panic which prevailed in the sinister situation by which Russia was suddenly confronted, owing to the provocative and menacing action of Austria and Germany; there was no cool and balanced judgment or strong hand to exercise control.

The extreme rapidity with which these events took place frustrated all the efforts at mediation which were in progress. Sir Edward Grey had put forward a new plan, very similar to the German Emperor's proposal that Austria should issue her terms from Belgrade, but he had accompanied it by conditions which if accepted would have got over the mobilisation difficulty. This had been communicated by Berlin to Vienna, but no answer had been received when Germany, by her ultimatum, broke through all the negotiations. None the less, even as late as Saturday, Aug. 1, this and other suggestions continued to be the subject of an interchange of telegrams. They had, however, no practical importance. There is indeed no indication that, so far as Austria was concerned, the postponement of the Russian general mobilisation would have had any effect upon the final issue. The order for general mobilisation was determined on the afternoon of July 30, and issued on July 31, before Russian mobilisation was known.

France and Germany.—In accordance with the terms of the Franco-Russian Alliance, an aggressive war declared by Germany against Russia inevitably entailed war with France. The French President, M. Poincaré, and the premier, M. Viviani, reached Paris on the evening of July 29; they at once telegraphed to Russia that France would fulfil the obligations of her alliance, while continuing her efforts to preserve peace. From the beginning of the crisis France had, like all other nations on the continent of Europe, immediately begun all the necessary military preparations. Even the smaller states, such as Holland, had from the beginning of the week been doing the same thing. The Austrian ultimatum to Serbia was an act of such a nature that, followed as it was by the rupture of diplomatic relations and the declaration of war, no responsible Government could afford to lose a moment in carrying through every measure short of the final act of calling up the reserves, to which the name of " mobilisation " is generally given. Suffice it to say that by July 31 the French and German covering troops on the frontier were both in position. The French, however, in order to avoid any untoward incident, took the precaution of keeping their troops 10 km. from the frontier.

This was not imitated by the Germans, and in fact could not be, for the great fortress of Metz was actually on the frontier, and there seems no doubt that before July 31, on several occasions, German troops had crossed the French frontier. The Russian mobilisation, the consequent German mobilisation, and the declaration of war against Russia, made it imperatively necessary

for the German Govt. without any delay to settle the issue with France. The basis of their whole plan of operations was an instantaneous invasion of France. They therefore could not allow a day to pass unused; if there was to be war with France, it must come at once. Accordingly at 7 o'clock on July 31, Herr von Schoen, the German ambassador, called on M. Viviani and announced that he would come again the next day to learn what the attitude of France would be in case of a war between Germany and Russia. He came in consequence on Aug. 1, and was informed merely that "France would do that which her interest dictated." French general mobilisation was ordered on Aug. 1, at almost exactly the same time as that of Germany. It would have been natural that the actual declaration of war by Germany should immediately have followed; it was, however, delayed for two days, partly in consequence apparently of a misunderstanding which arose in London. Lichnowsky telegraphed that he had received an inquiry whether Germany would stand out if England secured the neutrality of France. What seems to have been meant was an idea that both France and Germany should remain neutral, leaving Austria and Russia alone at war; this was misinterpreted as a suggestion that France should remain neutral in a war between Germany and Russia. Nothing could have been more favourable to Germany than this, but subsequent revelations have shown that even French neutrality alone would not have been accepted by Germany. Herr von Schoen was instructed, if France promised to remain neutral, to demand that she should hand over the fortified cities of Toul and Verdun to Germany as a guarantee. That such a proposal should ever have been seriously entertained shows how abnormal was the mentality of Berlin. There was never the slightest doubt that France could not leave Russia unprotected against a combined attack from both Germany and Austria.

The situation at the end of the week was a very anxious one in Paris. War with Germany was now certain, and France might anticipate that within a few days the whole force of the German army would be thrown against the frontier. The future of France seemed to depend upon the action of Great Britain. But in London all seemed uncertain. The strongest representations were made by M. Cambon to Sir Edward Grey, and the President of the French Republic addressed an autograph letter to King George urging the vital necessity for help from England. No promise could be given. The British Cabinet were then divided. Neither they nor, as was thought, the country would have approved of the interference of Great Britain in a continental war in which her interests and honour were not immediately involved. Though Great Britain could not stand by and passively watch the defeat and dismemberment of France, this might be a reason for preparing to intervene if at any time it became necessary, but not for taking part as a principal from the beginning. There was indeed one point in which, admittedly, both British interests and British honour were closely concerned, viz.: the neutrality of Belgium.

Great Britain was bound by the Treaties of 1839 to intervene if either party to a war violated that neutrality. Following, therefore, the precedent of 1870 Sir Edward Grey, on July 30, addressed a message both to the French and the German Governments, drawing their attention to this point and asking for assurance that Belgian neutrality would be respected. The answer from France was quite satisfactory. The German Govt., on the other hand, said that they were unable to give any answer to the question. On Sunday, Aug. 2, Sir Edward Grey, on his own responsibility, without obtaining the consent of the Cabinet, took another step. He informed the French that if a German fleet attacked France in the Channel or the Atlantic, Great Britain would immediately intervene with her fleet. Apart from the Belgian question, it would still have been possible for Germany to keep Great Britain neutral by limiting the war against France to land operations, and it would clearly have been in her interests to do so.

All then seemed to depend on the Belgian question. On Monday, Aug. 3, the German Govt. formally declared war against France. The actual reasons given were statements that the French had violated German territory by dropping bombs from aeroplanes, and in other ways. The German Govt. has since acknowledged that these statements were untrue. Meanwhile it became known in London (Aug. 2) that German forces had crossed the Luxembourg frontier and occupied the Grand Duchy, the neutrality of which was guaranteed by the Great Powers, Germany herself included; and also that the German minister at Brussels (as Sir E. Grey told the House of Commons on Aug. 3) had delivered a note to the Belgian Govt. demanding free passage for their troops across Belgian territory; if this was granted they undertook to leave Belgium at the end of the war with her independence and territory unimpaired, and in fact held out hopes of increase of territory at the expense of France, either in Europe or in the colonies. If the request was refused, Belgium would be treated as an enemy. An answer was required within 12 hours. This action was excused by the statement that the German Govt. had reliable information that French forces intended to enter Belgium. But it is now known that the whole note, including this statement, had been drafted more than a week before by the general staff. After a midnight sitting of the Belgian Council of State, presided over by the King, a refusal was handed to Herr von Below. Before this happened German troops had already crossed the frontier, and in consequence Herr von Below received his passport and was requested to leave the country immediately.

These events were decisive for Great Britain. All the doubts by which the Cabinet and large sections of the country had been assailed during the previous week were at once swept aside. On the afternoon of Aug. 3, Sir Edward Grey explained the menacing nature of the situation to the House of Commons, and on the next day (after a further statement in Parliament by the Prime Minister) an ultimatum was dispatched to Berlin requiring the German Govt. to respect Belgian neutrality. This was presented by Sir E. Goschen to Herr von Jagow; as the request was refused, he demanded his passport, and war between Great Britain and Germany began at midnight (Aug. 4–5).

BIBLIOGRAPHY.—The chief authority for the events dealt with above is the official correspondence published by the various Governments. A translation of the full text of all documents published at the beginning of the war will be found in *Collected Diplomatic Documents relating to the Outbreak of the European War*, printed by the Stationery Office (1915). Fuller publications have now been made by the British, German and Austrian Governments: *The Outbreak of War—Foreign Office Documents (June 28–August 4 1914)*, collected and arranged with introduction and notes by J. W. Headlam-Morley; *Die Deutschen Dokumente zum Kriegsausbruch*, collected by Karl Kautsky (4 vol., Berlin, 1919 *seq.*) English tr. "*Official German Documents relative to the World War*" (Carnegie Trust Endowment, Washington, 1923); *Diplomatische Aktenstücke zur Vorgeschichte des Krieges 1914* (Österreichisch-Ungarisches Rotbuch); Goos, *Das Wiener Kabinett und die Entstehung des Weltkrieges* (Vienna, 1919); Romberg, *The Falsifications of the Russian Orange-book* (English trans., London, 1923). In addition to the works referred to on pp. 1039–40, see Renouvin, *Les Origines immédiates de la Guerre* (1925); Montgelas, *The Case for the Central Powers* (London, 1925); Seton-Watson, Sarajevo, *A Study of the Origins of the War* (London, 1926). The very numerous works which appeared during the War are to a great extent superseded owing to the further information which is now available. (J. W. H.-M.)

III. THE WAR PERIOD

The Formation of the Alliances.—A month after the declaration of war by Austria-Hungary on Serbia (July 28 1914)—hostilities had already begun—France, Great Britain, Russia, Serbia, Montenegro and Japan (since Aug. 23) stood against Germany and Austria-Hungary. On Sept. 5 1914 the Entente between France, Britain and Russia was transformed in London into a treaty by which the signatories undertook the obligation, amongst others, to conclude no peace with the enemy except in concert.[1] Germany and Austria-Hungary were pledged to common action by the Treaty of Oct. 7 1879, which was still in force at the outbreak of the War, and by the Triple Alliance, which had been renewed for the fourth time on Dec. 7 1912.[2] Italy,

[1] *Parliamentary Papers*, Cd. 7737.

[2] For texts, see Pribram, *Die Politischen Geheimverträge Oesterreich-Ungarns, 1879–1914* (Vienna-Leipzig, 1920), pp. 3–9, 101–106.

the third signatory to the latter Treaty, replied to the request of the Central Powers for her co-operation that no *casus foederis* had arisen for her, since Austria-Hungary had taken the offensive against Serbia. When the conflict between Austria-Hungary and Serbia developed into the World War, the Italian Govt. promised benevolent neutrality, leaving the question open whether Italy would not range herself on the side of her Allies at some later date. Italy made this support, however, contingent on conditions which the persons in charge of Austro-Hungarian policy declared utterly impossible. The negotiations of the Central Powers with their second Ally, Rumania, had been no more fortunate. The hopes which the Emperor William, in particular, had entertained of King Charles were disappointed. The majority of influential Rumanian politicians were too friendly to the Entente, the old differences with the Habsburg Monarchy too deep, for King Charles to be able to fulfil the obligations undertaken in the secret treaty of 1883 with the Central Powers, which had been renewed for the fourth time in Feb. 1913.[1] Francis Joseph I. and William II. themselves brought their personal influence to bear on King Charles at the beginning of Aug., and offered him, amongst other inducements, the acqusition of Bessarabia after the successful termination of the War, in return for Rumania's active participation on the side of the Central Powers. It was in vain; the Crown Council of Aug. 4 decided that no *casus foederis* had arisen for Rumania, and she therefore preserved neutrality for the time.

The Central Powers were rather more fortunate in their quest for new Allies. On Aug. 1 1914 the representatives of Germany and Turkey signed a treaty whereby the latter undertook to remain neutral should the conflict confine itself to one between Austria-Hungary and Serbia, but to join the Central Powers as a belligerent should war break out between them and Russia. Soon after, when Russia's entry into the War was assured, the Central Powers increased their offers. They held out a promise to the Sultan—not, indeed, in writing—that his participation in the War would be rewarded on its successful close by the abolition of the capitulations which were so unpopular in Turkey, a favourable rectification of Turkey's frontier, and a proportionate share in any war indemnity obtained from the Allies. Meanwhile the representatives of the Western Powers in Constantinople were making every effort to prevent Turkey from joining their enemies. They were prepared to guarantee the Sultan's territory and to meet his wishes regarding the capitulations in return for his neutrality. The Sultan and the Grand Vizier returned courteous answers to these offers, but decided finally for the Central Powers. At the end of Oct. Turkey commenced hostilities against Russia; Russia answered by declaring war; the Western Powers followed suit.

The attitude of Bulgaria proved a great disappointment to the Central Powers. Austria-Hungary had long been engaged in negotiations with Bulgaria, and these were so far advanced at the beginning of Aug. 1914 that she confidently expected the treaty to be concluded almost immediately. In return for his active assistance in the War the Central Powers were prepared not merely to guarantee King Ferdinand his existing territories, but also to satisfy his comprehensive ambition to establish Bulgaria's " ethno-historical frontiers " at the expense of such of the Balkan States as did not ally themselves with the Central Powers. But King Ferdinand and his Government refused to enter on a war with Serbia until they were sufficiently guaranteed by treaty that the opening of hostilities against Serbia would not involve them in an attack from their neighbours, Greece, Rumania and Turkey. The assurances offered by the Entente for Bulgaria's alliance, or even her benevolent neutrality, contributed to this attitude. In Aug. 1914, Noel Buxton, chairman of the Balkan Committee, had semi-officially sounded the Bulgarian Govt. as to whether it would accept a revision of the Treaty of Bucharest and a loan in return for armed neutrality. At the same time Sazonov urged Pasic, the Serbian Minister President, to make Bulgaria territorial concessions in Macedonia if this would induce her to take the field against the Central Powers. Undoubtedly, however, the hesitations of the Sofia Govt. were largely due to the wish not to commit itself until one or the other group of combatants should have proved definitely superior in the field. Meanwhile, the Central Powers had been disappointed in their hopes of bringing the War to a speedy end by force of arms. Moreover, the consequences of the economic warfare to which the Allies, particularly Britain, had resorted were becoming felt. Germany had lost a great part of her overseas possessions, and the Central Powers had suffered considerable economic losses of the most varied nature.

The entry of Turkey into the War afforded them a very respectable addition to their fighting forces, and something even more important. The hand which commanded the Dardanelles controlled the sea route between the granaries of Russia and the industrial states of the West. An enemy in Mesopotamia and Mount Sinai could threaten Britain in India, Egypt and the Suez Canal. As suzerain of many Indian Mahommedans who revered the Sultan as their spiritual head, Britain, and France too, had to reckon with the solidarity and hostility of the Pan-Islamic movement. Britain at once took the necessary measures of precaution. She declared that she would annex Cyprus, proclaimed a protectorate over Egypt, declared the Khedive Abbas, who was the Sultan's partisan, deposed, and set the son of Ismail on the throne of Egypt in his stead.

Russia, unlike the Western Powers, found the idea of a war with Turkey not disagreeable. A victory held out prospect of rich spoils; above all, Constantinople and the Dardanelles. And the Western Powers showed themselves prepared to fulfil Russia's wishes. During the negotiations which occupied the succeeding months, Russia, encouraged by the success of her armies against those of Austria-Hungary, increased her demands. In a memorandum which she presented at the beginning of March 1915 she claimed as reward for a successful war Constantinople, the west coasts of the Bosporus, of the Sea of Marmora and of the Dardanelles, Thrace as far as the Enos-Midia line, the coast of Asia Minor between the Bosporus and the River Sakaria and the islands in the Sea of Marmora with Imbros and Tenedos. The British and French Govts. demanded in return that Constantinople be declared a free port for the transit of goods not originating from or bound for Russian ports, that free passage be guaranteed to their mercantile marine through the Straits, that their territorial claims to districts in Turkey in Asia, to be exactly defined later, be recognised. The holy places were to be put under independent Mahommedan rule, the north zone of Persia to be in the British sphere of influence. Russia agreed with all essential demands of the Western Powers, whereupon the latter gave their written consent on March 12 1915 to Russia's annexation of Constantinople and the Straits.[2]

Meanwhile hostilities had commenced between the Turks and their enemies, in which the former gave evidence of skill and endurance, but were hampered by shortage of arms and material of war. Their allies in Central Europe would have helped them here, but it was not easy, as they had no secure land route to Turkey; the countries in the way, especially Rumania, were by no means willing to conform to the wishes which the Central Powers expressed in this matter. It was therefore the more urgently necessary for the latter to persuade Rumania and Bulgaria, or one of them at least, to enter the War on their side. Negotiations to this effect had been in progress since the autumn of 1914, but remained without result as the reports which reached Sofia and Bucharest from the theatres of war ran unfavourably for the Central Powers. The representatives of the Entente Powers in Rumania gained ground. On Oct. 1 (Sept. 18 O.S.) an agreement had been concluded between Russia and Rumania, whereby Rumania pledged herself to benevolent neutrality towards Russia in return for a guarantee of her existing territory and the right to incorporate the Rumanian-speaking districts lying within Austro-Hungarian territory. On Sept. 23 the Rumanian statesmen made a compact with those of Italy to regulate their attitude to the belligerents in concert and unison

[1] Pribram, *op. cit.*, pp. 107–111.

[2] For text of this Constantinople Agreement, see H. W. V. Temperley, *History of the Peace Conference at Paris*, vol. 6, pp. 4–9.

only. At the same time they had carried the negotiations with the Central Powers further, but had increased their territorial demands. To these the Austro-Hungarian Govt. gave a firm refusal. So at the beginning of Oct. 1914 Rumania's entry into the camp of the Entente Powers, who had been lavish with their promises seemed imminent. Yet the fear of an attack from their neighbours, Bulgaria and Turkey, and the deathbed resistance of the old King, at last restrained the Government from declaring for war against the Central Powers, and determined it to abide by its neutrality for the time.

This attitude was preserved by Ferdinand, who succeeded to the throne when King Charles died on Oct. 10, although his personal sympathies were with the Entente and the influence of most of his ministers and of his wife pointed in the same direction. In the course of the winter 1914–5 the negotiations with the Central Powers were continued, but the Rumanian statesmen increased their demands, which now included, not merely the Bukovina, but Transylvania as well. In Feb. 1915 the agreement of Sept. with Italy was renewed and expanded; the two Powers now guaranteed each other mutual help in case of an unprovoked attack from Austria-Hungary. When the Government in Vienna rejected Rumania's comprehensive territorial demands, the outbreak of war seemed inevitable; but although Italy declared war on May 23rd 1915, the military revival of the Central Powers in Galicia just stopped Rumania from following her example.

As the prospects that the Central Powers would persuade Rumania to enter the World War on their side diminished, so their anxiety grew to secure Bulgaria as an ally. They needed her to secure a safe passage for the arms and materials of war which Germany had promised Turkey in the treaty of Jan. 11 1915, to which Austria-Hungary had adhered on March 21; to keep Rumania in check; and to take an active part in the coming campaign against Serbia. Throughout the spring Austria-Hungary had refused to grant Bulgaria's steadily increasing demands. But in the summer the views of Ferdinand and his advisers changed. They recognised the fact that the Central Powers—not to speak of the great improvement in their military situation—had nothing to prevent them from gratifying Bulgaria's territorial ambitions, especially those relating to Serb territory in Macedonia, while the Allies had always to fear that equal concessions on their part to Bulgaria must deeply offend their faithful ally Serbia. Their representatives in Sofia made the attempt all the same. As early as May, after the failure of the first attempts to force the Dardanelles, they had told Bulgaria that if she would attack Turkey she might occupy and retain Thrace up to the Enos-Midia line. Furthermore, they pledged themselves to bring pressure to bear on Greece to cede Kavalla, promised financial assistance, and were prepared to guarantee Bulgaria South Macedonia on condition that she only occupied it after the conclusion of peace and after Serbia had been previously compensated by Bosnia and Hercegovina and on the Adriatic coast.

This point far more than all the others brought their plan to nought. Under the pressure of the Western Powers, the Skuptchina declared itself ready on Aug. 16 1915 to cede Macedonian territory to Bulgaria, but insisted that it could only be handed over after Serbia was already in possession of those parts of the Habsburg Monarchy which the Allies had destined as compensation for her, while even in June Bulgaria had demanded from the Entente Powers that the Macedonian districts in Serbia's possession be handed over to her immediately. So the balance in Sofia inclined ever more towards the Central Powers. None the less, difficult negotiations were still to follow before the treaties were signed on Sept. 6 1915 which ranged Bulgaria definitely in the camp of the Central Powers and Turkey. Her reward was the guarantee of her independence and existing frontiers, a large loan and the assurance of the annexation of east Serbia and the greater part of Macedonia. In return she pledged herself to place at least four divisions at the service of the Central Powers in the offensive which was being planned against Serbia. In addition, Bulgaria was promised that if Rumania or Greece made an unprovoked attack on her, the districts which she had ceded to these Powers in 1913 by the Treaty of Bucharest should be restored to her. On the same day, the reconciliation between Bulgaria and Turkey, for which the Central Powers had worked so hard, was perfected, the Sultan having consented to a rectification of the frontier on both sides of the Maritsa in Bulgaria's favour. The line of communications between the Central Powers and Turkey was now open and the campaign against Serbia could commence.

The acquisition of Bulgaria was a success for the Central Powers, but could not compensate for the loss they had suffered some months previously when Italy passed over to their enemies. While both groups of combatants had vied for Italy's support since the outbreak of war, her statesmen had at first adopted an attitude of reserve towards both alike. They had assured their Allies of their intention to keep to the spirit and letter of the Triple Alliance, but at the same time they had nourished the hopes of the other side and meanwhile had armed busily. But the further their preparations for war had advanced, the larger were the demands which they made from both sides. From the Habsburg Monarchy they required territorial concessions which grew ever more extensive. They began with the Trentino; but as the negotiations went on, as the reluctance of the Austrian Govt. to give up home soil was overcome by the unfavourable military situation and the ceaseless pressure from Germany, Italy's claims grew enormous.

At the same time she negotiated with the Allies. They too, especially Russia, found Italy's demands difficult of fulfilment, and saw that to grant them must lead in the future to complications with other allies, especially with Serbia. But the resistance of the Entente diplomats grew less as the course of the campaign showed ever more clearly that they could not dispense with Italy's help if the War was to be brought, as they hoped, to a speedy and successful conclusion. And as the Italian statesmen saw more and more hope that their demands, which were exactly formulated at the beginning of March 1915, would be accepted by the Allies, they increased their pretensions to Austrian territory. In April 1915 they demanded from the Court at Vienna as the price of their neutrality for the duration of the War—there was no more talk of active participation on the side of the Central Powers—not only South Tirol, Gorizia and Gradisca, a number of the most important Adriatic islands, complete sovereignty for Italy over Valona, Austria-Hungary's "désintéressement" in Albania and the proclamation of Trieste and its surroundings as a territory independent of Austria-Hungary, but also the immediate occupation by Italy of the Austrian districts.

The last-named demand was definately refused by the Vienna Cabinet, but in view of the dangerous military situation of the moment, and at the urgent request of the German statesmen and generals, who were even reinforced for the time by Conrad von Hötzendorf, then Austria-Hungary's leading military authority, the Cabinet continued the negotiations and made one concession after another. But the Italian Govt., strongly pressed by the representatives of the Allies, who finally agreed to all Italy's demands, but insisted on a quick decision, dragged on the negotiations with the Central Powers, and finally, on April 26, signed the Treaty of London, by which Italy pledged herself to enter the War on the side of the Allies within a month. Her reward was to include the Trentino, South Tirol up to the Brenner, Gorizia and Gradisca, Istria, the town and district of Trieste, North Dalmatia, numerous islands off the Adriatic coast, Valona, the twelve islands off the coast of Asia Minor, the protection of her interests in the Mediterranean and possibly the annexation of Adalia, the extension of her possessions in Eritrea, Somaliland and Libya; a loan of £50,000,000 on easy terms; in case of a successful end to the War a due proportion of the war indemnity and the promise that the Pope should have no say at the conclusion of peace or in any other question affecting the War.[1]

After the conclusion of this Treaty, Italy continued her ne-

[1] For full text see Temperley, *op. cit.*, vol. 5, pp. 384–393. *See* also below, EUROPE: INTERALLIED DIPLOMACY.

gotiations with the Central Powers. Burian, who had succeeded Berchtold as Austro-Hungarian Foreign Minister in Jan. 1915, in vain increased his offers in the attempt to change the attitude of the Italian Government. On May 3 Italy denounced her treaty with Austria-Hungary; three weeks later, on May 23, she declared war. Germany broke off diplomatic relations with Italy, but war was not formally declared between these two Powers, since a few days before Italy's declaration of war on Austria-Hungary they had made agreements directed to the maintenance of certain economic relations. Italy only declared war on Germany on Aug. 27 1916, the day of Rumania's entry into the camp of the Allies.

After the conclusion of their treaty with Bulgaria on Sept. 6 1915, the Central Powers reopened their campaign against Serbia, whose situation now became most difficult. The state of affairs was such that the Western Powers, although prepared to send help to their Ally, could do so only through the Greek Aegean port of Salonika. The attitude of Greece was therefore all-important. The Minister President in Athens, Veniselos, since the outbreak of war, had worked tirelessly to make Greece side with the Western Powers. King Constantine, however, under the influence of his wife, who was William II.'s sister, refused most firmly to adopt his Minister President's policy, and dismissed him in March 1915. But the new elections in the summer of 1915 brought a majority for the friends of the Allies; the King was obliged once more to entrust the new Ministry to the leadership of Veniselos, who made every effort to force Constantine to join the enemies of the Central Powers unreservedly. The King, fortified by the loyalty of his military party, succeeded in maintaining his policy of neutrality. Veniselos resigned a second time.

But meanwhile, he had conducted the negotiations with the Allies so far that the first troops from the Dardanelles force could land at Salonika on Oct. 5 1915, although Greece made a formal protest. But they came too late. The campaign which the Central Powers and Bulgaria had conducted against Serbia ended in their complete victory, despite heroic resistance. Before the end of 1915 the whole of Serbia was in their occupation. Soon after the Austro-Hungarian troops conquered Montenegro and northern Albania. The Central Powers had further great victories to report on other theatres of war, especially against Russia; at the end of 1915 they had occupied Congress Poland, Lithuania and Courland. Yet they had won no victory which could determine the issue of the War, and both sides made the most extensive preparations to resume hostilities in 1916. Great Britain succeeded in bringing about a breach between Portugal and the Central Powers in Feb. 1916; but all the efforts of the Central Powers failed to persuade Rumania to abandon her neutrality in 1915, since Tisza's attitude made territorial concessions as a price impossible; although such concessions were urged by the German Govt. and Supreme Command and also by Conrad von Hötzendorf.

In June 1916 the great success of the Russians over the Austro-Hungarian troops at Luck and Okna had a deep effect on the Rumanian Government. The friends of the Allies now preponderated. The negotiations with the representatives of the Allies were resumed, and led, especially after France had succeeded in smoothing over certain hesitations felt by Russia, to the conclusion of the Treaty of Aug. 17 1916. Rumania was promised the acquisition of the Bukovina, Transylvania, the Eastern Banat and a number of other Hungarian *comitates*. A military convention was concluded on the same day between the Entente Powers and Rumania. Ten days later Rumania declared war on Austria-Hungary, and opened up hostilities immediately. The Central Powers took up the challenge with such complete success that by the end of 1916 a very great part of the country was in their hands.

This was only one of the many successes gained by their troops in 1916; but the situation of the Quadruple Alliance developed less favourably in the non-European theatres of War, notably Turkey in Asia and German East Africa. Even more serious to the Central Powers were the growing economic privations, the consequences of which grew ever more apparent in the course of 1916. Shut off as they were from the world market, they began to feel the shortage of raw materials, which they needed urgently for rationing their armies and civilian populations, and procuring the necessary requisites of war. The shortage of foodstuffs, which was especially felt in the large towns, provoked discontent among those circles of the population which were most deeply affected. Internal difficulties found expression in Germany in conflicts between the politically and socially divided parties, while in the Habsburg Monarchy in addition they added strength to the national movements which endangered the unity of the state.

The First Peace Offers: The U.S.A. as a Neutral.—These internal troubles were an important factor in the decision of the Central Powers to join with their Allies at the end of 1916 in laying an offer of peace before the enemy.

The first step was taken by Baron Burian. He brought his proposal forward while Francis Joseph still lived. Francis Joseph had spoken in favour of a peace by understanding shortly after the outbreak of war, and had listened attentively to all proposals in this direction, but had never tolerated the idea of a separate peace. On Oct. 16 1916 Burian was at the German headquarters in Pless, and there propounded his plan. Bethmann Hollweg and the majority of German statesmen approved it, but demanded postponement till the close of the campaign against Rumania, and refused to communicate their conditions of peace at once. After negotiations, which countinued until after the death of Francis Joseph on Nov. 21 1916 and the fall of Bucharest it was agreed to proclaim the Quadruple Alliance's readiness for peace and to propose to the enemy a peace conference in the course of which the conditions of the Quadruple Alliance should be communicated. But it was soon apparent that the leading statesmen of the Allies had no intention of sitting down to confer with the Quadruple Alliance. Negotiations had been in progress between the Western Powers and Russia which led in March 1917 to an agreement whereby the "zones of influence and territorial acquisitions" of the three Powers on a possible dismemberment of Turkish possessions in Asia had been defined. Britain was to receive southern Mesopotamia, with Baghdad and two ports in Syria; France, Syria, the Vilayet of Adana and western Kurdistan; Russia, amongst other prizes, Trebizond, Erzerum, Van and districts in southern Kurdistan. Alexandretta was to become a free port, Palestine with the holy places to be taken away from Turkey and placed under a "special régime," the nature of which was to be determined by agreement between France, Russia and Britain.[1]

These plans by themselves, combined with the promises which had been held out by the Entente to Italy, Serbia and Rumania, could have afforded the Quadruple Alliance no fitting basis for negotiations, as they would have imposed the greatest sacrifices on three of its members, Austria-Hungary, Bulgaria and Turkey. Germany also would have had to submit to exceedingly hard conditions. After the "miracle on the Marne" it had become an article of faith among the people of France that Alsace-Lorraine must be restored to France. But the plans of France's leading statesmen went further. In the negotiations with Russia, which were already far advanced at the end of 1916 and led to the conclusion of a treaty on Feb. 12 1917, that Power not only recognised the claims of France to Alsace-Lorraine, the Saar district and Syria; she pledged herself further to support France's plan of erecting a buffer state on the left bank of the Rhine. This state was indeed to be neutral, but was to stand under French protection. Italy demanded a share in any territorial extensions in Asia. At the end of Nov. 1915 she had adhered, according to Article 16 of the treaty of April 26 1915, to the treaty of Sept. 4 1914 against a separate peace. At that time and throughout 1916 she had made it quite plain to her Allies that she would in no circumstances allow a peace to be concluded which involved her renunciation of any part of the territorial acquisitions promised her in the Treaty of London.

In Britain, too, both the home political situation and the

[1] For text of this Agreement (Sykes-Picot), see Temperley, *op. cit.*, vol. 6, p. 16. *See* also below, EUROPE: INTERALLIED DIPLOMACY.

attitude of the Colonies showed the greatest determination. The chief mouthpiece of the " will to win " was Lloyd George, who had become first Secretary of State for War, then Prime Minister. In Dec. 1916 he proclaimed the " knock-out blow " as the resolve not only of himself but also of the British Cabinet, their military advisers and their Allies. Among the last-named he included Russia where, since the fall of Stürmer and Protopopov, who would probably not have been averse from a separate peace with the Quadruple Alliance in Nov. 1916, the war party, vigorously supported by the ambassadors of Great Britain and France, had gained the upper hand. At the end of 1916, Trepov, Stürmer's successor, declared the Tsar's fixed resolution to continue the War at the side of the Allies and to abide by his resolve to incorporate Constantinople in his Empire. At the same time a promise was issued to establish an autonomous Great Poland under the guarantee of the whole Entente. This was done to neutralise the effect which the Central Powers had caused by the " Polish Manifesto " of Nov. 5 1916. As, however, the latter could not agree over the fate of Congress Poland, although they had been deliberating the subject since the fall of Warsaw on Aug. 5 1915, they had decided to postpone the final solution of the Polish question. To allay the anxiety of the Poles about their future, and to induce them to render effective military assistance, a proclamation had been issued on Nov. 5 1916 promising the restoration of an independent Congress Poland, which should yet be closely connected with the Central Powers as a constitutional monarchy. The effect of this step was, however, neutralised by the above-mentioned declaration by Russia and the Western Powers; the hopes which the Central Powers had entertained of vigorous support from the Poles were not fulfilled. The Poles continued to negotiate with both sides, always keeping in view their aim of erecting an independent state to embrace all Polish territory.

The Western Powers were less successful in their efforts to persuade their Ally outside Europe, Japan, to render them active assistance. After taking Tsingtao, Japan thought it unnecessary to carry on further active hostilities. She now contented herself with supplying her Allies with material of war, and in the case of Russia with artillery instructors, taking advantage meanwhile of the favourable opportunity to extend her sphere of influence in the Far East. In fact, China, weakened by internal unrest, concluded a treaty on Jan. 2 1915 whereby she recognised the political and economic suzerainty of Japan in parts of the Chinese Empire, and something over a year later, in July 1916, there followed a separate treaty between Russia and Japan which left the latter almost a free hand in the Far East. This expansion of the Japanese power was not welcome to the Western Powers, but they accepted it, although unwillingly. Japan had adhered in Oct. 1915 to the Pact of London against a separate peace, but this did not weigh heavily on her, nor prevent the Japanese Govt. from entrusting its minister in Stockholm with the charge of negotiations with the German minister there, aiming at the conclusion of a peace to include Russia.

This was the situation when the Central Powers made their peace offer in the middle of Dec. 1916. It was to be expected that it would meet with no friendly reception from the other side. The lack of any closer details regarding the conditions of peace and the somewhat disingenuous estimate of the military situation were factors which must weaken the impression of this peace pronouncement. In these circumstances nothing but strong pressure from a neutral quarter could have persuaded the Allied statesmen to enter on negotiations with the enemy.

Of the neutrals the President of the United States alone could hope that his intercession would be powerful enough to give matters a turn in favour of a peace by agreement. His position was very difficult. By far the greater part of the population of the U.S. had sympathised strongly from the beginning with Great Britain. France, too, was more popular there than Germany. Wilson certainly never thought of ranging himself with the Quadruple Alliance. But it long remained his intention to keep neutral, and then play the part of peace intermediary when the moment arrived. Soon after the outbreak of war he had called on the belligerent Powers to respect the Declaration of London, and had replied to reservations made by Britain that he wished to see the rights and duties of the U.S. respected " in accordance with the accepted principles of international law and treaty obligations." The British blockade of the North Sea (Nov. 3 1914) had evoked a protest from the Government in Washington and led to negotiations, the course of which proved that Wilson was anxious to maintain the freedom of the seas. The question of submarine warfare and the use of floating mines and attacks on merchantmen again showed a wide difference of opinion between Britain and America. Even after a German submarine had torpedoed the " Lusitania " on May 7 1915, causing 124 American citizens to lose their lives, Wilson made every endeavour in face of the immense excitement prevailing among his countrymen to prevent the outbreak of war against Germany, and for a time was successful.

He promised that if Germany would abandon submarine warfare he would use every means of intervention with her enemies to have the hunger blockade raised, but made it clear at the same time that he would have to declare war on Germany if citizens of the U.S. lost their lives in this fashion. Germany had pleaded as justification that the " Lusitania " had been armed with guns and was carrying materials of war for the Allies. When the British passenger boat " Arabic " was torpedoed in Aug. and two Americans lost their lives, the German Govt. expressed its regret in Washington, and Count Bernstorff, its ambassador there, declared that the German submarines had already received orders not to attack passenger ships in the future. In spite of all this, the " Sussex " was torpedoed in March 1916, and several citizens of the U.S. perished with her. The U.S. now sent an ultimatum to the German Government. The latter gave a public declaration that merchant vessels should be sunk only in the future after warning given and after the crews had been saved. It demanded in return that the Govt. of the U.S. should intervene in London and make England " recognise the laws of humanity "; which Wilson refused to do. The Declaration of London which followed on July 7 1916 did not satisfy the German Govt.; nevertheless throughout 1916 it observed the assurances which it had given the United States.[1]

Thanks to this attitude, although the news of German torpedo attacks, the transportation of Belgian workmen into Germany and the anti-German propaganda of the Western Powers directed public opinion in America ever more towards active intervention against Germany, Wilson resolved to persevere in his pacific efforts. After his re-election as President in Nov. 1916 he approached the belligerents on Dec. 18 with an open offer of mediation. He called on them to publish their peace terms, giving expression at the same time to his favourite hope of securing lasting peace for the world by the formation of a League of Nations.[2] This pronouncement, although it followed only a few days after the offer of the Quadruple Alliance of Dec. 12, had been prepared long before and was not influenced by it. The German answer came quickly. It ran: " Germany considered that a lasting peace would be best attained through direct negotiations between the belligerent Powers in a neutral country. After the close of the present war Germany would gladly co-operate with the U.S. to prevent wars in the future."

Before Germany's answer had reached Wilson, the Entente Powers had published their reply, curtly declining the proposals of the Central Powers in favour of peace by agreement. Briand, the French Minister of Foreign Affairs, described the offer of the Quadruple Alliance as a war manoeuvre which must not be taken seriously. Pokrovsky, the Russian, declared that it must be rejected " with indignation "; Sonnino conjured his countrymen to stand solid with Italy's Allies in their attitude towards this " treacherous step "; and Lloyd George gave his opinion that to enter into a conference at Germany's invitation, and with Germany proclaiming herself victorious, and without any notion of the proposals she has to make, is " to put our heads into a

[1] For further information, see C. E. Seymour, *The Intimate Papers of Colonel House*, 2 vol., 1926.
[2] *Parliamentary Papers*. Cd. 8431 for text.

noose." These verbal declarations by the leading statesmen of the four Great Powers were followed on Dec. 30 by the written answer of the Allies. In this it was pointed out, not unjustly, that the enemy had based their estimate of the military situation exclusively on the European theatres of war. Their offer was devoid of " all substance or precision." The Central Powers were described as the sole authors of the World War; expiation was demanded from them and their Allies for the crimes which they had committed and full reparation for all destruction caused by the war.[1] The meaning of this phrase was shown most clearly by the answer which its authors gave to the President of the U.S. on Jan. 10 1917 in reply to his declaration of Dec. 18 1916. Germany was to suffer considerable territorial curtailments in the East and the West, the Habsburg Monarchy to be dismembered by the " liberation of the Italians, Slavs, Rumanians, Czechs and Serbs from foreign rule," Turkey banished from Europe, the peoples smarting under her yoke to be delivered from her tyrannies. The Poles were promised full autonomy in accordance with the Tsar's manifesto. The Allies declared themselves as agreeing " whole-heartedly with Wilson's ideal, " the League of Nations."[2]

The negative answer returned by Germany, which Wilson found too indefinite, contrasted with the approval shown by the Allies of his favourite idea; and their definite proposals could not but impress him and inevitably strengthen the influence of those circles in his entourage which were working tirelessly to bring the U.S. into the War on the side of the Allies. None the less, Wilson did not yet abandon his plan of mediation. He negotiated further with the German Govt. and asked it to define its peace terms exactly. Moreover, he declared himself prepared to carry on confidential conversations. Germany gave no official answer to these offers. Bernstorff was empowered to state in Washington that Germany was gladly prepared to enter into discussions aiming at preventing the outbreak of wars in the future. At the present moment, however, Germany could not welcome Wilson's official mediation, as this must give the Allies the impression that the peace offer of the Quadruple Alliance had been dictated by fear of the future. Germany's peace conditions, Washington was informed, were very moderate. She did not wish to annex Belgium, but allowed no discussion whatever on Alsace-Lorraine. These declarations impressed Wilson favourably, and he persevered in his efforts to advocate a peace by understanding. On Jan. 22 1917 he spoke in the Senate against a peace dictated by the victory of either group of belligerents, as this could not bring lasting peace. " Only peace between equals can last." He demanded freedom for the oppressed peoples, freedom of the seas, reduction of armaments. The U.S. would be ready to " join in guaranteeing the permanence of a peace based on such foundations."[3]

On the following day Wilson's confidant, Col. House, who had already held conversations on the possibility of peace with the leaders of both groups during journeys to Europe in 1915 and 1916—although indeed without success—asked Bernstorff to recommend his Government to communicate its peace terms to the President, either publicly or confidentially, whereupon the latter would propose a Peace Conference. Soon after, Wilson repeated his offer in person. Bernstorff urged his Government strongly to fall in with Wilson's wishes. But he had already been informed by his Government that Germany had determined to start unrestricted submarine warfare on Feb. 1 1917. This resolution, the outcome in the main of the ever-increasing influence which the supreme military and naval authorities were gaining over the leading German statesmen and the Emperor William II., had in fact been taken on Jan. 9 1917 in a Crown Council at Pless. The objections which had been raised in particular by the German Chancellor Bethmann Hollweg, including the consideration of the almost certain entry of the U.S. into the War, had been met by the statement of the German Admiralty that Britain would be forced to come to terms within five months of the commencement of the unrestricted submarine warfare, and by that of the Army Command that it could only guarantee the safety of the Western Front if the unrestricted submarine warfare were introduced.

A hard struggle was still necessary to win the consent of the Government in Vienna. The young Emperor Charles, who had only ascended the throne a few weeks previously, did not share the high expectations which the German Supreme Command based upon the unrestricted submarine warfare. The new Minister for Foreign Affairs, Count Czernin, shared the Emperor's views. Both declared that the direct result of the unrestricted submarine warfare would be the declaration of war by the U.S. and therefore the beginning of an unlucky end. Fully convinced that a victorious peace was now impossible for the Quadruple Alliance, they were working for a peace by agreement, and wished accordingly to avoid everything which would multiply their enemies and strengthen their determination. But their resistance was silenced by the increasing pressure from Germany and by the statements of Conrad von Hötzendorf and Admiral Haus that the introduction of unrestricted submarine warfare was necessary and promised good results.[4]

The U.S.A. as Belligerent: Weakening of Austria-Hungary.—On Jan. 31 1917 Bernstorff informed Wilson that Germany would begin the unrestricted submarine warfare on Feb. 1. This determined Wilson's attitude. On Feb. 3 the U.S. broke off diplomatic relations with Germany. Two months later, on April 6 1917—she had learnt meanwhile that Germany had offered the Mexican Govt. an alliance in case of a German-American war—she declared war on Germany; but on Austria-Hungary not till Dec. 4 1917. The other American states (except Mexico, Colombia, Venezuela, Paraguay, the Argentine and Chile) followed the example of the U.S.A. but did not go beyond giving the Allies their economic support. Britain had already succeeded in Feb. 1917 in overcoming Japan's resistance to China's joining the War against the Quadruple Alliance, and had induced Japan herself to furnish a squadron to protect British interests, especially in the Mediterranean. In return the British Govt. recognised Japan's claim to Germany's former rights in Shantung, and agreed that the former German South Sea Islands north of the Equator should be allotted to Japan, while those south of the equator should go to Australia. France adhered to this agreement at the beginning of March. China broke off diplomatic relations with Germany on March 14; her formal declaration of war on the Central Powers only followed on Aug. 14 1917, shortly before Siam, too, had resolved to join the Allies.

European neutrals, however, preserved their attitude. The sympathies of Denmark and Norway had always been with the Allies; in Sweden they moved in this direction under the influence of Branting, especially after the U.S. had entered the War. Holland was largely dependent, commercially, on Britain. Even in Spain, where the King favoured the Central Powers for family reasons and Dato's Conservative Govt. had supported this attitude, there was a period during 1916 and early 1917, while Romanones' Liberal Govt. was in power, when Spain might have joined the Allies but for the King's determined opposition. Switzerland remained strictly neutral. Only Greece grew ever more dependent on the Western Powers, although King Constantine resisted their encroachments with all vigour. In order to guard the rear of their army of the Orient, the Western Powers forced Greece to disarm her army in Oct. 1916, and soon after to hand over her fleet. Veniselos, who had been working for them tirelessly, proclaimed a revolutionary counter-government in Salonika and forced Constantine, whose life appeared in danger, to call on the representatives of the Central Powers on Nov. 11 to leave Athens. Under the circumstances Greece's entry into the Allied camp seemed only a question of time.[5]

[1] For text, see, *Parliamentary Papers*, Cd. 8467.
[2] For text see *Parliamentary Papers*, Cd. 8468.
[3] See G. Lowes Dickinson, *Documents Relating to Peace Proposals and War Aims* (Dec. 1916–Nov. 1918), pp. 24–30.

[4] For further information, see Czernin, *In the World War*, *passim*; Conrad von Hötzendorf, *Aus meiner Dienstzeit*, vol. 4, *passim*.
[5] For Greek negotiations with both the Central and the Entente Powers, see Frangulis, *La Grèce et la crise mondiale*, vol. 1.

In order to increase the determination of the Porte, which was groaning under its increased war burden, the German Govt. had promised it on Sept. 28 1916 to conclude no separate peace with the common enemy, and to admit Turkey to a share in the conquered territory proportionate to her military efforts. Soon afterwards, on Jan. 11 1917, these two Powers arrived at a further agreement, in which the abolition of the oppressive "capitulations" was granted. The provisions of these two treaties were expanded in a manner favourable to Turkey on Nov. 27 1917. The Government in Vienna gave its adherence to these treaties, although only after long hesitation.

The Allies had planned a general offensive in the west, east and south of Europe for 1917, with further campaigns in the theatres of war outside Europe. Various circumstances delayed the opening of hostilities. Meanwhile something happened which gravely disturbed their plans. The Russian dynasty was overthrown. On March 15 Nicholas II. was forced to abdicate. Miljukov, the Minister of Foreign Affairs of the first Revolutionary Govt., assured his Allies that Russia would remain loyal to them; but it was soon obvious that there could be no hope of effective co-operation by the Russian armies in the proposed general offensive. Germany was therefore enabled to employ a considerable number of her troops from the East to strengthen her Western Front, and thus successfully to resist the violent offensive of the Western Powers which began in April.

This fact and the comparatively great successes gained by Germany's unrestricted submarine warfare in its first months had a certain reaction on opinion in Britain and France. Many French soldiers gave vent to their discontent and war weariness in grave excesses and mutinies. In England too the fear of food shortage grew with the increasing success of the German submarines. In April and May there were days when the men in authority in Paris and London reckoned with the possibility that the War would take a final turn in favour of the Quadruple Alliance. Now, if ever, was the moment when a decisive success for the enemy in any theatre of war whatever could have brought the Entente to open up negotiations for a peace by understanding. But the Central Powers did not achieve this decisive victory, and the leading French and British statesmen were soon able to take severe measures against the malcontents, to stimulate patriotic passions and to imbue their armies and civilian population with fresh confidence in ultimate victory. Not only were they able to point out how the entry of the U.S.A. into the War increased their strength, how Russia had resumed the battle against the enemy, but their masterly propaganda had its effect on friend and foe alike in many ways. Indeed, this propaganda fostered the old internal conflicts within the Central Powers.[1]

It grew ever more apparent how widely the views of the different parties inside and outside the German Reichstag differed on the ultimate goal of the War. On the one side was the will to dictate a peace through victory and to stand staunch by the old form of the state; on the other the cry for a peace by agreement and more influence for the Reichstag on home and foreign policy.

In the Habsburg Monarchy all these social differences were aggravated by national feuds. The enemies at home of the dualist system and of the hegemony of the Germans in Austria and the Magyars in Hungary pointed out with ever-increasing vehemence that the victory of the Central Powers could only bring the Slavs and Latins of the monarchy the continuance in aggravated form of their present oppression. The emigrés, led by the Czech Masaryk, worked from abroad with the same arguments. The Emperor Charles and his Foreign Minister Czernin had ample occasion to convince themselves of the growing war-weariness of the soldiers and of those circles of the Austrian civilian population which were especially hard hit by the hunger blockade. These considerations, as well as the increasing directness with which the Slav and Latin irredentas aimed at destroying the unity of the monarchy, necessarily confirmed Charles and Czernin in the resolution to abide by the idea enunciated in the peace offer of Dec. 12 1916.

[1] For further information as to the Entente propaganda, see Sir Campbell Stuart, *The Secrets of Crewe House*.

Both thought that it was easier for them than for their Allies to pave the way towards a peace by understanding; both believed that the Western Powers were not aiming at that time at the complete destruction of the Habsburg Monarchy. They were at one, too, in the conviction that there was no time to be lost. They did not believe that the German U-boat warfare would bring a decisive success, and feared that once the United States had entered the War actively the Western Powers would refuse any proposal for a peace by understanding. They were resolved to aim at an universal peace, but they believed that this could not be achieved without strong pressure on the German Emperor and his Chancellor. And indeed William II., who was unduly influenced by his Army Command, still envisaged peace terms which could only have been achieved after a complete victory of the Quadruple Alliance. Charles and his minister, on the other hand, thought that the general situation imperatively required Germany to make a territorial sacrifice in Alsace-Lorraine, if peace negotiations with the enemy were to be conducted with any prospect of success.

In order to reconcile his allies to this sacrifice, Czernin had suggested to the Chancellor, when he visited Vienna in March 1917, that Germany might take Congress Poland as compensation for territorial sacrifices on her western frontier. Yet the pacifist feeling at the Vienna Court did not awaken the expected echo in Berlin. Czernin accordingly prepared a memorandum for the Emperor Charles on April 12, and had it communicated to William II.[2] In this the internal situation of the Habsburg Monarchy was painted in the blackest colours, and its collapse, involving a revolution and the downfall of the dynasty, was represented as imminent. A few days before, Czernin renewed in authoritative quarters in Germany his offer to compensate the German Empire for eventual losses in Alsace-Lorraine by the permanent acquisition of Congress Poland enlarged by the addition of Galicia. The Habsburg Monarchy should compensate herself at the expense of Rumania for this loss of territory.

But this attempt too met with failure. At first, indeed, the German Chancellor showed himself not entirely averse on principle from accepting Czernin's proposals; gradually, however, the plans of the Army Command prevailed, as expressed in the agreements made in Kreuznach on May 17 and 18. Here Germany proposed to annex the coal basins of Briey and Longwy, and to establish economic and military unity between Belgium and herself. There was no further mention of the cession of parts of Alsace-Lorraine, but Austria-Hungary stipulated, not only that her integrity should be guaranteed, but that she should receive some accessions of territory in the Balkans. Germany furthermore agreed, in the event of her being able to carry out "the territorial incorporation (Angliederung) of Courland and Lithuania together with the dependence (Anlehnung) of Poland contemplated on the German side, that Rumania so far as occupied, with the exception of the Dobruja (frontier anterior to 1913) and a border strip to the south of the Cerna-Voda-Constanta railway, falls as a separate state into the Austro-Hungarian sphere of interests, subject to a guarantee for Germany's economic interests in Rumania." On fulfilment of these conditions Austria-Hungary consented to renounce her condominium in Poland, and promised to declare her "désinteressement," political and military, in that country. On June 9 1917 William II. and Charles signed an agreement as to Poland's military forces, by which their organisation was placed entirely in the hands of Germany.

The attitude of the Emperor Charles and Czernin towards their ally is only comprehensible in conjunction with the negotiations which they had been conducting with the Western Powers since Feb. 1917 in the hope of attaining a peace by understanding. When Bethmann Hollweg visited Vienna in the middle of March 1917, Czernin had informed him that it looked as though France would not be averse from conversations; he stated at the same time that Italy had made an overture for peace. Bethmann-Hollweg pointed out in his answer that France would undoubtedly demand the cession of Alsace-Lorraine as a *condi-*

[2] For the text, see Czernin, *In the World War*, pp. 146–150.

tio sine qua non, and this he could neither propose to his Emperor nor justify before the German people. He also doubted the wisdom of evacuating the districts which Germany had occupied in France and Belgium before the conclusion of the negotiations, "since this was the only means of forcing England to give back the conquered German colonies." Yet he agreed in principle to the peace conversations proposed by Austria, but insisted that the Austrian intermediary must adopt a passive attitude; he might only hint cautiously that an understanding between France and Germany seemed possible on the basis of an exchange of territory in Europe, a general colonial agreement and economic compensation; at the same time he was to ask the French what Britain's attitude to such an agreement would be. As for the East, negotiations had been opened up from a Russian quarter, shortly before the Tsar's abdication, in favour of a separate peace with the Central Powers; but these had now become irrelevant. Bethmann Hollweg therefore thought that the Central Powers should not evacuate the territories in their occupation in Russia and the Balkans before the enemy had retired from the occupied territory of Austria-Hungary. The proposed new acquisitions for Germany and Austria-Hungary should be partitioned on as fair a scale as possible.

The German Chancellor was not informed that Charles and Czernin had already opened up negotiations with France through the Emperor's brother-in-law, Prince Sixtus of Parma, on a quite different basis. Since, however, Bethmann Hollweg had consented on principle to open up these negotiations with the enemy, Charles and Czernin considered themselves justified in pursuing the course which they had adopted. A few days after the German Chancellor had left Vienna Prince Sixtus arrived there. He proffered proposals on the lines of his letter of March 16 to the Emperor Charles which were certainly irreconcilable with the treaty obligations of the monarchy. Czernin treated the Prince coolly, but had not the energy to shake him off. So it came that his proposal for the Imperial answer to be given to Prince Sixtus' declarations was disregarded. Instead, a letter in the Emperor's own hand was given Sixtus on March 24 without Czernin's knowledge. This letter made, indeed, no mention of a separate armistice or of a separate peace, but contained an assurance to Poincaré of the Emperor's readiness to support "the just claims of France to Alsace Lorraine" in Berlin, and to work for the restoration of Belgium and Serbia as sovereign states. Belgium was to receive suitable compensation for the losses she had incurred, Serbia to receive a natural outlet in the Adriatic and far-reaching economic concessions. In return for the concessions made to Serbia, the Emperor demanded a declaration from her, given under the guarantee of the Entente Powers, that she would abstain from and suppress any future political agitation against the Habsburg Monarchy.[1]

But the Prince's communications had not the effect for which Charles hoped. The enemy saw in them only a proof of the weakness of the Central Powers and of the incipient decay of the German-Austrian Alliance, and hoped in this way to impose a peace favourable to themselves on Germany, or to checkmate Germany through a separate peace with Austria-Hungary. Charles' letter to Sixtus made no mention of territorial concessions by the Habsburg Monarchy to Italy; on the contrary, it emphasised the fixed determination of all peoples of the Monarchy "to defend the integrity of the monarchy, be it at the cost of the severest sacrifices." This point, more than any other, doomed Charles and Sixtus to failure. When Ribot and Lloyd George met Sonnino, the Italian Foreign Minister, at St. Jean de Maurienne on April 19 1917, and tried to persuade him to accept Smyrna in return for renouncing the acquisition of Trieste, Sonnino declared that he could not even allow a discussion on the Italian aspirations as recognised in the Treaty of London. French attempts to persuade Sonnino to change his views remained fruitless; the plan of the Emperor Charles and his brother-in-law had failed.

In Germany, meanwhile, the adherents of the circles which considered a peace by victory unattainable grew ever more numerous. Especially when it became clear that the hopes which the military and naval authorities had based on the unrestricted submarine warfare would probably not be justified, the cry that the Government should openly declare its war aims grew louder. On July 19 1917 the majority of the Reichstag voted, indeed, for a motion brought forward by Erzberger, the leader of the Centre, in favour of a peace by understanding, without forcible territorial acquisitions or political, financial or economic violation. "The freedom of the seas must be made secure. So long, however, as the enemy governments threaten Germany and her Allies with conquests and oppression, the German nation will fight till its own and its allies' right to life and development is secured." On the day on which this resolution was adopted by the Reichstag by a considerable majority, Bethmann Hollweg was no longer Chancellor. His successor Michaelis, who had been elected by agreement with the Supreme Command, immediately modified the effect of the Reichstag's resolution by declaring that his aims, including the inviolability of German territory and a guarantee against economic barriers, were attainable within the limits of the resolution "as I understand it."[2]

The consequence was that the Western Powers continued to doubt the good faith of the German Govt., to propose negotiations on a basis agreeable to themselves, and to see in the differences apparent inside and outside the Reichstag signs of weakness which confirmed them in their resolution to gather all their forces to carry the War to a victorious end. Under these circumstances, the efforts in which Czernin was fertile, even after the failure of Prince Sixtus' mission, to achieve a compromise with the enemy acceptable to both sides were unavailing. In Aug. two meetings were arranged in Switzerland, on the initiative of the French Govt., between the Austro-Hungarian diplomat Count Revertera and his relative, the French General Staff major, Count Armand. The negotiations broke down over the severity of the conditions which Germany was required to accept.[3]

The hopes of the Central Powers to find a compromise with Russia met also with disappointment. The Provisional Govt. in St. Petersburg was too deeply under the influence of the Western Powers to listen to the overtures which the Central Powers made for a separate peace. Efforts to stimulate the desire for peace among the war-weary Russian troops by direct propaganda across no man's land increased, indeed, the demoralisation among the Russian troops, but had no further result, since the commanders of the Russian army refused to conclude a formal armistice. Equally unsuccessful were the attempts of international Socialist circles to find a satisfactory solution of the peace question at a world congress at Stockholm,[4] and the effort made in Aug. by Pope Benedict XV. In accordance with the terms of the Treaty of London, France, Italy and Great Britain sent no reply to his invitation; President Wilson sent a formal refusal for himself, which was really intended to answer for his associates. At the same time Britain declared that any conversations must be preceded by an unequivocal declaration by the German Govt. that she would give up Belgium after the end of the War. The German Govt., however, refused to give such a declaration, especially since Ludendorff had spoken against it most decidedly in the Potsdam Crown Council of Sept. 14 1917. Germany answered the Pope without mentioning Belgium. So this attempt to bring about a *rapprochement* between the two groups of Powers broke down like the rest. The same fate attended efforts to pave the way towards peace conversations between France and Germany made by Lancken and Coppée—where Briand was also active—and between Germany and Britain by way of Brussels and Madrid.[5]

The Allied offensives in 1917 again brought no decisive victory, nor were the hopes of the Allies fulfilled in the Balkans.

[1] The texts of Charles' letters and Sixtus' memoranda to the Allied Powers are in Manteyer's *Austria's Peace Offer* (1921).

[2] On this subject see Erzberger, *Erlebnisse;* Ludendorff, *The General Staff*, vol. 2.

[3] See Czernin, *op. cit.*, pp. 164 and 169.

[4] See below, EUROPE: INTERALLIED DIPLOMACY (Section IV. of this article).

[5] See Mermeix, *Les négociations secrètes et les quatre armistices* (chaps. vii. and xiii.).

King Constantine and his eldest son were forced to leave Greece, and the new ruler, Alexander, was obliged to appoint Veniselos, the champion of the Western Powers, Minister President. Under Veniselos' influence Greece broke off diplomatic relations with the Quadruple Alliance, and Greek troops joined the Army of the Orient which was awaiting battle in Macedonia. Greece was promised, as reward, Thrace and Smyrna. But the Allies were disappointed of the victory for which they looked. They were more successful outside Europe. Turkey lost Jerusalem, Germany East Africa. Yet the military situation in the late autumn of 1917 was such that the German military authorities were convinced of their ability to carry on a fresh successful campaign in 1918, so long as their allies did not leave them in the lurch. This danger was, however, imminent, since war-weariness grew ever more apparent in Austria-Hungary, and reports to a similar effect reached Germany from Sofia and Constantinople.

Then came an event calculated to revive the courage of the Quadruple Alliance. The prospect was revealed to them of concluding a favourable peace with their enemies in the East which would enable them to fall with their full strength upon their enemies in the West. Early in Nov. 1917, the second period of the Russian revolution, the " social revolutionary " phase, led by Kerensky, who had come ever more under the influence of the representatives of the Western Powers,[1] was succeeded by the third, that of the " Bolsheviks," under Lenin and Trotsky. As early as the end of Nov. the new government called on all the belligerent Powers to conclude an immediate armistice and begin negotiations for the conclusion of a general peace, which should assure to every nation freedom of economic and cultural development. When the Entente Powers refused to comply with this summons, the Russians on Dec. 3 entered on a suspension of hostilities with Germany and her allies, to last till Dec. 17 1917. On Dec. 15 the suspension of hostilities was succeeded by an armistice, to last till Jan. 14 1918, and then to be continued with the right to denounce it on seven days' notice. Rumania adhered to this armistice, albeit unwillingly.

Peace negotiations began on Dec. 22 at Brest-Litovsk. They were conducted in public. It was not easy for the representatives of the Quadruple Alliance to accept the conditions of the Russian peace programme. If the German and Bulgarian delegates found a peace " without annexations or indemnities " to involve great sacrifices, considering the general situation, the " right of self-determination " which the Russian delegates demanded for all nations endangered the future existence of the Habsburg Monarchy and Turkey. The upshot was that on Dec. 25 the Quadruple Alliance accepted the Russian proposals for the conclusion of a peace without annexations or indemnities as the basis of a general peace. This was, however, contingent on the acceptance of this basis by the Allies also. At the suggestion of the Russian delegates the negotiations were suspended for 10 days, and a request was addressed to the other enemies of the Quadruple Alliance that they should take part in further deliberations on the basis of the resolutions adopted on Dec. 25. But the Entente Powers refused. Thereupon negotiations began on Jan. 9 1918 for a separate peace between Russia and the Quadruple Alliance. But they did not run so smoothly as the German and Austro-Hungarian politicians hoped. Trotsky, now the chief of the Russian delegation, demanded full freedom for the plebiscites to be held in the Russian provinces occupied by the Central Powers, and with this object proposed that their troops should evacuate them. When the German and Austro-Hungarian delegates rejected this suggestion, Trotsky protracted the negotiations in order meanwhile to introduce Bolshevik ideas into the territory of the Quadruple Alliance. The progress of the negotiations was impeded by quarrels among the Russians and by the appearance at Brest-Litovsk of an Ukrainian delegation which pressed for the establishment of a Russian Federal Republic.

Since no agreement could be reached on this question, the representatives of the Ukraine announced the complete independence of the Ukrainian People's Republic on Jan. 24, and on Feb. 9 concluded a separate peace with the Quadruple Alliance. The Ukraine was promised the province of Cholm, which had been a bone of contention between her and Poland for centuries; further, Austro-Hungary undertook in a secret clause to make a separate crownland out of east Galicia, where the population was predominantly Ukrainian (Ruthenian). In return, the representatives of the Ukraine promised to deliver at least 1,000,000 tons of cereals to the Central Powers by Aug. 1 1918, a promise which, however, could not be fulfilled, since the *Rada* in power in the Ukraine at the time was overthrown immediately after by the Bolsheviks, who disregarded the obligations into which their predecessors had entered. The troops of the Central Powers thereupon occupied the Ukraine, and divided it into a German and an Austro-Hungarian administrative district. They were now able, although with difficulty, to secure a portion of the cereals, which were indispensable, especially for Austria. But as a result of the concessions to the Ukrainians a Cabinet crisis broke out in Congress Poland; those circles which had hitherto favoured Austria changed round; some of the Polish legions stationed in east Galicia went over to Russia, whence they were brought to France under the command of General Haller to be united with the Polish Legion which had existed there since the summer of 1917.

Meanwhile, the negotiations with Russia had gone on. Czernin, zealously seconded by the Emperor Charles, pressed for a conclusion, but met with determined opposition from the German negotiators. On Feb. 10 1918 Trotsky declared that Russia renounced a formal treaty of peace, but regarded the state of war against the Quadruple Alliance as ended, and would reduce her troops to a peace footing on all fronts. But since this solution did not meet with the whole-hearted consent of the Central Powers, Germany resumed the struggle. The Russians, defeated by Germany in the field, now changed their tactics and made ready to conclude a formal peace, which was signed on March 3 1918 at Brest-Litovsk.

Russia pledged herself to surrender Courland, Lithuania and Poland entirely to the influence of the Central Powers, to evacuate the occupied Turkish territories, to grant freedom to Finland, Estonia, Livland and the Ukraine, and to the Caucasian districts of Ardahan, Kars and Batum. The undeniable contradiction between the basis of peace which the Central Powers had at first accepted, if with reservations, and the terms of the Treaty of Brest-Litovsk was most skilfully exploited by the statesmen of the Entente and their Press to brand Germany's insatiability.[2]

The peace with Russia was succeeded by that with Rumania, but the necessary negotiations had been long and difficult. A quick conclusion was rendered impossible, not only by the refusal of the Rumanian Govt. to accept the terms of the victors, but also—perhaps even more—by the lack of unanimity among the Quadruple Alliance as to how the booty should be divided. The resistance of the Rumanians was overcome by an ultimatum; on March 3 the Averescu Ministry signed the preliminary Peace of Buftea. Soon after this Ministry was replaced by the Germanophil Marghiloman Ministry, which concluded the definite peace with the Quadruple Alliance on May 7 1918 in Bucharest. This peace was never ratified. Austria-Hungary received a favourable strategic frontier in the Carpathians and the promise of the immediate evacuation of the provinces of the Habsburg Monarchy still occupied by Rumania. The whole of the Dobruja was left to the victors. The southern half was allotted to Bulgaria on the spot; the northern half was to be taken over and administered by the Quadruple Alliance in concert until the differences between Turkey and Bulgaria should have been composed. As compensation Rumania was promised the succession to Bessarabia, which had broken off from Russia in Feb. 1917 by arrangement with Rumania.[3]

[1] On the subject of Entente relations with Russia both before and after the revolution, see Sir G. Buchanan, *My Mission to Russia*, etc., 2 vol.; M. Paléologue, *La Russie pendant la Grande Guerre*, 3 vol.

[2] For the Brest-Litovsk negotiations, see Czernin, *op. cit.*, pp. 211–257; Gratz and Schüller, *Die Aeussere Wirtschaftspolitik Oesterreich-Ungarns*, pp. 115–169 (1925).

[3] See Czernin, *op. cit.*, pp. 258–270; Gratz and Schüller, *op. cit.*, pp. 177–255.

The appeal for peace which the Russian Govt. issued to all belligerent nations had given new voice to the old wish for an end to the War cherished among the peoples of the Quadruple Alliance, especially those of Austria-Hungary. It was intensified at the beginning of 1918, when Wilson published his Fourteen Points (*q. v.*) as the basis for the future world peace. These included, indeed, many conditions which imposed heavy sacrifices on the Powers of the Quadruple Alliance. The evacuation and restoration of Belgium, Northern France and the Russian border states, the cession of Alsace-Lorraine, the establishment of an independent Poland embracing all districts undoubtedly inhabited by the Poles—these were demands to which the German Govt., and especially the German Supreme Command, was unwilling to consent in the then military situation. The Austro-Hungarian statesmen, too, would find difficulty in allowing the frontier between Austria-Hungary and Italy to be drawn "on clearly recognisable national lines," Rumania, Serbia and Montenegro to be evacuated and restored, a free outlet for Serbia to the sea to be granted unconditionally—quite apart from the fact that Wilson's solution of the Polish question would have meant the loss of Galicia to the Habsburg Monarchy.

But the chief danger in the eyes of the Vienna Govt. was Wilson's demand for autonomy for the peoples of Austria-Hungary. It held its realisation—rightly, as later events proved—to mean the beginning of the end of the Habsburg Monarchy. Equally great were the sacrifices which Wilson thought to impose on Turkey by his demand for autonomy for her Christian peoples and internationalisation of the Straits. Even so, Wilson's territorial demands lagged far behind those to which his Allies had pledged themselves in secret treaties, some of them unknown to him offically. A favourable impression was made on the peoples of the Quadruple Alliance, especially those of the Central Powers, by the fact that Wilson had included in his programme the abolition of secret diplomacy, the freedom of the seas and of economic life, reduction of armaments, impartial settlement of colonial pretensions and the welding of the nations into a League of Nations, which should prevent future wars. Wilson's peace programme—which, indeed, imposed the brunt of the sacrifices exclusively on the States of the Quadruple Alliance—was, however, most skilfully exploited by the statesmen of the Western Powers against the Central Powers to strengthen, not only the peace parties, but also the subversive elements there. Disturbances broke out on a large scale in the most important industrial districts of Germany and Austria-Hungary, the forerunners of the social upheavals which were to convulse both states in the course of 1918.

Differences in Germany were accentuated by the weak attitude of Count Hertling, the leader of the Bavarian Centre, who had become Chancellor of the Reich in Nov. 1917. On principle he was not against a peace by understanding, but was not strong enough to carry his plans through in the teeth of the parties of the Right, which had been strongly reinforced by the *Vaterlandspartei* founded by Admiral Tirpitz in Sept. 1917. So it came about that the Supreme Command, of which Ludendorff was becoming ever more truly the ruling spirit, gained the upper hand when the decision was taken on the question "peace by compromise or continuation of the war." The Emperor William at heart was ready for peace, and inclined to make concessions in internal politics—general suffrage in Prussia and extension of the competencies of the Parliament had been demanded—yet he yielded to the advice of his military commanders and the pressure of the parties of the Right, and he decided for the continuation of the War.

Matters lay somewhat otherwise in the Habsburg Monarchy. Here the Emperor Charles and his Foreign Minister Czernin had never lost sight of their aim, a peace which should make the further existence of the monarchy possible, even if at the cost of heavy sacrifices at home and abroad. This ideal seemed ever more desirable as the dangers loomed more clearly which threatened the monarchy in its present form; the increasing war-weariness of the soldiers and the ever franker separatism of the different peoples of this polyglot state. Czechs, Southern Slavs and Poles grew ever more sweeping in their demands for unlimited autonomy. But a similar feeling had now infected the Magyars also. Despite the close connection between their fate and that of the other half of the realm, despite the predominating influence which they exercised on the general policy of the monarchy, many circles worked for full independence. In addition to all this, the German-Austrian Social Democrats began to believe that the disintegration of the monarchy could be only advantageous to the German-Austrian proletariat, since, if the monarchy fell into its component parts, its German-speaking districts would naturally become a part of Germany.

Under these circumstances, Charles and Czernin were anxious to miss no opportunity of resuming seriously the contact with the Governments of the Western Powers, which they had never quite given up. There was nothing to be done at this moment in France, since Clemenceau had taken over the Government after the fall of Ribot and Painlevé; his programme was "war, nothing but war," and he had taken strong measures against the "defeatists" and all advocates of a peace by understanding; so that it was improbable that he would listen to overtures. On the other hand, the Viennese Govt. imagined feeling in England, as expressed by Lord Lansdowne's letter to *The Daily Telegraph* at the end of Nov. 1917, to be such that negotiations here might have a chance of success. Lansdowne had, indeed, stated plainly that the aims of the Allies would be victorious in the long run. But he had pointed out at the same time that the continuation of the struggle must lead to the ruin of the civilised world, and had advocated a revision of the Allied war aims, in the hope of thus strengthening the peace party in Germany. In Dec. 1917 conversations took place between Gen. Smuts and Count Mensdorff. As the latter was authorised to work for a general peace between the belligerents while Smuts refused Mensdorff's proposal to discuss an agreement with Germany, and was only prepared to conduct negotiations aiming at a separate peace with Austria-Hungary, the conversations led to no result.

Soon after, at the beginning of 1918, Lloyd George communicated the conditions which he considered a basis for possible peace negotiations. They were much more moderate than those which the Allies had laid down a year previously. Britain, he declared, did not want the destruction or disruption of Germany and would not fight merely to alter or destroy the Imperial Constitution; yet military autocracy was a dangerous anachronism. The adoption of a really democratic constitution would be the most convincing evidence that the old spirit of military domination had died, and would make it easier to conclude a broad democratic peace. Among the conditions on which he was prepared to commence peace negotiations he mentioned the complete restoration, security and indemnification of Belgium for the losses and damage which she had suffered; the restoration of Serbia, Montenegro and the occupied parts of France, Italy and Rumania. As regards Alsace-Lorraine, nothing was said of an integral restoration of the Provinces; only: "We mean to stand by the French democracy to the death in the demand they make for a reconsideration of the great wrong of 1871." Britain would only safeguard Russia's interests if the present rulers of the Republic remained loyal to their Allies. "We believe, however, that an independent Poland comprising all those genuinely Polish elements who desire to form part of it is an urgent necessity for the stability of Eastern Europe."

As for the Habsburg Monarchy, Lloyd George declared: "The break-up of Austria-Hungary is no part of our war aims; but genuine self-government must be granted to those Austro-Hungarian nationalities which have long desired it." Only in the case of the Italians of the monarchy he regarded as vital "the satisfaction of the legitimate claims of the Italians for union with those of their own race and tongue." These demands were a great deal more modest than the previous ones, and could not be reconciled with the promises which had been made in the course of the war to the Italians, the Serbs and the Slav emigrés.[1]

This moderation was even more marked in the conditions laid

[1] Of Rumanians in the Dual Monarchy the Premier said, "We also mean to press that justice be done to men of Rumanian blood and speech in these legitimate aspirations."

down for Turkey. "We are not fighting" they ran now, "to deprive Turkey of her capital nor of the rich and renowned lands of Asia Minor or Thrace, which are predominantly Turkish by race." Only the Straits were to be internationalised and neutralised—Arabia, Armenia, Mesopotamia, Syria and Palestine—were entitled to a recognition of separate national conditions. For Wilson's benefit came the declaration: "finally, a great attempt must be made to establish by some international organisation an alternative to war as a means of settling international disputes." Three conditions were essential to permanent peace: "the re-establishment of the sanctity of treaties, territorial settlement based on the right of self-determination or the consent of the governed, and the creation of some international organisation to limit the burden of armaments and diminish the probability of war."[1]

Nevertheless, the German Chancellor found the military situation so favourable that he declared himself unable to open up peace negotiations on the basis proposed by Lloyd George and demanded a fresh revision of the enemy proposals. As he let it be understood at the same time that Germany entertained no idea of giving up either the whole or parts of Alsace-Lorraine, the Supreme Council in Versailles declared on Feb. 4 1918 that a suitable basis for making peace was not given. The War must, therefore, continue till its pressure should have brought about a change of temper in the enemy governments and peoples. The Vienna Govt. endeavoured indeed to bring about another meeting between Revertera and Armand in Feb. 1918, to pave the way for official conversations with the French Government. But it at once encountered insuperable difficulties. When Revertera asked whether France would be inclined to renounce the reacquisition of Alsace-Lorraine, Clemenceau answered at the beginning of March 1918 with a curt negative. This doomed to failure the attempt which the Emperor Charles had been making meanwhile to work for a peace by understanding by an appeal to Wilson through Spain; efforts which from the outset had had little chance of success.

Disintegration of the Central Powers.—Once again the decision lay with arms. The Germans achieved great successes in the first months; but the Allied troops in the West were now brought under a single command,[2] and were effectively reinforced from America. Moreover the hope of the Central Powers that the relief of their Eastern Front would enable them to concentrate their entire forces in the west and southwest had been only partly fulfilled. The state of war in the east appeared, indeed, to be at an end after the conclusion of the Treaties of Brest-Litovsk and Bucharest, and after Finland too had concluded peace with each of the Powers of the Quadruple Alliance separately between March and May 1918. As, however, the German Army Command and the civilian circles which worked in concert with it were aiming at extending Germany's frontiers and her political, military and economic sphere of influence in the east, not all the troops hitherto employed in the east could be transferred to the west. And this all the less since the Western Powers, in view of the great interests which they too had in the eastern question, made every effort to thwart Germany's plans. They had military detachments in various parts of Russia, and a strong reinforcement in the Czechoslovak legions, which had been raised with the greatest energy. These forces assisted the counter-revolutionaries in the numerous bloody battles in which they engaged the armies of the Soviet Government.

The danger thus presented to Germany induced the Berlin Govt. to approach that of Soviet Russia, although their tendencies were completely opposite and the Bolsheviks never relaxed their efforts to introduce their revolutionary ideas into the German ranks. The German Govt. refused the request of the Soviet Govt. to grant them support, if only unofficially, against the enemy in the Murmansk district and on the Don. But they signed a supplementary treaty to the Peace of Brest-Litovsk on Aug. 27 1918, whereby they promised neither to initiate nor assist the formation of any further independent states on the territory of Soviet Russia, nor to support the operations conducted against the Bolsheviks in the Caucasus and to prevent the attack which Turkey was planning on Baku. In return, Russia was to allow Livland and Estonia to be assigned, as Courland and Lithuania had already been, entirely to the German sphere of influence and to pay a large indemnity.

The advantageous results of this agreement for Soviet Russia were soon apparent. The Red Army was able to advance successfully against the enemy; a number of districts were conquered; its authority in its own territory strengthened. But this agreement, which Germany had concluded without the co-operation of her Allies, had evil consequences for her. Her Allies had long been discontented with the selfish attitude, as they saw it, of the German Govt., and this discontent was voiced ever more plainly when instead of the victory which Ludendorff had promised in the west, the Allied troops under Foch opened a most successful counter-offensive. A conference of the leading statesmen and generals was held at general headquarters in Spa on Aug. 14 under the Emperor William's presidency, to adopt a policy to meet the altered military situation. Ludendorff stated that the chances of victory were now gone, but he hoped to put up a successful defence which would increase the enemy's inclination for peace. Hintze, the new German Secretary of State for Foreign Affairs, strongly urged the opening up of peace negotiations, and carried his point. The Army Command agreed.

One of the chief factors which contributed to this decision were the statements of the Emperor Charles and Burian, who had arrived in Spa the same day and declared that Austria was unequal to a fifth winter campaign. The Governments in Sofia and Constantinople reported to the same effect. Furthermore, the relations between Germany and her Allies had become ever more strained during 1918. The Bulgarians complained that Berlin had paid too little attention to their requests for military assistance; the Turks that Germany wanted to stop them from taking advantage of the favourable opportunity to extend their frontiers in the Caucasus.

But the worst effect was produced by the increasing resentment felt by the Emperor Charles and his Government at Germany's attitude. For as their need of peace grew ever stronger, they felt more bitterly the refusal of the German Govt., which had become increasingly dependent on the military command, to make a general peace possible by sacrificing territory in the west of Germany. Their loyalty to the idea of a general peace and their rejection of their enemies' proposals for a separate peace had already involved them in great dangers. The Ministry of Propaganda, which had been formed in London, and was under Lord Northcliffe's direction had declared openly in Feb. 1918 that it was "impossible to renounce the liberation of the peoples oppressed by the House of Habsburg." The Congress, which met in Rome in the second week of April 1918, and was attended by emigrants from the Czechoslovak, Polish, Yugoslav, Italian and Rumanian-speaking districts of the Habsburg Monarchy, had shown how far the separatist ambitions of these circles had already advanced. At this Congress the Italians agreed to settle their territorial disputes by amicable arrangement with the Southern Slavs, who had already smoothed over differences in their own camp by the Pact of Corfu, July 20 1917. A joint commission consisting of representatives of Italy, Great Britain and France, was established at Italian Headquarters, which became the centre of the national propaganda directed against the Dual Monarchy, and increased the danger which threatened that State.

In order to enlighten the world on the difficulties which stood in the way of his efforts for a general peace, Count Czernin had stated in a public speech at the beginning of April 1918 that Clemenceau's refusal to renounce the restoration of Alsace-Lorraine to France was the decisive reason of the non-success of the peace idea advocated by the Vienna Govt.; and had been

[1] For text see Lowes Dickinson, *op. cit.*, pp. 108–115.

[2] By the decision taken at Doullens on March 26 1918 to place the oversight of the Allied Armies in the hands of Marshal Foch.

rash enough to refer here to the conversations of Feb. 1918 between Revertera and Armand, which had hitherto been kept secret. Clemenceau answered by publishing the Emperor's letter of March 24 1917, which had only recently come to his knowledge. Czernin, who did not wish to cover the Emperor—and could hardly have done so—fell.

In Germany the contents of the Imperial letter and Charles' attitude in the polemic which followed its publication aroused most violent and universal indignation. The affair was described as an act of treachery against an ally at whose expense Charles had wished to buy a separate peace on terms favourable to himself. In order to allay this excitement, Charles, accompanied by his new Foreign Minister, Burian, travelled to Spa, where he concluded an agreement on May 12 1918 which arranged for the closest possible connection between the two empires in all political, economic and military matters both during and after the War. Had this come into force, it would certainly have meant a great increase in the predominance of the stronger partner over the government and peoples of the Habsburg Monarchy. The Emperor Charles had, indeed, made this agreement contingent on the condition that the Polish question be first settled on the Austro-Polish lines, a solution which had, however, little chance of realisation in view of the general opposition to it in authoritative circles in Germany. The enemies of the Central Powers, however, saw in the meeting at Spa a step further along the road towards the dreaded "Mittel-Europa" on which much had been written and spoken in Germany and Austria and whose best-known exponent was Friedrich Naumann.

One of the consequences of this view was that the idea of thwarting these plans by dismembering Austria-Hungary gained more and more adherents in Paris and London. This consideration, together with the valuable help which the Czech legions in the East were rendering to the Entente Powers, induced the French Govt. on June 28 1918 to confirm the rights of the Czechs to independence and to recognise the Czechoslovak National Council in Paris as their supreme organ, the forerunner of a future Czechoslovak Government. These concessions were at once approved by France's allies and extended by the declarations made by Britain on Aug. 9 and the United States on Sept. 3—this was largely due to Masaryk, who had been in that country since May 1918—by which the status of an Allied army was conceded to the Czech troops in Siberia and their legions in France and Italy, and the National Council in Paris was allowed the rights of an Allied Government.

Meanwhile the failures of the Austro-Hungarian troops in Italy and the Germans in the West had reacted on internal conditions in the Dual Monarchy. The new Austrian Minister, President Hussarek, had produced a plan for a revision of the Constitution on federalist lines, but with little effect. The resolutions of the Congress of Laibach of Aug. 18 1918 showed that the non-German peoples of the western half of the monarchy were working for the establishment of independent states, and the central authority was no longer strong enough to check these endeavours, especially as the Magyars refused to release Croatia-Slavonia from the Hungarian body politic. Charles and his Foreign Minister, Burian, thought an immediate offer of peace the only way to save what was still to be saved. The resolutions of the Congress of Spa showed Burian the way to fresh conversations with Germany. He encountered no more absolute resistance.

Yet great differences presented themselves during the negotiations as to the course to be adopted. The Germans wanted to wait till the military situation in the west improved and then begin negotiations with the enemy through a neutral Power—Holland or Spain—while Burian advocated an immediate and open appeal to all the belligerent Powers. At the beginning of Sept. 1918 Hintze spent some time in Vienna in the endeavour to arrive at a concerted course of action. When, however, Ludendorff's promise of a successful military defensive was not fulfilled; when, on the contrary the German troops were forced to retire on to the "Siegfried lines," Burian, seeing no prospect of an agreement with Germany, decided on Sept. 14 to disregard her opposition and to issue an appeal to all belligerent States to open peace negotiations. This step was not attended by the success for which Burian had hoped. President Wilson answered, after a few days' interval, that he had repeatedly and in the plainest terms made known the conditions upon which he was prepared to consider the conclusion of peace; hence the Government of the United States could not and would not accept a proposal for a conference concerning a matter on which it had already clearly made known its attitude and aims. The Cabinets of London and Paris were equally cold.

The sole result of Burian's new effort for peace was to increase the Entente's confidence of victory. On Sept. 15 ensued a violent attack against the Bulgarian Army, in the ranks of which war-weariness had for some time made serious inroads. The Bulgarian troops offered but little resistance; great bodies of them laid down their arms and returned to their homes. The Sofia Govt., at the head of which Malinov, who was friendly to the Entente, had succeeded Radoslavov some months previously, resolved, since its appeals to the Central Powers had met with practically no response, to propose an armistice. This was granted on Sept. 29 upon conditions which, for the Central Powers, spelled the loss of the Balkans. King Ferdinand abdicated in favour of his son Boris.

These events and the great successes of the British troops in Palestine produced their effect upon Turkey. At the beginning of Oct. Enver and Talat, the chief advocates of the policy of the Central Powers in Constantinople, fell from power, and thus the way towards a separate peace lay open here also. The Entente concluded an armistice with Turkey on Oct. 31 which brought the Dardanelles and the Bosporus under its control, and pledged the Turks to break off all relations with the Central Powers.

Meanwhile the position of the Central Powers had likewise become untenable. Under the effect of the crushing defeat of the Turkish and Bulgarian troops and the new, most violent assault of the Entente troops on the "Siegfried line," Ludendorff demanded at the end of Sept. that an immediate request be addressed to Wilson for an armistice and the opening of peace negotiations. Prince Max of Baden, the new German Chancellor, agreed with the ideas of the Supreme Command, but advised that the first step should only concern the peace offer, which he too thought inevitable, while the request for an immediate armistice should be postponed, since the enemy would only look upon and utilise this as an indisputable proof of the complete breakdown of the German Army. Ludendorff, however, stood by his demand and forced it through. On Oct. 5 the Govts. of Germany, Austria-Hungary and Turkey appealed to Wilson for an armistice, to be followed by peace negotiations. Wilson answered that he could not consult his Allies about an armistice until the Central Powers had admitted defeat by evacuating the Allied territory still in their occupation. He refused to admit any discussion of his Fourteen Points; at the most he would allow conversations on the details of their application. Furthermore, he asked whether the German Chancellor still spoke in the name "of the persons responsible for the War."

A week later he produced further demands. He called for abandonment of the U-boat warfare and guarantees for the maintenance of the military superiority of the Entente Powers. In a third note (Oct. 23) he defined the last-named demand as follows—that "he and his Allies, before granting an armistice, must have the assurance that they could at any time impose the conditions of peace." At the same time he declared that he must demand "not peace negotiations but surrender" if he had to continue in the future to negotiate "with the military rulers and monarchist autocrats of Germany." The severity of these conditions of armistice evoked the most lively excitement in German military and civilian circles. In both the opinions were violently divided. Ludendorff demanded the breakoff of the negotiations, the continuance of the War and an appeal to the German people for a *levée en masse* to defend the Fatherland. Other military leaders, on the other hand, declared it useless to continue the War, since the superiority of the enemy became more obvious every week, while war-weariness among the German troops had much increased under the strong influence

of extreme socialist and enemy propaganda. The new German Govt. pronounced on the same lines. It called for, and carried, subjection to the commands of the enemy. Ludendorff resigned (Oct. 27).

Meanwhile the catastrophe had taken place in Austria-Hungary. Encouraged by President Wilson's repeated pronouncements as to the right of nations to self-determination, the separatist ideas of those peoples of the monarchy which did not acknowledge German or Magyar nationality had become ever more articulate. There were disturbances in various parts of the Empire, and these disruptive influences had made it month by month increasingly difficult to keep the army efficient for war. The Viennese Govt., although recognising the dangers of the experiment, resolved to reorganise the monarchy on a new basis, in accordance with the 10th of Wilson's Fourteen Points. On Oct. 16 the Emperor Charles issued a manifesto in which he proclaimed that Austria, in accordance with the will of her peoples, was to be created into a Federal State in which every race would be free to establish its own form of body politic on the territory occupied by it. This was not, however, to anticipate the union of the Austrian Poles with an independent Polish State. The Imperial manifesto was to apply to Austria only. For Hungary, where forces were already at work for a personal union and for a complete separation from Austria, the manifesto affirmed the unity of the Kingdom of Hungary. It thus became clear to the Southern Slavs that they must no longer hope for a realisation of their national aspirations within the bounds of the monarchy. But the Emperor's hope of conciliating opinion among the Austrian Slavs with this manifesto was disappointed; the more so, as Wilson had informed Vienna that the United States had already recognised Czechoslovakia as a belligerent Power and the Czechoslovak National Council as a belligerent government, and had also recognised the justice of the national aspirations of the Southern Slavs; these peoples had therefore to decide for themselves which of the resolutions of the Austrian Govt. were acceptable to them.

In the last days of Oct. independent governments or other national authorities formed themselves in Prague, Agram, Laibach, Sarajevo, Cracow, Lemberg and Trieste. These internal movements led to the collapse of the armies; the governments of the several countries constituting the monarchy, Hungary leading the way, summoned their co-nationals to the defence of their particular frontiers or called them back home.

The Emperor Charles now attempted to achieve a separate peace; but his intermediaries hardly gained a hearing. At the end of Oct., after the revolution in Hungary, and after increasing numbers of the troops in Italy had started for home, the Austro-Hungarian Army Command asked an armistice from the Italians, who were advancing without meeting resistance. This was granted on Nov. 3 on conditions of pitiless severity. The negotiations for a separate peace were carried on even now, but without any result. The process of dissolution ran its course in the Dual Monarchy. On Nov. 11 1918 the Emperor Charles renounced all share in the business of government in Austria, on Nov. 13 in Hungary; he did not, however, renounce his crown. On Nov. 12 the Austrian National Assembly proclaimed a Republic, which was at first intended to form a component part of the new German Republic. On Nov. 16 Hungary inaugurated the Republican form of government. The ancient Austro-Hungarian Monarchy ceased to exist. The armistices with Bulgaria, Turkey and Austria-Hungary were granted on terms of unconditional surrender, and gave none of these Powers the legal right to claim self-determination on the Fourteen Points.

Wilson's offer to the fresh demand of Germany for definition of the conditions of an armistice and peace was different. It is stated in his communication of Nov. 5. All the Entente Great Powers agreed to the basis of the Fourteen Points, and addresses of President Wilson in 1916, being applied to Germany; but all reference to her allies was excluded. The Entente Powers "reserve to themselves complete freedom" (Point 2 relating to Freedom of the Seas) on this subject when they entered the Peace Conference. Further, in the conditions of peace laid down in his Address to Congress of Jan. 8 1918, the President had declared that the invaded territories must be restored as well as evacuated and freed, "and the Allied Govts. feel that no doubt ought to be allowed to exist as to what this provision implies." By it they understood "that compensation will be made by Germany for all damage done to the civilian population of the Allies and their property by the aggression of Germany by land, by sea and from the air."

Marshal Foch was empowered to communicate the conditions of armistice to suitable accredited military representatives. On Nov. 8 the German Delegation met Marshal Foch in the Forest of Compiègne. The conditions communicated to it were even harder than events in Bulgaria, Turkey and Austria-Hungary had led Germany to expect. A violent difference of opinion arose once more in Germany whether these conditions should be accepted or rejected and the struggle continued. In reality, there could be no doubt as to the course which must be adopted. For the enemy troops had been advancing unceasingly, and the "home front" had been broken by the revolution, which had begun with the mutiny of the sailors in Kiel and had quickly extended over wide districts of Germany. On Nov. 4 soldiers' and workmen's councils were formed on the Russian model. The cry that William II. should abdicate grew ever louder; but he hesitated to obey it. Thereupon Prince Max of Baden, the German Chancellor, under the continuous pressure of the Social Democrats and in view of the threatening attitude of the masses, proclaimed the abdication of William II. and his eldest son, without waiting for their consent (Nov. 9). His hope to save the monarchy by this means was disappointed. A few hours later the Republic was proclaimed. The Emperor William abandoned his resistance in the face of the accomplished fact and fled to Holland. The other German monarchs shared his fall. The new government declared itself prepared to accept the Armistice, which was signed for Germany by Erzberger, the leader of the Centre, and three others, with Hindenburg's approval, on Nov. 11 1918.

Thus ended the four years and more of the War. It had led to the fall of three Empires, to the complete dismemberment of the Habsburg Monarchy, to the formation of a number of independent states on the territory of the Dual Monarchy and of the former Empire of the Tsar, who had met with a violent end in 1918. The further fate of the conquered peoples depended on the decision of the victorious states, whose leading personalities immediately began to occupy themselves with the re-making of Europe.

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IV. INTER-ALLIED DIPLOMACY

Pact of London.—The legal consecration and the basis for the further development of the co-operation of the Allied and Associated Powers is to be found in the Pact of London[1] (Sept. 5 1914), in which Great Britain, France and Russia mutually engaged "not to conclude peace separately" and that no one of them should "demand conditions of peace without the previous agreement of the other allies."

The Treaty of London.—By the Treaty of London[2] (April 26 1915) Italy pledged her military assistance to the Entente in return for the realisation of her political and territorial ambitions at the close of the War. As recorded in the Treaty of London, the price paid by the Entente to Italy was a heavy one. The Entente was committed to the assignment of part of the territory of the Austro-Hungarian Empire to Italy. Italy's aspirations in the Adriatic were to be satisfied, and, still more important in view of subsequent controversies between the Allies, her position as a factor in the Mediterranean balance of power was acknowledged. Her interests in the Near East were to be safeguarded in the event of either a partition or a retention of the Turkish Empire. Although the treaty contains no hint of it, France and Great Britain had already made up their minds to a partition of Turkey.

The Constantinople Agreement.—In March they had signed with Russia an agreement, the so-called "Constantinople" agreement[3] (March 18 1915), by which they promised her Constantinople and all European Turkey east of the Enos-Midia line; Italy became a party to this agreement after her signature of the London Treaty.

The accession of Italy to the Entente opened up a new theatre of war, and revealed more than ever the need for co-ordination of military effort. Hitherto ordinary diplomatic channels had been made use of by the Allies in their communications with one another; but in a short time these were proved to be hopelessly inadequate. Early in 1915 the visits of M. Millerand to London and of Mr. Asquith to Sir John French's military headquarters, where he met M. Millerand and Generals Joffre and Foch, revealed the need for, and inaugurated, the long succession of inter-Allied conferences that took place during the next three years,[4] of which only those of outstanding political importance can be mentioned here. (For certain conferences not here mentioned see Control, Inter-Allied.)

Inter-Allied Conferences July 1915–March 1916.—In July 1915 there met at Calais the first inter-Allied conference to be attended by the heads of the British and French governments. In addition to the French and British Prime Ministers, there were present Lord Kitchener, Lord Crewe, Mr. Balfour and MM. Millerand, Albert Thomas, Delcassé and Augagneur. At this conference certain decisions affecting war strategy were taken, and its success was demonstrated when matters that had been awaiting decision for weeks were dealt with in a single day.[5] So successful was it that only a few weeks elapsed before an even more important one was held at Paris (Nov. 17 1915)

[1] For text see *Parliamentary Papers*, Cd. 7737.

[2] For full text see Temperley, *History of the Peace Conference*, vol. 5, pp. 384–93. The terms were, in brief, as follows: Italy promised to assist the Entente with her "entire resources." Military and naval conventions were to be drawn up to establish the assistance to be given to Italy by the Russian Army and the British and French Fleets. Under the Treaty of Peace, Italy was to receive "the Trentino, Cis-Alpine Tirol with its geographical and natural frontier (the Brenner frontier), as well as Trieste, the counties of Gradisca and Gorizia, all Istria as far as the Quarnero," with the Istrian islands. Also "Dalmatia within its present administrative boundaries" down to Cape Planka, with the adjacent islands. Southern Dalmatia down to the Montenegrin frontier, to be neutralised. Southern Istria, "all the coast of Croatia with the port of Fiume" and some small islands, and the neutralised strip of Southern Dalmatia, were to be assigned to "Croatia, Serbia and Montenegro." Italy received Valona, and the foreign representation of Albania, but consented to a partition of Northern and Southern Albania between Montenegro, Serbia and Greece, should her Allies desire it. She received full sovereignty over the islands of the Dodecanese. It was recognised that Italy was "interested in the balance of power in the Mediterranean," and in the event of a "partial partition of Turkey in Asia" she was to receive a "just share" to be delimited later, in the Mediterranean region adjacent to Adalia. All rights and privileges of the Sultan in Libya were transferred to Italy. She was to receive a proportionate share of any war indemnity. She agreed that Arabia and the Moslem holy places should be left under an independent Moslem Power. If France and Great Britain increased their African colonies at Germany's expense, Italy was to receive "some equitable compensation," particularly on the frontiers of "the Italian colonies of Eritrea, Somaliland and Libya." Great Britain undertook "to facilitate the immediate conclusion, under equitable conditions, of a loan of at least £50,000,000." Her Allies would support her in opposing the introduction of a representative of the Holy See in the peace negotiations, etc.

[3] For text see Temperley, *op. cit.*, vol. 6, pp. 4–9. The main points were: Russia was to receive "the town of Constantinople, the western coast of the Bosporus, the Sea of Marmara and the Dardanelles; Southern Thrace as far as the Enos-Midia line; the coast of Asia Minor between the Bosporus and the River Sakaria and a point on the Gulf of Ismid to be defined later; the islands in the Sea of Marmara and the islands of Imbros and Tenedos." Constantinople was to be recognised as a free port for transit of goods not coming from nor proceeding to Russia. The sacred Mahommedan places to be protected and Arabia to be under an independent Mahommedan rule. The neutral zone in Persia established under the Anglo-Russian Agreement of 1907 to be "included in the English sphere of influence."

[4] See Sir M. A. P. Hankey, *Diplomacy by Conference*, p. 6.

[5] *Ibid.*

between the British and French Prime Ministers, Ministers of Foreign Affairs, War, Marine, etc.[1] Here matters of the greatest importance were discussed and decisions taken upon them: the position of Greece, Serbia (including the question of Salonika) and the Gallipoli Expeditionary Force; the general problem of the co-ordination of military efforts; the determination of reinforcements to be sent to Salonika. Most important of all, a decision was taken in principle to set up a committee to co-ordinate the action of the Allies in regard to the War, the task of making proposals for this purpose being placed in Mr. Asquith's hands. In this decision lies the germ of the organisation of the subsequent inter-Allied conferences. Salonika and Gallipoli loomed large at this conference, for events in those theatres of war had not favoured the Allies. Indeed, in Sept. a conference between the French and British War Ministers, commanders-in-chief, chiefs of the general staffs and other technical experts had been held at Calais to discuss the question of reinforcements for Gallipoli and the possibility of effecting a landing on the Asiatic side of the Straits.

At a meeting between M. Briand and Mr. Asquith in London (Jan. 19 1916),[2] the constitution and rules for the proposed committee were agreed upon. In brief, it was to be an advisory body subject as to its conclusions to the approval of the governments. Its membership consisted of the Allied Prime Ministers and other such members of the Allied Govts. and their technical advisers as might be summoned to attend it. Underlying its creation was the idea of keeping the control of the military power in civil hands, for the meetings of the committee were to be preceded by meetings between the general staffs of the Allies, and it would be for the committee to decide upon the recommendations of the staffs in regard to naval, military and economic policy. All inter-Allied conferences held after 1915 at which the heads of the Allied Govts. were present were in reality meetings of this committee.

Its first meeting was the representative conference held in Paris on March 26 1916, at which were present the British, French, Belgian, Italian and Serbian Prime Ministers, the Russian and Japanese Ambassadors and the Portuguese Minister to the French Republic. As agreed, the conference was preceded by a meeting of the Allied general staffs, whose recommendations were subsequently reported to the conference by Marshal Joffre. Upon these the conference gave its decision; and upon certain economic and shipping questions, including that of the establishment of an Allied maritime transport council in London Opportunity was taken of the presence of so many members of the Alliance both to draft and pass a declaration of the unity of their aims in military, economic and diplomatic affairs, and to renew the decision contained in the Pact of London not separately to conclude peace.

In formal conference the Allied statesmen were preoccupied with the effectual prosecution of the War, yet speculation, even negotiation, as to the nature of the political settlement to follow an Allied victory was never far from their minds. When brought together, as by the conference in Paris, they informally canvassed one another as to the bases of a possible peace. The knowledge that " conversations " were taking place contributed to the reaffirmation of the Pact of London. Though bound not to negotiate peace separately, the Great Powers saw no reason why they should not predetermine among themselves the details of peace; and it was with the territorial settlement of the Near East that their minds were chiefly occupied in the early summer of 1916.

The Sykes-Picot Agreement.—Anxious to obtain Arab assistance against the Turks, Great Britain in 1915 had come to a secret and loosely defined arrangement with the Sherif of Mecca by which, in return for the armed assistance of the Arabs, she promised her support for the Sherif's plan for the creation of an independent Arab kingdom. The French, however, had for well-nigh a century entertained ambitions in regard to Syria and Cilicia—ambitions conflicting directly with those of the Sherif. The reconcilement was effected by the late Sir Mark Sykes and M. Georges Picot, without the knowledge of the Sherif of Mecca, in an agreement that has come to bear their names.[3] As the Sykes-Picot Agreement affected certain vital Russian interests in the Middle East, it was communicated to the Russian Govt., who assented to it in May 1916; but its provisions and even its existence were carefully concealed from Italy, with whose interests it might be expected to conflict. The full importance of this agreement in the history of inter-Allied relations became apparent in 1917 at the conference at St. Jean de Maurienne. It serves here to illustrate both the rifts that existed within the outward harmony of the Alliance, and the fact that not a few of the many subsequent disputes between the Allies had their origin in similar instances, where immediate military aid was purchased by promises, given by one or the other of the Powers, irreconcilable with the ambitions of some other member of the Alliance.

Negotiations with Bulgaria and Greece.—By winning Italy to their side the Entente had attacked the Triple Alliance in its Achilles-heel. The next step was to seek to place a barrier in the Balkans between the Central Empires and their Turkish ally. Geographically and politically, Bulgaria was obviously designed to act as barrier. Her ultimate refusal to do so, after protracted negotiations, was due as much to the inability of the Western Powers to induce Serbia to make concessions to Bulgarian aspirations in Macedonia as to the Germanophil feeling of her Coburg King. When Bulgaria finally threw in her lot with the Central Powers and invaded Serbia in Oct. 1915, the Allies turned to Serbia's ally, Greeee, for help. Greece, too, was ruled by a Germanophil King and, despite the efforts of Veniselos and the bait of the possession of Cyprus held out by the British Govt., she proclaimed herself neutral in the conflict between Serbia and Bulgaria.

Political discussion remained in abeyance during the summer of 1916, until it was clear that the Allied offensive on the Somme would bring no decisive results; the attention of France and Great Britain, in particular, was again turned to wider problems. At a conference at Boulogne on Oct. 20 the British and French Prime Ministers, Ministers for Foreign Affairs, War, Marine, commanders-in-chief, chiefs-of-staffs, etc., discussed the question of Greek military co-operation against Bulgaria. In the previous Aug. Rumania had joined the Allies at a price which it had taken much negotiation to arrange, her demands conflicting dangerously with Serbian ideals. Now, after a few weeks' fighting, the total collapse of Rumania was imminent. The Boulogne conference found itself face to face with complete German domination in the Balkans; not only was Bulgaria an ally of the Central Powers, but Belgrade was, and Bucharest was about to become a German possession. Alone of the Balkan States Greece had not yet intervened in the struggle. At the end of Aug. an internecine struggle had broken out there between the King and his pro-German advisers and the pro-Ally Veniselos. When the Boulogne conference was assembling Veniselos had set up a provisional government at Salonika and declared war upon Bulgaria; but his government depended solely for its support upon the Greek islands. The mainland remained loyal to Constantine, whose deposition, desired by France and Great Britain, was opposed by the Tsar and by Italy.[4] At Boulogne the French and British Ministers found themselves called upon to arrange financial support for Veniselos,

[1] See Sir M. A. P. Hankey, *Diplomacy by Conference*, p. 7.
[2] *Ibid.* p. 7.

[3] For text see Temperley, *op. cit.*, vol. 6, p. 16. The main terms were: Russia obtains " the provinces of Erzerum, Trebizond, Van and Bitlis " and part of Southern Kurdistan. France obtains " the coastal strip of Syria, the vilayet of Adana and the territory bounded on the south by a line Aintab-Mardin to the future Russian frontier, and on the north by a line Ala Dagh, Kaisariya, Ak-dagh, Sildiz-dagh, Zara and Egin, Kharput." Great Britain obtains Southern Mesopotamia with Baghdad and Haifa and Akka in Syria. The zone between the French and British territories forms an independent Arab state or states. Alexandretta becomes a free port. The holy places are put under a special régime.

[4] For valuable information as to the relations between Greece and the Entente Powers, see A. F. Frangulis, *La Grèce et la Crise mondiale*, vol. 1 (1926).

military co-operation with his forces against Bulgaria, transport of Allied troops to Salonika, the constitution of these troops, and, lastly, whether or not Portuguese regiments should be included in their ranks.

Conferences on Russian Situation.—In the meantime, the situation in Russia was growing more serious from day to day, and at a conference in Paris on Nov. 15 Russia formed the chief subject for discussion. In reality there were two conferences held on this day: the first, in the morning, was an Anglo-French conference; in the afternoon a second was held to which representatives of Russia and Italy were admitted. At the Anglo-French conference a frank interchange of views took place between Mr. Asquith and Mr. Lloyd George, representing Great Britain, and M. Briand and Admiral La Caze, the French representatives, on the subject of Russia and a political and military inter-Allied conference it was proposed to hold at Petrograd. It was agreed that, in addition to France, Great Britain and Russia, Italy should also take part, and that the conference should be composed solely of statesmen of the first rank with eminent soldiers and technical experts from each of the participating Powers.

In these circumstances Mr. Lloyd George attached so great importance to the results likely to be obtained that he himself offered to be the British delegate.[1] Poland, in whose future France had a deep concern, and Greece, were also discussed; agreement was reached upon all these subjects. Great Britain and France having thus arranged matters between themselves admitted Italy and Russia to the afternoon discussion. Russia was represented by her ambassador at Paris, M. Isvolsky; Italy by Signori Tittoni and Carcano and the Italian Ambassador at Paris. The decisions arrived at in the morning were again debated, as well as the relations between the various governments and general staffs in regard to the conduct of the War. Already that need for unity of direction that was ultimately to result in the creation of the Supreme War Council was making itself felt. The discussion proving too long to be concluded the same day, the conference was resumed on Nov. 16. As regards Russia the work of this conference proved fruitless. The inter-Allied conference held at St. Petersburg (Leningrad) in the following Jan. found that, in the rapidity of their occurrence, events in Russia had outstripped human power to control them.

The Peace Proposals of the Central Powers, Dec. 12 1916.—British statesmen had frequently declared that the War could be terminated for either side only by a "knock-out blow." Shortly before he resigned the Premiership in Dec. 1916 Mr. Asquith defined the objects of the Allies as "adequate" reparation for the past and adequate security for the future."[2] Three days after the Boulogne Conference Sir Edward Grey delivered a speech (Oct. 23) in which he expressed his conviction that the world must look to some league of nations as the preventive of future wars.[3] Bethmann Hollweg, the German Chancellor, seized upon this reference as opening the way to a possible peace negotiation, and dispatched (Dec. 12) a vaguely worded Note to the Allies in which he voiced his conviction that proposals Germany and her allies were prepared to bring forward "would be such as to serve as a basis for the restoration of a lasting peace."[4] The reception accorded this Note by the Allies showed that there was as yet no serious rift in the Entente, nor any weakening of the common determination to prosecute the War to a victorious termination. Allied statesmen denounced the Note as an endeavour to create discord within their ranks,[5] while on Dec. 26 the heads of the French and British Govts. conferred in London over a reply to the German Note. In replying, the Allies rejected the German proposal as a manoeuvre, and reaffirmed their determination to carry on the War until assured of a peace that would secure "reparation of violated rights and liberties, recognition of the principle of nationalities and of the free existence of small States."[6]

President Wilson's Peace Proposals.—The reply to the German Note was only one among many subjects discussed and decided at this Anglo-French Conference. Another peace proposal—that of the American President—received a fuller reply. Deferring to the President's request for more detailed information as to the terms upon which the Allies were prepared to conclude a peace,[7] the French and British statesmen drafted in this conference the famous Reply that was returned to the President in the name of the Allied Powers on Jan. 10 1917. The Entente Powers committed themselves and their Allies to a peace programme that embraced the "reorganisation of Europe," including, as it did, "the liberation of the Italians, as also of the Slavs, Rumanians and Czechoslovaks from foreign domination . . . the setting free of the populations subject to the bloody tyranny of the Turks; and the turning out of Europe of the Ottoman Empire as decidedly foreign to Western civilisation."[8] Inspiring these phrases, unknown to the public and perhaps to certain of the statesmen agreeing to them, were the secret treaties and agreements, the Treaty of London and the Constantinople and Sykes-Picot Agreements. This conference also busied itself with the strategical problems in Palestine, with the Balkans and with the extension of the British front in France. Greece was again discussed, and Russia and the holding of the proposed conference at St. Petersburg. Arrangements were made for holding an Anglo-French-Italian conference in Rome at the New Year. Diplomacy by conference was again justified by its results: all these important matters were discussed and decided upon within three days.

Conference of Rome.—The conference at Rome on Jan. 5 was more representative, and occupied itself with matters no less important, than its predecessor in London. Italy and Russia were represented, as well as France and Great Britain. This was the second conference Mr. Lloyd George attended as Prime Minister (he had succeeded Mr. Asquith in that office in Dec.), and he had the French and Italian Prime Ministers as neighbours at the conference table, in addition to the chiefs of the staffs of the Allies, with a great number of technical advisers.[9] The proposed conference in Petrograd was again discussed, as also the possibility of affording some measure of military and economic assistance to Russia. Co-ordination had so justified itself by results in other departments of the War that a resolution was taken to hold a naval and shipping conference in London at an early date to take counsel regarding the submarine menace, maritime transport and other cognate matters.

So grave was the menace that a new line of communication with Salonika and the Allied forces in Macedonia was agreed upon by which, as it passed through Italy, a great shortening of the sea journey would be effected. Those forces were menaced by another danger; the opposition of King Constantine to the policy of the Allies. Hence the conference was led to decide what policy should be adopted towards the Royal Greek Govt., and what instructions should be given to General Sarrail, the commander-in-chief of the Allied forces at Salonika for his guidance in his relations with that Government and with the general officers commanding the Allied Armies in the Balkans. Greece and Russia were not the only causes for anxiety to the Allies; the military situation in Italy, as Mr. Lloyd George told the conference in a memorandum he circulated amongst its members, left much to be desired. Convinced that the collapse of Russia was imminent and inevitable, the Prime Minister believed that it would set free enemy forces sufficient to render an intensive attack upon the Italian front a feasible and probable operation on the part of the Central Empires. He therefore urged the desirability of preparation on the part of the Allies, so that in the event of the need arising large reinforcements could

[1] Hankey, *op. cit.*, p. 9.
[2] Speech on Oct. 11.
[3] Speech to Foreign Press Association, Oct. 23.
[4] *Parliamentary Papers*, Cd. 8,406.
[5] On this subject generally, see *Cambridge History of British Foreign Policy*, vol. 3.
[6] *Parliamentary Papers*, Cd. 8,467.
[7] *Parliamentary Papers*, Cd. 8,431.
[8] *Parliamentary Papers*, Cd. 8,468.
[9] For information as to this conference, see Hankey, *op. cit.*, pp. 10–11; Sir W. Robertson, *From Private to Field-Marshal;* Temperley, *op. cit.*, among others.

at once be dispatched to the Italian front. The Italian débâcle at Caporetto 10 months later demonstrated the truth of his warning; the fact that that debacle was stayed in time is testimony to the efficiency of the plans worked out by the conference in Rome.

Conference of St. Jean de Maurienne.—While the Rome conference was sitting another of some importance was taking place in London between Mr. Balfour, the French and Italian ambassadors and the Russian Chargé d'Affaires. The British Govt. again found themselves called upon to reconcile conflicting ambitions with regard to the post-War territorial settlement in the Near East. The Sykes-Picot Agreement had been kept secret from Italy and the Sherif of Mecca, but the fact of its existence and its terms, if not an actual copy of the agreement itself, had come into possession of the Italian Government. At once that Government sought from its Allies a very definite and binding interpretation of the admission in principle of Italian claims in Asia Minor contained in Article 9 of the Treaty of London. When these claims came to be discussed in conference in London, their irreconcilability with those of Russia, France and Great Britain became embarrassingly apparent. A way had to be found out of this tangle of diplomatic promises; but after some weeks of negotiation and discussion the Conference failed to secure complete unanimity. Italy continued to be insistent in her demands, and, as she was mistress of the new route to the Salonika front and any defection on her part from the Alliance would have entailed the most serious consequences, the French and British Prime Ministers met the Italian Prime Minister and Foreign Ministers at St. Jean de Maurienne on April 17 and achieved an agreement. The terms of this agreement have never been published; but it was intended that it should be a corollary to the Sykes-Picot Agreement. One fact alone is certain: that the Italian Prime Minister received a promise of Smyrna in answer to his demand for that town.[1]

Events in Greece were now steadily leading up to the crisis which culminated with Mr. Jonnart's mission and the deposition of King Constantine. The Allies, especially Great Britain, wished to reconcile the Veniselist and Royal factions, and when that became impossible to side with whichever party was most likely to further the Allied cause in the War. By April 1917 Constantine was the sole obstacle in the way of a Greek declaration of war on the Central Empires; therefore, at St. Jean de Maurienne, M. Ribot proposed that the Allies should demand his abdication. This proposal, if not unwelcome to the British Prime Minister, met with heated opposition from Baron Sonnino for the same reason that Italy in the previous year had refused to demand Constantine's deposition—that to place Veniselos in power would be to endanger Italy's Near Eastern and Mediterranean interests by rendering possible the creation of a Greater Greece. The conference rejected M. Ribot's proposal, and decided to postpone any demand for the King's abdication until popular movements or other causes at Athens should render it inevitable.[2] When that occurred the crown should pass to Constantine's eldest son. The conference resolved in the meantime to take certain measures that would virtually make them the masters of Greece.

The Sixtus Letters.—A final question still remained for decision. The Emperor Charles of Austria had transmitted a peace proposal to the Allies through his brother-in-law, Prince Sixtus of Bourbon-Parma. The Emperor consented to the restoration and indemnification of Belgium; to the restoration of Serbia with an outlet to the sea [through Albania]; and promised to support "the just claims of France to Alsace-Lorraine." He did not mention Italy.[3] When Lloyd George and Ribot, being inclined to treat with Austria, raised the question at St. Jean de Maurienne, Sonnino refused scornfully to listen to it. Italy, said Sonnino, could not conclude a "white peace"; her demands as stated and agreed to in the Treaty of London must be fulfilled to the letter.[4] Subsequently the Emperor agreed to certain minor concessions to Italy; but Sonnino's refusal at St. Jean de Maurienne had dealt the movement its deathblow.

The Greek Question: the Stockholm Conference.—The Allied Prime Ministers had no sooner returned to their capitals than Greek affairs once more claimed their attention. At an Anglo-French Conference, that met in London on May 28, it was resolved to address a demand to the Greek Govt. for the abdication of King Constantine, and within a fortnight that monarch had abdicated in favour of his second son Alexander. The Salonika front again came up for discussion, as also did a new subject at inter-Allied conferences—Socialism. The outbreak of revolution in Russia had inspired the Dutch Socialist, Troelstra, to propose a Labour conference in Stockholm to discuss the possibilities of peace. This idea was strongly supported by the Kerensky Govt. in Russia and by Mr. Henderson, the British Labour leader and Cabinet Minister, who had been on a mission to Russia with Vandervelde and Albert Thomas; more important still, it was favoured by Mr. Lloyd George.[5] The conference, however, decided against the Allied Powers being in any way represented at the proposed Labour conference, and even went so far as to agree that the Allied Govts. should refuse passports to their subjects desiring to attend its deliberations.

A few months later the Allies were confronted with the complete military collapse of Russia and her disappearance from among their ranks. In order to make arrangements for meeting the military, economic and political consequences of Russia's defection, a great inter-Allied conference assembled in Paris on July 25. At the first session Great Britain, France, Italy, Russia, Greece, Rumania and Serbia were represented, while at the final session on July 26 representatives of Belgium, Japan, Montenegro and Portugal were also invited to be present. The deposition of King Constantine had rendered it possible for Veniselos to bring Greece into the Alliance; but one of the chief problems before the conference was that of providing the financial sinews of war for the new Ally. The situation at Salonika gave rise to a discussion that finally embraced the general Balkan policy of the Allies. This conference also discussed the establishment of an Allied base at Corfu, the Italians in Epirus, the formation of an Arab legion, and the holding of a conference in London to effect co-ordination of transport arrangements.

The Russian collapse was speedily followed on the Italian front by the very consequence Mr. Lloyd George had foretold at the Rome conference in January. At the end of Oct. the Austro-German armies gained a great victory at Caporetto. At a conference at Rapallo on Nov. 7 the British, French and Italian Prime Ministers and chiefs of staff took measures that proved effective in stemming and eventually repulsing the danger. Always an advocate of unity of action and purpose among the Allies, Mr. Lloyd George found at Rapallo the strongest possible argument in the Caporetto disaster for urging upon them the establishment of some central directing organisation. His arguments prevailed, and resulted in the establishment of the Supreme War Council, composed of the Prime Minister and another representative of each of the Great Powers.[6]

The Supreme War Council.—At a great inter-Allied conference that met in Paris on Nov. 29 the decisions come to at Rapallo were endorsed; on Dec. 1 the Supreme War Council held its opening meeting. With its inception this record of inter-Allied conferences comes to a close. The Supreme War Council was indeed in one sense an inter-Allied conference *en permanence* in that it was a deliberative body composed primarily of the heads of the Allied Governments. But in another sense it was something less than a full inter-Allied conference, inasmuch as it was an advisory body whose recommendations could be put into practice only after they had been assented to by the Allied Governments. Certain it is that at times it tended to take on the aspect of a full inter-

[1] For information as to this conference see G. P. Gooch, *Modern Europe;* Frangulis, *op. cit.*
[2] Frangulis, *op. cit.*, vol. 1, p. 519.
[3] See Manteyer, *The Austrian Peace Offer.*
[4] See Gooch, *op. cit.*, pp. 627–9.
[5] Gooch, *op. cit.*, p. 623.
[6] See on this conference Hankey, *op. cit.*, pp. 12–3; *War Cabinet Report*, 1917 (Cd. 9,005); P. Wright, *The Supreme War Council;* Robertson, *op. cit.*, among others.

Allied conference, as when, in addition to representatives of the British Colonies and of the Indian Empire, a great many of the Allied States were also represented. For the most part secrecy has been successfully maintained as to the actual proceedings at the meetings of the Supreme War Council.

From a few of these meetings, however, the veil has been lifted—the meeting at Versailles from Jan. 30 to Feb. 2 1918, at which the " creation of a general reserve for the whole of the armies on the Western, Italian and Balkan fronts " was decided upon, and the task of creation assigned " to an executive, composed of the permanent military representatives of Great Britain, Italy and the United States of America, with Marshal Foch for France."[1] Consequent upon the German offensive on March 21 a meeting was held at Doullens on March 26 at which the decision was taken to place the task of co-ordination of the British and French armies in the hands of Marshal Foch; following the repulse of the German offensive a meeting was held in Abbeville on May 1 at which it was decided to dissolve the military executive appointed the previous Jan., and a few days later the title of Commander-in-Chief of the Allied Armies was conferred upon Marshal Foch[2]; finally, from Oct. 31 to Nov. 4 a session was held at Paris at which were present the British, French and Italian Prime Ministers and Foreign Ministers, and at which two matters preliminary to the termination of the War were dealt with—the Austro-German request for an armistice, and the conditions of armistice to be granted to Turkey. At this conference man-power and that recurring subject on the agenda of inter-Allied conferences, military operations in the Balkans, were also discussed.

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(I. F. D. M.)

V. EUROPE AFTER THE WAR

The object of the following article is to give an account of the political condition of Europe during the six years from Jan. 1920 to the beginning of 1926. It does not include a formal narrative of the events which took place during this period; for that, reference must be made to the various special articles included in these volumes; the aim is to concentrate attention on those matters which affected the Continent as a whole and to point out the main characteristics in the general political development. The chief of these can be at once indicated for it gives a unity to the whole. The period is one of transition, a transition from the state of war to a state of peace. It begins with the ratification of the Treaty of Versailles, followed shortly by that of the treaties of St. Germain, Trianon and Neuilly, by which the formal state of war on the continent of Europe ceased.

But even after the treaties had come into force it required some years to liquidate the immediate effect of the War and to restore a normal political condition. The most important step in this direction was the adoption in 1924 of the Dawes scheme for the payment of reparation, by which what had been the chief cause both of economic and political trouble in Europe was to a great extent removed. This was followed in the autumn of 1925 by the Treaties of Locarno, but it was an essential part of these treaties that Germany should be admitted to the League of Nations. This, owing to unforeseen obstacles, was not realised in the spring of 1926 and in consequence the political situation still remained obscure and unsatisfactory.

The New Europe.—The settlement arranged in the Peace Conference of Paris had produced changes equal to if not greater in importance than those embodied in the former similar settlements, the Treaty of Westphalia, the Peace of Utrecht and the Congress of Vienna. The War, short as it had been, compared with the Thirty Years War—the War of the Spanish Succession or the Revolutionary and Napoleonic Wars—had in fact completely upset the existing political system. In the west indeed the changes were few and of minor importance. The Iberian Peninsula, Holland, Switzerland and the Scandinavian States, retained their old position and their old possessions almost unaltered, though Belgium was freed from the limitations on her full sovereignty implied in the guarantee of permanent neutrality. France had regained the provinces of Alsace and Lorraine which she had lost in 1870 and, at the same time, come back into the position of the first of the European nations which had so long been hers. In Central Europe it was very different. There the three great monarchies, which since the days of Catherine, Frederick the Great and Maria Theresa, had dominated so large a part of the Continent, had disappeared. In Petrograd, Berlin and Vienna, the old centres of monarchical authority, the Court had made way for republican government and the great armies by which Europe had been overawed had ceased to exist. But the character of the change in each case was very different. Germany had not only lost the military and political predominance which she had held since 1871, but she had been deprived of considerable territories: Alsace-Lorraine had been ceded to France; to Denmark the northern part of Slesvig; to Poland the greater part of the provinces of Posen and West Prussia, and, in addition, the heart of the great mining district of Upper Silesia; while the city of Danzig, commanding the mouth of the Vistula, was created a separate state in close association with Poland.

Perhaps even more important than the loss of territory, were the economic and financial disabilities imposed by the peace settlement, and the state of internal instability caused by the revolution. At the same time Germany was effectually crippled by the disarmament enforced on her, the establishment of control, and the occupation of the Rhineland. The general effect was that for the moment Germany was unable to take any active part in European politics; she had become a passive element in the continental system. The utmost she could do was to concentrate on the slow and arduous task of internal reconstruction, which at the best must take many years. None the less, she had come out of the War a united state. Subsequent projects for disruption, for instance in the Rhine provinces, Bavaria or East Prussia, failed, and she was still in population the largest country, except Russia, on the continent of Europe. It could be foreseen that sooner or later the time must come when she would be restored, not indeed to the old position of predominance, but to that of a Great Power.

Russia.—Very different was the change which had taken place in the relations of Russia to Europe. From the time of Peter the Great it had been the object of the Tsars to introduce European civilisation into their country and at the same time, by the Western extension of the Empire, to establish themselves as one of the European Powers. In this they had been successful, and ever since the Congress of Vienna they had taken an important and often a leading part in all the Conferences, and intervened even in matters which primarily concerned Western Europe alone, such as the establishment of the Kingdom of the Belgians. By the defeat of Russia in the War, followed as it was by the Bolshevik revolution, all this was changed. Russia lost the border territories from Finland to Bessarabia, and was now confined to the semi-Asiatic areas which had never come under the direct influence of European culture and the Western Church. She had in fact once more become not a European but an Asiatic Power.[3]

[1] *War Cabinet Report*, 1918, Cmd. 325.

[2] *Ibid.*

[3] This may appear to be so if we look at territory alone, but the vast bulk of the Russian population speaks a great European language, possesses a great European literature and belongs mainly, in every way, to the European family system.—Ed. *E. B.*

More than this, the religious fervour with which her self-imposed governors adopted the principles of militant communism, set her in pronounced opposition to the whole established system of Western Europe. She became therefore, instead of an integral part of Europe, an alien state threatening Europe.[1] During 1919–20 the Soviet Govt. entertained hopes of imposing on the European states the new system which they had themselves adopted.

The first serious success was the establishment of a Communist Govt. in Hungary; there were hopes, which were not fulfilled, that this would be followed by a similar revolution in Germany. The crisis came in the summer of 1920. In the war which had broken out between Poland and Russia, the Russian troops advanced to the gates of Warsaw. The attempt failed; they were defeated and driven back in disorder, and this was quickly followed by treaties of peace in which the Soviet Govt. recognised the independence not only of Poland but also of the Baltic States and Finland. By this the immediate danger of Europe was stayed, but none the less the estrangement continued. The ill-advised attempts, which had been made in 1918 and 1919 to overthrow the Soviet Govt. by force of arms and the help of the Russian Whites, had failed.

The policy of the Soviet Govt. indeed gradually changed. Urged largely by the necessity of foreign capital for internal reconstruction, they aimed at negotiating treaties, both political and commercial, with individual states. Their first success was the Treaty of Rapallo with Germany, signed during the Conference of Genoa in April 1922, but it was not until the spring that formal *de jure* recognition was awarded by the British Labour Govt. under Mr. Ramsay MacDonald; this step was quickly followed by Italy, France and other states. From this time Russia has had diplomatic representation in the most important European capitals. But her efforts at closer relationship have in general not been successful, and her decisive refusal up to 1926 even to consider an application for admission to the League of Nations showed her unchanged opposition to the general principles by which the European States were governed. Meanwhile, in accordance with the old traditions of the Tsarist Govts., the new Russia aimed at extending her influence and authority on the continent of Asia. It was there—in Persia, in Afghanistan and in the Far East—that her power was most felt, and here the old rivalry between England and Russia reasserted itself.

The Succession States.—Germany was then temporarily in eclipse. Russia was alienated from Europe, but the third and oldest of the Great Powers—the one formerly though inaccurately known as the "Austrian Empire"—had been shattered never to rise again. The great Habsburg Monarchy, which since the days of Charles V. had played so important a part, had disappeared from the map of Europe. This is an event for which there is no parallel in modern European history. It is the first time that one of the Great Powers has, not by a slow and long delay, but by a sudden collapse, ceased to exist. It was not the result of any definite decision; the dissolution of the Empire had never been one of the avowed War-aims of the Allies: it was the spontaneous act of the population, an act which the Allies had not the power, even had they the will, to prevent.

As a consequence of these events the number of states comprising the European family of nations had been greatly increased. The new states were Finland, Estonia, Latvia, Lithuania, Poland, Czechoslovakia and Yugoslavia, and among them may also be included the Republics of Austria and Hungary. Of these the majority, though new from the point of view of the politician and the lawyer, to the historian were familiar. They were the recreation of states which had been absorbed in the two great monarchies of the Habsburgs and the Romanoffs. The Polish nation had regained the independence which it had lost in the partitions; Czechoslovakia, though with different frontiers, was really an incarnation of the ancient Kingdom of Bohemia; the new Austria and the new Hungary were parts of the hereditary dominions of the House of Habsburg and of the Hungarian Kingdom which, after a union of some four centuries, had now separated and regained the position, which they had had in the 15th century, of separate states. Serbia and Rumania had as a result of the series of wars increased in size. The fall of the Austrian Empire had in fact had results similar to those involved in the decay of the Turkish Empire: there too, the recognition as independent European states of Serbia, Bulgaria and Rumania, meant the restoration to independent life of nationalities which had for a time been submerged under the Ottoman conquest.

This comparison struck all observers and it led to the use of a phrase, the "Balkanisation of Europe," which formed a convenient catchword. In truth it might easily become dangerous and misleading. What had really happened was that the principle of the compact national state which after centuries of war had established itself in Western Europe, in the case, for instance, of Holland, Belgium, Denmark, Norway and Sweden, had now asserted itself in the more backward territories of Central Europe. That had been attained which had for 100 years been the ideal and the dream of liberal thought. Curiously enough it was just those parties who before the War had been most vociferous in the proclamation of the ideals of nationality and liberty who showed themselves after the War most ready to criticise the results when these ideals had been realised.[2] There was indeed legitimate cause for apprehension. These new states were confronted by the task of building up the whole of their national institutions and creating afresh a centre of authority.

At the best this is not easy. It was made more difficult in that it had to be undertaken at a time when economic resources had been wasted and destroyed by four years of war, and, in addition, by the fact that every one of these states made for itself a constitution in which were adopted the most extreme principles of democracy. It could only be expected that numerous mistakes would be made and that long years would be required before a fully satisfactory system of government had been established. Moreover, in most of these states there were inevitably incorporated very considerable minorities of population who were alien in language and religion or in nationality. Of the twenty millions of whom the new Republic of Poland consisted, there were two million Germans, four or five million Jews, and an undetermined number—Ukrainians and White Russians—who were more closely attached to the Russian than to the Polish branch of the Slavonic peoples. In Czechoslovakia there were some 3,500,000 Germans who felt their new position of inferiority all the more keenly, that up to 1914 they had belonged to the ruling caste of the Empire. In Rumania were incorporated large Slav, Magyar and German minorities.

With wise foresight the Allies, when determining the new frontiers of Europe, had imposed on these states in the east of Europe special treaties by which they bound themselves, under international guarantee, to give to these subject and unwilling populations full rights of citizenship and complete equality before the law, as well as the right of recognition of their own language and religion in the schools and courts of law. The enforcement of these stipulations was necessarily attended with much difficulty. In one case, at any rate, the proposal of the Polish Govt. to dispossess German farmers in the Grand Duchy of Posen, was prevented, and thereby a threatened act of injustice, which would have caused national enmity, was averted. It was of the highest importance that the new system of Europe should recognise the obligation to provide an international guarantee of justice and protection against the unjust administration of the laws in these new states. It was to the League of Nations that was entrusted by treaty the responsibility of watching over the execution of these new treaties. In fact, they only perpetuated a principle which by the Treaties of Berlin had already

[1] Historically it is very important to note that Lenin and his colleagues believed themselves, however wrongly, to be the most European of Russians, the executors of the latest and best European ideas and the true spokesmen of the industrial masses throughout Europe. (*See* RUSSIA.)—Ed. *E. B.*

[2] Much of the criticism, however, was deeply reflective and guided by historical and ethnographical study. The new system was far from being animated by a pure principle of national liberty. Poland, Czechoslovakia and Rumania contain a mixture of peoples, with a dominant race, and corresponding minority problems.—Ed. *E. B.*

been adopted when the Great Powers of Europe had recognised the new independence of Rumania and Serbia.

The Principal Allied Powers.—These political and territorial changes had radically altered the political balance of the continent. For the last 100 years, by common consent, the five—later six—Great Powers had exercised a general control and supervision over all European matters, and had in particular claimed the right of intervening when any important territorial change was proposed. This system, which at the best had only worked intermittently and had often failed owing to dissensions among the Great Powers, had now broken down. The three eastern monarchies were eliminated, and there remained only Great Britain, France and Italy. It was these three states, who, together with the United States of America and Japan, acting as the Principal Allied and Associated Powers, had determined the conditions of peace, and there naturally fell to them the responsibility of enforcing their observance. The United States, by their refusal to ratify the Treaty of Versailles, fell out. In regard to European matters, Japan had no direct interest and claimed none; on these the three European Powers in effect acted alone; to them fell also, as the only organised centre of authority in Europe, a general prerogative of control. It soon appeared, however, that their real powers were very limited. Notwithstanding the victory which they had achieved in the War, they were so exhausted by the effort that they had not the effective military power nor the financial resources to impose their will throughout the great expanse of Central or Eastern Europe. Their position was very different from that of the allied monarchs who, after 1814, were in military occupation of large parts of the Continent and were able, almost without resistance, to carry into effect any resolution on which they jointly agreed. In 1919 the Allies found difficulty in exercising any effective control over the steps by which the new states, such as Poland and Czechoslovakia, came into existence, and they encountered serious obstacles when they attempted to supervise and limit the large extensions of territory demanded by Poland, Yugoslavia and Rumania.

None the less, it was necessary for them to set up machinery for dealing with the very numerous and sometimes important problems arising out of the treaties which could be dealt with by them alone. Almost every chapter of the treaties left important points, including the right of interpretation, to the Principal Allied and Associated Powers. Some of these, *e.g.*, reparation and the control of the occupied areas in Germany, were referred to special commissions. Matters of outstanding importance were dealt with by periodical meetings of the allied statesmen who continued, under the title of the Supreme Council, the work done by the Council of Four at Paris. These meetings varied from long and formal conferences, such as those of Spa in July 1920 or of London in Feb. 1921, to brief and transitory conversations between the Prime Ministers of Great Britain and France, hastily summoned to deal with some special point or special emergency. They were similar in character and object to the conference of Aix-la-Chapelle and other conferences which followed on the conclusion of the Napoleonic Wars.

Matters of less importance were referred to the Conference of Ambassadors, a body created in 1920, which sat in Paris. To it there reported, for instance, the territorial commissions which had been set up to mark the new frontiers; it had to frame the decisions arrived at after the various plebiscites ordained by the Peace treaties, had been held. Much of the work which came before it was of an extremely subordinate character. It is a mistake, which is not uncommon, to speak of the Conference of Ambassadors as a body with its own independent rights and duties. In itself it had no power or authority; it was merely a clearing house established to avoid the long delay involved in dealing with questions by the ordinary diplomatic channels. The members of the conference were each directly responsible to the Government by which he was appointed. Its functions were also strictly limited to questions which arose out of the execution or interpretation of the treaties; there does not seem any case in which it transcended them. As the years went on, the points referred to it, which at first had been very numerous and sometimes of considerable importance, naturally diminished.

The League of Nations.—Of greater importance was the institution of the League of Nations. This differed fundamentally from the older system of meetings of the Great Powers and, in fact was something quite new in the machinery of dealing with international affairs. The first point to be noted in its organisation was that it was a permanent body with a standing secretariat and regular meetings. By this alone it showed a great advance. Matters of a political nature could be referred to it and dealt with immediately before they had had time to become politically dangerous. When any local dispute arose, it was no longer necessary to create special machinery for dealing with it or to resort to the cumbrous method of calling a special conference; the machinery was there ready and able to get to work without delay. Moreover, it was found that an appreciable advantage was gained by transferring discussions from the more electric atmosphere prevailing in cities such as Paris, London or Rome, to the more neutral and impartial surroundings of Geneva.

Almost as important as the creation of the League itself was that of the Court of International Justice, which was set up in the year 1920–1 at The Hague; the settlement of international disputes was much facilitated by the existence of a permanent organ to which all questions of a judicial nature were automatically referred. Again, in the constitution of the League there was found a solution of a long-standing difficulty. The dominance of the Great Powers had during the 19th century been pushed so far as seriously to threaten the sovereignty and independence of the smaller states. In the Assembly of the League, however, every European State, except Germany and Russia, had a seat, and in the Council (which was for most purposes the executive organ) side by side with the permanent members, the Great Powers, there was an actual majority of elected representatives of the other states. All this gave to the smaller states an influence and importance of which they had long been deprived. Of this opportunity they were quick to avail themselves. Many of the representatives, for instance Mr. Branting of Sweden, M. Hymans of Belgium, M. Beneš of Czechoslovakia, M. Politis of Greece, M. Quinones of Spain, quickly won a high position in public esteem; they showed eloquence in debate and wisdom in counsel. It soon became apparent that in dealing with political matters one of the chief weapons of the League was publicity. The open discussion in the Assembly and the Council had a great effect in creating a general public opinion which no state could afford to ignore.

Naturally time was required before the League could undertake its political duties. It was fortunate that the major questions which were agitating Europe at this time, especially the continued conflicts between the Allies and Germany, did not fall within its sphere. They, like all other questions concerning the interpretation and enforcement of the treaties, had in the first place to be dealt with by the Allies. It was an important stage when, owing to continued differences of opinion in the Conference of Ambassadors as to the partition of Upper Silesia after the plebiscite, this question was referred to the League for decision. They were asked to adjudicate on the difference of opinion between Great Britain, France and Italy, all three Powers, having agreed beforehand to accept their verdict. The decision when given was at once adopted and enforced, and though the justice of it has often been criticised, the very fact that a decision was obtained in this manner was a good omen for the future. Other matters arising out of the treaties were by them definitely referred to the League and not to the Allies, as for instance the control of the Saar Valley, the adjudication between Poland and Danzig of disputed points which arose in great number owing to the anomalous position in which the free city of Danzig had been placed. These, and the working of the Minority Treaties, which also belonged to the League, gave valuable experience and materially helped to solidify the new institution. In some cases it was not so successful.

The League failed, as did the Allies, to bring about a satisfactory solution of the controversy which arose between Poland

and Lithuania after the lawless seizure of Vilna by General Zeligowski. When a similar problem arose out of a raid by the Lithuanians on the town of Memel, outstanding points were eventually referred to the League by the Conference of Ambassadors; here again a solution was arrived at, though in this case the terms of settlement were such that grave apprehension might be felt as to the feasibility of enforcing them. The most marked success which the League achieved was the settlement in June 1921 of the dispute between Sweden and Finland regarding the ownership of the Aaland Islands. But they also intervened effectively to determine awkward frontier questions between Albania and Yugoslavia, and they averted what would probably have been an outbreak of war between Greece and Bulgaria in 1925 over a serious frontier incident. In another sphere the League proved itself of great use, when its assistance was called upon to create a scheme for the financial rehabilitation of Austria, and, this having been done, in a similar way to bring about an international agreement for the restoration of Hungarian finances.

Great Britain and France.—Ultimately the peaceful progress of the Continent depended upon the mutual relations between the three Great Powers, Great Britain, France and Italy, and particularly on those between Great Britain and France. Not only in the more informal diplomatic discussions, but in the meetings of the Supreme Council, the Conference of Ambassadors, the Reparation Commission, and also the Council of the League of Nations, no satisfactory conclusion could be obtained unless an agreement had been arrived at between France and Great Britain. This agreement was often difficult. Even during the War there was constant evidence that the close understanding which had been temporarily brought about owing to the insistent pressure of the German danger, was fragile and uncertain. From the moment that this danger was over, divergence of policy began. It was present throughout all the discussions in Paris and increased after the peace treaties had been signed. There were many matters on which the two states were by their interests and traditions disposed to take conflicting views.

The French Govt. and people, naturally intent on future security desired to protect themselves by a new system of defensive alliances, in which the military superiority of the Allies should be made permanent. Great Britain, owing to her world-wide interests and the fact that her representatives had to speak not only for these islands but also for the Dominions, was forced to take a more detached view of purely European problems, and in particular, public opinion was very averse from any formal commitments which might force her on some future occasion to take part in a new European war. While the French aimed at a common guarantee for the maintenance of the new system among the states adjacent to Germany, especially with Poland and Czechoslovakia, the British wished to pursue a policy rather of reconciliation, and were very opposed to anything that would bind them to a formal guarantee of the new frontiers in the East of Europe. Throughout the long negotiations with Germany on military control, on reparation, on the occupation of the Rhineland, the British representatives always tended to take a more lenient view than the French; these differences led to something like an open conflict of policies, especially during the period when M. Poincaré held office as French Minister President. There was, for instance, definite British opposition to the occupation of the Ruhr and to the French attitude towards the Separatist movement in the Palatinate and the Rhine provinces.

The diplomatic situation created was often difficult, for however great the difference of opinion might be, no one could doubt the supreme importance of maintaining the closest touch between the two countries. Any definite severance or diplomatic opposition would necessarily have had the gravest consequences. Europe was full of inflammable material; there were many places where at any moment a conflagration might break out. If in any of these questions, as for instance the attempts of the Emperor Charles to recover his throne and the consequent mobilisation of the forces of the Little Entente, the constant causes of friction between Yugoslavia on the one hand, Italy, Greece and Bulgaria on the other, the two Great Powers, instead of using their common influence to damp down the growing excitement and enmity, had taken sides, each supporting one of the antagonists, there would have been, instead of a brief and unimportant local controversy, a formal division of interests which would have affected the whole Continent.

This period of strained relations came to an end in the spring of 1924, when the fall of M. Poincaré followed shortly after the establishment of the Labour Ministry in this country. From this time there took place a remarkable change in French policy. They had, as we have seen, concentrated their endeavours on procuring by alliances a permanent military superiority on the Continent; they now became keenly interested in the rival policy of producing security by disarmament. French representatives took a leading part in the drafting of the treaty for mutual security and also in advocating the adoption of the Geneva Protocol. In both matters the British Govt. was less accommodating. There was a curious change of position. The English representatives now found that they were quickly losing the position which they had hitherto occupied, of being the principal supporters of the methods of avoiding war, with which the League was especially associated. As a result it seemed for the time that the French would step into this position, and there is no doubt that thereby they would greatly increase the influence, always important, which they had exercised at Geneva.

Italy.—In this association of the Allies during the first years after the War, Italy, under successive weak and embarrassed Govts., hampered as she was by internal dissensions, took no permanent part and pursued on the whole a pacifist rôle. A great change ensued when in Oct. 1922, after the march on Rome, Signor Mussolini, with a firm hand, took over the control. There was some apprehension that as a consequence of the strong nationalist element in the Fascist movement, the Government might adopt an ambitious and aggressive policy. Support for this was given by the very vigorous action of Mussolini when, in consequence of the murder of Italian officers occupied in the delimitation of the Greco-Albanian frontiers, an Italian fleet was sent to Corfu and attacked and occupied the town. Confronted, however, by the strong expression of opinion at a meeting of the League of Nations, the Italian Govt. accepted the intervention and agreed to abide by the decisions of the Conference of Ambassadors, and what seemed for a moment a dangerous episode passed over (*see* CORFU; LEAGUE OF NATIONS). In other matters, as for instance the settlement of the prolonged Fiume controversy and the general amelioration of relations with Yugoslavia, the new Italian Govt., while effectively protecting the interests of its own country, showed a considerable amount of diplomatic skill and discretion.

The Little Entente.—In no part of Europe did it seem that the danger of continued unrest, both political and social, and then the outbreak of a fresh war, was so imminent as in the southeast. The disappearance of the Austro-Hungarian Monarchy had brought about a state of things which is often referred to as the Balkanisation of Europe. Instead of one of the Great Powers, which with all its faults and internal weaknesses, had maintained for many centuries settled order, there were a number of small states of which some had to start the work of government from the very beginning. It was feared by many that they would be unequal to the task, that they would fail in maintaining internal order and cohesion, and that consequently fresh wars might break out between them.

It was under these circumstances that the " Succession States " arranged with one another a network of defensive alliances. This new system, commonly known as the Little Entente is undoubtedly one of the most remarkable diplomatic and political developments in Europe since the War. Among other things it shows a determination on the part of these states boldly and vigorously to take their place in Europe; they refused to accept a position, which perhaps some had anticipated they would hold, as clients to the Great Powers; they appear indeed to have acted without consulting, and perhaps to some extent contrary to the wishes of the Principal Allied and Associated Powers. It

was a significant and not unwholesome reminder that the smaller states of Europe proposed to make the fullest use of the position which they had won, and it was the fitting outcome of a war in which the cause of small nations played so large a part. A German victory would certainly have implied complete German predominance over the whole of Central Europe; the Allied victory had brought into existence new states of the second rank, but these were animated by the strongest assertion of their sovereign rights and influenced by a keen sense of national independence. In this the lead throughout was taken by Dr. Beneš, the Foreign Secretary of the Czechoslovak Republic.

The beginning of this system (*see* LITTLE ENTENTE) is to be found in a treaty between Czechoslovakia and Yugoslavia of Aug. 1920; this is in form a defensive alliance against an unprovoked attack from Hungary. In April 1921 a similar treaty was concluded between Czechoslovakia and Rumania: this, unlike the first, provided for a separate military convention to be eventually concluded. In June 1921 an identical treaty was signed between Rumania and Yugoslavia. It was the alliances between these three states by which the nucleus of the Little Entente was formed, and the basis of the alliance was mutual protection against the possibility of attack by Hungary. The reason of this is obvious; the territories of each of these states included large areas which had formerly belonged to Hungary, part of which were inhabited by a considerable Magyar population. The Hungarians, though they had been forced to sign the Treaty of Trianon, consistently refused to recognise the moral justice of the new frontiers, and it was the policy of the national parties to work for the restoration, at any rate of large parts of the territory which they had lost. Subsequently on March 3 1921 Poland concluded a treaty with Rumania in which, for obvious reasons, there was no specific mention of Hungary. It is an alliance for the defence of their existing frontiers. It becomes, therefore, a defensive alliance against Russia. In Dec. of the same year a treaty by which the two states mutually guaranteed each other's territories, was concluded between Czechoslovakia and Austria. This is of importance because it is the first case in which one of the states defeated in the War entered into a treaty of this nature with one of the victors, and thereby the Austrians formally gave up the claim which they had made in 1919 to those parts of Czechoslovakia in which there was a predominantly German population.

While the British Govt., though maintaining the most friendly relations with the different states concerned, and particularly with Czechoslovakia, held aloof from these arrangements, the French Govt., without any formal treaty, kept in close touch with the Government of Czechoslovakia and throughout assisted them by advice and the maintenance of a military mission, in building up their new army. With Poland, in Feb. 1921, they entered into a treaty by which the two Governments bound themselves to discuss together all questions of foreign policy in which they were mutually interested, and agreed, if necessary, to take steps for the mutual defence of their territory and the safeguarding of their legitimate interests. By an exchange of notes in 1921 the Italian and Czechoslovak Ministers declared that there was a complete identity between the views and aims of the two countries in the sphere of international politics, especially as regards the application of the treaties of peace and the policy to be followed towards the Successor States of the Austro-Hungarian Monarchy.

By the end of 1921, therefore, the new group of states had come into effective existence, and it was cemented by repeated meetings on each other's territory of the leading ministers. It acquired additional strength in 1924, when the prolonged difficulties between Italy and Yugoslavia, arising out of the Fiume question, had at length been settled, and in consequence a treaty of alliance was signed at Rome on Jan. 27 1924. In the same year a formal treaty of alliance was made by Czechoslovakia with both Italy and France. It must be noted that in all these treaties it is expressly stated that they were in accordance with the Covenant of the League of Nations, and were, of course, as required by the Covenant, published and deposited at Geneva. In this way they differ from previous systems, such as that of the Triple Alliance, which were to a large extent secret. This, however, does not apply to the military conventions by which some of the treaties were accompanied.

Politically the general result of these treaties seems to have been to maintain peace and security. Hungary, disarmed as she was and with her greatly reduced territory, was not in a position to take the offensive. That the treaties were effective and that action would be taken in accordance with them was shown on more than one occasion, especially when the ex-Emperor Charles, in Oct. 1921 suddenly appeared in Hungary with the object of regaining the throne which he had lost. On this occasion the Czechoslovak Army was mobilised and it was probably only the intervention of the Great Powers which prevented the occupation of Hungarian territory.

The problems and difficulties caused by the peace settlement were, however, not only political. The economic and financial results were equally important. The Empire had formed a unit, with a common railway system and common customs frontier, (Austria and Hungary, though technically distinct, had entered into a customs agreement) the financial centre being placed in Vienna, which was the headquarters of the great banks by which capital was distributed throughout the territories. From the moment of dissolution each of the successor states claimed and exercised the right to complete control of its own economic and financial policy. Animated by an intense spirit of nationality, they were above all anxious to assert their full sovereignty, and refused to consent to efforts which were made during 1919 to maintain in some form or another financial, if not political unity.

They were just as frightened of the maintenance of the economic superiority of Vienna as they were of its political control. Each of these states was animated by the desire to make itself economically sufficient, and with this object, set to work to impose very high tariffs in order to foster its own industries. The result was a sudden and complete severance of long standing commercial ties. Trade and industry were disorganised; moreover, pending the liquidation of the great railway companies and railway material, the whole system of communication was thrown out of joint, as was the trade on the Danube, which was in the hands of several competing states, who created new impediments to its commercial use. The results were especially disastrous for the city of Vienna, which had largely depended on the trade in articles of luxury to the less highly developed parts of the Empire, and also to the Balkans, but it seriously interfered with the prosperity of all the countries concerned. Under these circumstances many still maintained the hope of restoring in some form the old economic unity.

Immediately after the War there were indications that some similar system of mutual guarantee between the smaller states might be formed among the countries bordering on the Baltic, in particular, among the states which had been separated from Russia. It was perhaps hoped that the three Scandinavian states would be willing to lend their support to such an alliance. If so, the hopes were disappointed. Sweden, Norway and Denmark, which had established and maintained during the War co-operation on matters of common interest, preferred, when the immediate danger was over, to revert to their older condition of isolation. They were prepared to rest their security on the general guarantee given by the League of Nations. In the summer of 1921 a Conference was held at Warsaw, which was attended by representatives of Finland and the three Baltic states, with a view to a defensive alliance, which in effect would have been one against Russia. The people of Finland, however, were not unnaturally alarmed by the prospect of being entangled in a war with Russia arising out of questions connected with the Polish frontier. At that time the relations between Russia and Poland were still very strained. In consequence, Holsti, the Prime Minister, finding that he could not get support for his policy, had to resign, and from this time these larger schemes fell to the ground. All, therefore, that was achieved was an alliance between the two small states of Latvia and Estonia, the political and commercial interests of which were almost identical. From

this alliance, Lithuania, chiefly occupied by her perennial struggle with Poland, and therefore to some extent tending to depend on Russian support, held aloof.

Guarantee Treaties.—It was the strength, but also the weakness of the League of Nations, that as its members were recruited from all continents, so also in its formal constitution it gave no recognition of, or method of dealing with, those matters which concerned peculiarly the continent of Europe. This was shown by the treatment of the whole question of disarmament in connection especially with the different schemes for treaties of mutual guarantee and disarmament, and for the further proposals contained in the Geneva Protocol of 1924. Quite apart from the fact that by the preamble to the disarmament clauses of the treaty, the Allies had formally bound themselves to the principle of disarmament, there was a general agreement that a great reduction of armaments was essential to the future peace and progress of the Continent. Whatever view might be held about the particular degree of responsibility for the War of 1914 which attached to each Power or each group of Powers, on one matter all were agreed—that the chief predisposing cause of the outbreak of war was the intense rivalry of armaments which had continued and increased ever since the war of 1870. It was a natural deduction that if this rivalry in armaments was to continue, it would at some future period almost inevitably result in a new outbreak.

It could probably be foreseen that whatever the terms of the treaty were, it would not be possible permanently to maintain the system by which Germany was compelled to almost complete disarmament if, after she had become a member of the League of Nations, other nations of Europe, by which she was surrounded, especially France and Poland, recognised no restriction of the preparations which they might make for war. There was also ground for legitimate apprehension that if the newly constituted states of southeastern Europe devoted a large part of their energies and other resources to the building up of general armaments, sooner or later temptation might become irresistible to use these armies, not necessarily against their old enemies, Hungary and Bulgaria, but in some quarrel between themselves. There were, for instance, causes of friction between Yugoslavia on the one side, Italy and Greece on the other. It was obviously very undesirable that in a time of general financial depression and economic embarrassment, the countries of Europe should squander an undue part of their resources in military preparation.

For this reason, various schemes were projected, the general object of which was to work out a system in which the nations should mutually bind themselves each to reduce its army and navy to a specified strength, while at the same time, by a general mutual guarantee, they should undertake to protect one another against aggression. As soon, however, as any attempt was made to reduce these schemes to a precise form, difficulties arose from the fact that if they were to be made generally binding on all the states, members of the League of Nations, the mutual guarantee would apply both to European, and to Asiatic and American States. This affected more particularly the British Dominions, which, while they acted as independent members of the League, were united in their refusal to enter into any binding engagement again to intervene in matters of purely local European importance. In truth, the problem of disarmament as it existed in Europe, owing to historical reasons, did not apply elsewhere. In South America there was no such great military tradition. In the Pacific the rivalry of armaments was naval rather than military, and it therefore was quite properly dealt with, not at Geneva, but at a special conference summoned for this purpose at Washington in Nov. 1921, a conference which was attended only by Great Britain and France among the European States, and in which a major part was taken by the United States of America, Japan and Great Britain, in her capacity as a Power specially interested in the affairs of the Far East.

What was wanted, however, was some special arrangement between the European States themselves; as M. Briand said: "Pour assurer la paix, c'est l'Europe qu'il s'agit d'organiser."[1] This became more evident in the discussions on the Treaty of Mutual Assurance and the Geneva Protocol. It could not be expected that the South American Republics would be ready to co-operate in enforcing sanctions arising out of a purely European conflict. This point of view was also expressed by the British Dominions; everything seemed to point to the necessity for some arrangement for special treatment of the affairs of each continent, but the more the matter was investigated, the clearer did it become that the European problem was too varied and too complex to allow the whole of it to be dealt with in a single instrument. This was the view put forward authoritatively by Mr. Austen Chamberlain when expounding the reasons why Great Britain was unable to accept the proposals of the Geneva Protocol; as he explained, it would be wiser to approach the question not from a general, but from a local, agreement.

On the continent of Europe there were three areas from which danger could be anticipated:—the Rhineland, which had so often been the cause of war between France and Germany during the last thousand years; the Eastern frontiers of Germany, where, as we have seen, the Germans refused to accept as a permanent solution the frontiers laid down in the Treaty of Versailles; and the southeast of Europe. Of these at the moment the Franco-German problem presented the smallest difficulty. No one really anticipated that the Germans, if they attempted at any future time to recover by force the position which they had lost, would begin upon the Rhine; there, they knew, the opposition they would have to meet would be strongest; the French Army was the largest in Europe, and though the draft treaties of mutual assurance by which Great Britain and the United States had in 1919 offered their help to France against a renewed war of aggression from Germany, had not come into force, the Germans would still fear that anything in the nature of an unprovoked attack on France would recreate the coalition by which they had been defeated. They were not likely in the future to hazard a new war against the combination of France and England.

Locarno.—From 1922 onwards constant discussions and negotiations had taken place with the object of bringing into existence some new treaty by which the security of France against invasion would be guaranteed. None of the proposals made had been successful. The chief reason for this was that the French now asked, what they had not asked in 1919, that any such treaty should apply not only to the western, but to all the frontiers of Germany. This the British Govt. was unable to accept. There was, moreover, a strong feeling in this country against continental commitments in general, and particularly against any treaty which would seem designed to perpetuate the division of Europe into victors and vanquished. But a solution was eventually found in a proposal which, in March 1925 was put forward by the German Govt.; they suggested a mutual pact of non-aggression between Germany on the one side, France, Belgium and Great Britain on the other. This was a very notable proposal because in effect it implied that Germany would voluntarily bind herself not to attempt by arms to recover Alsace-Lorraine. She relinquished the idea of a war of revenge. It was first made confidentially to the British Govt., and afterwards embodied in a formal note to France, and was made the basis of discussions which took place at Locarno during the month of Oct. 1925. The agreement arrived at was embodied in a series of treaties, all of which were signed in London on Dec. 1, of that year.

The essential points in these treaties were that Germany on the one side, France and Belgium on the other, agreed mutually to refrain from any act of aggression, to respect and keep inviolate the frontiers arranged in 1919: and, in addition to this, to submit all causes of dispute which might arise, to arbitration. These basic agreements were supplemented in the main treaty of Locarno by a mutual guarantee, in which Great Britain and Italy also joined. The result was that every cause of dispute was to be submitted to arbitration, and that if any one of the states violated this undertaking, all the other signatory Powers, including this country, would be compelled, if necessary, to come to the help in arms of the state whose territory had been attacked. It was a condition, moreover, that Germany should immediately apply for admission to the League of Nations. After some delay,

[1] *Journal officiel*, Feb. 27 1926.

owing to the internal weakness of the German Govt., formal permission was given by the Reichstag, and the application was presented at Geneva on Feb. 11 1926.

In addition to the treaties dealing with the western frontier of Germany, general arbitration treaties were concluded between Germany on the one side, Poland and Czechoslovakia on the other, and by a separate instrument France undertook in this case a unilateral obligation to Poland and Czechoslovakia to guarantee this treaty.

As soon as the treaties had been signed, the Allies, in accordance with the promise already made, hastened to carry out the evacuation of the northern part of the occupied Rhenish area which, by the Treaty of Versailles, was to have been concluded in Jan. 1925, and numerous other concessions were made to Germany in regard both to the number of troops maintained in the occupied area, and the exceptional measures introduced at the time of the occupation of the Ruhr were withdrawn. Outstanding points concerning the disarmament of Germany, and in particular aerial control, were also settled.

These two events mean that Germany signed the treaties of Locarno as an equal Power, on the same status as the Allies. By the fact that the British guarantee was given equally to her and to France, and by her prospective admission to the League of Nations, she regained her position as an equal member of the European family of nations. It was an act similar to that by which, at the Congress of Aix-la-Chapelle in 1818, France was welcomed into the Concert of Europe, which hitherto had been an association of the Allies against France. On the other hand, on some points the change was not complete. Germany was, and would remain, in an inferior position so long as part of her territory was still occupied by Allied troops, and so long as, in respect of her naval, military and aerial forces, she was subject to restrictions which did not apply to the other European states. Moreover, at the last moment an unexpected difficulty prevented the final conclusion of the arrangements made at Locarno. It was an essential part of the settlement that Germany should apply for and be admitted to the League of Nations, and should on admission to the League be granted the status of a permanent member of the Council, the position held by all the other Great Powers.

In March 1926 a special meeting of the Council and Assembly was summoned; unfortunately proposals were put forward that the opportunity should be used for far-reaching changes in the constitution of the Council, and in particular that Poland, Spain and Brazil should, at the same time as Germany, one or all of them, be made permanent members. Even more unfortunately it was publicly suggested that some step of this kind would be a protection to Europe against German influence. Inevitably, therefore, the German Govt. let it be known that she could not enter the League if any changes in the constitution of the Council were made prior to her admission. Before and after the meeting of the Assembly, prolonged negotiations took place; it appeared that they had reached a satisfactory conclusion, but eventually Brazil intimated that unless a permanent seat was accorded to her, she would refuse to vote for Germany's admission. As unanimity was required among members of the Council, her single veto would be effective. There was nothing left to be done but to postpone the consideration of the matter until the next regular meeting of the Assembly in Sept. 1926.

The result was most unsatisfactory. Germany was condemned to wait for nearly a year before she could be admitted to the League, and it was quite natural that in order to strengthen her own political position she should enter into a fresh treaty with the Soviet Govt. which in political inportance went very far beyond the Treaty of Rapallo. The text of the treaty raised serious questions of interpretation which might be used to prevent her admission to the League. In the spring of 1926 the whole situation was therefore most obscure and unsatisfactory.

See A. J. Toynbee, *Survey of International Affairs 1920–3, and 1924* (1925–6). Issued by Oxford Univ. Press under the auspices of the British Institute of International Affairs. "Post-War Political Alignments" in *World Peace Foundation Pamphlet. League of Nations* vol. vi. No. 2. (World Peace Foundation 1923). *See* also the articles on individual European states: FRANCE; GERMANY; GREAT BRITAIN; ITALY; RUSSIA; etc.; also LEAGUE OF NATIONS, and the special articles on the subjects referred to in the second part of that article on the work of the League during the first six years of its existence.

(X.)

EVANS, SIR ARTHUR JOHN (1851–), British archaeologist was born at Nash Mills, Herts, July 8 1851, the eldest son of Sir John Evans, K.C.B. (*see* 10.2). Educated at Harrow, Brasenose College, Oxford and Göttingen, he was elected fellow of Brasenose, and in 1884 keeper of the Ashmolean Museum at Oxford, holding this post till 1908. He travelled in Finland and Lapland in 1873–4, and in 1875 made a special study of archaeology and ethnology in the Balkan States. In 1893 he began his investigations in Crete, which have resulted in discoveries of the utmost importance concerning the early history of Greece and the eastern Mediterranean (*see* 1.246, 7.421 and ARCHAEOLOGY: CRETE). In 1911 he was knighted.

His chief publications are: *Cretan Pictographs and Prae-Phoenician Script* (1896); *Further Discoveries of Cretan and Aegean Script* (1898); *The Mycenaean Tree and Pillar Cult* (1901); *Scripta Minoa* (1909); *Palace of Minos I.* (1922); and reports on the excavations at Knossos. He also edited, E. A. Freeman's *History of Sicily*, vol. iv.

EVEREST, MOUNT (*see* 10.7).—A description of the attempts to climb Mount Everest, the highest known summit in the world, may be divided under three headings, the reconnaissance expedition of 1921, the first attempt to ascend the mountain in 1922 and the second attempt in 1924.

Previous attempts had been made to obtain permission to travel in that part of Tibet and to explore and attempt to climb Mount Everest, but only the expeditions of 1921, 1922 and 1924 are dealt with here. The extraordinary advance in the relations between Tibet and the outside world were such that it was possible in 1920 to approach the Tibetan Govt. with every hope of success in obtaining from them permission to approach the mountain and explore its surroundings. As a preliminary, Col. Howard-Bury, in 1920, visited Phari Dzong. His negotiations were successful, and in the winter of that year the first expedition was organised to reconnoitre and explore all the approaches to the great group and to make preliminary climbs on the mountain to ascertain the conditions and favourable points of attack.

THE RECONNAISSANCE EXPEDITION OF 1921

This preliminary expedition carried out their work in the most complete manner the following summer. Roads and approaches to the Everest district, which are contained in the district of Shekar and Kharta Sheka, were thoroughly explored and mapped. The approaches to Mount Everest on all its northern faces were thoroughly examined. Relations were established with all the local authorities. This expedition was excellently constituted for the work in hand. Under the leadership of Lt.-Col. C. K. Howard-Bury, D.S.O., the climbing party consisted of Mr. C. H. Bullock, Dr. A. M. Kellas, Mr. G. L. Mallory and Mr. Harold Raeburn. Maj. H. T. Morshead, D.S.O., and Maj. O. E. Wheeler, M.C., went as surveyors and Dr. A. M. Heron as geologist. Mr. A. F. Wollaston was doctor, naturalist and botanist. Among them was one mountaineer and scientist whose name stands out pre-eminently in the exploration of the East Central Himalaya—Dr. Kellas. Unfortunately Dr. Kellas died during the progress of the expedition's march through Tibet, and now lies buried under the fort of Khampa Dzong. The expedition was accompanied by two officers of the Indian Survey in Maj. Morshead and Maj. Wheeler, as well as by Dr. Heron, a representative of the Geological Survey of India.

The Rongbuk Valley.—The first object was to explore the Rongbuk Valley beyond the great Rongbuk monastery. From there the mountaineering party pushed up the west Rongbuk glacier, which descends directly from the northern faces of Mount Everest, but failed to find the true approach to the mountain up the narrow mouth of the east Rongbuk glacier. This glacier was later on in the year surveyed by Wheeler and the true approach was established. Later, the expedition crossed over to the low-lying country to the east of Mount Everest at Kharta Sheka.

From there a pass was found named the Lhakpa La, 22,000 ft.,

which led to the head of the east Rongbuk glacier. From this point the mountaineering members of the party were able to trace the most likely line of attack on the mountain and actually mounted by difficult snow and ice slopes to a col on the main north ridge descending from Everest, which they named the Chang La or North Col. By this time the season was late, the weather was breaking and no more work could be effected. The reconnaissance expedition had collected an immense amount of information and had mapped the country to the north of Everest.

The Attempt of 1922

On the information and experience of the reconnaissance expedition, the second expedition to Everest was organised, which was to complete the exploration of the group and to carry out the ascent of the great mountain. Brig.-Gen. the Hon. C. G. Bruce, C.B., M.V.O., was in command, with Col. E. L. Strutt as second-in-command. The climbing party consisted of Mr. G. L. Mallory, Maj. E. F. Norton, D.S.O., R.A., Dr. T. H. Somervell, Dr. A. W. Wakefield and Capt. G. I. Finch, who was oxygen officer to this party. Dr. T. G. Longstaff was doctor and naturalist. Mr. C. G. Crawford, Capt. J. G. Bruce, M.C., and Capt. C. J. Morris were the transport officers. Maj. H. T. Morshead, D.S.O., as surveyor and Capt. J. B. L. Noel as photographer completed the party forming the second expedition.

Choice of Season.—It had been found necessary to make the attempt early in the year, as giving a better chance of good weather and of finding the snow conditions on the mountain more favourable to an assault; but this early start also carried with it a great deal more exposure and, naturally, fatigue on the journey from Darjeeling to Everest; for on this route not only are the passes which cut off the southern Himalaya from the north to be crossed, but on the way a large number of high and exposed ridges have also to be negotiated. Naturally, too, the outfit was much greater; and for the first time in the exploration of the mountains experiments were to be made in the artificial administration of oxygen as an assistance in counteracting the effects of low atmospheric pressure. By the end of April 1922 the expedition was collected in the Rongbuk valley and the base camp established within two miles of the snout of the west Rongbuk glacier. An immense amount of stores of all descriptions had been transported to this spot, employing some 350 transport animals.

The Transport Problem.—It is necessary at this point to explain how great is the problem of attacking such a mountain as Everest. It differs immensely from an ordinary mountaineering expedition, and besides the pure mountaineering technique which is required, many of the methods necessary for polar exploration must be put in force. Besides, a large number of first-class porters are required owing to the immense amount of stores which must be moved to great altitudes. For them special clothing and food are necessary, which greatly adds to the difficulties of equipment. The expedition drew its porters mainly from subjects of Nepal, belonging to a tribe known as Sherpas. They are true Tibetans, who in the course of generations have settled on the southern slope of the Himalaya. They live in a steeper and slightly less elevated country than Tibet, and are thoroughly suitable for the work; but among them there were also certain true Tibetans of Tibet. These men have proved through all the expeditions a great success.

Importance of the Monsoon.—But the real problem is the race with the monsoon. This period of time, from May 1 to early June, is the only suitable time for the attack on the mountain, and even this is dominated by the approach of the monsoon. Up to the arrival of the south-west monsoon the whole northern slopes of the Himalaya are swept by an intensely dry and cold wind. While these conditions continue, the mountains are safe if human beings can stand the terrible cold, immense fatigue and the dominating factor of low atmospheric pressure. When once the humid and warm southwest monsoon is established, the mountains are unapproachable, snows thaw, avalanches fall and progress is impossible. Hence the great difficulty is an immense exertion to be undertaken in a short time.

Camps Established.—Up the east Rongbuk glacier camps were established, from the base camp at 16,500 ft. above sea level to camp 3, four stages higher up, which was placed near the foot of the slopes leading to the Chang La or North Col. At camp 3 the advanced base of the expedition was established, at a height of 21,000 ft., and here were accumulated stores of every description for the attack on the mountain, with food supplies sufficient to last 12 Europeans and 50 natives for one month. From here a high camp was pushed on up to the North Col, which was successfully established in good weather. From this camp the first attempt without the assistance of oxygen was made.

First Assault on the Mountain.—The four members of the party who were chosen for this effort, Maj. Norton, Dr. Somervell, Mallory and Morshead, set out from the North Col. With great difficulty they established a camp at about 25,000 ft. on the sheltered side of the great north ridge which descends from Everest. This camp was carried up for them and pitched by the special Sherpa porters. It is worthy of note that until this expedition only once in the whole history of mountain exploration has a camp been pitched as high as 23,000 ft., the height of the Chang La, and that was only for one night. The camp referred to was that of Mr. Meade's expedition on Kamet in Garhwal. This camp at 25,000 ft. was occupied on May 19. The following morning three of the climbers, Somervell, Norton and Mallory, continued their attempt on Everest, Morshead having to be left behind as he was suffering from frost-bite and exhaustion. The climbing party pushed on under trying conditions of wind and weather until they attained the height of 26,985 ft., the highest point yet reached by human beings.

At this point their strength was so far exhausted as to make further progress unsafe, and a retreat was made. Their descent was most toilsome and slow, but finally the camp at 25,000 ft. was reached, and Morshead had to be conducted back from this point in bad weather to the North Col. In traversing back from the gîte on the face of the mountain, an accident as nearly as possible occurred from a slip; but after a dramatic and exciting incident their laborious descent was continued, and finally, completely worn out, they reached the camp on the North Col at midnight. Morshead was badly frost-bitten, and each of the other members of the party in a lesser degree.

First Attempt with Oxygen.—Later, on May 25, a second attempt was made by Finch and J. G. Bruce, using the oxygen apparatus from as low down as camp 3. They were accompanied by Naik Tejbir Bura, a young Gurkha non-commissioned officer who belonged to Capt. Bruce's regiment, the 6th Gurkha Rifles. This party followed on the footsteps of the previous one, camping, however, some 500 ft. higher, at a height of 25,500 ft. on the main ridge itself, their porters thus surpassing the efforts of the previous party. The porters returned to the North Col, but the climbing party were caught that night in a furious hurricane and were camp-bound for two nights and a day. Their experiences were most trying, and it is lucky that they ever survived that terrible exposure.

The morning of the second day, the weather having calmed, they set out, using the full oxygen apparatus and employing the Gurkha non-commissioned officer to carry spare oxygen bottles. On reaching the height of 26,000 ft. this young man could proceed no farther. The two mountaineers continued alone from this point, and before being completely exhausted reached a height of some 27,300 feet.

Their return journey, still using oxygen and picking up reserve oxygen supplies on the way down, was in great contrast to the experiences of the first party. They not only descended the mountain at good speed but continued from the North Col or Chang La directly down to the advanced base camp at camp 3. The expedition then returned to the base camp for rest, all members of the party being greatly exhausted. From this camp certain members of the expedition, including Morshead, were obliged to return to India.

Third Assault.—A third attempt was organised, and the party left on June 3, consisting of Finch, Mallory, Somervell, Crawford and Wakefield. Finch shortly returned and joined the homing party. The remainder again pitched their camp at the advanced

base, and on the morning of June 7 attempted to reach the North Col; but unfortunately they had been overtaken the previous three days by bad weather and heavy snow, and following the formerly used route to the North Col they were obliged to traverse the snow slopes rendered extremely dangerous by the accumulation of fresh snow.

They were caught in a great avalanche which swept down the face of the mountain side and carried down the whole of the party of 17 roped-in groups of four and five. Two of these groups, one of four and one of five men, were swept over an ice cliff some 60 ft. high, and only two out of the nine men thus carried away were saved. The leading rope, consisting of three climbers, Crawford, Mallory and Somervell, was carried down for some 150 ft. by the avalanche and stopped well above the danger point without injury to the climbers. This third attempt ended the expedition of 1922, which then, as a body, returned to India, having added immensely to the knowledge of the possibilities of further acclimatisation at high altitudes.

The Attempt of 1924

The 1924 expedition consisted of Brig.-Gen. the Hon. C. G. Bruce, C.B., M.V.O., in command, and of Lt.-Col. E. F. Norton, D.S.O., R.A., second-in-command. The climbing party consisted of Mr. Bentley Beetham, Capt. J. G. Bruce, M.C., Mr. J. de V. Hazard, Mr. A. C. Irvine, Mr. G. L. Mallory, Mr. N. E. Odell and Dr. T. H. Somervell. Mr. E. O. Shebbeare was transport officer, Dr. R. W. J. Hingston, doctor and naturalist, and Capt. J. B. L. Noel was again photographer. This expedition was able to profit in a great number of ways by the experience of the two previous expeditions. Leaving Darjeeling at about the same time as before, it arrived a few days earlier at the same base camp at Rongbuk. Its transport had been improved and increased. Unfortunately, during the march up, Gen. Bruce had been obliged to return to India owing to illness, and his place was filled by Norton.

Bad Weather at Base Camp.—On arrival at the base camp, every effort was made to establish a line of intermediary camps between the base camp and camp 3 with the greatest possible rapidity; but the expedition was overtaken by hurricane after hurricane during the month of May, at a time when fair weather is ordinarily to be expected. The temperatures experienced were very much lower than in 1922, and it was very soon discovered that a low temperature, high wind, hard work and a low atmospheric pressure together are enough to wear out the very strongest constitution in a very short period.

So for some three weeks the expedition struggled in a continuous battle to establish not only the camps on the line of communication but also the Alpine base on the summit of the North Col. This terrible fight against the elements, occasioning several returns for recuperation to the base camp, not only delayed the expedition very much indeed but reduced their strength and that reserve of power which is necessary for the final great assault—the great test of all; nor at high altitudes can that lost strength be ever adequately regained.

New Route to North Col.—The route that it was necessary to utilise between camp 3 at 21,000 ft. and the North Col camp at 23,000 ft. was far steeper and more difficult than that of 1922; but it had the advantage of being safe from the avalanches, which render the easier slopes of the 1922 route most dangerous after such weather as was experienced in this season. But it was on this route that another accident almost occurred. After the new difficult route to the North Col had been forced by Norton, Hazard led the first party of porters and established the camp on May 22. On the following day, on his descent from the North Col camp to camp 3 in bad weather, it was discovered that four porters had remained actually on the North Col itself. A hurricane that night and the following day prevented communication with them, but on the day succeeding, Norton, Somervell and Mallory formed a rescue party to extricate these men from their awkward position.

This they successfully accomplished after a most dramatic incident, two of the porters, when crossing a dangerous face, slipping down and being brought up at the edge of an ice cliff. From this position they were rescued after a very severe struggle. All members of the party were at this time terribly worn by exposure to the low temperatures and gales, the temperatures registered even at camp 3 being as low as −23° F. After this, the expedition retired to the base camp for a complete rest.

The members of the party and porters were all completely worn out. Norton led his party down to the monastery at the mouth of the Rongbuk valley, presided over by a remarkable Lama or Buddhistic priest, a man in whom every Buddhist member of the party placed absolute faith. Here a service was held, the Lama blessed and encouraged the men, and then, when morale was established, Norton, reorganising his party, led the whole expedition back again to the advanced base camp 3.

Hopes were now raised by the splendour of the weather. With reorganised plans, on June 1 camp 4 was re-established on a greater basis than ever, and from this camp the climbing party started the real assault on the mountain. There were few porters left who were fit to make such an immense effort as was required of them, and therefore several attempts were made by parties of two climbers, assisted by whatever porters were available. Mallory and J. G. Bruce pitched camp 5 at 25,000 ft., but owing to the exhaustion of their porters were obliged to return.

They were followed on June 3 by Norton and Somervell, who, passing through them, actually pitched a camp at 26,800 ft. elevation, men having been found fit enough to carry loads without the assistance of oxygen to this great height. From this point, with the greatest pain and trouble, Somervell and Norton reached a height on the following day of 28,200 ft.; they again descended to the North Col. Somervell had been working under disadvantageous conditions, suffering terribly from a high altitude throat. So dry and parched does one's throat become in this intensely cold and dry air that it forms more than an inconvenience, even a danger. Norton had been fit and well, but the following morning awoke absolutely sightless from snow blindness. An unforgettable episode occurred the following morning when Norton, stone blind, was taken down that steep and difficult descent by Hingston and Hazard.

The Last Attempt.—There was still one more attempt to be made by Mallory and Irvine. There had been defects in the oxygen apparatus and but little oxygen was now available. They were assisted by a supporting party consisting of Odell and Hazard, who accompanied them to the 25,000 ft. camp. This point, on June 6, they left with porters, who again carried loads for them to 27,000 feet. On June 8 they left camp 6, the highest camp, for their attempt. Odell on that morning arrived, according to arrangements previously made with Mallory, at this highest camp, to watch their progress and report on it and to take such steps for their comfort as were considered necessary.

He caught a glimpse of the climbers high up on the mountain side for a short space of time; the mists blew across and he saw them no more. Returning to camp 4 he awaited their return, but on the following morning, seeing no signs of them, he searched with signal and magnesium flare the whole hillside without effect. On June 10, for the third time, he mounted the slopes to 27,000 ft.—in itself an unprecedented effort—but could find no signs of Mallory and Irvine, and, communicating with Norton, evacuated the mountain.

Thus stands the battle with Everest up to 1926. Unfortunately, the expedition also lost one young Gurkha non-commissioned officer from over-exposure, and one Tibetan follower from frostbite and pneumonia. At the base camp stands a monument to those who gave their lives in this great attempt.

Bibliography.—C. G. Bruce, *The Assault on Mount Everest, 1922* (1923); E. F. Norton, *The Fight for Everest, 1924* (1925). See also *The Alpine Journal* (1922–5) and *The Geographical Journal*, incl. *Proc. Roy. Geog. Soc.* (1924–5). (C. G. B.*)

EVOLUTION (*see* 10.22).—The topic of evolution is a very wide one. In its broadest sense it denotes little more than gradual change, as is indicated by the common French equivalent *transformisme*. In a somewhat more restricted sense it implies orderly change, while certain authors wish to combine it with

orderly and progressive change. The two fields, however, in which it is most often applied are those of cosmic and of organic evolution, the former dealing with the development of stars and stellar systems, the latter with the changes undergone by life upon this planet. Here, only the topic of organic evolution will be discussed.

I. GENERAL SURVEY

Organic Evolution.—There are three quite distinct angles from which the subject can be treated. In the first place, there is the question of the *fact* of evolution: has organic evolution occurred or has it not occurred? Secondly, there is the *method* of evolution: by what mechanism has evolution been brought about? And thirdly, there is the *course* of evolution: granted that it has occurred, what were the main results of the process?

The Evidence

The evidences on the first point are well known. They are chiefly drawn from the facts of comparative anatomy, of embryology, of geographical distribution and of palaeontology.

Palaeontology.—The last, or the history of life as revealed by actual fossil remains of organisms in the sedimentary rocks, affords the most direct evidence, since we find that many past organisms are now extinct, and that there are frequently to be traced long evolutionary chains, leading up from primitive extinct forms to specialised modern types.

Embryology.—That of embryology is, however, equally important. The majority of animals run through, in the course of their development, stages which resemble other organisms. The fact that a fowl or a man passes through a stage in which its organisation is essentially like that of a fish is meaningless, save on the assumption that land vertebrates originally evolved from fish-like, aquatic ancestors.

Distribution of Animals.—The distribution of animals and plants over the earth's surface is, further, such that it cannot be explained except by assuming that evolution has occurred. If certain types have had their origins in certain areas, and have then spread thence, the facts are intelligible, but not otherwise. In the same way, the fact that oceanic islands contain but a very limited fauna and flora, and that, in oceanic archipelagoes, the types of animal life are often represented by different species on each different island, is readily explicable on the idea of chance spreading, followed by isolation and consequent evolutionary divergence.

Comparative Anatomy.—The evidence from comparative anatomy, though perhaps the most indirect, is equally strong, and was historically the first to attract attention. When we examine a series of, say, vertebrates, we soon perceive that a common general plan runs through them all, in spite of great differences in their various modes of life. The same is true for each particular organ. The hand and arm of man, the foreleg of a dog, the wing of a bird, the flipper of a whale—all these, and indeed the fore-limbs of all terrestrial vertebrates, show the same essential plan, though often much modified to suit the exigencies of the animal's particular mode of life. It must not be supposed that no other general ground-plan can exist: far from it. The insect or the crustacean is built on a wholly different general plan, and the special plan of its limbs is entirely different from that of the vertebrate limb. It is very difficult to explain these facts except on the theory of evolution.

Vestigial Organs.—The conclusion is strengthened by the existence of vestigial organs (often called rudimentary organs), which are useless to their possessor, although corresponding (homologous) organs in other species are of service. The vestigial hair on the surface of the human body affords one excellent example, while another is provided by the wholly useless remnants of limbs in various snakes. Often vestigial organs are recapitulatory as well, being better developed in the embryo or young than in the adult (hair and tail of man, teeth of certain whales, etc.).

Natural Selection.—The evidences for evolution having taken place were first cogently marshalled by Charles Darwin in the *Origin of Species* (1859). No satisfactory alternative explanation of the data he adduced has ever been advanced, and the fact of evolution has passed beyond the realm of discussion. Darwin, however, accomplished much more than this. He also advanced a theory as to the method of evolution, and one so reasonable that it could be and is still widely held by scientific men. This was the theory of natural selection. He assumed as a fact the existence of variation, showed the universal presence of a struggle for existence due to the invariable birth of more young than can come to maturity, and then pointed out that this would inevitably lead on the average to the survival of those that were best fitted to survive and so to evolutionary change and progress. By so doing at one stroke he cut the ground from under the feet of those who, like Paley, argued that organic adaptations were evidences of conscious design.

Sexual Selection.—He also advanced the subsidiary hypothesis of sexual selection to account for the development of special sexual adornments employed in courtship or display. Here the underlying idea of the automatic selection of some types and the failure of others remains the same, but the selective agency is now the mind of the opposite sex; and, further, the selection may be between rival males as concerning success in mating only, and the characters selected may not only have no utility in relation to the ordinary business of survival, but in extreme cases may handicap their possessor in the struggle for individual existence. However, the biological advantage gained by being selected as the father of offspring, especially in polygamous species, may be so great as to compensate for disadvantage in other directions. This theory has been much criticised, but has now, in somewhat modified form, been shown to rest on a firm basis.

Darwin also, in part, adopted the second main theory of the method of evolution, that of Lamarck, by assigning some weight to the direct effect of the environment and to the effects of use and disuse.

Three other main types of hypothesis to account for evolutionary change have also been advanced. The first has been styled Orthogenesis. It is frequently observed by palaeontologists that evolutionary trends in particular directions can be traced in series of fossils. The theory of orthogenesis assumes that the straight course pursued by such evolving types is due not to moulding, direct or indirect, from without, but to inner necessity, the hereditary constitution of the race unfolding and changing according to predetermined laws. Next, there is what may be called the crude theory of mutation, according to which species may enter upon a mutating period, and rapidly throw off a number of new and markedly distinct types, which may often be merely new without being better or worse suited to the environment. Finally, there is the view urged by Lotsy, that new types arise by recombination of characters after crossing. We know that when very distinct types are crossed and are fertile, there is (as demanded by the Mendelian theory) great diversity among their offspring from the second generation onward. Lotsy imagines that very wide crosses may occur, with enormous resultant variation, and that this variation is the sole raw material of evolutionary change. We may call this the recombination hypothesis, since it supposes that evolutionary novelty is due to new combinations of old characteristics.

The last three theories emphasise the force of inner variation as against that of outer environment. The mutation and the recombination theories think of the process as occasional and random, that of orthogenesis as continuous and directional. The other two lay greater stress upon the environment. But whereas the Lamarckian theory assumes a direct effect of the environment, the hereditary constitution responding like wax to outer changes, the effect in Darwin's theory of natural selection is only indirect. The source of variation is here in the hereditary constitution and it occurs in all directions; the environment is exerting a constant pressure and ensuring that only the "right" variations shall survive.

It cannot be said that the problem is yet by any means solved. In particular, the first origin of variations remains one of the great problems of biology. It would appear, however, that all

theories can contribute something of value, although an adjustment of the theory of natural selection to a modified mutation theory will probably account for the majority of the facts.

Heredity in the Light of Mendelism.—We must remember in any case that any accurate knowledge of the processes of heredity was denied to Darwin. Not until the rediscovery of Mendel's work in 1900 was it possible to push forward along this path. We now know that the great majority of inherited characteristics are dependent upon the presence of definite units (factors or genes) present in the hereditary constitution; and that these are lodged in a definite proportion and definite arrangement in the chromosomes which are transmitted from parent to offspring in the gametes (*see* CYTOLOGY; GENETICS; MENDELISM). Normally, these units remain constant, and resist change with extraordinary resistance. Occasionally, however, they have been found to change apparently spontaneously (though this, of course, only means that we have not yet ascertained the cause), and, once changed, to remain constant in their changed form. Such changes are now generally known by the name of mutations. It is important to note that mutations of this type may be of any extent, some causing marked, others very slight, changes and the generally accepted view now is that mutations of slight extent afford the major part of the raw material of variation; natural selection may then act. It is a curious fact that the "mutations" of the evening primrose adduced by De Vries, in the earliest presentation of the pure mutation theory, have turned out to be, some of them, not mutations at all, others mutations of a different and rarer type (due to subtraction or addition of whole chromosomes).

There is further evidence that in some apparently rare cases mutations may be caused directly by changes in external conditions; so that in respect of these, a modified Lamarckian theory will hold.

Melanism in Moths.—The latest and most satisfactory evidence on this matter, the production of melanism in moths by treatment with the metallic salts found deposited by smoke in industrial areas (J. W. H. Harrison and F. C. Garrett, *Proc. Roy. Soc.*, 1926) indicates that the induced hereditary change is not directly adaptive, and, once produced, remains constant and is inherited according to Mendel's laws—in other words, that such changes are induced Mendelian mutations. On the other hand, there is as yet no evidence which has satisfied the majority of biologists that the effects of use and disuse are ever directly inheritable. As regards orthogenesis, there is no doubt that beautiful series of fossil forms, each tending in a particular direction towards specialisation for one particular mode of life, may be found. But there is no evidence whatever that these are to be accounted for by some inner necessity for determinate variation in a particular direction, and not rather by gradual improvement at the hand of natural selection.

In addition, however, to such series (which obviously run counter to Lotsy's theory of recombination) detailed studies of variation among existing species bring to light numerous characters which appear to be of no biological advantage or the reverse to their possessors, and are most readily to be accounted for as due to random mutations. Finally, in some cases, especially among plants (as roses, willows, etc.) enormous variability is found combined with evidences of hybridity. Here it appears almost certain that evolution by hybridisation and recombination has been effective. The most plausible view as to the mechanism of organic change (although it must again be emphasised that there is as yet no unanimity on the matter) is therefore somewhat as follows:—

A Mechanism of Organic Change.—The raw material of evolution is provided chiefly by variations in the form of factorial or point mutations. Some of these may be directly caused by changes in the outer world; but even when this is the case, there is no reason that they should be adaptive—sometimes they may be, sometimes they may not. Others, probably the majority, are not as yet to be traced to definite external causes; they are "spontaneous" (as in another field of science are the disintegration changes suffered by the radioactive elements). Some of these come under the action of natural selection: the biologically favourable benefit their possessors and are preserved, the biologically unfavourable are weeded out. Still others appear to be neither favourable nor unfavourable; and their survival is a matter of accident. It is further clear that if an organic type possesses a hereditary constitution of a chemically definite nature, this will restrict the possible changes which it may undergo—in other words, will make variation, within certain wide limits, determinate. To this limited extent the principle of orthogenesis will be at work. Finally, we obtain evolution by recombination in the comparatively rare cases in which two or more distinct races or species can cross and produce normally fertile offspring.

One thing at least can be stated to-day with assurance, and that is that the mechanism of evolution is not simple, and that no single one of the various theories previously advanced will by itself prove to be sufficient.

Creative Evolution and Climatic Changes.—In considering the evidence bearing upon orthogenesis, biologists have been forced to take account of the geological evidence bearing upon past climates. As a result, opinion is inclining more and more to the view that the marked bursts of "creative" evolution, when new types are rapidly and abundantly produced, as with the mammals at the very beginning of the Caenozoic epoch, are to be correlated with pronounced changes in climatic conditions. When a single pond dries up, the species inhabiting it simply become dispersed to other neighbouring ponds. But when a whole area of the world's surface becomes progressively drier or colder, the life which inhabits it must either change or die. The detailed working out of this difficult subject of past climates will be of great importance for a study of evolution.

We now come to the third main heading under which we can study evolution. Taking for granted both the fact of its occurrence, and the existence of some sufficient mechanism, we can seek to discover what has actually happened, and whether any general principles or laws can be traced in the process.

The Fossil Record.—We are at the outset placed under a grave handicap, in that our most trustworthy and direct source of evidence—that from fossils—is only available for a limited part of evolutionary history. The earlier fossil-bearing rocks have in part been denuded away (to be carried down to the sea and deposited once more as rocks of a later age), or else so much altered by the heat and the pressure to which they have been subjected in the course of geological time, that they are completely *metamorphosed*, and their fossil record obliterated. Opinions differ as to the proportion of the geological record which has thus been destroyed, but at a very conservative estimate it comprises at least half the time during which life has existed upon the earth. As a result, when the earliest richly fossiliferous rocks are examined, they are found already to contain representatives of most of the main groups of animals. With regard to the vertebrates, however, this is luckily not the case. They evolved late; and the rocks provide us with an excellent record of the evolution of their main groups (*see* PALAEONTOLOGY). In addition, however, the indirect evidences of comparative anatomy and embryology do permit us to draw a number of broad conclusions concerning the other groups with a reasonable degree of certitude. When we assemble and analyse the evidences drawn from every possible source we find that we can obtain from them a body of important general principles concerning the direction which evolution has actually pursued. These principles appear to hold good equally well for all the main groups of animals in which they can be checked and not only for vertebrates.

Lower and Higher Types.—In the first place, when a higher type evolves from a lower, it is usually found that this does not involve the total disappearance of the lower type. Commonly, representatives of the lower type survive, but the total number of its species is reduced, and the survivors are often smaller in size and lead less conspicuous lives than when the type was in its prime. The classical example is afforded by the reptiles and the mammals. The former with their "cold blood" and absence of placenta and of milk are definitely of lower organisation than the latter. In the Mesozoic epoch, they became the dominant

group of vertebrates, and branched out into various striking types—gigantic herbivores, carnivores of corresponding bulk, flying forms, marine fishlike types and so forth. By the onset of the Caenozoic period, the mammals had become dominant; the reptiles still survive but only in the shape of crocodiles, tortoises and turtles, snakes and lizards.

Similar survival of "lower" types, but in reduced numbers and reduced variety, alongside of "higher" types is also seen when we look at the evolution of human inventions, an obvious example being afforded by the survival of pack transport and horse-drawn wheeled vehicles after the introduction of mechanically-propelled vehicles. A consideration of the causes operating to produce such effects with human inventions often clarifies the causes of similar survivals in biological evolution.

Directional Change.—As a result, we find that at any given moment the organic world provides us with a selection, not merely of the latest-evolved types, but of most of the main types which have ever come into being. When, on the other hand, we consider the latest types only—in other words, the upper level reached by life instead of its whole range—we are enabled to trace a definite directional change in evolution. There has been a tendency to produce types which can respond with greater precision to changes in the environment, which have greater control over external objects, are increasingly independent of the environment, and more self-regulatory.

These tendencies are revealed in various concrete ways. The efficiency of the various organs of animals has become greater. Sense organs come to have greater range and greater accuracy; one has only to compare the nervous system—brain, spinal cord and nerves—of a mammal with the nerve-net of a jelly-fish and this with the nervelessness and almost total absence of co-ordination in a sponge to have the advance as regards conduction and co-ordination very forcibly brought home; and equally striking examples could be drawn from other systems, such as the locomotor, the skeletal, the blood-circulatory or the digestive. A very striking step was that taken by the birds and mammals alone among all organisms—the acquisition of special machinery permitting the body temperature to remain constant ("warm blood"); this permits the general activity of the organism to remain at the same level in spite of great changes in outer temperature, whereas that of all other organisms rises and falls with the temperature like an ordinary chemical reaction.

General and Special Organisation.—Efficiency of machinery for control and self-regulation may be improved in two main ways—in relation to the organisation as a whole, or in relation to a particular mode of life. For example, the general organisation of the mammalian type is an improvement upon the reptilian. On the other hand, the organisation of the horse is an improvement upon that of the early mammals when considered in relation to a cursorial and vegetarian existence, that of a whale in relation to a marine existence. But it cannot be said that in general organisation either horse or whale is superior to the other. This latter type of improvement we speak of as specialisation, the former as improvement of general organisation, or more succinctly as biological progress. Biological progress involves all-round advance; but specialisation, which is by definition specialisation in regard to one particular direction and mode of life, invariably involves a sacrifice of possibilities in other directions and for other modes of life. The horse, by the very fact of being adapted to grass-eating, is cut off from all carnivorous diets; the whale, through being so thoroughly adapted to life in water, is debarred from the possibility of life on land or in the air.

Sometimes the adaptation is such a limited mode of life that the sacrifices appear to outnumber the gains. We then speak of degenerative evolution. This is best seen in animals which have exchanged a free-swimming for a sessile existence, or those which have taken to parasitism. It should not, however, be forgotten that degeneration is always a form of specialisation. Even the most "degenerate" parasite is beautifully adapted to its mode of life in its mechanisms for passage from host to host and in its arrangements for maintaining itself unharmed within a particular part of its host's body.

Specialisation.—Further, the evidence seems clear on one important point—no highly-specialised form appears to retain the possibility of giving rise to types specialised in some quite other direction, or to a type which shows a general advance in organisation. It was among the most generalised fishes that the ancestors of land animals took their rise; and the ancestors of man are not to be sought among any of the specialised groups of mammals like ungulates, carnivores or the like, but in the humble and generalised insectivora. In other words, the sacrifice involved by specialisation is not only a morphological one; the special improvement involves also a sacrifice of general evolutionary possibility.

As each new type comes into being we find in general the following series of events. There is first a considerable period during which the new type is not fully perfected; its representatives remain small in size, few in numbers and in kinds, and of little importance as compared with the dominant type from among whose more primitive members they have sprung. Then, comparatively suddenly, the new type ousts the old from its position of dominance. This is well exemplified by the early mammals which existed during the Age of Reptiles and their sudden rise to supremacy at the close of the secondary period; or by the long period during which primitive man existed at a low stage of attainment, prior to his quick rise to biological dominance in the last 10,000 or 20,000 years, or—to utilise our example from human inventions once more—by the early decades in the history of the motor-car, when it was regarded as either a joke or a nuisance, before its sudden rise into general use.

Once the new type becomes well established, it usually evolves into a number of specialised branches, together with other branches which remain relatively primitive and generalised. This specialisation of a group into a number of adaptive lines is usually known by Osborn's term of adaptive radiation. It is beautifully illustrated in the fossil history both of the reptiles and of the mammals (and again in the origin of numerous divergent types of motor vehicle as soon as the motor type came into favour).

Progress from Lower to Higher.—It remains to ask whether one type can legitimately be called "higher" than another, whether the term "progress" can legitimately be used for any purely biological process, since such terms involve the idea of value. Types undoubtedly differ in regard to their degree of efficiency, self-regulative capacity, etc.; and there is also undoubtedly a general directional trend to be traced in the evolutionary history of life as a whole. It is further found, however, that this trend is in the general direction of producing qualities and characteristics which are regarded as valuable by us (control, efficiency, independence, etc.), and that the difference between what are customarily called lower and higher organisms does again correspond with a difference in regard to qualities which do seem valuable to us. In other words, the terms high and low as applied to organisms, and biological progress as applied to a certain direction of evolution are perfectly legitimate.

Conclusion.—In conclusion, it should be remembered that the fact of biological progress, of a steady trend of the upper level of life in an upward direction, by no means implies, as is sometimes stated, the existence of an internal "urge," or of a non-natural guiding force; nor need we assume any purpose in the process. The matter is on a par with the question of purpose in regard to specific adaptations, which were taken by Paley as definite proofs of purposeful design by a personal designer. Darwin, however, pointed out that the purpose here was only apparent, and that adaptations could be satisfactorily accounted for by the non-purposeful automatic working of natural forces. Precisely the same is true of the apparent purposefulness revealed in biological progress. On reflection, it, too, is seen to receive a satisfactory explanation on the same Darwinian principles. The struggle for existence being as keen as it is, any advance, whether specialisation along a restricted line, or progress in general organisation, will be a biological advantage.

Purpose is a purely psychological category, and the term should only be used when other explanations can be excluded. It is, however, important to notice that, with man, purpose has

come to have evolutionary significance. Any future progressive evolution of the human species (*see* EUGENICS) or of human institutions must inevitably depend, in greater or lesser degree, upon true purpose; and this itself is a biological advance, for purposive planning is both more direct and less wasteful than the pseudo-teleological methods of natural selection. (J. S. H.)

II. EVOLUTION AND COMPARATIVE ANATOMY

The science which is concerned with the resemblances and differences which exist between the bodily structures of animals, was cultivated by the zoologists of the 19th century with such success that by 1870 the structure of representative members of all the greater groups of vertebrates was known, and even the invertebrate groups were well understood. The body of facts so brought together forms the foundation of the theory of organic evolution. It established that the whole series of living animals, some 2,000,000 in number, resembled one another in such a way that their organisation could be referred to a small number of fundamental types, sharply marked off from one another, and not connected by any animals of intermediate structure. The more important of these groups are the Protozoa, Porifera, Coelenterata, Platyhelmia, Chaetopoda, Arthropoda, Mollusca, Polyzoa and Chordata, whose characters and mutual relationships are well explained in the zoological articles of the *Encyclopædia* (*see* 28.1033 esp.).

The general acceptance of the truth of the doctrine of evolution led to a great deal of work on comparative anatomy, with the intention of displaying the steps by which the structure of the higher animals had arisen from that of lower forms. It was soon realised that a continuation of this work resulted merely in the accumulation of details, which although sometimes interesting, could not bring about any important changes in the conclusions which had already been reached. Two lines of research appeared open to the morphologists of 1870; they could add the investigations of function to that study of pure form which was their selected field, or they could determine the actual mode in which the structures they described came into existence during the embryological development of an animal.

Study of Embryology.—The problems raised by an attempt to relate the structure of an animal to the functions performed by its organs are, except in specially simple cases, of great difficulty, requiring resources of physics and chemistry which were not available in 1870; thus it was to the study of embryology (*q.v.*) that the majority of morphologists turned. Their work soon led to results which revolutionised the whole subject, placing many homologies between the parts of different animals, which had previously been disputed, on a firm foundation and introducing the element of succession of events in time. But embryology in its turn has reached a stage in which the new work is concerned solely with detail, and no fundamental new facts are likely to be discovered by the old methods. There is however another way in which the time element can be brought into morphology; study of the remains of fossil animals has, of late, solved some outstanding problems amongst vertebrates and has revived interest in the whole subject.

Experimental Work.—The most promising mode of attack is, however, through experiment. It is possible to interfere with the development of an animal: by altering the rate at which it proceeds, by cooling or by chemical means; by the removal of the primordium of one of its organs; by transplanting a developing eye or ear into a new region of the body, or even by grafting halves of two different species together. Work of this kind is being very actively carried on, especially in the Unites States of America, and it has already revolutionised our outlook on morphology.

The study of evolution, and of the causes which have brought it about, is not now fashionable. All zoologists regard the truth of the doctrine as established more by the patent incredibility of other explanations than by direct evidence; indeed only the study of palaeontology (*q.v.*) leads to a vivid realisation of its truth and of the details of the process. Thus zoologists, being no longer compelled to concern themselves with the truth of a fundamental principle, have been free to devote their attention to those problems which gave promise of rapid solution.

At present it is difficult to design and carry out experiments whose direct object is the establishment of the factors which bring about evolutionary changes, because the whole subject is overlain by a mass of theoretical conclusions based entirely on the examination of observed facts, whilst many aspects of the subject which are quite fundamental have never yet been adequately explored by an experimental method under controlled conditions.

Mendelism (*q.v.*).—The rediscovery in 1900 of Mendel's Principles of Heredity showed that the assumptions made by the earlier naturalists, and even the conclusions reached by statistical methods of investigation, might have no validity so far as the individual was concerned, and emphasised the necessity of a renewed and rigorous investigation of that heredity to which every animal owes its morphology. But this work, as it has been carried on, especially by the school of Morgan, is itself morphological, it relates the structure of an adult animal to that of the chromosomes contained in the nucleus of the zygote from which it arises. The problem which now confronts morphologists is to discover the mode in which the " genes " function, that is, the nature of the factors which so control development as to determine the final structure attained by the animal. This problem is being attacked by the methods of experimental embryology, which are leading to a better understanding of the meaning of the facts of comparative anatomy. Thus, by their early work, comparative anatomists established the prima facie case on which our belief in the reality of evolution rests, whilst by the work that they are now carrying on they hope in the end to come to an understanding of those forces which underlie the phenomenon of evolution.

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III. THE PALAEONTOLOGICAL ASPECT

The law of evolution, especially as applied to human origin, has again been challenged in the United States by adherents of religious bodies who are described as Fundamentalists as distinguished from Modernists (*see* FUNDAMENTALISM). The movement is based on a revival of the literal interpretation of Creation as described in the book of Genesis, largely under the eloquent leadership of the national politician, William Jennings Bryan. Evolution is characterised as an unfounded hypothesis, unsupported by evidence, subversive of youthful morals, and, therefore, a menace not only to religion but to the state.

Bryan and other lay and clerical opponents of evolution sustained their course by direct citations from Dr. William Bateson's Toronto address to the American Association for the Advancement of Science (1921), " Evolutionary Faith and Modern Doubts," which supported the law of evolution and, while completely negative as to the causes of the origin of species, served to clear the biologic atmosphere and to intensify research for veritable causes.

PALAEONTOLOGIC ASPECTS OF THE THEORY OF ORGANIC EVOLUTION

Zoological researches on variation, selection and the origin of species, up to the year 1926, have ended in a series of negative conclusions and opened the way to consider the new light thrown on the problem of adaptation by palaeontologic research. In such research we may sharply distinguish between the illumination of the law of evolution as a universal principle of plant and animal descent and the light which palaeontology throws upon the *causes* of evolution and, consequently, on the older theories of causation. (1) Palaeontology substantiates natural selection in its larger meaning but deprives it of its creative or originative power. (2) Palaeontology gives an equally strong negation to Lamarckism in its creative sense of immediate inheritance in course of present time. (3) Palaeontology presents an equally strong front against discontinuity and mutation, or sudden sal-

tations in mechanical characters, and substitutes an absolute, unbroken continuity in secular evolution as in growth.

Material Observed.—In palaeontology, however, the field of observation is chiefly limited to the adaptations of the hard parts preserved in a fossil state, to the relations of function and form, to the adaptation and development of new proportions (allometrons) in mechanical structures—adaptations which are primarily biomechanical. Thus while palaeontology negatives both selection and Lamarckism in biomechanical evolution, it has its strict limitations, it throws no light on the possibility of discontinuity or mutation in biochemical or biophysical evolution. There are grounds for believing that saltation, mutation and other forms of discontinuity, such as may frequently occur in adaptations primarily biophysical and biochemical, immunity and non-immunity, fertility and non-fertility and interbreeding, physical reactions to temperature, atmospheric pressure, etc.

As the unique result of palaeontological research we perceive evolution as a *secular* phenomenon, a process of the ages which, measured either by geology or by the radium content of the rocks, is infinitely slower than either Lamarck or Darwin conceived. Lamarckism in part holds true as a cause of secular evolution, just as Darwinism (*i.e.*, survival of the fittest) holds true as a potent cause of secular evolution. On the other hand, palaeontology denies absolutely the origin of species according to the original conceptions and literal interpretations of either Lamarck or Darwin. In claiming that all that is acquired is transmitted, Lamarck was over-confident, as Darwin was over-confident in claiming that every variation, however slight, may favour the chance of survival.

The second unique result of palaeontological research is to transfer from the field of reason, imagination and speculation to the field of direct observation the whole question of the modes and methods of evolution and the whole problem of the manner in which new specific adaptations originate and of the details by which new biomechanical species are constantly created. We refer to such biomechanical adaptations as the elongated neck of the giraffe, the classic case cited by Lamarck and Darwin, the highly complicated mechanical evolution of the teeth, the origin and development of horns and of defensive armature.

The Record of the Rocks.—In the 60 years since 1865 some palaeontologists have been speculating, while others were quietly devoting themselves to gathering harvest after harvest of facts about the modes and methods of the origin of species. The palaeozoic rocks of eastern America afforded Hyatt (1866) opportunities similar to those enjoyed in Europe by Waagen (1869) and Neumayr (1871) of observing in closely successive and continuous stages (mutations of Waagen) that the old barriers between "species" as conceived by Lamarck and Darwin are entirely broken down and one specific stage merges into the next without a break; in this respect evolution appears exactly like growth. In vertebrate palaeontology finely successive fossil horizons in the arid western states of America yielded Osborn and others closely continuous stages in all the hard parts of many lines of mammalian descent, especially horses, rhinoceroses and titanotheres.

The Creative Origin of Species

Thus between 1859 and 1926 the "origin of species" has become an entirely different problem from that conceived of by Darwin or, in fact, by any other zoologist, because our knowledge of what constitutes a species is entirely different. As palaeontologists we are observing the initial and terminal phases of a *continuous creative evolution and adaptation of the germ plasm*, because palaeontology forces upon us this new creational definition and conception of evolution, namely, of a *continuous creative unfolding of life fitted to a continuously changing environment.* It is remarkable that through palaeontological research the original Latin word "evolution" becomes inadequate and the old Sanskrit word √*kar* reasserts itself.

CREATE (Lat. *creatus*, make, create, akin to Gr. *κραίνειν*, complete, Skt. √*kar*, make.) 1. Trans. To bring into being; cause to exist. 2. Intrans. To originate; engage in originative action.

This new creative definition of evolution expresses the two new principles of evolution discovered in palaeontology, namely, the principle of continuity and the principle of rectigradation, the one a denial of *mutation* in biomechanical evolution, the other a denial of *fortuity* in biomechanical evolution.

Species and Adaptations.—It appears through the study of continuous series of invertebrate and vertebrate fossils that "species" and "adaptations" are synonymous terms, as may be clearly seen in the history of these two terms, from Aristotle to Linnaeus.[1] The origin of species and the origin of adaptations are phenomena of the same significance, for every "species" is an ensemble of countless "adaptations" in various stages of rise and decline. What Aristotle (300 B.C.) called an adaptation, Linnaeus in 1758 called a species. When Aristotle in his *History of Animals* and his *Physics* debated the natural causes of adaptations he had in mind the same structures and functions as those which Linnaeus used in defining his species. For example, the celebrated "survival of the fittest" passage in Aristotle's Physics (Taylor's translation):—

> What, then, hinders but that the parts in nature may also thus arise? For instance, that the teeth should arise from necessity, the front teeth sharp and adapted to divide the food, the grinders broad and adapted to breaking the food into pieces. . . . It is argued that where all things happened as if they were made for some purpose, being aptly united by chance, these were preserved, but such as were not aptly made, these were lost and still perish, according to what Empedocles says concerning the bull species with human heads. . . . Nature produces those things which, being continually moved by a certain principle contained in themselves, arrive at a certain end.

For example, again, Linnaeus (1758) defines the anthropoid ape known as the orang:—

> SIMIA: *Dentes Primores* IV., approximati. *Laniarii* solitarii, longiores hinc remoti. *Molares* obtusi. *Cauda nulla:* Simiae *veterum.*

Seven Principles of Origin

Baldwin thus defines the word "principle" in its bearing on science in general:—

> PRINCIPLE (Lat. *principium*, commencement, beginning: trans. of Gr. *ἀρχή*, beginning, authority): Ger. *Princip;* Fr. *Principe;* Ital. *principio.* Scientifically, it is the law through which a diversity of facts, otherwise unrelated and unexplained, are classified and interpreted: opposed to datum, brute fact or "mere" fact. . . . Greek philosophy began with the search after the principle in the literal sense: that original reality (*a*) from which other things are derived, and (*b*) out of which they consist. In the sense (*a*) it was implicitly or explicitly dynamic, a force, a causal power; in the sense (*b*) it was static, an element of subsistence. The first meaning led up to Aristotle's form *εἶδος* as a principle; the second to his matter *ὕλη.*

The Seven Principles.—Briefly, the first of these subsidiary principles discovered and formulated in zoology as confirmed and amplified in palaeontology are five in number: First, the principle of individual adaptation or reaction to changes of motion or function which invariably precede changes of form, as first observed by Aristotle and finally confirmed by the experimental observations of Arbuthnot Lane and Felix Regnault; second, the Aristotle-Lamarck principle of development through use, of degeneration through disuse, of balance through unchanged or static function. These two principles were understood and expressed by Goethe in the pre-Lamarckian year 1784 when as a brilliant novitiate in human and comparative anatomy he was on the very threshold of evolution:—

> Thus by the animal's form is its manner of living determined;
> Likewise the manner of life affecteth every creature,
> Moulding its form.

Third, the ontogenetic principle by von Baer in embryology and Hyatt in palaeontology, of Acceleration or the hurrying forward of characters in development and in evolution, and of Retardation or the slowing down of characters, according to juvenile or adult needs in the struggle for existence; fourth, the Empedocles-Darwin principle of individual and racial struggle for existence and individual and racial survival of the fittest; fifth, the

[1] There are, however, many specific characters to which no adaptive significance can yet be assigned.—Ed. *E.B.*

Lamarck-Darwin principle of *ébranchement*, of divergence, the adaptive radiation of Osborn, which permeates the diversity of the plant and animal world.

These five pioneer or zoologic principles, all alike discovered in zoology, have been confirmed and ratified in palaeontology as the principles of progression and of retrogression, manifested first only in the individual and finally in the race. They are the coefficients both of individual development and of racial evolution or phylogeny, as set forth in what Osborn has termed "tetraplasy" in ontogeny and "tetrakinesis" in phylogeny. To cite Baldwin again:—

COEFFICIENT. *a.* Co-operating; acting in union to the same end. *n.* That which unites in action with something else to produce a given effect; that which unites its action with the action of another.

The two remaining principles are palaeontologic, namely (VI.) *Continuity* and (VII.) *Rectigradation*. To the zoologist every minute mechanical part of every animal is still and dead; to the palaeontologist every detail is alive and moving, slowly unfolding in the original sense of the Latin *evolvere* (*evolutio*); to the vision of the embryologist, individual development is an unfolding of the potency of the germ.

In this creative movement the palaeontologist discovers his two new principles, a sixth and a seventh, namely the principle of continuity, of continuous and unbroken advance or recession of each character from invisibility into visibility, and, closely connected therewith, the principle of rectigradation, of the continuous orthogenetic rise of each new organ out of heredity, passing through stages of increasing mechanical perfection, then perhaps gradually subsiding again into the germplasm until it finally disappears.

These seven principles which govern the origin of species in mechanical adaptation also concern an enlarged heredity, for only through palaeontology can we broaden and clarify our vision of heredity and distinguish the ripples of "saltation" or "mutation" (De Vries) from the waves of "evolution," the local currents and vortices of "variation" from the rise and fall of the tide of great characters (*cf.* Scott, 1894). The minute fossilised tissues of the ivory tusks of the mastodon and the stupendous "thunder-saurian" *Brontosaurus* are alike mirrors and "phenotypes" of the evolving germ-plasm out of which they once developed. The stages in the evolution of the horse, camel, mastodon and elephant, in the largest and in the minutest detail, are mirrors of the evolution of the germ-plasm.

Palaeontology Against Vitalism or "Entelechy"

The principles of rectigradation, that is, of the direct adaptive origin of new specific characters from the germ, presents the greatest theoretic difficulties; certain new specific characters arise adaptively, without antecedent use or function, and are therefore unexplainable on the original Lamarckian principles (Lamarck, Spencer, Cope). Nor is the cause of these orthogenetic characters traceable to an "entelechy" or internal perfecting principle, or to an *évolution créatrice* in Bergson's sense. New organs chiefly appear as *secular* reactions to new conditions of life. Entirely inexplicable as the reaction process is, all of the numerous rectigradations which have been closely observed in many lines of descent are responses to secular changes in environment or in habit. In this secular sense the Lamarckian principle of new needs of the organism inducing a change of function and the change of function inducing change of structure acquires a new significance. For example, the browsing horse (*Hypohippus*), remaining in a forested environment, retains an arrested dental mechanism, whereas the plains-living horse (*Hipparion*), finally contending with the grasses of an extremely arid environment, shows the most highly progressive and intricate dental structure; the browsing Pleistocene proboscidean (*Mastodon*) retains the same kind of grinder as its Oligocene ancestor (*Palaeomastodon*); the grazing mammoth (*E. primigenius*) rapidly evolves a grass-eating mechanism.

Such facts as these, however, do not justify a revival of Lamarckian confidence, because, taking biomechanical evolution as a whole as revealed in palaeolontogy, it is like a two-edged sword, equally damaging to the original Darwin and the original Lamarck hypotheses. It substitutes a firm and undeviating order in biomechanical adaptation, of which we have at present no conceivable explanation as to causes.[1]

Bibliography.—H. F. Osborn, *The Origin and Evolution of Life* (1917–25); *The Origin of Species as Revealed by Vertebrate Palaeontology* (1925); *The Origin of Species II.* (1925) and *The Origin of Species, 1859–1925* (1925).

The definitions of "principle" and "coefficient" are taken from Baldwin's *Dictionary of Philosophy and Psychology*: that of "create" from *The Century Dictionary*. (H. F. O.)

IV. THEORY OF ORGANIC EVOLUTION

Two important advances in the study of evolution have taken place since 1859, when Darwin published his *Origin of Species*. The first of these was Mendel's discovery of the fundamental laws of heredity, announced in 1865 but lost sight of until 1900. The second advance was the discovery of the importance of discontinuous germinal variation, whose value in relation to evolution was foreshadowed by W. Bateson's work on *Materials for the Study of Variation* (1894), and brought prominently forward by H. de Vries in his *Mutation Theory* (1901). Even before Darwin's time it was known that new types, departing widely from the parent type, occasionally appear and that their characters may be inherited. The more extreme variations of this kind had been called sports. It was not realised, however, that many of the minute differences in individuals arise in the same way.

The writings of August Weismann between 1885–93, more especially his essays on *The Continuity of the Germ-plasm as the Foundation of a Theory of Heredity* (1885), *The Significance of Sexual Reproduction in the Theory of Natural Selection* (1886) and *The Germ Plasm* (1889) had shown that variations originate in changes that first take place in the germinal material. His discussion of the problem of variation gave a new trend to all later studies on variability. Twenty-four years later the penetrating analysis of W. Johannsen (1909), based on experimentally obtained data, furnished a secure basis for all later discussion relating to selection. These advances have furnished material for a scientific discussion of the evolution theory. The phylogenetic generalities formerly indulged in when questions of variation and heredity were discussed have to-day little more than historical interest; for it has become apparent that those discussions were lacking in a precise knowledge of the facts with which they dealt. A more detailed and systematic statement concerning those matters referred to above may now be made.

Mendelian Theory of Heredity

Mendel (*see* Mendelism, 18.115) has shown that when two plants belonging to races with contrasted characters, such as peas with green seeds and peas with yellow seeds, are crossed the hybrid offspring may be like one of the parents with respect to the pair of characters involved in the cross. If the hybrids are next bred to each other (or when monoecious, self-fertilised) the next generation consists of the two kinds of individuals in the ratio of 3:1. Mendel explained this ratio by assuming that one of the original races carried an element for yellow seed, the other race an element for green. When these elements are brought together in the hybrid the influence of one *dominates* the influence of the other. If, at the time when the egg-cells and the pollen grains of the hybrid reach maturity, the elements separate so that half of the germ-cells come to contain the element for yellow and half the other element for green, then chance fertilisation of any egg by any pollen grain will give a three to one ratio. For when yellow meets yellow a pure yellow individual will result; when yellow meets green a yellow individual will be produced (yellow dominating); similarly when green meets yellow a yellow individual will result; and when green meets green a pure green individual will be formed. The outcome is three yellow to one

[1] It is important to recall that the study of palaeontology cannot in the nature of things give information as to the kind of hereditary processes occurring in evolution. The important fact of gradual evolutionary change established by palaeontology could be quite well accounted for by the accumulation by selection of small mutations.—Ed. *E.B.*

green. Of these three kinds one is pure for yellow and breeds true to that character; one is pure for green and breeds true to green; while two are hybrids, and, if selfed, will give again three yellow to one green.

Mendel also discovered that when two pairs of contrasted characters enter a cross, *e.g.*, when a tall plant with coloured flowers is crossed to a short plant with white flowers, each pair behaves as above, and independently of the other, giving in consequence in the second generation four kinds of individuals in the ratio of 9:3:3:1. Two of these kinds are like the two original grandparents; the other two present new recombinations of their characters. The same independent assortment of pairs of characters is supposed to hold for any number of pairs, but later results have shown that this is true only to a certain point.

Thus the inheritance of characters can be explained by the theory that there are independent elements in the germinal materials (eggs and sperm-cells) to which, in a sense (see below), the differentials that distinguish individuals may be referred. Equally important is the demonstration that these elements do not fuse or blend when brought together in the hybrid, but separate there cleanly from each other, and half of the gametes come to contain one member of a pair and half the other member. When Mendel wrote, no mechanism was known to which an appeal could be made to account for this separation (technically called segregation) of the elements in the hybrid, but, later, the extensive work carried out on the ripening of the germ-cells made it evident that the chromosomes furnish a mechanism that fulfils all the requirements of Mendel's principles both for one pair and for more than one pair of elements. In the examples that Mendel chose to illustrate the fundamental laws of heredity, one character completely dominates the other; but, while this often happens, in many other cases the hybrid character is more or less intermediate between those of the parents. Thus when a white-flowered four o'clock is crossed to a red-flowered plant, the flowers of the hybrid are pink. Nevertheless, the results in the next generation (namely, 1 red; 2 pink; 1 white) show that the hereditary elements have not blended in the hybrid but separate as cleanly as do the elements for yellow and green peas. It is true that when a given character in one race differs from the contrasted character of the other race in many elements (as height, *e.g.*, tall *v.* short in man) the results are not simple but even here there is every reason to suppose that Mendel's laws also hold for the character pairs taken separately.

Each individual contains in every cell of its body as well as in the germ-cells two elements of each kind, one of which has come from the father, the other from the mother. In other words, it is not a characteristic of the hybrid alone to have pairs of elements, but all ordinary animals and plants also are "double" or duplex. When the germ-cells mature the members of all these pairs separate and each ripe cell comes to contain half of the entire number. At the time of fertilisation of the egg by the sperm the full number of elements is again restored.

The postulated elements in the germ-cells, now usually called genes, are not to be confused with the characters of the individuals for which, in a sense, they are responsible. Each character is not supposed to be the direct product of one particular gene. On the contrary, characters or organs, as realised, are complex in origin—the product of a great many genes—but a difference that distinguishes one kind of individual from another may be due to a difference in only one pair of genes that act, so to speak, as differentials. Moreover, there is much evidence to show that these differentials cause not only a single main difference but a great many other minor differences in all parts of the body. What is called a Mendelian "character" therefore is only the most conspicuous amongst these several effects, all of which, however, accompany one or the other differentiating gene.

Whenever dominance is complete the measure of a given character in the hybrid cannot serve as a measure either of the past history of the individual or of its potential progeny. For example, if a grey house mouse is bred to a tame white or albino mouse the hybrid is grey and is undistinguishable in colour from the house mouse, whose ancestry may never have contained a white mouse and whose offspring by other house mice would be always grey; while half of the gametes of the grey hybrid that has had one white parent will contain an element for white. Failure to recognise these simple facts made all the earlier work on heredity extremely difficult and inaccurate when applied to individual cases. In this respect Mendel's discovery has made possible a more accurate interpretation of heredity, and consequently has an important bearing on theories of evolution.

Since the elements in the gametes of the hybrid come out as they went in, the character of the individual is shown not to have any influence whatsoever on the elements in the germ-cells. It follows that Lamarck's theory of the inheritance of acquired characters is erroneous. That theory postulates that the character of the individual has a direct effect on the germ-cells, so that the offspring show the influence of the characters of the body of the parents. If this were true there could be no reappearance of clean-cut elements in the gametes of a hybrid as Mendel's law postulates and as the facts demonstrate. Since this law has been shown to hold, wherever tested, it follows that there is no influence of the sort postulated by Lamarck's hypothesis, although evidence is at hand to show that external agencies may, in rare cases, alter the gene, the alteration being then inherited in Mendelian fashion.

Applications of Mendelism

It thus follows that a theory of organic evolution must be in conformity with Mendel's principles, quite irrespective of the way in which the elements in the germ-material may be supposed to have arisen. There may be some dispute as to whether this or that character shown by domesticated animals and plants has arisen in the same way as have the contrasted characters in the wild forms from which they have been derived, but there can be no doubt that the elements or genes in both are inherited in precisely the same way.

Mutation Theory.—The mutation theory, as it is called to-day, postulates that new types arise by sudden changes in the constitution of the germinal material. The new type, if sufficiently equipped to survive, shows the same degree of stability as the original type, *i.e.*, it breeds true to its new characteristics. The mutation may involve one striking change or many changes of small or large degree. Whether the new mutant type is or is not to be called a new species is in part a question of definition, for it is true that new mutant types do not show for the most part, when bred to the parent stock, a peculiarity that has often been found to distinguish wild species when crossed, namely cross-infertility or sterility of the hybrids when such are produced. If this distinction is held as essential to the definition of new species, then it must be positively stated that most mutant types differing from the original type do not show this relation to the original type or to each other. There is, nevertheless, something further to be said before admitting this argument as the crucial test of the origin of types by mutation or by any other process.

The doctrine of the origin of new types by mutation owes its vogue to-day mainly to the work of Hugo de Vries, and to a large extent to his observations on an escaped variety of evening primrose (Oenothera Lamarckiana). He found that this plant produces in each generation a small percentage of new types that breed true to their kind. These new types he called elementary species. They cross freely with the parent and with each other. It has been objected many times, especially by the opponents of the mutation theory, that the appearance of the new types in this evening primrose is due to its hybrid origin, and in support of their contention they point out that O. Lamarckiana is not known to exist as a wild species. These who relied on this evidence failed to appreciate that the appearance of its mutants does not conform to the ordinary rules of hybrid splitting, and their arguments were rudely shaken by the fact that other wild species of Oenothera behave in this respect in the same way as does Lamarck's evening primrose.

More recent discoveries have shown, it is true, that a few of the more striking mutants of this plant owe their origin to processes some of which at least can scarcely be admitted as repre-

senting, in general, the way in which wild species arise. An example of this may be cited here: one mutant type, O. gigas, is due to a doubling of the number of chromosomes; several others to the addition of an extra chromosome to the chromosome group, and the latter process is one that can hardly be supposed to be a method by which new species arise. There remain still a few other types whose appearance is not yet clear, but some of them at least can be accounted for on the assumption of what is known as balanced lethal factors. Without attempting to discuss this technical question it may be said that the appearance of this last kind of new type does not represent the original act of mutating but rather the liberation of genes from their lethal connection. These genes may have arisen earlier by what is now known as point mutation. If so, some of De Vries' results fall into line with the results of more recent work on mutation. This work has shown that new characters arise from time to time as a result of a single change (point mutation) of an element of a germ-cell. The new element gives with the one from which it arose a contrasted pair of Mendelian units (called allelomorphs). If the new type is crossed to the parent type, the new and the old elements segregate in the hybrid as a characteristic pair of Mendelian differentials. The new mutant type breeds true to its kind as does the parent type. The only serious question that may arise is whether these mutant types furnish materials for evolution, or whether they represent no more than the materials from which many of our domesticated types of animals and plants have originated. There can be no doubt that a large number of domesticated types have arisen in this way, nevertheless it might still be true that the origin of such types has nothing in common with the process by which wild types and species originated. A further consideration of the situation may help to show which way probability lies.

1. Some of the mutant types are characterised by the loss of characters or parts present in the old type. The albino, for example, has no pigment in the eye, hair or skin. But evolution may be at times in the direction of simplification as with the eyes of many cave-dwelling forms.

2. New mutant types are often abnormal or defective. Because of their small chance of survival such new types cannot, of course, be supposed to contribute materials for evolution, unless the origin of variations has some mystical relation to their fitness—a supposition not uncommon in the latter part of the 19th century. But nothing in the theory of evolution requires that all new variations shall be in the direction of fitness. For the theory of evolution it is only necessary that some sorts of variations appear that have a chance for survival in the old or in a new environment.

3. Some of the new mutant types are less resistant (weaker) or are less fertile than the original type from which they arose. These under natural conditions would die out. In fact, many observations go to show that animals and plants under natural conditions are kept up to their top level of strength and fertility by the constant elimination of the less viable variations. Wild types have already been brought as near the upper-limits as their particular organisation is capable of, and it is not to be expected, therefore, that any particular departures from this type will be an improvement. The situation would not be very different if a change could be "purposely" brought about, for, as stated, the adjustment of most organisms to the varied conditions under which they live—an adjustment that has been reached after an immense interval of time—may be as nearly perfect as the materials of its organisation and the varying condition of its environment permit. In a new environment or in a new relation to its present surroundings the chance for a change in an adaptive direction may seem greater. The relation of domesticated types to human needs or fancy supplies such a novel situation; but human intelligence as an agent in evolution, while it may speed up the process or increase the chances of survival of a particular type, bears the same relation to variability which makes evolution possible as does any other environmental agency.

If the preceding discussion appears to weaken rather than enhance the value of mutant types as material for evolution, this is equally true for any other kind of material, unless there were kinds in which the response of the organism to a possible need takes place. Carefully controlled observations have discovered no adequate evidence of this latter sort of variation. The extravagant claims and speculations that have been advanced in support of such views rest on confused thinking or unwarranted assumptions or false deductions from insufficient evidence.

More specifically in support of the mutational origin of new types the following facts carry considerable weight: (1) The differences that distinguish wild variations and even wild species have been shown in a number of cases to depend on genetic elements that behave toward each as do Mendelian elements. (2) Genetic elements that modify common characters, making them a little more or a little less developed, are well known. They conform in every way to the laws regulating larger changes. Many of the individual differences that make organisms a little better or a little less well adapted depend on these modifying elements. Any theory of evolution based on observed facts, and not on imaginary suppositions, must appeal to these genetic elements as material out of which to construct a theory of evolution or descent through gradual modifications. As already stated, it does not follow that these modifying factors, which can generally be found when looked for, have arisen by mutations even though they obey Mendel's laws, but until some other origin can be discovered it seems better to construct a working hypothesis on this assumption than on one that appeals to purely fictitious agencies. (3) Darwin argued that since all degrees of infertility between types and all degrees of fertility of hybrids are known to exist, there is no need to suppose that these differences have had any origin than other kinds of differences. In fact, if evolution has taken place, we might expect to find just such an inconstant relation. Later work supports Darwin's contention. The attempt to set up artificial distinctions between the frequently observed infertility between wild "species" and the complete fertility of nearly all domesticated and mutant types does not appear to-day as a real difficulty in the path of the mutation theory of evolution.

Modern experimental research has brought to light an important distinction in relation to those individual differences that are always found to be present in any group (variety or species) of individuals. The individual differences, that are often called fluctuating variations, are due sometimes to environmental effects produced on the individual during its development. These are not transmitted to the offspring and can take, therefore, no part in evolution. Other individual differences are genetic differences due to elements or genes in the germinal materials. These differences are inherited according to Mendel's laws and may take part in evolution. At the time when Darwin wrote the *Origin of Species* (1859) these distinctions were not clearly understood, although, of course, it had been known long before that time that while some individual differences are transmitted others are not. Darwin's theory of natural selection was based on the occurrence of individual variations, which, under selection, furnish the materials by which progressive evolution takes place.

It was, however, not then sufficiently realised that selection of individual differences, even of those that are inherited, can not bring about an advance in the direction of selection to an indefinite extent. The changes due to selection come abruptly to a standstill unless new mutation occurs. The explanation of this is well understood to-day, owing more especially to the thorough examination of the problem by a Danish botanist, W. Johannsen. The first advance that takes place under selection is due to the sorting out of the genetic differences present that modify this or that organ in one or another direction. When selection has brought together those genetic elements that modify a particular character in the direction of selection, further advance ceases. The selected type will still vary, it is true, due to the environmental influence acting on each individual during its development; but, since these are not inherited, no further advance in the selected group of individuals as a whole takes place. Only by the appearance of a new mutation or of some other sort of change is any further progress possible. The rather widespread popular fallacy that selection can go on changing a group as long as the process continues is now known to be erroneous. The selective process does not furnish a new base from which further progress may be made, but acts only in so far as genetic differences are already present and then comes to an end, or unless new differences arise by mutation. It is a creative process only in so far as it sorts out what is already given. On the other hand

if mutations are constantly arising, selection will *guide* the resultant evolution.

Darwin's ideas concerning the nature of variation and the power of natural selection could not have been as precise as the ideas of the present time based on accurate experimental work, and there is nowhere to be found any statement in his writings to the effect that selection itself creates the possibility of further advance in the direction of selection. It could not have been as clear to him as to us that the power of selection to bring about a progressive change in a given material is extremely limited. Nevertheless, he took for granted that new variations are constantly occurring, and in all directions. If this were strictly true, selection would cause progress indefinitely. We realise that genetic variability is by no means such a common event as Darwin supposed. On the contrary, all the evidence indicates that it is a rather remarkably rare event in proportion to the individual environmental changes that are ever present. Compensating for the rarity of new genetic variations is the fact that when they do appear they are constant and not necessarily lost by the swamping effects of intercrossing. Thus what the theory of natural selection lost in one direction it gained in another, and the probability that evolution has taken place by the selection of chance variations is as great as at the time when Darwin advanced his theory of natural selection.

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V. EVOLUTION AND RESPONSE TO ENVIRONMENTAL CHANGE

The word evolution, literally translated, means unfolding or unrolling, and in Latin signified the opening up of the bud into the perfect flower or leaf-shoot. Its meaning was extended later by metaphor to denote the growth of an institution or a people. In the 18th century it was introduced into biology to denote one particular theory of the development of the individual. According to this theory all development was a mere unfolding or unrolling: the perfect individual complete in all its parts already existed in miniature in the germ; growth consisted in separating out and making evident what had been previously wrapped up together.

History of the Term.—The geologist, Lyell, employed it to denote the moulding of the earth by natural forces. Darwin, in 1859, did not employ the word evolution at all in his celebrated book on the *Origin of Species*. When Herbert Spencer, in his famous *First Principles*, attempted to show that the same process which had condensed nebulae into suns and planets had also produced life from lifeless matter and modern animals and plants from the first simple living things, he gave to this hypothetical process the name "evolution"; but his term "evolution" has come into general use to denote the Darwinian theory that the inexhaustible variety of living plants and animals have arisen by descent from a few or, perhaps, only one stock of simple ancestors.

Nature of Evidence.—Now since evolution is *ex hypothesi*, a process which required for its accomplishment millions of years, direct evidence of its occurrence is of course unobtainable, and the indirect evidence in its favour may be grouped under three heads, viz.: (1) deductions from the comparison of allied species with each other, (2) deductions from the comparison of fossil species with one another and with living species, (3) deductions from the comparison of the stages which the individual of one species passes through during its growth from the egg to the adult condition, with the adult stages of other species. Darwin relied mainly on the first category of evidence. He showed that those who contended for the fixity and independent creation of each species, nevertheless divided many species into local races which in their view had arisen through the modification of different portions of the mother species by exposure to different types of external conditions, but that in practice no sharp line could be drawn between such races and species which graded into each other. Huxley, however, relied chiefly on the second category of evidence, for at the time of his great fight for Darwin, series of closely related fossils deposited in immediately succeeding beds had been discovered, in which to his mind there was exhibited a veritable record of evolutionary change, the fossils in the lower beds being the remains of the ancestors of the animals preserved in the younger and succeeding beds. The comparison of the embryonic stages in the life history of one animal with the adult stages of another was brought into prominence by Haeckel, who interpreted the life history of the individual as a recapitulation of the history of the race: this interpretation is of course a great assumption: its validity has to be first established by arguments drawn from categories 1 and 2; but once its general truth is admitted it furnishes a splendid means of unravelling the actual course which evolution has pursued.

Present Position.—The present position of affairs may be summarised as follows: by arguments belonging to all three categories mentioned above, the educated mass of mankind have been convinced that evolution has actually taken place; that as time has flowed on a species has gradually changed its character and that one mother species has split up into local races which, by diverging more and more from one another, have gradually changed into distinct daughter species. But how this has been brought about is an extremely disputed question, for the constancy of specific characters within the span of observation afforded by a human life is the most familiar of all the facts of natural history.

Main Hypotheses.—Three main hypotheses as to how evolutionary change has been produced have been put forward, the Lamarckian, the Darwinian and de Vriesian respectively. Lamarck's hypothesis in its original form was that the direct cause of evolution is a change in the environment. Animals exposed to new conditions experience new needs, and the effort to satisfy these needs leads them to make greater use of certain organs and less use of others; greater use leads to greater growth and lesser use to diminished growth; and these tendencies to greater or less growth are transmitted by heredity to offspring.

Darwinian Hypothesis.—The Darwinian view is that change of conditions induces a tendency in animals to vary slightly in all directions; that many of these variations are inheritable, and that those that *happen* to suit the new environment are preserved and affect the character of subsequent generations, whilst the individuals which exhibit harmful variations are wiped out by natural selection. Darwin implicitly assumed that the descendants of each individual exhibiting a favourable variation might be expected to vary again in the same way as did their progenitor, and that so the character of the stock would be gradually modified in a given favourable direction.

Mutation Theory.—The theory of de Vries is founded on his experiments with the evening primrose *Oenothera lamarckiana*. He found that when thousands of this plant were cultivated in the botanical gardens at Amsterdam, in each generation a small number of individuals were produced which exhibited marked divergences in structure from the type, divergences which at the same time affected roots, leaves, stem, flowers and seeds. In nearly every case the divergent individual, when fertilised with its own pollen, transmitted its peculiarities to its offspring; so that new species were being produced from the mother species in each generation complete in all their characters.

The causes of this production of new species, however, were quite mysterious, and de Vries suggested that species underwent fits of variation. To very similar conclusions Morgan was led by his cultures of the fruit fly *Drosophila melanogaster*, of which he has bred several hundred thousand individuals. Here, too, small numbers of individuals, differing definitely, though to varying extents from the type, were encountered, and each such individual, when mated with its like, transmitted its peculiarities to its offspring. Morgan believed that in these aberrant individ-

uals he had discovered the raw material of evolution, and is usually known as the "mutation theory."

Pure Lines.—The reason that the mutation theory has gained in favour whilst the pure Darwinian theory is less widely accepted than formerly is to be found in the results of what are called the pure-line experiments. Galton and Weldon had shown that if the individuals of species are measured with respect to the development of a single character, they did exhibit variations on both sides of the mean of approximately the same extent and with very nearly equivalent frequency, but the question remained to be answered whether these variations were inheritable or not. This question was attacked by Johannsen, Agar and Jennings, each of whom investigated inheritance in a pure line—that is, amongst the offspring of a single parent. Johannsen chose the bean-plant, in which the flowers can be fertilised with their own pollen; Agar worked on the little crustacean *Simocephalus*, in which the eggs develop parthenogenetically, that is, without fertilisation; and Jennings chose the *protist Paramecium*, commonly known as the slipper animalcule, for his investigations. This animal is equivalent to a single cell and multiplies by division into two. In all three cases it was found that the progeny varied considerably amongst themselves, but that if a divergent individual were selected to carry on the strain, the progeny of such an individual were exactly like those of a typical individual and that the possibility imagined by Darwin of continuously increasing or diminishing the size of an organ by continually selecting in each generation for continued propagation those individuals which exhibited the largest or smallest developments of an organ did not in fact exist.

Difficulties and Criticisms of the Mutation Theory.—The objections to the mutation theory are of a different character. While "mutations" do appear suddenly and are in most cases inheritable, most of the mutations described by Morgan and the "sports" used to propagate fancy races in other species, differ strongly in their character from the diagnostic marks which distinguish allied species from one another. On this subject the judgment of leading systematic zoologists is decisive. Most mutations are as Haecker has recently expressed it: "inhibitions of development" and correlated with diminished vital energy. As they never fail to make their appearance when plants are cultivated or animals bred in confinement there must be what Baur terms "idiokinetic factors" in environments of this kind which alter the hereditary tendencies. The nature of these factors has been investigated by Tornier in the case of goldfish. No domesticated race of animals exhibits such aberrant types as the goldfish; but all the divergences of structure from the normal are the secondary results of what Tornier calls "plasma-weakness" or the diminished vital energy of the protoplasmic part of the egg, in consequence of which this portion became crushed and distorted by the swelling yolky portion. This weakness is due to the deprivation of the egg of sufficient oxygen during the critical period of its development immediately succeeding fertilisation; but once acquired, this weakness is transmitted from one generation to another and produces similar results in each. If Tornier's conclusions are accepted, "mutants" can have played no part in the process of evolution, for owing to their relatively feeble constitution they would be the first to be eliminated by natural selection.

Lamarckian Hypothesis.—As to Lamarck's principle of "response to the environment" as the cause of evolution: that animals do respond to changes in the environment by slight changes in habits and consequent modifications of structure is admitted by all, so far as the life of the individual is concerned. The point in dispute and one that is vital for the evolution theory is whether such modifications can be transmitted in any degree to subsequent generations. Thus, children who run about with bare legs acquire an abundant growth of hair on these members, professional singers acquire enlarged chests and prize-fighters enormous muscles in their arms. It is obvious that if these changes affect the children of such people the changes in structure will keep pace with changes in habits, or, as it is usually phrased, structure will change with function.

Evolution of the Horse.—In the succession of fossil remains, which convinced Huxley of the truth of evolution, this slow concomitant change of structure and function is the salient fact which impresses itself on the observer. Thus, in the series which is apparently the record of the evolution of the horse, we start with animals with four toes on each foot. As we proceed upwards in the series the outer toe, corresponding to the human little toe, gradually diminishes in size and disappears first on the hind foot and then on the fore foot. The second and fourth toes then begin to diminish slowly and are ultimately reduced to mere vestiges concealed under the skin, in which condition they remain in the modern horse, leaving only the third toe active and functional. Whilst the toes are shortening the teeth are undergoing changes also. In the earlier four-toed forms the grinding teeth are studded with cusps—but as we ascend in the series the cusps become connected by ridges, and the valleys between the ridges become filled with cement and the crown is at the same time greatly increased in height. The changes both in teeth and feet are clearly related to the gradual changes of swampy plains into dry steppes, and the resultant modification of succulent soft marsh plants into dry harsh grasses.

Embryological Evidence.—But the study of comparative embryology leads also to the conclusion that evolution results from changes in habits. Whenever in an order, where the type of structure is fairly constant, one genus is met with which exhibits an aberrant type of structure, this aberrant genus, when young, almost invariably exhibits the structure characteristic of the other members of the order. The cat-fish, widely distributed over Europe and Asia, (*see* DISTRIBUTION OF ANIMALS) are freshwater fish devoid of scales and with darkly pigmented skins. They have broad mouths adorned with long barbels, which have been fancifully compared to the whiskers of a cat. There is a cat-fish, however, which is a denizen of small ponds and tanks in India, belonging to the genus *Clarias*, which has learned to breathe air. This fish, when young, is exactly like other cat-fish, but as it grows a sac-like extension of the opercular cavity is formed above the gills and into this cavity peculiar tree-like organs extend. These organs are adapted to absorb oxygen from the air; they arise as little buds from the uppermost sections of the gill arches, and as they grow the fish begins to make excursions out of the tanks on to the swampy meadow and gardens round them in pursuit of earthworms. It is difficult to take seriously the suggestion that "accidental" mutations led to the production of the trees in fish which remained in the water and that then these aberrances enabled their happy possessors to extend their hunting grounds, whilst other simultaneous mutations inspired them with the instinct to do so.

Zoological Evidence.—The study of closely allied species or detailed systematic zoology has led Dr. Tate Regan, to exactly the same conclusion. Change of habits, he avers, has preceded and determined change of structure and so caused evolution. So in the case of the viviparous blenny Zoarces, which retains the young in the maternal body till they have acquired the structure of the parent and are ready to assume the parental habits, small colonies of this fish in different localities differ from one another slightly in the shape of the body. Those that live in the quiet headwaters of the Danish fjords have shorter and deeper bodies with a reduced number of vertebrae, while those that lead a more active life in the open sea have longer and more slender bodies with an increased number of vertebrae. Activities—habits—are here, as Lamarck phrased it, called forth by the demands of the situation in which the fish find themselves and become crystallised into changes of structure.

Transmission of Acquired or Adoptive Characters.—Most palaeontologists are supporters of the Lamarckian view, but so far the evidence adduced in favour of the Lamarckian view has been indirect; the question now arises: can we induce animals to adopt different habits from those to which they have been accustomed, and show that these changed habits and the modifications resulting therefrom are transmitted to their descendants? Weismann, who on theoretical grounds was strongly opposed to the theory of the inheritability of the effects of habit, endeavoured

to give a negative answer to this question. He cut off the tails of mice and bred these mutilated specimens together and showed that their progeny were born with normal tails. These experiments, which betray ignorance on the part of the experimenter of what the Lamarckian doctrine was or what was meant by an "acquired character," have been cited for a generation as conclusive evidence against this doctrine.

Recent Experiments.—Of recent years, however, a series of carefully planned experiments have been carried out which give positive answers to the question. Thus, Kammerer took specimens of the common European Fire-salamander, (*Salamandra maculosa*) and reared them in cages the walls of which were coloured yellow or black. The skins of these animals are black diversified with patches of yellow pigment. This yellow pigment, however, only makes its appearance at the time of the metamorphosis of the gilled larva into the land-living adult. It varies in extent in different individuals. During larval life Kammerer kept his specimens in surroundings of a neutral grey tint; after metamorphosis he placed relatively black specimens in yellow cages and yellower specimens in black cages. In these cages they lived and grew till they reached maturity, a process which occupied between four and five years. At the end of this time the specimens in the yellow cages had amalgamated their yellow spots into two broad longitudinal dorsal bands; in those in the black cages, on the contrary, the spots had diminished to minute dots. When two yellowed specimens were mated together and their offspring reared to maturity in yellow boxes, the yellow increased so much in extent as almost to exclude the black pigment altogether: when on the contrary, these offspring were reared in black boxes *the yellow pigment still increased in quantity for the first year of their life owing to the influence of parental conditions;* then, and then only, did the black environment begin to exert its effect and the yellow pigment was ultimately reduced to small spots.

Durkhen enclosed the caterpillars of the common white butterfly (*Pierisbrassicae*) in boxes covered with lids of orange-coloured glass. In these boxes they pupated, and from the pupae the butterflies emerged and were used to propagate a second generation. The orange-coloured light inhibits the formation of the pigments (chalky white and minute dots of black) in the skin of the pupa and allows the green blood to shine through. In ordinary light about 4% of the pupae are green: of those reared in orange light 65% were green. When a second generation were reared under similar conditions 95% were green, and when this generation was exposed to the influence of ordinary daylight 34% were still green owing to the influences to which their parents were exposed.

MacBride once endeavoured to force the stick insect (*Carausius morosus*) to feed on leaves of the common ivy plant. The insects disliked this plant very much and took to it with reluctance—those that survived produced few eggs, but these eggs produced larvae which took to ivy with avidity when opportunity offered.

Time Factor.—Lamarck had expressly asserted that the influence of conditions in modifying structure only begins to be evident "after a long time," and all the evidence derivable from palaeontology bears out this conclusion. Pigmentation, however, is the most recently acquired and variable character which animals possess; and it was therefore to be expected that it would be this character which would yield results to experiments conducted over a relatively limited period of time. The objection sometimes raised that the changes induced in these experiments might not be permanent is due to a confusion of thought. The objector tacitly assumes that a change in hereditary tendency, once produced, should persist, whatever the nature of the subsequent environment may be.

But if hereditary potences are of such a nature that they can be deflected from their course by environmental change, a transference of the organism back to typical conditions must work in the opposed sense to the previous environmental change. The utmost that we could expect in such cases would be (1) an intensification of the effect when the environmental change is prolonged for several generations; (2) a trace of the effect, especially in earlier stages of life, when the organism in the second generation is removed to normal surroundings; these expectations are fulfilled by the results of Kammerer and Durkhen.

It appears therefore that the whole constitution of an animal can be expressed as a superposed series of adaptations or habits. This, indeed, has always been the basal assumption underlying comparative anatomy—and that these habits have produced corresponding structural modifications. Those most recently acquired are assumed to be most quickly affected by changes in conditions—long established habits acquire a kind of inertia, or are, so to say, more "deeply engrained" and only yield slowly to new stimuli.

Two *a priori* theoretical objections have been made to the Lamarckian doctrine by its opponents. These are: (1) that there are structures, such as the peculiar features of neuter insects and the phenomena of mimicry in insects, which could not have been evolved by the handing on to posterity of the results of changes of habits, and (2) that there is no conceivable mechanism by which changes in the body of the adult organism could be transmitted to the egg-cell.

The first objection may be at once countered by the reflection that in many cases where the evolutionary history has been clearly deciphered the dependence of change of structure or change of habit is obvious. If in these difficult cases alluded to above we knew the evolutionary history, the same explanation would be seen to apply to them. Elsewhere (*see* BIBLIOGRAPHY) suggestions have been made as to how these exceptional cases might be explained, but it is waste of time to discuss them until we know more of their history.

The Mechanism.—To the second objection we may reply that whether we can conceive it or not some means of transmitting the effects of changes in bodily structure to the egg must exist. Guyer and Smith made an emulsion of the lens of the eye of a rabbit in Ringer's solution and injected it into the blood of a fowl. After an interval of three weeks the serum of the fowl's blood had acquired the power of attacking and dissolving the lens of the rabbit's eye. If now this serum were injected into the veins of a pregnant rabbit some of the embryos were born with minute defective lenses. If these young were allowed to breed the defect could be transmitted through six generations without any further administration of serum, and was, moreover, transmitted through the male, so that any explanation of the transmission by a supposititious infection of the embryos of each generation through the placenta of the mother was excluded. Guyer was driven to the conclusion that the germ-cells of the rabbits originally injected had acquired the power of forming a "cytolysm" which destroyed the lens, and that this power was transmitted by heredity.

But it is really idle to raise the objection that there is no "mechanism" by which the properties of the body can be transmitted to the egg. No "mechanism" is yet discovered by which the growth of the adult body from the egg can be explained.

Evolution of Plants.—Does evolution as a result of the transmission of the effects of habit apply to plants also? As there is a strong fundamental similarity in the characters and reactions of living substance in both animals and plants, it is to be expected that plants, like animals, will inherit acquired qualities. But the life of the plant and all its reactions are much slower than those of an animal, and the period of a human life would probably be too short to demonstrate this inheritance. Some evidence, however, exists. In the 17th century the peach tree was introduced by the French colonists into the Island of Reunion. In France the peach is a deciduous tree, but those planted at sea-level in Reunion became evergreens, whilst those on the summits of the mountains remained deciduous. If now the seed of a tree living at sea-level is planted at a higher elevation, it remains an evergreen, so that this acquired habit has become hereditary.

To sum up, there is in every organism something which feels, reacts by striving, learns, remembers and transmits its memories to its posterity. Striving and memory are fundamental properties of life and give the only satisfactory explanation of evolution.

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(E. W. MACB.)

VI. EVOLUTION AND MIND

The word "evolution" has been used in many senses. Some of them may now be regarded as obsolete. But there is still diversity of usage. Traced to its source this is not merely a matter of verbal definition. It depends on the place that is assigned to mind in, or in relation to, the course of events. In what may be called an unrestricted usage of the word "evolution," mind is the outcome of the progressive differentiation and integration of world-events. In a specially restricted usage those world-events which are distinctive of organisms are the outcome of the directive activity of mind. This divergence of usage is based on the acceptance of this or that speculative hypothesis. On one hypothesis mind is the evolutionary *terminus ad quem:* on the other hypothesis mind is the creative *terminus a quo*. But the biologist within his province may reject both these hypotheses. For him evolution is neither more nor less than a doctrine of descent.

Take first the unrestricted use of the word. The noun stands for a concept of very wide range, and needs adjectival qualification or referential completion to focus its meaning. Thus we read of cosmic evolution, of mental evolution, of social evolution; of the evolution of the atom, of the solar system, of scenery and so forth.

Those who accept this unrestricted usage must be prepared to state that which is common to each several instances of the use of the noun, when they talk, for example, now of geological and now of mental evolution, or turn from the evolution of a crystal to that of trial by jury. Herbert Spencer, who rendered current the unrestricted use of the word, enunciated a "law of evolution" stating certain criteria which he regarded as salient. But his formulation is rarely quoted now save by those who seek to show the inadequacy of the concept he sought to express with such emphasis on redistribution of matter and motion as seemed to leave mental and social evolution interpretable only on a basis of questionable analogy.

Those who still use the word in an unrestricted sense mean by it something comprehensible though necessarily expressible only in very comprehensive form. They mean something like this: any set of events or state of affairs, physical or mental, which exemplifies evolution is a passing phase in an orderly sequence; and it comes into existence in such wise that its place in the sequence, and its relations to precedent and consequent phases, are interpretable under the accredited methods of scientific procedure. Otherwise stated: Evolution implies a determinate plan of advance to which any given instance of advance may be referred, and as thus referred is susceptible of interpretation, such interpretation is commonly spoken of as natural. But it is commonly held that there are some phases of events or some states of affairs of which no natural interpretation, evolutionary or other, can be given. These are said to be supernatural.

If we wish to understand why so many people regard evolution as a live issue we cannot disregard this antithesis between natural and supernatural. But though it is preserved in much controversial discussion, nay more, is widely regarded as essential, it has for long been subjected to criticism. Many urge, rightly or wrongly, that it is a relic of primitive mythology. There are those who believe that some world-events demand supernatural intervention in order that the direction they take may be explained, whereas other world-events do not. Hence one must ask: which do and which do not? But many eminent thinkers believe that the concept of supernatural intervention, here, there or elsewhere, as directive of the current course of world-events, should be ruled out as invalid. The supernatural, they urge, is omnipresent. If they be right, the antithesis between "some" events and "others" lapses. The question then is: Are all world-events not only natural but in some valid sense supernatural also? We are not here concerned with this philosophical question. But we must not prejudge the issue. Hence we must be content to say: There are at any rate some events which occur in enchained sequence of which it may be affirmed that to all these events the concept of evolution in an unrestricted sense is applicable.

A further question then arises. Does every enchained sequence of natural events furnish an instance of evolutionary advance? Of course there is temporal sequence; and this may be called "advance in time." But this means only that in any sequence of phases, say l, m, n, l precedes m, which is succeeded by n. It tells nothing of the character of the group of events l, m or n. If there be evolution some change of character is implied. Now it was one of Herbert Spencer's noteworthy contributions to the discussion of enchained natural sequence that he sought to distinguish groups of events or states of affairs as in some sense "lower" and "higher." Progress is from lower to higher; regress is from higher to lower. Evolution is always progressive. Regressive change is not evolution but "dissolution."

The difficulty still remains how to characterise in some way "higher" and "lower." It may be that at present we can best deal with the question departmentally and say that n is higher (or lower) than m, as an organism, as a mind, as a social institution and so on. But to justify the concept of unrestricted evolution there must be some character or characters, which may be taken as distinctive of all instances of what we are to call "higher." Perhaps there is as yet no common agreement as to the criteria on which reliance can be placed. It has, however, been suggested that complexity in the constituents of any l, m or n, and comprehensiveness in their plan of going together as an integral whole may serve to distinguish higher from lower in any context of natural events.

So far we have taken the sequence of events, say l, m, n, as susceptible of observation or inferable from observation duly recorded. Let us assume that l, m and n, are integral entities wherein certain natural events as constituents go together in substantial unity in accordance with some determinate plan, as in an atom, a molecule, a crystal, an organism. Then m may be (1) a stage in progressive evolution, or it may be (2) a stage in regressive "dissolution." Let m be an atom of lead. It is admittedly in being. We seem to have evidence of its becoming or natural origin, in isotope form, by regressive dissolution of the uranium or the thorium atom. But we have as yet no evidence of its origin through progressive evolution. If, however, m be a molecule, say of water, there may be evidence of its origin (1) in this instance by evolution or (2) in that instance by dissolution. And if m be an organism its status in being may have been reached either by evolutionary progress from an organism which was lower than it is, or by regressive dissolution (degradation) from one which was higher than it is. Here we take it for granted that l, m and n are affiliated organisms. It may then be said that, since there is no affiliation in atoms or molecules or crystals, the words evolution or "dissolution" (in the biological sense of regressive degradation) are inapplicable. Furthermore, in biology, adaptation means changing attunement to changing external conditions and of such progressive or regressive adaptation there is no evidence in the inorganic world.

We thus pass from the unrestricted usage to one that is restricted to that province of inquiry in which l, m or n are living organisms. And here yet a further restriction is customary—namely, to that which is otherwise spoken of as the "doctrine of descent," where l, m and n are affiliated organisms, reserving the word "development" for the branch of inquiry which deals with l, m and n as stages in the life-history of the individual. The question then arises: In what way is the story of the individual development (ontogeny) connected with the story of racial or linear evolution (phylogeny)?

Now it is part of the business of the biologist to describe (1) the intrinsic nature of this or that organism, and (2) its extrinsic relations to the world in which it lives—its environment. In order that it may continue in being (survive) there must be

adaptation to surrounding circumstances. The evidence of such adaptation must primarily be sought in the story of development in the course of individual life. But the story of *l*, of *m* and of *n*, as affiliated individuals, may have much in common in respect of their intrinsic nature and of their adaptation to environing conditions. In any evolutionary hypothesis, that which is common to the affiliated organisms *l*, *m* and *n*, is discussed under heredity (*see* HEREDITY). Apart from a doctrine of heredity there can be no doctrine of descent. And this applies to the intrinsic nature of the individuals, and to the adaptation of these individuals to their environment.

Such in brief—apart from contributory matters—is the concept of evolution in a restricted sense. It needs emphasis, however, that under intrinsic nature and adaptation there are commonly included such mental characters as may be attributed to the organism on presumptive evidence. This provides for mental evolution on a doctrine of descent.

We may now ask on what grounds one usage or the other is accepted. They may broadly be distinguished as practical and speculative. There seems to be a hierarchy of modes of being. And this hierarchy may be reducible to the three modes of being, physico-chemical, vital and mental. The unrestricted theory is that these three exemplify the evolutionary sequence *l*, *m* and *n* and are interpretable as successive stages of world-progress in one order of nature. The vital *m* has certain distinctive characters, such as hereditary adaptation, which are absent in *l;* the mental *n* has characters which are absent in *m*—let us say endeavour to reach a foreseen end. The presence of *n* implies that the stage *m* has already been reached; the presence of *m* implies that the stage *l* has already been reached. It does not necessarily follow that *m* can be interpreted in terms of *l*, or that *n* can be interpreted in terms of *m*. Nay rather it seems, on the evidence, that in passing from *l* to *m*, and from *m* to *n*, there is something really new. For this the word " emergent " has been suggested. Emergence labels the concept which may thus be expressed: When certain constituents with distinctive characterising properties go together in accordance with some determinate plan so as to form an integral whole, the properties of that whole are not the algebraical sum of the properties of the constituents as they exist (*a*) independently or (*b*) within some other and different whole. There are *new* properties which are said to be emergent.

Whether there be in nature instances of emergence in this sense is a matter of evidence. If so they may be found only in *l*—in the physico-chemical realm, or they may be found also in *m* and in *n*. Wherever they be found, we must loyally accept this finding, which implies that in these cases—not necessarily in all cases—evolutionary advance is by emergent steps with continuity of direction towards higher modes of being. Acceptance of some such evolutionary scheme for the interpretation of life and mind is admittedly on speculative grounds.

On practical grounds botanists and zoologists of the older school may say: We keep to known facts and work within our province. Of an enchained series of steps from the not-living to the living there is at present no evidence which carries conviction. We start, therefore, with organisms in being. We adduce evidence in favour of evolution, by which we mean a doctrine of descent. We adduce evidence from which we infer that, accompanying certain organic events, the physiological nature of which we seek to characterise, there is in some organisms, but not in all, and even in man in some but not all of his behaviour, conscious guidance which contributes to fuller life and to nicer and more delicate adaptation. This " mind " we accept where the evidence justifies its acceptance, just as we " accept " life on the evidence. We find it in being at a describable stage of individual development. It is then a factor in further development and on this wise, under heredity, a factor in organic evolution. It is not within our province to ask: Whence does life arise? or Whence does mind arise? When once they are in being (through what mode of becoming, sudden or gradual, is unknown) we trace their evolution under our doctrine of descent. We submit that all this is based on sound scientific method.

Let us grant that it is based on sound biological method, and that the botanist or zoologist is wise to keep within his own province. But there are border-land sub-provinces in which other specialists are busily at work, and the interconnection of provinces (physico-chemical, organic and mental) is itself worthy of serious discussion. We must set no barriers to scientific inquiry.

Unrestricted evolution is unquestionably speculative in the sense that it is a hypothesis to be accepted or rejected on evidential grounds. It includes in its purview the origin of living beings and the origin of conscious endeavour to attain foreseen ends. Under restricted evolution biologists of the older school exclude these questions of origin (that of life and of mind) either (1) as beyond the scope of their special inquiry, or (2) as one with which science has no concern. But in either case they commonly urge that conscious endeavour as distinctive of mind, comes into effective existence quite late in the developmental history of the individual and quite late in evolution under their doctrine of descent. And when it does come, so as to be a new factor in adaptation to environing circumstances, they commonly accept as an unexplained fact that it in some way " accompanies " certain highly differentiated physiological events the story of which falls within their province.

There is, however, a newer school of biologists, and among them the logically consistent extremists say: not late in the course of development or of evolution does mind appear, but at the very outset of life, which from first to last is but the organic expression of mind as endeavour to accomplish its ends in development and evolution. For them evolution assumes a radically different meaning. It is still restricted to the realm or order of life and mind as definitely contrasted with the utterly diverse order of matter and energy. Here only is endeavour in being, but here always. Even in the plant, even in the fertilised ovum, even in processes of cell-division, that endeavour which is distinctive of mind, and which is absent in the inorganic realm, intervenes as directive of the course of events. The word " supernatural " may not be used, but sufficient emphasis can be laid on the analogous concept—" wholly other than naturalistic or deterministic."

Endeavour belongs to a disparate order of being, that of the mind which animates the organism and uses the material provided by nature as a means to the accomplishment of its ends. However stereotyped the development of oak from acorn may be, it is none the less the expression of life which is one with mind and is utterly different from the forces concerned in any mechanical occurrence. It betokens a persistent and consistent aim directed to, and directive of the fulfilment of " oakly " being. It is this that is spoken of as endeavour; this that demands a concept which is inapplicable to atoms or molecules or crystals or the solar system. Such a form of restricted evolution is a speculative hypothesis to be accepted or rejected on evidential grounds. What is the evidence in support of the cardinal concept? That is the crucial question which must here be left *sub judice*.

In view of the rival claims of this special form of restricted evolution on the one hand, and of unrestricted evolution on the other hand, controversy, often embittered, arises, and there is talk of " obsession " by this or that " dogma." The issue is at the bottom the place and the status of mind in its relation to matter.

Dr. Broad has recently discussed no less than seventeen logically possible solutions of this vexed problem under certain definitions. They lie beyond our purview here. Much has been written—much remains to be written—on evolution. The careful reader should ask: Which of at least three different usages of the word is implied in this or that statement, in this context or that?

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(C. Ll. M.)

EXAMINATIONS (*see* 10.41; also INTELLIGENCE, HUMAN).—As far as Great Britain is concerned progress since 1911 has been made in three directions:—

(1) It is suggested that the following criteria applicable to physical tests should be applied as far as possible to examination tests:

(*a*) The test of a given characteristic should demonstrably yield a suitable measure of that characteristic; (*b*) in cases where the whole material under investigation cannot be tested, it should be shown that the sample tested is an average sample of the whole; (*c*) the test should be trustworthy, *i.e.*, when repeated a number of times by the same observer, or when repeated by different observers, it should yield approximately the same results; (*d*) the application of the test should not sensibly affect the characteristic tested, or injuriously affect the material as a whole; (*e*) the characteristic tested should be demonstrably of a permanent or semi-permanent nature.[1]

(2) The British Govt. has taken action with a view to the improvement of the most difficult civil service examinations in the country and of secondary school examinations. The report of the Treasury Committee on Civil Service, Class I. Examinations (1917), has led to important reforms in that examination, of which the chief are the introduction of a viva-voce examination and the modification of the examination in "English" so as to make it a real "capacity-test" of "the understanding of English and the workmanlike use of words." The test in this subject has now a definite purpose and is designed to meet that purpose; and the whole tendency of the examinations in other subjects is also to test capacity rather than mere memory.

The Secondary Schools Examination Council set up by the Board of Education in 1917 is making, with the help of expert investigators in each subject, periodical investigations of examinations and scripts with a view to correlating the standards of public examinations at the ages of 16 and 18 (approximately), conducted by universities and other public bodies, while avoiding the introduction of an educational dead-level which would block progress. This "continuous audit" of examinations is valuable, and probably the first of its kind. In regard to one point there has been no visible advance—the statistical investigation of the marking by different examiners, in which Edgeworth's important researches remain almost isolated. Starch and Elliott, in 1913, showed that the marks allotted independently to a single script by 115 mathematical teachers varied from 28 to 92, confirming Edgeworth's results.[2] Further investigation of this point is essential. In regard to "interview" and viva-voce examinations, there appears to be far greater uniformity of valuation.[3]

(3) The development of intelligence tests has introduced a new element into examinations. In the marking (or "scoring") of these tests, differences between different examiners are eliminated: the tests are "trustworthy" as defined under (1) above. Ballard (*loc. cit.*) points out that most ordinary examinations are incidentally tests of English composition, which is difficult to mark; whereas in "intelligence" tests writing is reduced to a minimum, the answer being often given by a mark or a number instead of by words. But much of the old difficulty remains as to the precise significance of the examination results in their bearing on the purpose of the examination. The fact remains that in the emergency of the War the "group-tests," which are rapid, were successfully applied in 1917–8 in the United States of America to nearly 2,000,000 men with the object of separating them into various classes for military employment or registering them as unemployable (*see* JOB ANALYSIS).[4] Ballard, who has extended the new methods to such school subjects as history and geography, claims that there is a high degree of correlation between the results and the estimates of teachers based on long experience. The Consultative Committee of the English Board of Education in their important *Report on Psychological Tests of Educable Capacity*, etc. (1924), state that

"though in the present state of development of 'intelligence' tests it is hardly possible to explain simply what is measured or tested by them, it is tolerably well established that these tests ..... have shown themselves capable of giving a useful common measurement of what teachers generally call capacity or intelligence."

The committee think the new tests will probably exert an important influence on examinations of the ordinary type, and recommend especially that further research should be instituted into the use of individual "intelligence" tests in connection with oral examinations for all ages or types.

Although progress has been made, there is still much room for the improvement of examinations, it being especially necessary to define the exact purpose of each examination, and to ascertain by investigation how far it fulfils that purpose.

BIBLIOGRAPHY.—In addition to sources quoted, *Circular 996* of May 25 1917, of the *Board of Education*, London, re the Secondary Schools Examination Council; Publications of that Council; chapters on "Examinations" in the *Calcutta University Commission Report*, vol. 2, chap. 18; vol. 5, chap. 40; vol. 7, App. 18 (1919).

(P. J. H.)

THE UNITED STATES

Examinations in subject matter in school and college have been undergoing a very radical change during the period 1910–26. This change may be characterized as a turning away from the old-type question, which asked the candidate to "describe," "state" or "explain" in essay form a certain topic, to the new-type question, which calls for a specific response to an item, this response being made by underlining, checking or writing a word or at most a phrase. In an old-type examination[5] the candidate might be asked to write an essay in answer to the question, "Describe the secretion of gastric juice." In the new-type examination his knowledge about gastric juice would be tested by his responses to many short items. Such items may take several forms, as will be illustrated by items from different subjects:—

Analogy: Gastric juice is to the stomach as (saliva, adrenin, *tears*, bile) is to the lachrymal glands.

Completion: The part of a circle included between two—and an —is called a sector.

Recognition: Planets move around the sun in orbits that are circular, *elliptical*, hyperbolic, cylindrical.

True-False: T. F. The chief crop in Ohio is tobacco.

There are many different varieties and combinations of such forms, and those quoted above must be considered only as samples.

The reasons for this change from old- to new-type examinations may be ascribed to the unreliability of the old-type and the development of the new-type item in intelligence testing. The old-type question is difficult to score accurately and it fails to cover the whole field of the subject examined. The development of group intelligence tests led the way to a study of the technique of constructing the questions, arranging them in sub-tests and in standardising the whole test. The methods of scoring were also developed through the group intelligence test. The construction of an examination in a school subject for nation-wide use (generally called a standardised educational test) is now quite a technical matter.[6] There are such standardised subject-matter examinations or tests for practically every subject taught in the elementary and high schools of the country.

In addition to these standardised tests made by experts, teachers are everywhere using the new-type examinations in their class room work. Wood[7] describes such examinations at the university level and Russell[8] shows in detail how school teachers can construct such examinations in all subjects in the elementary school. He goes further and suggests how they may be used as effective teaching devices. None of these authorities advises the absolute

[1] P. J. Hartog, *Examinations and Their Relation to Culture and Efficiency* (1918).

[2] See P. B. Ballard, *The New Examiner*, p. 182 (1924).

[3] *Cf.* Sir Stanley Leathes on "The Qualifications ..... of Public Servants," *Jour. of Public Administration*, 1, p. 356 (1923).

[4] C. S. Yoakum and R. M. Yerkes, *Mental Tests in the American Army* (1920).

[5] Examples taken from D. G. Paterson, *Preparation and Use of New-Type Examinations*. Yonkers, 1925.

[6] W. A. McCall, *How to Measure in Education* (New York, 1922).

[7] B. D. Wood, *Measurement in Higher Education* (Yonkers, 1923).

[8] C. Russell, *Classroom Tests* (Boston, 1926).

abandonment of the old-type essay examination, but all of them believe it to be insufficient for the accurate examination of the pupil. All of them emphasise the necessity for a careful construction of the new-type examination, and they maintain that it can be made to measure the pupil's ability to reason. They deny that it merely tests the memory of the pupil.

These new type examinations are now being used by such examining bodies as the College Entrance Examination Board and the Board of Examiners of the New York City Board of Education, and by many civil service commissions, both state and municipal. In *Public Personnel Studies*, a journal issued by the Bureau of Public Personnel Administration, Institute for Government Research at Washington, suggested examinations for a great many civil service positions have been published. Almost all of these examinations are of the new type. (R. Pr.)

EXCESS PROFITS DUTY.—This describes a tax on the excess of the actual profit of an accounting period over a standard of profit.

I. IN THE UNITED KINGDOM

Immediately after the outbreak of War in 1914 it was apparent, from the movement of the monthly index numbers of the wholesale prices of commodities, that profits of businesses, especially of those concerns whose products would immediately be in increased demand, would move upwards at a rate even greater than that shown by the index number. For instance, the Sauerbeck-Statist index number for July 1914 was 82·4, by Dec. it was 91·6 and in July 1915 it had reached 106·4, or an increase of over 25% in 12 months. When the results shown by accounts of trading concerns embracing part of the War period became available to the authorities, the figures which emerged more than confirmed this anticipation, and so the excess profits duty was born. It was imposed by Part 3 of the Finance (No. 2) Act 1915, which passed into law on Dec. 23 of that year.

Scope of the Duty.—The excess profits duty was a duty, where a chargeable amount of profit existed, on the profit of trades and businesses carried on in the United Kingdom, or owned or carried on in any other place by persons ordinarily resident in the United Kingdom. The duty did not extend to the profit derived from husbandry in the United Kingdom, or from the exercise of a profession or from offices or employments—though in certain cases the remuneration of directors and other persons concerned in the management of a business was indirectly made subject to the duty. The duty was imposed upon the profit of a business concern as an entity, and not by reference to the profit or income of individuals as such. A chargeable amount of profit was the excess of the actual profit of an accounting period over a standard of profit increased by certain free allowances. An accounting period was in general the period for which the accounts of the business are made up; it might cover any period not exceeding 12 months.

Both for the accounting period and for purposes of the standard, profit was determined, subject to the modifications set out in the statutes, on the same principles which determined profits under the Income Tax Acts. It was limited to the profit inuring to the proprietors of the business, exclusive (with certain exceptions) of interest received on investments. Interest paid upon loans and other charges upon the business was therefore deducted in arriving at profit.

Standard of Profit.—The standard of profit was represented in the normal case of a business which had been carried on for some years prior to the outbreak of War by either: (*a*) a profits standard, or (*b*) a percentage standard. A profits standard was normally the average profit of any two of the three years to the end of the last accounting period ended before the outbreak of War. In exceptional cases the profit of a different period of pre-War trading was adopted. A percentage standard was normally a statutory percentage (in the case of companies 6% and in other cases 7% for accounting periods ended on or before Dec. 31 1916, and 8% thereafter) on the amount of capital employed in the business at the end of the last accounting period ended before the outbreak of War. Provision was made for the increase of these percentages in the case of classes of trade or business which proved that the capital employed in the class of trade or business was subject to special circumstances (*e.g.*, special risk, etc.). Applications for any such increase of the statutory percentage was dealt with by a board of referees appointed for the purpose by the Treasury. A large number of such applications was made to that board, embracing many trading activities carried on abroad by British concerns, *e.g.*, mining, teaplanting, etc., and numerous awards were issued by the board increasing the statutory percentage.

Since the scheme of the duty involved a comparison of the profit of the accounting period with the standard of profit (the excess of the former over the standard being the amount on which the duty was charged), it was necessary that the basis of computation should be similar and comparable in both cases. Provision was therefore made for a reduction or increase of the profit of the accounting period, by reference to a statutory percentage upon the additional or reduced amount of capital employed in the accounting period as compared with the capital employed during the period or at the date to which the standard related. The statutory percentage here referred to was for cases where there was a decrease in the amount of capital employed, 6% in the case of companies and 7% in the case of other persons since the imposition of the duty. Where there had been an increase in the amount of capital the statutory percentage was at different times: in the case of companies, 6, 9 and 11%; in the case of other persons, 7, 11 and 13%.

Capital as computed for the purpose of the duty represented the proprietors' trading capital, and borrowed money was, therefore, excluded from the computation of capital. In general, capital of a business consisted of money; assets acquired by purchase at the price paid, subject to any deductions for wear and tear or replacement; debts due to the business and assets not acquired by purchase taken at their value when they became assets of the business. Accumulated profits employed in the business were treated as capital; any capital (the income of which was not taken into account in computing profits for the purposes of duty) and any borrowed money or debts were to be deducted in computing the capital. Assets paid for otherwise than in cash were to be taken at the value of the consideration when the asset was acquired, but if the business had been converted into a company so that the shares therein were held by the late owner, no value was to be attached to those shares so far as they were represented by good-will or otherwise than by material assets. For this purpose patents and secret processes were deemed material assets. The free allowance was in general £200 for an accounting period of a year. In certain cases of ex-soldier, etc., proprietors of businesses it was £500.

Relief under the Original Act.—Special provisions affording relief from the full weight of the duty were introduced as from Jan. 1 1917 in the case of small businesses. The relief was given either by reference to the deficiency of the profit of the accounting period below a prescribed sum (at first a sum of £2,000 for an accounting period of a year and subsequently £4,000), or by reference (as from Jan. 1 1920) to a substituted standard dependent upon the number of working proprietors and the capital employed during the period or at the date to which the original standard related.

A special and novel feature of the duty was found in a provision under which in the normal case a percentage—equal to the percentage rate of duty in force for the period concerned—of any deficiency of profit of a business below the standard in any accounting period was set off against the amount of duty applicable to an excess of profit over the standard in another period.

Special provisions were included in the statutes as regards businesses where there had been only two pre-War years or only one or part of one pre-War year, or where the business had been commenced since the outbreak of the War; as regards depreciation and obsolescence of assets, unremunerative capital, remuneration of directors, etc.; the businesses of local authorities, industrial and provident societies and of shipping; and other matters of detail.

In the case of an accounting period which commenced before and ended after any of the times stated, the excess profits were apportioned on a time basis between the relative parts of the accounting period and the apportioned parts of the profits were charged at the several appropriate rates of duty.

The duties imposed are shown in the following table:—

Rates of Duty on the amount by which the profits from any trade or business to which the law applied, in any accounting period which ended after Aug. 4 1914, exceeded by more than £200 the pre-War standard of profits.

Excess profits arising:—	%
(*a*) Within a year from the commencement of the first accounting period[1]	50
(*b*) After the end of the period mentioned in (*a*) but before Jan. 1 1917[1]	60
(*c*) During the calendar years 1917 and 1918	80
(*d*) During the calendar year 1919	40
(*e*) On and after Jan. 1 1920, until Parliament otherwise determined	60

[1] In the case of trades or businesses commencing after Aug. 4 1914, the rate was 50%, if the accounting period ended on or before Aug. 4 1915, and 60% if it ended thereafter.

Munitions Levy.—For a time there existed side by side with the excess profits duty another duty known as munitions levy, or munitions Exchequer payments, which was imposed by the Munitions of War Act 1915. It applied only to certain concerns or parts of concerns engaged in the manufacture of munitions or War materials which the Minister of Munitions "controlled" under the provisions of that Act.

The Act limited the profits of controlled establishments, as from the date of control, to a retainable amount, ascertained in accordance with the statute and rules made thereunder. Any excess of net profits of the establishment over such retainable amount was payable to the Exchequer in the form of munitions levy.

The retainable amount of profits was, broadly speaking, made up of:—

(*a*) The standard amount of profits,
(*b*) One-fifth of that standard,
(*c*) Special allowances for increased output or for increased capital, and
(*d*) Special allowances for exceptional services by the controlled owner or other exceptional circumstances.

Controlled establishments liable to the munitions levy were liable also, like other trades and businesses, to the general excess-profits duty, but under Section 48 of the Finance Act 1916, it was provided in effect that the concern should be liable to pay for any period an amount equivalent to the higher of the two charges, but not both.

The operation of the munitions levy was terminated as from Dec. 31 1916 by the Finance Act 1917 (section 24). The ground for the repeal of the levy as from Dec. 31 1916, is to be found in the fact that as from that date the rate of excess-profits duty was increased to 80%. At that rate the duty became, practically without exception, the heavier charge, and the munitions levy would, if it had been continued, have been inoperative in its result.

Repeal of the Duty.—Excess-profits duty was abolished by the Finance Act 1921. As different businesses had become first subject to the duty at different dates, provision was made for them to cease to be liable to the duty at different dates in such a manner as to result in every business which had commenced before the outbreak of War being subject to the duty for an aggregate period of seven years and no longer. Businesses which had commenced after the outbreak of War had their liability terminated at a fixed date of Dec. 31 1920.

Refund of Relief.—It was a general principle that against the duty chargeable upon the excess profits of any accounting period there might be set off the duty applicable to any deficiency of profits sustained in another accounting period. The various changes which were enacted in the rate of duty made it possible for a taxpayer to be required to pay an amount of duty in excess of his aggregate net excess profits over the whole period for which the duty was in force. To obviate this anomalous result, provision was made that in such cases the excess should be remitted or repaid. In calculating the duty to be compared with the net aggregate excess profits, payments of munitions levy were to be counted as payments of excess-profits duty to the extent that duty would have been payable if munitions levy had not existed.

Part of the productivity of the duty was due to the continuous rise of the price level, and as early as 1917 the trading community, anticipating that at some time this period of high prices might be succeeded by a heavy fall in prices, urged upon the Government the necessity of providing relief from excess-profits duty, in any cases in which losses were incurred shortly after the duty came to an end, in consequence of such a fall in value. Complex provisions to this end were contained in the Finance Act 1921, granting three reliefs in connection with trading stocks, two of which were alternative to one another. A maximum period of four years from Aug. 31 1921, within which relief could operate, was allowed. During the four years from 1921 to 1924, inclusive, £184,000,000 of excess-profits duty and munitions levy were repaid, and a large part of this repayment is to be ascribed to these reliefs. That the fears of the trading community as respects the price level were justified, is shown by the movement of the Sauerbeck-Statist index number from its peak of 266·1 for April 1920 to 134·8 in April 1922.

The net amount of duty collected and retained in the Exchequer from the inception of the tax to March 31 1926 was £1,280,000,000. Even at that date a considerable volume of arrears was still outstanding, although the authorities anticipated that little more benefit to the Exchequer could be expected.

In order to expedite the clearing up of arrears, steps were taken in 1922 to charge simple interest at the rate of 4½% per annum without deduction for income tax on excess-profits duty outstanding as from the date at which the debt became payable, or, if it had become payable on or before Jan. 1 1922, as from that date.

In the earlier years of the debt the number of assessments made was about 50,000, but when prices were at their peak the number of concerns liable to the duty was round about 70,000.

Yield.—The approximate true excess profits arising in accounting periods classified in financial years were officially estimated to be as follows:—

Accounting Periods Ended in the Period or Year	Approximate True Excess Profits £
Aug. 5 1914 to March 31 1915	50,000,000
Year to March 31 1916	200,000,000
Year to March 31 1917	350,000,000
Year to March 31 1918	430,000,000
Year to March 31 1919	500,000,000
Year to March 31 1920	600,000,000[1]
Year to March 31 1921	200,000,000[1]

[1] Subject to revision in the light of assessments still being made for accounting periods ended in the year 1919–20, and 1920–1. The estimate for the latter year does not allow for the reduction in value of trading stocks arising after the end of the final accounting period under the relief provisions. (W. H. C.)

II. THE UNITED STATES

Although during the American Civil War the State of Georgia had adopted (1863) a tax on business profits in excess of 8% on the capital stock, at rates varying from 5% to 25% according to the amount of such excess profits, the first federal excess-profits tax was adopted in the Act of March 3 1917, for the purpose of creating a "special preparedness fund." After the United States entered the World War, this tax, at higher rates and in more complex form, was continued in the Acts of Oct. 3 1917, Feb. 24 1919 and Nov. 23 1921. In all these Acts, less use was made of pre-War profits as a base than in the British Acts. The American tax was aimed at "supernormal profits"—profits in excess of normal profits—rather than profits in excess of pre-War profits. The decision to subordinate pre-War profits was made deliberately by the framers of the law on the ground that a deduction based upon invested capital was simpler, better designed to serve as the basis of a permanent tax, and more equitable in that it prevented tax-payers from escaping the tax merely because they had been unusually prosperous before the World War. Under the American tax a business which had been unusually profitable before the War and merely maintained the former rate of profits during the War, was still subject to a heavy excess-profits tax. However, minor recognition of the War-profits idea was incorporated in the Act of Oct. 3 1917; and for the one year 1918 a dual or alternative tax was imposed, the taxpayer in effect paying an 80% War-profits tax or an excess-profits tax at progressive rates of 30% and 65%, whichever tax was larger. During the years 1919–21 only the excess profits tax was retained.

Provisions.—The 1917 law applied to all trades and businesses, including professions and occupations, but beginning with 1918 the tax was confined to corporations, excluding "personal-service corporations." The normal exemption or "excess-profits credit" consisted of a specific exemption of $3,000 plus 8% of the invested capital. Income in excess of this credit but not in excess of 20% of the invested capital was taxed (after the year 1918) at the rate of 20%, and the remaining income, if any, at the rate of 40%. The upper rate for the year 1917 rose to 60% and for 1918 to 65%. Under the Act of Oct. 3 1917 the specific exemption to individuals and partnerships was $6,000; but to corporations only, $3,000.

Yield.—Judged by the standard of productivity—the most important quality of a War tax—the excess-profits tax was conspicuously successful during the World War. The yield of the tax was as shown on following page.

The figures for 1918 represent possibly the largest annual amount ever produced in one country by a single tax. During the years 1917–9 the excess-profits tax produced more than 25% of the total ordinary receipts. But despite the high rates, the tax was collected

without crippling industry, owing to the high level of profits and to the protective effect of the normal exemption, the relief provisions, and the large degree of administrative discretion authorised in the law.

Excess-Profits Tax Returned for Calendar Year

1917	Individuals, etc.	$101,249,781	
	Partnerships	103,887,984	
	Corporations	1,638,747,740	
	Total		$1,843,885,505
1918			2,505,565,939
1919			1,431,805,690
1920			988,726,351
1921			335,131,811

In accordance with the promises of both political parties, the tax was repealed, after stubborn opposition, as on Dec. 31 1921. The termination of the tax gave rise to no special problems such as arose in Great Britain, because under the American tax the liability of the taxpayer for any one year was not dependent in any important way upon his income for other years. The repeal of the tax was due mainly to the sharp decline in its productivity under peace conditions; its discrimination in favour of overcapitalised concerns and against conservatively financed corporations; the general belief that it was passed on, loaded with additions, to the general body of consumers; its capricious inequalities; and its great complexity. The complexity of the tax, which, in the words of one secretary of the Treasury, threatened to cause an administrative breakdown, is illustrated by the fact that the tax liability for the year 1917 of many of the large corporate consolidations had not been finally determined at the close of the year 1925.

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(T. S. A.)

EXCHANGES, FOREIGN (*see* 10.50).—The main reason why we pay anything for a foreign currency is of course that this currency represents in the foreign country a purchasing power which can be used for acquiring the goods or for paying for the services of that country. Thus, it is clear that the amount we can pay for the unit of the foreign currency must, broadly speaking, be in direct proportion to the internal purchasing power of that currency, *i.e.*, in inverse proportion to the country's general level of prices.

On the other hand, it is clear that we can afford to pay more in our own currency the more abundant this currency is, *i.e.*, the lower its internal purchasing power, and the higher the general level of home prices. This is easily seen if we reflect on the fact that the price paid for a foreign currency is ultimately a price for foreign commodities, a price which must stand in a certain relation to the prices of commodities on the home market. Thus we arrive at the conclusion that the rate of exchange between two currencies must depend essentially on the quotient of the internal purchasing powers of these currencies. Again, the internal purchasing power of a currency must essentially depend upon the supply of means of payment in that currency. By unlimited supply any price could be paid for goods and a currency could have no definite purchasing power. A certain restriction of the supply of means of payment is therefore necessary, and the scarcity of this supply determines the purchasing power of the currency. Thus the rate of exchange between two currencies is ultimately dependent upon the limitation of the supply of means of payment in both countries.

The fact that the rate of exchange is determined by the quotient of the purchasing powers of the currencies is most obvious in the case of independent paper standards, where no other basis can be found for the determination of the exchange. But the principle applies equally well to the exchange between gold standards. The essential reason why the pound sterling before the War was worth about 25 fr. in French currency was that the internal purchasing power of the pound was about 25 times as large as that of the French franc. It is true that the existence of a gold standard in both countries determines a certain gold parity. But it would be impossible to keep up the gold standard if the purchasing powers of the currencies were not maintained at a corresponding level and if the supply of means of payment in both countries were not regulated to that end.

If, however, we wish to apply our principle to exact calculations we are faced with the difficulty that the absolute purchasing power of a currency cannot strictly be compared with that of another currency. Of course, if all prices in the country B are 10 times as high as those in the country A, it is obvious that the purchasing power of the B currency is one tenth of that of the A currency. If some prices in B are somewhat more and some prices somewhat less than 10 times the corresponding prices in A, we may still say that the purchasing power of the B currency is, broadly speaking, one tenth of the A currency. But this formula will no longer be exact. Now this is precisely the case with which we always have to deal in making international comparisons. For an international exchange of goods can only exist if the constellation of relative prices in one country is different from that in the other country.

In the simple case of only two countries, A and B, exchanging goods with one another, their international trade will come to an equilibrium at a certain rate of exchange determined by the condition that there must be equality in value between A's imports from B and exports to B. This equilibrium rate is determined essentially by the internal purchasing powers of the two currencies and, in the second instance, by the constellation of relative prices in each country and by the conditions prevailing for the interchange of goods between them. Assuming the latter factors to be given, the equilibrium rate of exchange will be determined exclusively by the quotient of the internal purchasing powers of the currencies. If the internal purchasing power of one currency is doubled and that of the other remains constant, the value in exchange of the former currency will likewise be doubled. In order to emphasise this dominating influence of the internal purchasing power in fixing the equilibrium rate of exchange, we call this rate, as here defined, the purchasing power parity between the two currencies.

It is always possible to find such a rate of exchange as will establish equilibrium in the international trade. Thus a country can never be excluded from international trade by being handicapped with regard to costs of production. High prices will always be counteracted by a sufficiently low valuation of the country's currency, and the rate of exchange will always stabilise itself at a point where all disadvantages are counterbalanced and where, therefore, the country is able to export just as much as it imports. This observation is sufficient to show the usefulness of the purchasing power parity theory for a clear exposition of the theory of international trade.

The internal purchasing power of the two currencies contemplated determines only the equilibrium of the rate of exchange. The actual rate generally shows deviations from this equilibrium. When more is paid for a foreign currency than would correspond to its purchasing power parity, the currency is said to be over-valued. Again, when less is paid, the currency is under-valued. If a currency is over-valued, foreign currencies are under-valued in that currency. The result is that the export trade of the country is handicapped and that the import trade receives an artificial stimulus. In the case of an under-valued currency, the effect is of course the reverse.

After the outbreak of the World War, radical revolutions took place in the internal purchasing powers of all the currencies of the world. These revolutions were reflected in corresponding revolutions in the exchanges, which could naturally be explained only by a theory giving the internal purchasing power of the different currencies its due place as the fundamental factor in the formation of exchanges. In fact, the history of exchanges after 1914 affords the most complete illustration to the paramount rôle of the purchasing power parity in the determination of exchanges as well as to the deviations of actual exchanges from this equilibrium and the causes and effects of such deviations.

In order to finance the War, the belligerent countries had recourse to a creation of purchasing power by the aid of note-printing and book credits with central banks. Neutral countries soon followed suit, partly in order to finance extraordinary expenses in connection with the War, and partly in order to grant extensive credits to the belligerents. As nothing was produced to

be set up against this extra purchasing power, the result was a rise in prices. At the higher level of prices a correspondingly greater supply of means of payment was required and was therefore retained by the public. The creation of fresh purchasing power, however, was continually repeated, and the result was a continual rise in prices and an equally continual increase in the amount of means of payment in use. These two quantities grew in proportion to one another, but the ultimate cause of this movement was the continual creation of fresh purchasing power. We call such a movement "inflation." Thus inflation is a rise in the general level of prices caused by creation of artificial purchasing power in the form of a superabundant supply of means of payment. A country may of course see its supply of commodities reduced and its general level of prices raised in consequence of such a scarcity of commodities. But if the supply of commodities is reduced, say to three-fourths—which means a very serious deprivation indeed—the corresponding rise in prices is only as 3 to 4, and this is not very much in comparison with the tremendous rise in prices which has taken place in so many countries since 1914. The essential cause of rising prices has, therefore, always been an inflation. Further, from a more rigorous point of view, we must say that a country which sees its supply of commodities diminishing, ought to reduce its supply of means of payment in the same proportion. If this is done, the scarcity of commodities can cause no general rise in prices and the price level will remain intact. Therefore, strictly speaking, every rise in the general level of prices is a result of a too abundant supply of means of payment and may consequently be described as an "inflation" in a wider sense.

The most conspicuous case of inflation was that of Germany. The inflation in that country began on a small scale in the beginning of the War, and as it proceeded meant a continual deterioration of the German mark. This deterioration was, of course, according to the purchasing power parity theory, reflected in a corresponding fall of the German exchange in the international market. However, people in Germany were very reluctant to acknowledge that a real deterioration of their own currency had taken place, and they resorted to all sorts of more popular explanations of the fall of the exchange. Particularly, it was held that the extraordinary difficulties of Germany's foreign trade were a sufficient explanation of the unfavourable development of the rate of exchange.

In this case, however, later events were to prove the complete incapacity of the popular market-theory of exchanges to explain alterations in the exchanges brought about by a radical alteration of the internal value of the currency. German inflation, under the influence of the revolution and under the pressure of the treaty and particularly of the Ruhr occupation, surpassed all limits and ultimately brought down the value of the German mark to a millionth of a millionth of its pre-War value. This catastrophe opened the eyes of even the blindest, and people began to realise both that the internal value of the mark had been deteriorated and that the external value as expressed in the exchanges essentially only reflected this internal deterioration.

What was truth in the case of Germany had gradually to be acknowledged as truth also with regard to other countries. In fact, inflation has taken place in all countries, although not to such a fantastic extent as in Germany. Generally people have been extremely unwilling to admit the existence of a deterioration of their own currency. But statistical figures put the fact beyond all doubt. For most countries the maximum of inflation was reached in 1920, when such price index figures were attained as 366 for Sweden, 588 for France and 670 for Italy. In the United States the price level reached its highest point in May 1920 with 264 and in the same month the British price index reached its maximum with 336. The two last figures are those given by the Federal Reserve Board of the United States, which calculates index numbers particularly for purposes of international comparison.

It is important to observe that inflation did not reach its maximum before 1920, whereas the War came to an end in Nov. 1918. This shows that the enhancement of prices and the disturbances of the exchanges which took place during the War were not, as many people had believed, merely a result of the conditions of the War. Inflation went on as long as the false methods of finance and the unsound monetary policy originated during the War were continued. In most countries a deflation has since taken place and substantially lowered the general level of prices. Nevertheless, in all countries the general level of prices remains considerably above the pre-War level. This is so even where the pre-War gold standard has been restored, the price indexes of the United States and England being, for instance, for June 1925, 163 and 164 respectively. Thus value of gold in 1925 was only about 60% of the pre-War value.

What, now, has been the effect on the exchanges of all these revolutions of the internal values of the currencies? We may calculate the new equilibrium of the exchange between two currencies, if we start from their pre-War purchasing power parity and multiply it by the quotient of the degrees of inflation of both currencies. We thus arrive at a new purchasing power parity which represents the new equilibrium of the exchange. If, *e.g.*, inflation has brought the general level of prices in A up to six times the pre-War height, but in B only to four times that height, the new purchasing power parity between the A currency and the B currency will be two-thirds of the pre-War purchasing power parity, and therefore the equilibrium rate of exchange of the A currency as expressed in the B currency will be two-thirds of the normal rate of pre-War time. Strictly speaking, this new equilibrium can be expected to establish itself only when normal conditions of international commerce similar to those which existed before the War have been restored. However, experience seems to show that this requirement is in most cases already beginning to be fulfilled in a measure sufficient to make the application of the principle here enunciated possible, at least in a broad sense.

The calculation is most reliable in the case of England and the United States. In May 1920, when, as mentioned above, the price level of these countries reached their maximum with 336 and 264 respectively, the purchasing power parity between them could be calculated by multiplying the pre-War parity, $4.87 for £1 with the quotient of 264 and 336. We thus arrive at the result that in May 1920 the purchasing power parity of the pound sterling was $3.83. The mean actual rate of exchange for the month was almost exactly the same ($3.85). Consequently, at that time the depression of the Sterling-Dollar exchange was exclusively a result of alterations in the internal purchasing power of the currencies concerned. In June 1925, when the price indexes of both countries were practically equal, the exchange had also returned to practically the pre-War par.

Of course the actual exchanges do not always so closely coincide with the purchasing power parities. In the present case a particularly noteworthy deviation was caused during the War by the so-called "pegging" of the Sterling-Dollar exchange. This meant that the pound sterling was by a deliberate policy kept very nearly to its pre-War par, namely, at the constant value of about $4.76, and this result was obtained during a period when inflation in England had gone so much further than in the United States that the purchasing power parity of the pound was considerably lower. The possibility of stabilising an exchange at such an artificial height is explained by the fact that not only were the immense financial resources of the United States placed at disposal for the purpose in the form of almost unlimited credits to the British Govt. but also private trade between the countries was severely restricted. After the Armistice, it was soon found impossible to continue such a policy and the exchange was "unpegged" in March 1919, with the result that there was a considerable fall in the rate which for April 1919 showed a mean figure of $4.66. Since that time, the actual exchange has oscillated round the purchasing power parity. The deviations have seldom exceeded 10% and have usually been much smaller; for the whole period after March 1919 the mean deviation of the actual exchange from the purchasing power parity has been almost nil.

A closer study of the deviations, however, is of considerable interest. It reveals the fact that the main cause of such devia-

tions has been the movement of capital between the countries. When dollar credits have been granted on a large scale and when the rate of interest in New York has been lower than that

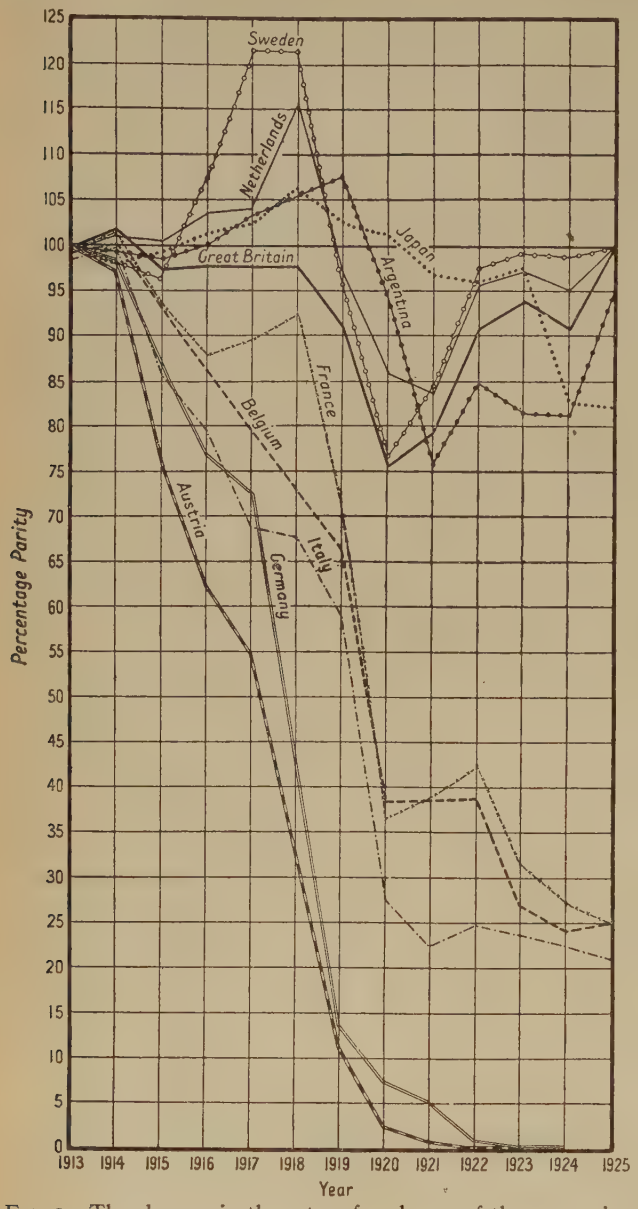

FIG. 1. The changes in the rates of exchange of the currencies of certain selected countries from 1913 to 1925, as compared with the dollar, are here shown as percentages above or below parity. The rate for each year is the daily average of cable transfer rates in New York: the rate in 1925 is therefore the average for the year, not the rate on December 31 1925. No figures are available for Belgium from 1914 to 1918 owing to the occupation of the country by the Germans: the average rate for 1914 is therefore linked up with that for 1919 by a straight line in order to make a continuous graph. Figures are not available for Germany and Austria for 1918, and the rates for 1917 and 1919 are similarly linked up. The most striking features are the appreciation of the currencies of Sweden, the Netherlands and Argentina during the war period, and the startling collapse of the Austrian and German currencies after the War. The rates for these two countries during 1925 are not shown, as new currencies, which remained practically at par during the year, were introduced. The chart is based on figures in "The Review of Economic Statistics" (Statistical Record 1924 Supplement) of the Harvard Economic Service, and in the United States Department of Commerce Survey of Current Statistics (Semiannual number, Feb. 1926).

in London, this has created an abundance of dollars in England, which has exerted some pressure on the value of the dollar in terms of sterling. At such periods we can observe a clear under-valuation of the dollar. Again, in periods when America has restricted its credit-giving to Europe and when a comparatively high rate of interest has prevailed in the United States, a certain scarcity of dollars has made itself felt in Europe, resulting in an over-valuation of the dollar. After the Dawes Scheme for the reorganisation of the German currency and for the payment of reparations had been finally adopted and the Dawes loan had been floated in the autumn of 1924, America displayed her restored confidence in Europe by a very considerably increased grant of credits, resulting in an under-valuation of the dollar, which lasted for the first four months of 1925.

This under-valuation, which may also be regarded as an over-valuation of the pound sterling in terms of dollars, was strengthened by the expectation of an early restoration of the gold standard in England, which of course would mean the raising of the pound to the old parity with the dollar. In fact, this restoration of the gold standard was carried through on April 29 1925, when the large gold resources of the Bank of England and huge dollar credits in the United States were placed at disposal for stabilising the Sterling-Dollar exchange in the neighbourhood of the old parity, $4.87. When this was done, however, the English currency was not yet in full parity with gold in regard to internal purchasing power. The dollar exchange, therefore, meant an over-valuation of the pound. Naturally, the gold standard could not be founded on such an over-valuation, but had to be built on the more solid basis of a raising of the internal purchasing power of the pound to the official parity with the dollar. This meant that prices in England had to be forced down by 4 or 5%. This was in fact what was done. During a time when the American price level stood nearly constant at 163, the English price level was brought down from 171 in April to 166 in May, and to 164 in June. Thus the internal purchasing power of the English currency had practically been brought to a level with that of the dollar.

In this case it seems clear enough that the artificial raising of the external value of the pound, which was accomplished by the restoration of the gold standard, has to some extent drawn the internal value of the pound with it. Clearly, the artificial depression of the exchange value of the dollar cheapened imports and had some depressing influence on the prices of British exports, and in both these ways helped to bring down the general level of prices in England. Such a process, however, is of an extraordinary nature, and is only possible when vast resources are at disposal for raising the currency's external value which is normally determined by the internal purchasing power. In the long run, an increase of this purchasing power is possible only when supported by a suitable restriction of the supply of means of payment. As a preliminary measure for the restoration of the gold standard, the Bank of England in fact raised its rate from 4 to 5% on March 5 1925. The effect showed itself immediately. The British price level, which had been rising from Sept. 1924 and which had attained a maximum of 178 for Jan. and Feb. 1925, was in March pressed down to 175, and, as has already been mentioned, right down to 164 for July. How far this fall in prices is to be ascribed to the raising of the international value of the pound and how far to the pressure of the higher rate of discount, it is hardly possible exactly to decide.

The artificial over-valuation of the pound, which was a result of the restoration of the gold standard in April, meant of course a handicap to British producers who had to face foreign competition without being able immediately to reduce their sterling costs of production in proportion to the increase in the international value of the pound. Some authors laid great stress on this disadvantage, and on that account not only opposed the restoration of the gold standard, but also, after the reform had been carried out, made it responsible for the prevailing unemployment and other economic difficulties. This argument was doubtless much exaggerated. The over-valuation of the pound caused by the restoration of the gold standard was, as our figures show, not very considerable, and, at any rate, as it disappeared as early as in July, it cannot reasonably be made responsible for more permanent economic difficulties.

In cases of continued inflation the deviations of exchanges from their purchasing power parities have been much greater. When,

e.g., the internal purchasing power of the German currency, in consequence of continued inflation, showed a regular fall, month after month, this fall was discounted on the international market, which generally paid a price considerably below the purchasing power parity of the German currency, but still a price corresponding to the internal purchasing power which that currency was to possess some months later. This under-valuation of the German currency made it possible for foreigners to buy goods in Germany at an unreasonably low price, or, what is the same, for German producers to sell their goods on foreign markets at prices ruinous for their foreign competitors. Both consequences called forth counteracting measures.

In Germany exports were prohibited except under licence, and every endeavour was made to force foreigners to pay more for German goods than the Germans did themselves. Of course, such measures diminished the value of the German mark for foreigners and the under-valuation grew still worse. In other countries the cheap German exports were regarded as a form of " dumping," and efforts were made to safeguard industries against competition from countries having a depreciated currency. Such measures, again, tended further to accentuate the under-valuation of the German currency, as its employment for the import of German goods was made more difficult. Thus, again, German competition was strengthened. It should also be observed that the exports of a country are artificially stimulated only by the under-valuation of its currency. The mere fact that the currency is depreciated gives no advantage to the exporter, provided the exchange value of the currency corresponds to its internal purchasing power.

A considerable over-valuation of a currency has sometimes taken place when it has been believed that the internal value of the currency was to be raised from a depreciated level to a pre-War gold parity. This was particularly the case with the Danish and Norwegian currencies during the second half of 1925. The over-valuation which in these cases has been supported by a strong international speculation has of course been a great drawback to the export trade of the countries concerned, and has also contributed to a general fall in prices within those countries and to a consequent serious economic depression.

The only way out of all these difficulties is, of course, to stabilise the internal values of the currencies and to bring back such normal conditions as will make exchanges correspond to these internal values. After the violent disturbances of its monetary systems which the world had witnessed the only practical possibility of attaining general stabilisation of currencies and a corresponding stability of exchanges was without doubt a return to the gold standard. Currencies which were very near to their pre-War gold parity could be restored to that parity, but for other currencies a new lower gold par had to be chosen, in conformity with the already existent purchasing power parity. A series of currencies have already been stabilised on this principle, and it seems certain that other countries which have hitherto been hesitating with regard to the ultimate aim of their monetary policy will soon come to a decision in favour of a similar stabilisation.

The adoption of the gold standard has the effect of compelling the purchasing power of the currency to be kept in a definite relation to that of gold and, therefore, the purchasing power parity between two gold standard currencies will always remain in the neighbourhood of the gold par. Still, smaller deviations of exchanges from the purchasing power parities are possible on account of fluctuations in the market. Such deviations, however, will always call forth an adjustment in the demand and supply of the currencies concerned, tending to restore the equilibrium of the market. The main factor in this adjustment is the movement of capital, which is made profitable by the abnormal rate of exchange. Of course, an over-valuation of the currency of a country also calls forth an increase in the imports to that country and hampers its exports. But these movements are much slower than the corresponding movements of securities and the transfers of short-term credits, and are, therefore, under normal conditions, of only secondary importance for the adjustment of the exchanges to their purchasing power parities. *See* also CURRENCY.

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EXHIBITION (*see* 10.67).—Following on the great exhibition of London, under the influence of Ruskin and Morris, the first tendencies towards the emancipation of decorative art made themselves evident. The movement took root in France, and led in 1863 to the creation of the Union Centrale des Arts Décoratifs, which was in time to achieve the formation, modelled on the South Kensington Museum, of the Musée des Arts Décoratifs. In the end the decorative artists won the right of citation in the artistic salons, in 1892 and 1895. They participated in the two great exhibitions of 1889 and 1900. In ceramics, in jewellery, in metal working, the creations of a Chapelet, a Lalique, a Brateau, and a Gallé met with the highest esteem.

The manufacture of furniture, characterised by the description "modern style," stirred the lively hostility of the public. This modern style was in its way a protest against the copying of the antique, and marked the break with all the secular traditions which had been the glory of furniture; and it created a fashion in reaction and in contrast rather than a style truly representative of contemporary life. Opposed by lovers of the antique, treated as suspect by the mass of the public, its vogue was brief.

The effort pursued since 1900 rests on a more solid basis and on more durable ideas. It strives to associate in one common work both the artist, the creator of models, and the commercial firm, the former contributing his original conception, the latter his capital, equipment and clientèle. This alliance, which was achieved in Germany by the foundation of the Werkbund in 1907, required more laborious efforts for its realisation in France. It is in a way the charter of modern decorative art. It was the guiding principle of the Paris exhibition of 1925.

The exhibitions which took place after 1900 in different capitals reserved space, restricted, no doubt, but still very significant, for modern decorators. They had their salon at Turin in 1902, at St. Louis in 1904, at Liége in 1905, at Milan in 1906, London in 1908, at Copenhagen in 1909, at Brussels in 1910, and at Turin in 1911, where the Union Centrale des Arts Décoratifs showed in its pavilion all the advances made up to then.

Important Exhibitions.—The Turin exhibition was to have been the overture of the Exposition des Arts Décoratifs Modernes. But the War delayed its realisation for 10 years. Various exhibitions in the interval called attention to the advances made in certain special branches. The Anglo-Latin exhibition in London in 1912 gave hospitality notably to France, Italy and the South American republics. The Ghent exhibition of 1913 renewed and surpassed the results already achieved at Liége and Brussels. Three groups were devoted to Letters, to Science and to Art, in a vast palace which covered an area of 20,000 sq. mètres. The urban exhibition at Lyon in 1914 covered the vast and complex problems which, in our day, are raised by the systematic expansion, and the life itself, of urban agglomerations: vital statistics, protection of childhood, home and school hygiene, organisation of labour, water supply, thoroughfares, transport and town amenities. All these aspects of life were set out, along a great avenue lined with 60 pavilions. Leipzig, in the same year, offered an exhibition of the advances made in the graphic arts and the book industry. In 1915, in the midst of war-time activities, France, Belgium and Italy accepted the invitation of the United States, which was then organising an exhibition at San Francisco to celebrate the opening of the Panama Canal. The French pavilion there reproduced the Palace of the Legion of Honour.

Post War Exhibitions.—The return of peace allowed the revival of regular exhibitions, national and international. Among the first may be mentioned the exhibition at Strasbourg in 1919, intended to re-establish the necessary contact between France and the restored provinces. In 1922, an international exhibition in celebration of the centenary of Brazilian independence was held at Rio de Janeiro. Two great Colonial exhibitions, French and British, took place in 1922 and 1924 respectively. The Marseilles exhibition made a survey of French colonial expansion. From 1870, onward it drew up, as it were, an economic inventory of France's overseas Empire. It paid tribute to the colonising methods of France, and to the attachment of the native races, who, in the course of the War, had sacrificed their lives in the common cause. The exhibition held at Wembley in 1924, and revived in 1925, was evidence of the vast extent and the great resources of the British Empire in all regions of the globe. In 1923 Italy inaugurated at the Monza Palace, the Versailles of Milan, an exhibition devoted to the art of housing. Made a biennial function, it was renewed with equal success, its scheme comprising furniture, bronzes, ironwork, jewellery, ceramics, glass and textiles. Every region of Italy had contributed to this effort of modern art, and a French section also took part.

In the same year a similar display was organised at Barcelona, on the Hill of Montjuich, destined to become the site of permanent palaces to house specialised exhibitions covering successively various aspects of modern life. The first was devoted to furnishing and interior decoration, and comprised three sections, one retrospective, the second for modern interiors, the third for special furnishings for offices, schools and public services. In 1925 France could show two great exhibitions. At Grenoble was held the exhibition of electric power and of touring facilities. One palace was reserved for the applied uses of electricity and the means of its conveyance. A dwelling-house was equipped to show its application to domestic life, and a farm exhibited its possibilities in rural communities. The touring section had two palaces, the first devoted to administrative organisations, the *Office du Tourisme*, the Touring Club, the local information bureaux, while the second displayed advances in the industries connected with the influx of tourists. The capital of the French Alps was thus combining in one exhibition the advance in the transportation of energy and its uses in modern life.

The Paris Exhibition.—At the same time Paris was exhibiting on both banks of the Seine, on the Champs-Elysées and on the Esplanade des Invalides, the creations of modern decorative art. This long-awaited exhibition, delayed for 10 years by the World War, covered all the *ensemble* of the background of our life. Architecture, furnishings, clothing, theatre, street and garden, education—the works displayed were all to be exclusively modern. No retrospective work was admitted. For the first time modern art was offered by itself to public judgment. The experiment was favourable and its success was fulfilled, and even surpassed what was hoped for. More than 16,000,000 visitors thronged enthusiastically the magical spectacle, to which a special character, at once alluring and impressive, was given by the waters of the Seine and the lighting effects. Objects were presented as much as possible in their proper settings. Special settings were designed so as to reproduce the actual conditions of life. Pavilions, separate rooms, shops and stores, rivalled each other in their realism. A great advance was achieved in the art of presentation. And the exhibition marked also, in a final manner, the alliance of art and industry in practice, an alliance adumbrated in 1900 towards which the movement had been working ever since.

This exhibition was international and specialised. It had not the vast extent of the old great exhibitions, but it was shown to be more sharply instructive in effect within the scope assigned to it. Specialisation tends to show itself, not only in restriction of programmes, but in that of geographical range also. All countries are returning to the old-fashioned formula of city fairs, annual or biennial. Paris, Lyon and Dijon in France have adopted these regular demonstrations. They take place likewise in London, Milan, Riga, Leipzig, Nijni Novgorod and many other cities, in various forms and under varying conditions. It seems as if here, as elsewhere, progress sometimes returns to old conceptions, modified to the ideas of our generation. An annual exhibition of national scope is the Canadian National Exhibition held each autumn on permanently equipped premises at Toronto, Canada.

International Co-operation.—The need for assuring a certain unity among institutions of such varied characters brought about the meeting at Berlin, in 1912, of a diplomatic conference in which 16 states took part. The conference defined and classified the various sorts of general or specialised exhibitions, official or private, national or international. It fixed the rules governing the participation of states and limiting the number of exhibitions and their duration, the modes of issuing invitations, the procedures for adjudicating bodies, the scale of awards. This work is continued by the international federation of the permanent committees of exhibitions.

Thus these great institutions have their regular place in the lives of the peoples. If they have lost the vastness and all-embracing range of former times, the limitation of their scope seems, on the other hand, to make for their increased efficacy, and for their becoming a permanent instrument of economic expansion and social progress. (*See* DECORATIVE ART.)

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EXHIBITION, BRITISH EMPIRE.—The British Empire Exhibition, held at Wembley, Middlesex, in 1924 and 1925, was the largest exhibition of its kind ever held in Great Britain. The site chosen lies about 10 m. west-north-west of the city, and is served by the Metropolitan, L.N.E. and L.M.S. railways.

The construction of the exhibition was begun in January 1922, and the exhibition was opened by the King on April 23 1924. The first season lasted till Nov. 1 1924; and at a banquet held at the Guildhall on Nov. 10 the Prime Minister indicated the intention of the Govt. to re-open the exhibition the following year. A second season was accordingly undertaken. This lasted from May 9 1925 to Oct. 31; and the buildings and other paraphernalia of the exhibition were shortly afterwards put in the hands of liquidators for sale.

The aims and objects of the exhibition, as set out in early exhibition literature, were as follows:—

To find in the development and utilisation of the raw materials of the empire new sources of imperial wealth.

To foster intra-imperial trade and open fresh world markets for Dominion and home products.

To make the different races of the British Empire better known to each other and to demonstrate to the people of Britain the almost illimitable possibilities of the Dominions, Colonies and Dependencies overseas.

In the 1924 season Imperial exhibits came from Australia, Bermuda, British Guiana, Burmah, Canada, Ceylon, Cyprus, East Africa (Nyasaland, Seychelles and Zanzibar), Fiji, Hong Kong, India, Malaya, Malta, Newfoundland, New Zealand, Palestine, Sarawak, South Africa, West Africa (Nigeria, Gold Coast and Sierra Leone), West Indian and Atlantic group (Barbados, British Honduras, Falkland Is., Jamaica, Leeward Is., Saint Lucia, Trinidad and Tobago).

In addition to these exhibits, in each of which were displayed as far as possible the main characteristics of the life and potentialities of the dominion or dependency in question, there were various industrial and commercial exhibits of importance, such as the Palace of Industry, the Palace of Arts, and the Palace of Engineering, the last being changed in 1925 to the Palace of Housing and Transport.

The Pavilion of H. M. Govt. was an enterprise without precedent. In addition to its function of presenting some account of the nation's public services, its purpose was to illuminate and epitomise the imperial idea. The Pavilion was British civ-

ilisation in microcosm. To that civilisation each of the countries brought its share and the function of the Pavilion was to illustrate the broad result.

Defence was represented by the navy, army and air force; health by the exhibits of the Tropical Health and Hygiene Committee, and the Ministry of Health; public services by such departments as the Post Office, Royal Mint, Dept. of Overseas Trade, Committee of Overseas Settlement, Ministry of Agriculture, Stationery Office, etc.

The following statistical records will be of interest:—

Total area	220 acres
Cost of construction	nearly £3,000,000
Total attendance, 1924	17,403,119
Total attendance, 1925	9,699,231
Cash paid for admission, 1924	£991,000
Cash paid for admission, 1925	£428,000
Labour employed on construction (in man weeks)	444,800
Approximate number of people employed daily, 1924	24,200
Approximate number of people employed daily, 1925	21,000

On Monday, Dec. 1 1925 the auditors to the British Empire Exhibition issued a statement of accounts and an interim certificate. According to their figures, it was estimated that the financial loss on the exhibition for the two seasons would be £1,581,905. The various guarantors, of whom the British Govt. was by far the largest, were on Dec. 5 1925 officially called upon to pay as an immediate call 15s. in the £ on the amount of their guarantees, the liquidators reserving the right to fix later the ultimate and final liability of the guarantors. (J. H. T.)

EXPLORATION.—The explorers of previous centuries had the poles to reach, great blank spaces on the maps to fill in, the source of the Nile to trace and other major topographical facts to determine. The progress of exploration has brought the accomplishment of one after another of these primary tasks, but has opened up many more, involving more intensive work. Detailed topographical surveys are still needed for many regions, even if the major lines of mountain and valley and ocean abyss are known. And from topography the explorer proceeds to structure and physiography on the one hand, to climate and ecology of plants, animals and man on the other. The progress of exploration is involving a gradual change of emphasis in geographical research from topographical work to an understanding of the earth as the scene of man's activities (*see* HUMAN GEOGRAPHY).

Polar Regions.—Some of the primary tasks relating to polar regions are still far from being achieved, and we need only remark that the exploration of the atmosphere in the polar regions is leading to valuable conclusions promoting a more satisfactory knowledge of the world's climates in general. The exploration of sub-polar regions has been pursued with some vigour, partly for economic reasons. The coal and other possibilities of Spitsbergen have received attention, and Stefansson has emphasised stock-raising potentialities of the prairies of Arctic America for reindeer and musk-ox, while he also claims to have shown the possibility of entrusting oneself to the sea-ice of the frozen seas (*see* ARCTIC REGIONS; POLAR EXPLORATION).

Asia.—The immense interior of Asia, though known in a broad sense, has large areas which lacked even topographical investigation until the present century, when explorations of these regions have been numerous. Stein's many-sided work has included much mapping, and Sven Hedin has also published a great deal, chiefly for Southern Tibet. The courses of the great rivers from Eastern Tibet toward China, Further India and Assam, have been investigated and general lines on our maps are replaced by far more accurate ones, especially as regards the Tsang-po and its continuation, the Brahmaputra. Structure and physiography in this region have received much attention from the same explorers, as well as from Dainelli, who, in the reports of the Filippi expedition to the Himalaya, Karakorum, etc., brings forward important evidence for a series of extended glaciations of those mountain ranges analogous with several of those of the Alps.

Inner Asia.—The ecology and climate of Inner Asia have been the subject of much discussion. Huntington has advanced the view that the climate has long varied cyclically with alternating wetter and drier phases, but he thinks that successive wet phases have meant less and less moisture for the land (*see* CLIMATE; GEOLOGY). His opinions have been attacked by several explorers, who have pointed out the caprice of rivers in a dry region with loose soil, and the consequent liability to accident from which irrigation systems may have suffered in the past. There is at least much reason to suppose that decay of irrigation systems from both physical and human causes may account for many ruined cities of Central Asia, quite apart from possible increase of drought. Stein has advanced the very probable view that even after the passing away of the great Ice age large stores of water remained locked up as ice on the central Asiatic mountain ranges, and their melting gave supplies of moisture to the lowlands. The drought, in his view, would have become intensified when these supplies suffered marked reduction at some period not far removed from the beginning of the Christian era. From these references it will be seen that attention is turning increasingly toward investigation of the environment of man, though this type of work has long accompanied that of topographical surveying. Besides Stein's and Sven Hedin's works, we may mention among recent contributions, A. D. Carruthers' writings on Mongolia and Dzungaria, Baddeley's book on Russia, Mongolia and China, Dr. Legendre's work on the upper Yalung in Western China, Kingdon Ward's *From China to Hkamti Long* and among many others J. W. Gregory and Teichman on Eastern Tibet. Behind all these lies the great work of von Richthofen on China, which opened up to modern science many problems of Central and Eastern Asia. Younghusband's entry into Tibet must also be mentioned.

The Filippi expedition, as well as that of Stein, contributed fresh data concerning races and peoples in the regions visited and our knowledge of Central Asia is growing in all directions. The geological exploration of China, begun by von Richthofen, has been pursued under the aegis of the Japanese Geological Survey, and it seems likely that, with the growing discussion of new views of the history of the earth's surface, much re-examination of geological facts of Central Asia will be undertaken in the next generation. Expeditions are at work in Mongolia on both geological and ecological problems, and are also hunting for traces of early man. (*See* MONGOLIA, PALAEONTOLOGICAL DISCOVERIES IN.)

Western Asia.—The area between the Caspian Sea and the Sahara has long interested students as a home of ancient civilisation, and great military and political interest has turned scientific attention to it in the 20th century. Surveys and mapping in Mesopotamia have progressed a great deal, and numerous details have been gleaned concerning Arabia. H. St. J. Philby's *Heart of Arabia* is one of the most important books on the region since A. G. Doughty's *Arabia Deserta*, and it gives both direct knowledge of the oasis fortress towns of Central Arabia and information gleaned about the great southern desert. Besides this, there has been great activity in exploration of ancient sites at Susa, Kish, Ur of the Chaldees, in Palestine, and as always, in Egypt, resulting in new knowledge, especially of the developmental background of ancient Egypt and Babylonia. (*See* ARCHAEOLOGY.) Our knowledge of ancient Hittite civilisation has grown through explorations in Asia Minor and near the Upper Euphrates, and the beginnings of decipherment of Hittite writing show that it had Indo-European links, which had probably come into it from the Russian steppe via Thrace and the Bosporus. This idea of movements of influence from Europe to Asia in remote times is a rather new one.

The site of Anau, some distance from the southeastern corner of the Caspian Sea, has also yielded valued indications of very early settlement, and students of the finds have urged that probably nomad herdsmen of the great grasslands and deserts of Inner Asia are less the descendants of ancient nomad hunters than people who gradually cut adrift from a humble settled life as they acquired power over the herds of those grasslands. In Egypt, the exploration of ancient cultures in some of the oases and the opening of new tombs in the Valley of the Kings, leading to the rich finds in the tomb of Tutankhamun, have been the greatest achievements in this field. The long-continued

discussion of the origins of elements of civilisation has by no means closed. On the whole, of late years, the view that Egypt originated civilisation has been heavily attacked, and evidence has come forward pointing to the importance of the fertile crescent from Syria round via Palmyra to Mesopotamia in the earliest stages. The region of ancient civilisations has been seized upon by modern man with the idea of re-creating its ancient wealth. Mesopotamia has been explored by irrigation engineers with a view to cotton planting, and schemes of the same kind are going forward in the Anglo-Egyptian Sudan (*see* IRRIGATION ENGINEERING). Explorations for oil have been made and widely discussed, and routes for motor-cars between Syria and Mesopotamia have been planned and established.

Europe.—The construction of detailed topographical maps in Europe is of too old standing for any notable addition to have been made in this respect yet. Explorations have been of more intensive kind for scientific, economic or social purposes. The re-examination of the Alps by Argand and Staub and their colleagues had led to the formulation of a new view of the origin of the chain (*see* GEOGRAPHY), and if these fresh theories are maintained there will be need to re-explore several other mountain lands of Europe. Engineering surveys have been conducted in several lands, and notably in Norway and Sweden, south Germany, Switzerland, north Italy and southeast France, to find and utilise sources of hydroelectric power (*see* HYDROELECTRIC ENGINEERING). North Italy, with its glacier-fed streams giving a good steady power supply in summer and its juxtaposed city sites on the plain, gains greatly from this combination of physical advantages with the possession of an able and industrious population in old, established cities.

Early Man in Europe.—There has been much exploration of Europe for traces of ancient man and the beginnings of our civilisation. The French caves have continued to yield traces of art of the Old Stone age, and the wealth of Spain in this respect has been further demonstrated, while the rock-drawings of eastern Spain have been shown to relate to another early culture of African origin. The evidences of the importance of Spain when metal was first coming into use have been explored, especially by Bosch-Gimpera and Obermaier. The re-exploration of Stonehenge has shown that the " foreign stones " which form a part of that monument were brought in prehistoric times from Pembrokeshire, probably by sea rather than by land, and this is one of many indications pointing to an antiquity of sea faring along the western shores of Europe much greater than had previously been supposed; this form of activity in our region is now thought to go back to 2,000 B.C. or earlier.

The exploration of the lake village at Glastonbury has brought much knowledge of the early Iron age in Britain; and caves in the Mendips, especially Aveline's Hole, have given information about life in Britain not long after the end of the great Ice age.

The finding of the Piltdown skull and of the skull under the new Lloyd's building in the City of London has shown that variant types existed already in very early periods, and skeletons found at Predmost in Czechoslovakia and near the Caucasus as well as in Galilee seem likely to give indications of the evolution of modern types of man. (*See* MAN, EVOLUTION OF.) Sir Arthur Evans continued the publication of his famous researches on ancient Crete, and intervals in war duties led officers to begin explorations in Macedonia, which were subsequently continued. Beginnings of promising re-explorations of ancient sites in the Danube basin and Transylvania are noteworthy.

North Africa.—In North Africa a number of detailed explorations have been made in Morocco, Algeria and Tunisia, and the site of ancient Carthage, for example, has been studied, but the less-known desert behind has been the scene of most important work. Augieras has described the intensely desert character of the western Sahara, with few oases save on the periphery and with extremes of temperature, because the land lies low and the dunes lose heat quickly. Tilho has explored Tibesti, Borkou and Ennedi. The first, as a belt of highland between Tunis and Darfur, probably played a great part in southward spreads of fauna and flora in Miocene and Pliocene times. Mrs. Rosita Forbes travelled across from the Cyrenaica to Kufara oasis, the Senuss headquarters; and Hassanein Bey gathered valuable geological, cartographical and other data for all this region and the desert toward Darfur. His accounts of two oases connected with a route from south-west Egypt into Darfur aroused much interest. In the west of the Sahara, experiments have been made towards the establishment of motor transport with caterpillar attachments to overcome the sand.

Central and South Africa.—Though equatorial and southern Africa have witnessed less of the primary type of exploration, that of major topographical features, in the last generation a great deal of more intensive work was done. It has been shown that there have been changes of level of Victoria and Albert Nyanza, changes concordant with the variations of sunspots. There have been numerous surveys of race-types and studies of native society. Explorers have examined parts of Africa for cotton soils and mineral products in several regions, and Uganda promises to yield a good cotton crop. The controversies concerning Natives, Indians and Whites in East Africa, especially in Kenya, led to inquiries culminating, officially, in a report of the East Africa Commission to the Colonial Office. Farther south, MacIver claimed that the famous Zimbabwe ruins are essentially African and not more than 400 years old. (*See* ARCHAEOLOGY: AFRICA, SOUTH AND CENTRAL). The finding of a very interesting skull of ancient type but possibly of relatively recent date at Broken Hill, Rhodesia, opened up a large problem.

North America.—Explorations in North America accompanied the delimitation of the boundary between Canada and Alaska, and there have been studies of geomorphology in Central America, contributing to establish the theory of the eastward folding of the Cordillera and to bring out its relation to the Antillean arcs. Of more general interest were Stefansson's explorations in Arctic Canada, leading to topographical mapping around the difficult ice-bound coasts and to arguments on his part in favour of using the Arctic for herds of reindeer and musk-ox. British Columbia has been explored for economic purposes, and especially for sources of hydroelectric power.

South America.—In South America there was exploration attendant upon the delimitation of Bolivia's frontiers 1911–3, and at about the same time some detailed studies were made in southern Peru and the Cordilleran fringe of Argentina. Topographical maps, geological and physiographical conclusions, and social studies have resulted from this work. Rice mapped in detail the unique Cassequaire stream which conducts water from the Upper Orinoco to the Rio Negro, a northern affluent of the Amazon. Koch Grünberg studied the same district. In economic exploration an important step was taken in the appointment of a British committee, which reported in 1920 upon the reserves of the dependencies of the Falkland Is., such as South Georgia and South Shetland.

Oceania.—In the Pacific, the mystery of Easter I. has been examined afresh by Mr. and Mrs. Routledge, and Galapagos has been studied by William Beebe. Haddon has added to his many explorations by examining Papuan peoples and their cultures and Wollaston and Chinnery have also contributed to knowledge of this part of the world, while both Dutch and British have made progress toward a better understanding of the corrugations of the sea-floor in the East Indies. The work of scientific exploration of the sea, which owes so much to the initiative and the help of the late Prince of Monaco, has been continued; and much work has been done in European waters by Fisheries Commissions (*see* OCEANOGRAPHY).

This brief survey of some of the better known work of the early part of the 20th century illustrates the point that surveying for major topographical features has largely given place to detailed work, with increasing attention and application of scientific methods to economic and social exploration. The increased dependence of the industrial areas of the world upon tropical products has made the latter types of work very important, and more and more effort is likely to be concentrated in this direction. Along with this goes medical exploration, such as that leading to delimitation of fly-belts and to the combating of fly-borne dis-

eases, especially in Africa. The success of medical efforts during the cutting of the Panama Canal altered estimates of the white man's adaptability to the tropics, but it is generally admitted that the problem remains a serious one, even if parasitic diseases are conquered by medical science (*see* PARASITOLOGY; TROPICAL MEDICINE).

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EXPLOSIVES (*see* 10.81).—A very large number of explosives is now known, and apart from warlike purposes they are used extensively for mining, quarrying, tunnelling, road making, and like purposes..

The Nature of Explosion.—The phenomenon of explosion is accompanied usually by a loud report, and frequently by a destructive effect, due to the sudden liberation of a large volume of gas. Explosives are substances which are capable of resolving themselves, under suitable impulses, almost instantaneously into gases which occupy a very much larger volume than the original substances. The explosion is invariably accompanied by a considerable evolution of heat, which still further increases the expansion of the gases.

In general, explosion is akin to combustion, inasmuch as it depends in most cases upon the combination of carbon and hydrogen with oxygen. When a combustible material such as charcoal burns in the air, the combination of carbon with oxygen necessarily takes place slowly, since the spent air must be continuously swept away and replenished by fresh air. In a draught of air, the burning is accelerated. If we were to mix the charcoal with liquid oxygen there would be no such delay, and it would be possible for the combustion to take place almost instantaneously. This is the essential nature of explosion, the sudden release of energy accompanied by a large volume of gas. In gunpowder we have a mixture of charcoal and sulphur, both of which are combustible, with saltpetre (potassium nitrate), which contains an excess of oxygen, and thus on ignition the oxidation of the carbon and sulphur can take place very rapidly.

Modern Explosives.—The main advance in modern explosives lies in the discovery of substances in which each molecule contains, in addition to carbon and hydrogen, the oxygen necessary for its combustion. Gunpowder is merely a mechanical mixture and, although the ingredients are very finely powdered and closely mixed, they still form separate particles. The advantages of combining the oxygen with the combustible elements in one and the same substance are:—

1. Gunpowder contains a large proportion of useless potash, which is merely a vehicle for the oxygen. The self-contained explosives on the other hand do not contain any such waste mineral matter, and hence have a greater store of useful energy.
2. Gunpowder gives a cloud of smoke when fired from a gun in consequence of the potash which it contains. The use of explosives containing no mineral matter gives rise to "smokeless powders," which permit of much more rapid firing.
3. The closer contact of the oxygen with the combustible elements renders possible a much more rapid internal combustion, leading to a greater violence of explosion in the so-called "high explosives."

The compounds which are mainly used as explosives are those containing "nitro groups," in which the oxygen is attached, somewhat loosely, to nitrogen. For instance trinitrotoluene (TNT) is represented by the chemical formula $C_7H_5(NO_2)_3$. The oxygen may be considered to be in a state of strain, as it is striving to pass from the nitrogen to the carbon and hydrogen, to which it has a much greater affinity.

The question naturally arises: if the molecules of an explosive are in a state of internal strain, why do they not fall to pieces spontaneously? The explanation is that a certain amount of energy must be imparted to the molecules to detach the oxygen from the nitrogen, before it can unite with the carbon and hydrogen. When the reaction has once started, the much greater energy given out in the oxidation of the carbon and hydrogen loosens the oxygen of the nitro groups in the surrounding molecules, and so the explosion is propagated throughout the mass. The amount of energy which is necessary to loosen the atoms in the molecule differs greatly in different explosives, and this determines their chemical and mechanical stability, and the ease with which they can be brought to explode violently. Thus trinitrotoluene is very stable, whilst mercury fulminate is very sensitive, and requires only a slight shock to cause it to explode with great violence. If a small quantity of mercury fulminate be exploded in contact with a larger quantity of trinitrotoluene, the fulminate ensures that the explosion is effectively started, and thus overcomes the initial inertia of the trinitrotoluene. The explosion then propagates itself through the mass of the explosive with a very high velocity. This very rapid explosion is termed detonation, and its velocity may vary from about 3,000 to 8,000 metres (2 to 5 m.) per second.

Classification.—It is sometimes a matter for surprise that so many different explosives should be in use, and it may appear at first sight that the one aim in the study of explosives should be to obtain an explosive of the greatest possible power. In practice, however, the greatest explosive violence is not always desired. In firing a shot from a gun, for instance, a very violent explosive would shatter the gun. For this purpose a more gradual and sustained pressure is required. This leads to the first important classification into (*a*) propellants, which are used to drive the shot from a gun, and (*b*) high explosives, which are used for their shattering effect, *e.g.*, in bombs and shells, and for rock blasting, etc.

Among high explosives again, different degrees of violence are required. Thus in blasting soft materials, a relatively slow, heaving effect is required, whilst a shattering effect is required for hard rock. In some cases, the degrees of sensitiveness and stability on storage are of great importance, in others less important. Special conditions have to be met in certain cases; thus the danger of ignition of firedamp in coal mines has led to the creation of a distinct class of explosives which can safely be used in such mines. Economic considerations are naturally of importance, and in many cases cheapness has to be balanced against efficiency. Detonants such as mercury fulminate form a separate class of explosives. These are limited to a very few representatives, and are used in caps and detonators in conjunction with other explosives.

Manufacture.—The most important explosive compounds are made by the action of nitric acid on various organic compounds. Two main classes of chemical compounds come into consideration as explosives, namely nitric esters, that is nitrates of carbon compounds, and true nitro compounds. The chemical reactions, which are utilised in the preparation of these two classes of

compounds, may be typified by the formation of glycerol trinitrate or nitroglycerine, a nitric ester, and trinitrotoluene, a true nitro-compound.

$$C_3H_5(OH)_3 + 3HNO_3 = C_3H_5(ONO_2)_3 + 3H_2O$$
Glycerol — Glycerol trinitrate

$$CH_3C_6H_5 + 3HNO_3 = CH_3C_6H_2(NO_2)_3 + 3H_2O$$
Toluene — Trinitrotoluene

The process of conversion to a nitro compound or nitric ester is commonly called "nitration." In practice sulphuric acid is mixed with the nitric acid, to take up the water formed in the reaction.

Glycerol trinitrate or "nitroglycerine" is made by the nitration of glycerol (glycerine) and forms a heavy yellow oil. Glycerol dinitrate is also used to some extent. Cellulose nitrates or "nitrocelluloses" are made by the nitration of cellulose, generally in the form of cotton waste. The cotton retains its fibrous condition during nitration, but can be reduced to a gelatinous condition by solvents such as acetone, or a mixture of ether and alcohol. Advantage is taken of this in the preparation of smokeless powders. The viscous jelly is forced through an orifice, so as to form long sticks or cords, and the solvent is then dried off. Cordite contains both nitrocellulose and nitroglycerine, together with a little mineral jelly. Other nitric esters can be made by the nitration of starch and sugar, but have only a limited application.

The true nitro-compounds are all prepared by the nitration of coal-tar products of the benzene series. They are generally yellow solid compounds, and are used either as such, or mixed with nitrates, etc. The nitro-compounds chiefly used for explosive purposes are dinitrobenzene, di- and trinitrotoluene (TNT), trinitrophenol (picric acid or lyddite) and nitronaphthalenes. For war purposes, trinitroxylene, trinitroanisol, hexanitro-diphenylamine and others have also been used.

Mercury fulminate, $Hg(CNO)_2$, is not a nitro-compound, but is nevertheless made by the action of nitric acid on mercury and alcohol. In all cases, the explosives require careful purification, all traces of acid being carefully removed.

Mixed Explosives.—Most industrial explosives consist of mixtures of several constituents. As in gunpowder, the general principle is to mix substances containing an excess of oxygen with combustible materials. The choice of oxidising agents is very limited, the main ones being nitrates, chlorates and perchlorates. In many cases the mixtures are reinforced by admixture with explosives such as nitroglycerine, nitrocellulose or trinitrotoluene. A special type of mixed explosive, which has been increasingly used, is made by adding liquefied oxygen to carbonaceous materials. The oxygen evaporates very quickly, and the mixture must therefore be made on the spot, and exploded at once.

Properties and Testing.—Apart from ordinary chemical and analytical tests, the following characteristics are examined:—

1. Explosive properties. The power is measured by detonating the explosive in a cavity in a lead block and measuring the increase in the size of the cavity. The heat of explosion and volume of the explosion gases are measured in a calorimetric bomb. The velocity of detonation can be determined by means of an electric chronograph.
2. Sensitiveness to shock and friction. A falling weight machine serves to ascertain the sensitiveness to shock, and various friction devices are in use.
3. Chemical stability. This determines the safety on storage. Numerous tests are available, the general principle being to heat the explosive under carefully regulated conditions, and to ascertain the extent to which decomposition occurs, either by chemical reactions depending on the presence of oxides of nitrogen, by the evolution of gas or by the alteration in weight.

Other tests are carried out to ascertain the safety of explosives under special conditions. Thus the length of flash and its duration are determined photographically; the safety of explosives in presence of firedamp is examined in experimental galleries simulating the conditions in mines.

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EXPLOSIVES, MILITARY (*see* 1.864).—For military purposes, explosives are divided into two main classes: (*a*) Propellants; (*b*) High explosives (disruptives). The difference in functioning of these two classes is obtained by regulating the rate of explosion, *i.e.*, the rapidity with which the explosive is converted into gases. In the case of a propellant, so as not to burst the gun, a relatively slow rate of transformation, corresponding to a prolonged push is required; whilst a very high rate (detonation) which is equivalent to a sudden blow, in order to cause fracture by shock, is necessitated in explosives used for disruptive purposes. It follows, therefore, that the rapidity of the explosion or burning of a propellant, must be strictly controlled and that of a disruptive enhanced as far as possible, so as to liberate almost instantaneously the whole of its potential energy, if the utmost violence is desired.

Propellants and Their Nature

It was found that the temperature developed by the explosion of Mark I. cordite (7.138) was unduly high, owing to its large content of nitro-glycerine. In order to lessen the wearing and scoring effect of the hot gases on the bore of a gun, known as erosion, it is essential to keep the temperature of explosion of the charge as low as possible and a "cooler" cordite of modified composition, designated cordite M.D., was introduced, and remains to this day the standard British propellant for naval and military uses.

The composition of cordite M.D. is:—

Nitro-glycerine, 30%.
Guncotton, 65%.
Mineral jelly, 5%.

The so-called "nitro-cellulose powders" do not contain nitro-glycerine and find favour in France, Germany and America on account of their lower temperature of explosion, thereby decreasing the erosion of the gun barrel. They are made from soluble nitro-cellulose, which is gelatinised by a mixture of ether and alcohol and then dried in the form of sticks, cubes or flakes, as found most suitable for the particular ordnance intended.

High Explosives (*Disruptives*).—High explosives for naval and military purposes are required for the bursting charges of shell, mortar and aerial bombs, grenades, mines (land or sea), torpedoes and for general demolition purposes. For such uses, an extremely violent and disruptive effect (brisance) is necessary in their explosion, but at the same time a very high order of chemical stability and insensitiveness is called for, particularly in the fillings for shell, which are subjected to an extremely severe shock at the moment of discharge of the gun.

To bring about the effective explosion of such stable compounds requires the employment of a powerful initiatory impulse. This may be effected by means of a small quantity of a more sensitive explosive, which then acts as a detonating agent or detonator. A high explosive is said to "detonate" when its explosion is propagated at the maximum velocity possible for the particular substance in question. There is no definite line of demarcation between a "high" and what may for the want of a better term be called a "low" explosive, such as gunpowder; the term is purely relative. No intensity of initial impulse can cause gunpowder to explode at a greater velocity than about 350 ft. per second. In the recognised high explosives the velocity of detonation is at least 2,000 or 3,000 ft. per sec. and may reach to as much as 9,000 ft. per second. It is owing to this intensely sudden evolution of gases that the shattering and disruptive effect of high explosives is obtained.

In order to appreciate the function of the detonator in initiating explosion, it is necessary to consider that in an explosive substance each molecule in its decomposition gives out a surplus of energy, and so provides the initial impulse required to decompose the neighbouring molecules. When, however, a stable high explosive, for instance T.N.T., is merely ignited, the decomposition propagates itself slowly at first and may cease

altogether owing to external cooling; in any case, the velocity of decomposition increases but gradually or may even die out, and it is only after a considerable quantity has decomposed that detonation may ensue. By employing a detonating agent to initiate the explosion, decomposition of sufficient of the stable explosive in contact with the detonator is ensured, so that the explosion wave is propagated throughout the whole mass with certainty.

The value of fulminate of mercury, discovered by Howard in 1800 as a detonating agent for more stable high explosives, was not recognised till a considerably later date. This sensitive chemical compound may be readily caused to detonate "*en masse*" by heat, friction or percussion, and the detonation is similarly imparted to any high explosive with which the fulminate is in contact. Another detonating agent, for similar purposes, which is now increasing in favour is lead azide, for which better keeping qualities, particularly in hot climates, are claimed. By reason of their sensitiveness, the quantities of such detonating agents employed are strictly limited—in the case of percussion fuses, for shell up to about 10 grains. A greater amount of an explosive such as tetryl, which is intermediate in sensitiveness between the detonator proper and the bulk filling, may, if necessary, be used to increase the "send off."

Shell Filling.—For shell filling, very insensitive high explosives are required, on account of the severe shock to which they are subjected at the moment of discharge. In fact it was the fear of premature explosion in the gun which militated for many years against the introduction of H.E. shell. The high explosives most suitable for shell filling are nitro-benzene derivatives, derived from coal tar. The first to be employed for this purpose was picric acid, tri-nitro-phenol (*see* 10.82) discovered by Woulffe in 1771, and used for many years as a dye without its explosive properties being recognised. It was first used in actual warfare by the British Army in the South African War of 1899–1902, under the name of lyddite. Picric acid is also the main or sole constituent of the French mélinite, the Japanese Shimosé powder and the Austrian ékrasit. It has now largely been superseded by Trinitrotoluene, which is known generally as T.N.T. It is very similar in its action and appearance to picric acid, over which it possesses certain advantages in ease of manufacture and facility of manipulation.

In the World War economic considerations played a large part in determining the types of explosives used and their methods of manufacture, and so led to the adoption of others hitherto untried and unproved for military purposes. For these reasons, the high explosive which was used in the greatest quantities by Great Britain was "Amatol," the name given to various mixtures of ammonium nitrate and T.N.T. The proportion most favoured was Amatol 80/20, which contains 80% of ammonium nitrate and 20% of T.N.T., these being approximately the proportions necessary for the complete combustion of the T.N.T., through the agency of the extra oxygen required, which is supplied by the ammonium nitrate constituent. Such an amatol can be compressed into the shell or other munition, in the form of a powder, or loaded in a plastic condition by heating it above the melting point of the T.N.T. This is a consideration of great importance, as it enables more rapid output to be obtained than in the melt process used with lyddite or T.N.T.

The high explosive fillings described for shell are equally applicable to the numerous other kinds of munitions, but in addition wet guncotton has been used for the filling of torpedo war heads and floating mines. For hasty demolitions in the field wet guncotton slabs packed in watertight boxes are convenient, the detonator being inserted before use in a disk or primer of dry guncotton which fits into a correspondingly shaped cavity in the wet slab and thereby brings the whole to detonation.

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EXPORT CREDITS, a post-War scheme adopted by the British Govt. to assist British export trade. The Export Credits Scheme was initiated by Mr. Lloyd George's Coalition Govt. in the autumn of 1919 as a means of facilitating the finance of export business and of promoting the restoration of British trade. Importers in many markets found it difficult at the time to pay cash or do business on short-term bills; and it was felt that trade could be secured if facilities were provided for financing transactions which owing to the length of credit required, or for other reasons would not be acceptable to the banks.

Power was also taken to insure goods against risks of an abnormal or exceptional nature, but this part of the scheme has remained inoperative. At first the application of the scheme was limited to business with certain European states, viz., Finland the Baltic States, Poland, Czechoslovakia, Yugoslavia, Rumania and others. This restriction was due in part to a concomitant policy of assisting in the economic reconstruction of countries which had been specially disorganised by the World War. In 1921 the sphere of operations was enlarged to include the whole world, subject to certain exceptions adopted in the actual administration of the scheme.

The legislation governing the scheme is contained in the Overseas Trade (Credit and Insurance) Act 1920; in an amending Act of 1921; and in the Trade Facilities Acts 1921–4. It is administered on behalf of the Board of Trade by the Export Credits Dept. of the Dept. of Overseas Trade, with the assistance of an advisory committee of business men. The aggregate amount outstanding in respect of credits at any given time may not exceed £26,000,000. Credits may only be given for British goods. The period within which new credits may be given expires in Sept. 1926, but legislation was introduced in 1926 to extend it for another three years.

Under the original scheme the Export Credits Dept. made advances to the exporter in cash up to 80% of the cost of the goods, but early in 1921 an important modification was introduced, the object of which was to bring the method of operation into closer correspondence with the normal machinery of trade. Instead of making advances the department was authorised to guarantee drafts drawn against the shipment of export goods. The advances system was in consequence discontinued, and the bulk of the business done under the scheme was effected under the guarantee plan.

The *modus operandi* is that the exporter makes application to the department through his bank (an arrangement introduced so as to preclude overlapping with the banks), and if the proposed credit is sanctioned, the government's guarantee is given usually in the form of a guarantee endorsed on the actual bills drawn by the exporter, but sometimes in the form of a letter of guarantee. An appropriate premium is charged. Bills may be guaranteed up to 100% of the invoice value if the length of the credit does not exceed one year, and up to 85% if the term is for more than one year. If adequate security is provided by the importer, usually in the form of a bank guarantee, there is no recourse on the exporter in event of loss; in other cases the department takes recourse up to 57½% if 100% has been guaranteed, and up to 42½% if 85% has been guaranteed. It will thus be seen that the exporter gets both assistance in his finance, since the guaranteed bills can be discounted or used as collateral security for a bank advance, and a measure of insurance against loss, since the department, in only taking partial recourse upon him, makes itself responsible for part of any loss which may arise. This is the broad outline of the scheme; there are variants in the actual facilities offered which need not be set out in detail.

The total amount of business done up to Dec. 1925 was about £1,750,000 under the advances scheme, and rather less than £6,000,000 under the guarantee scheme. As the limit fixed by the original Act was £26,000,000 it is clear that the scheme has not been taken advantage of to the extent expected. This may be due to various causes. The scheme probably has not been very widely known; business men have been perhaps sceptical about the handling of such matters by a government department; there may have been complications and rigidities of practice such as would discourage applicants. Published figures, however, show that very much larger amounts of credits have been sanctioned than have actually been taken up—presumably because the applicant eventually failed to secure the business for which the credit was required, or perhaps was ultimately able to finance

it without assistance from the department. On the whole, the figures indicate that the scheme has been helpful to trade at a difficult juncture.

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(W. CL.)

EYE: *see* OPHTHALMOLOGY.

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